



Ecosystem services and urban greenways: What's the public's perspective?

Lincoln R. Larson^{a,*}, Samuel J. Keith^a, Mariela Fernandez^a, Jeffrey C. Hallo^a, C. Scott Shafer^b,
Viniece Jennings^c

^a Department of Parks, Recreation & Tourism Management, Clemson University, Clemson, SC 29634, USA

^b Department of Recreation, Park, and Tourism Sciences, Texas A & M University, College Station, TX 77843, USA

^c USDA Forest Service, Southern Research Station, Athens, GA 30602, USA



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ABSTRACT

Ecosystem services (ES) are an important tool for quantifying the value of nature, yet there are often disconnects between services defined and measured by scientists and those that are realized and appreciated by the general public. Our study explored public perceptions of urban ES by examining benefits associated with greenways in two U.S. cities. Respondents ($n = 460$) recognized all types of ES, though environmental benefits (e.g., air and water quality regulation; acknowledged by 74% of respondents) were less widely recognized than cultural benefits (e.g., economic impacts, social connectivity; 90%) or experiential benefits (e.g., attractive scenery, recreation; 98%). The distinction between these last two categories is rarely made in conventional ES frameworks, but it may be practically significant from the public's perspective. Benefit perceptions varied across geographic and socio-demographic contexts. Enhanced integration of cultural and experiential benefits into urban ES frameworks could lead to more equitable and informed decisions about the provision, management, and valuation of urban green space across diverse settings and populations.

1. Introduction

The concept of ecosystem services (ES) has been widely adopted as a framework for understanding and evaluating the direct and indirect contributions of ecosystems to human well-being (Boyd and Banzhaf, 2007; Braat and de Groot, 2012). Although ES typologies such as the Millennium Ecosystem Assessment (MEA, 2005), the Economics of Ecosystems & Biodiversity (TEEB, 2010), and the Common International Classification of Ecosystem Services (CICES, 2016) are useful for understanding the “value” of nature, there is often a disconnect between the services frequently defined and measured by scientists and those that may be realized and appreciated by the general public (Nahlik et al., 2012). Enhanced awareness of public perceptions regarding ES and the way that nature is directly enjoyed or consumed could help to inform ecosystem management for the public good (Landers and Nahlik, 2013; Martin-Lopez et al., 2012), particularly in urban settings.

Scholars have synthesized a wide, interdisciplinary body of literature investigating the range of services provided by urban ecosystems (Gomez-Baggethun et al., 2013; Haase et al., 2014). Most studies examining the value of urban ecosystems have centered on measuring and quantifying biophysical attributes and processes that yield material

benefits (Haase et al., 2014); however, this approach typically overlooks the non-material benefits that people obtain from direct experience with and appreciation of natural settings (e.g., recreation and aesthetic appreciation), often termed cultural ES. In urban areas, these cultural services may be the most valuable contributions that green space has to offer (Chiesura, 2004; Gobster et al., 2007; Martin-Lopez et al., 2012). For instance, many studies have shown that proximity to and use of urban parks and green space is positively associated with physical activity levels and cardiovascular health (Cohen et al., 2007; Godbey and Mowen, 2010), mental and emotional health (Russell et al., 2013; White et al., 2013), cognitive functioning (Bratman, Hamilton, and Daily, 2012), expression of cultural values linked to biodiversity (Clark et al., 2014), community attachment (Arneberger and Eder, 2012), and other aspects of well-being (Larson et al., 2016).

Despite the importance of cultural services in urban areas, they remain poorly integrated into conventional ES frameworks (Daniel et al., 2012; Gomez-Baggethun et al., 2013). Challenges to integration include intangible impacts that are difficult to specify, subjective outcomes that conflict with conventional market-oriented valuation strategies, and variations in utility associated with different cultural and geographical contexts (Chan et al., 2012; Daniel et al., 2012; de Groot et al., 2010). Although cultural ES are specified in both the MEA

* Corresponding author.

E-mail addresses: LRL@clemson.edu (L.R. Larson), sam.keith14@gmail.com (S.J. Keith), marielf@clemson.edu (M. Fernandez), jhallo@clemson.edu (J.C. Hallo), sshafer@tamu.edu (C.S. Shafer), vjennings02@fs.fed.us (V. Jennings).

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(2005) and CICES (2016) frameworks, many scholars and practitioners have highlighted a growing need to clarify the social and cultural benefits derived from nature (Bull et al., 2016; Chan et al., 2012; Daniel et al., 2012) and emphasize tangible connections to multiple domains of human health and well-being (de Groot et al., 2010; Haines-Young and Potschin, 2008).

Our study aimed to address this growing need to define and operationalize cultural services provided by urban ecosystems. We focused on greenways, an increasingly popular urban amenity whose unique fusion of natural green space and built infrastructure provides diverse benefits (i.e., ES) to urban residents (Benedict and McMahon, 2006; Fabos, 2004). The mere existence of urban greenways provides corridors of natural vegetation that affect wildlife habitat, air and water quality, flood mitigation, and a variety of other maintenance and regulatory ES in cities (de Groot et al., 2010; Shafer et al., 2000). Greenways also serve as an epicenter for cultural services that revolve around human use. Greenways connect parks, neighborhoods, businesses, and other public spaces and enhance quality of life through active outdoor recreation (Shafer et al., 2000), which can positively impact well-being (Chiesura, 2004), increase social interaction and inclusion (Kazmierczak, 2013), and encourage sustainable human-nature interactions (Chon and Shafer, 2009; Gobster, 1995).

As the literature on this topic evolves, a key question then becomes: which of these services are most valuable, and to whom? This question has typically been addressed through an economic lens that reduces services to environmental accounting units (Boyd and Banzhaf, 2007) or an ecological lens that focuses primarily on broader ecological structure and functions (Elmqvist et al., 2015). However, when utilized as a recreation destination or social gathering space, urban amenities such as greenways become a cultural hub – a place where city dwellers from diverse backgrounds have a unique opportunity to interact with and within nature (Shafer et al., 2000). It is this aspect of greenways, which centers on cultural ES, that may be critically important to urban residents, yet it is this aspect that is often overlooked or understudied (Baur et al., 2016; Chan et al., 2012; Daniel et al., 2012).

Our study examined users' perceptions of different types of greenway-related benefits (i.e., ES) on two urban trails: the Eastside Trail of the rapidly expanding Atlanta Beltline (in Atlanta, GA, USA), and the Leon Creek Greenway, a segment of the larger Howard W. Peak Greenway Trails System (in San Antonio, TX, USA). The purpose of our study was to describe and quantify different types of ES recognized by greenway users and identify geographical and socio-demographic factors influencing greenway users' perceptions of ES.

2. Methods

The two greenways selected for this study were located in large, diverse southern U.S. cities. Both trails were recently completed, and they represent segments of much larger trail systems that remain under construction. Structural differences between the two greenways' surrounding corridor are noteworthy, for they may influence users' perceptions of ecosystem services. The Eastside Trail (in Atlanta) includes 2.25 miles of paved trail within a mile of downtown, while the Leon Creek Greenway (in San Antonio) includes 13.5 miles of paved trail in the suburbs several miles from the city center. The Eastside Trail (Fig. 1a) features high population density in adjacent neighborhoods with a narrow greenway corridor encompassing a few recently planted trees and limited green space. The Leon Creek Greenway corridor (Fig. 1b), on the other hand, includes dense riparian greenery along a creek-side flood plain, with more limited development along the trail and its access points. Both trails present unique opportunities to study the effects of urbanization on ES, a topic that warrants further investigation (Kreuter et al., 2001).

Intercept surveys of greenway users were conducted at key access points along each greenway from May–August 2015, with sampling protocols and instruments informed by earlier greenway studies

(Gobster, 1995; Reed, 2014). Every Leon Creek Greenway user age 18 years or older who passed a sampling location was approached and asked if he/she would be willing to participate in a brief survey about greenway use. However, due to the high volume of users on the Eastside Trail (where it was not feasible to sample every user), systematic random sampling was used to approach every *k*th visitor, depending on user density at the time of observation. Following consent, the survey took 5–10 min to complete. Cool water and shade were offered as an incentive to pause and fill out the questionnaire.

The survey instrument included questions about demographic information (e.g., gender, race/ethnicity), greenway use (e.g., frequency, intensity, activity type and purpose), greenway access (e.g., mode of access, distance traveled to the trail), and the focus of this study: perceived benefits associated with greenways rated on a scale from 1=“Strongly Disagree” to 5=“Strongly Agree” (Appendix A). Because instruments for measuring public perceptions of ES, and cultural ES in particular, are relatively rare (Baur et al., 2016; Kremen and Ostfeld, 2005), we could not find an existing scale to suit our research context. Based on ES identified in previous studies (Brown and Raymond, 2007; Crossman et al., 2013; Haase et al., 2014; Kremen and Ostfeld, 2005), we developed a concise set of items to represent both environmental and cultural benefits. We included more items focused on historically understudied cultural services because they might be especially relevant in a greenway context. Refusal rates and reasons were recorded to calculate response rates and identify potential sampling bias. A total of 252 surveys were collected on the Eastside Trail and 208 surveys on the Leon Creek Greenway, resulting in response rates of 65% and 78%, respectively. After listwise deletion of cases with missing or incomplete data, the effective sample size for analysis was 242 for the Eastside Trail and 191 for the Leon Creek Greenway (total *n* = 433). Although the demographic distribution of survey respondents on each trail differed, the numbers generally reflected population ratios in city neighborhoods surrounding each trail (Appendix B). Following recommendations from Costello and Osborne (2005), we used principal axis factor analysis (PAF) with an oblique rotation (Promax) to identify broader categories of greenway-related benefits (i.e., ES) among the sample of survey respondents. First, our PAF examined data from each trail independently. Despite some site-specific variation in the importance ratings for certain groups of benefits (e.g., cultural benefits more important along urban Eastside Trail, environmental benefits more important along suburban Leon Creek Greenway), both analyses revealed a comparable overall factor structure (Appendix C). We therefore conducted a final PAF using the pooled responses for benefit items in both locations. Data were then analyzed using various non-parametric (e.g., Chi square tests) and general linear modeling approaches (e.g., ANOVA) to examine factors associated with perceived benefits. Independent variables hypothesized as potential ES correlates were the trail itself, distance from participants' home to the trail (calculated using ArcGIS), race/ethnicity, gender, and activity type (e.g., walking, running, bicycling).

3. Results

Our pooled PAF analysis of the 10 benefit items converged in four iterations and resulted in three categories of ES identified by underlying themes: environmental, cultural, and experiential (Table 1). Environmental benefits (3 items that explained 10.3% of variance, Eigenvalue = 1.03), analogous to regulatory and maintenance ES, referred to the ecological benefits provided by the greenway, including things such as air/water quality regulation and enhanced storm water management. Cultural benefits (3 items, 13.1% of variance, Eigenvalue = 1.31), analogous to cultural ES, were those directly involving people and communities, such as the local economy, heritage/tradition and neighborhood connectivity. The third category that emerged was somewhat unexpected (there is currently no analog in conventional ES frameworks), yet it accounted for the largest portion of variance

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