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

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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 Millenium 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

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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 kth 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

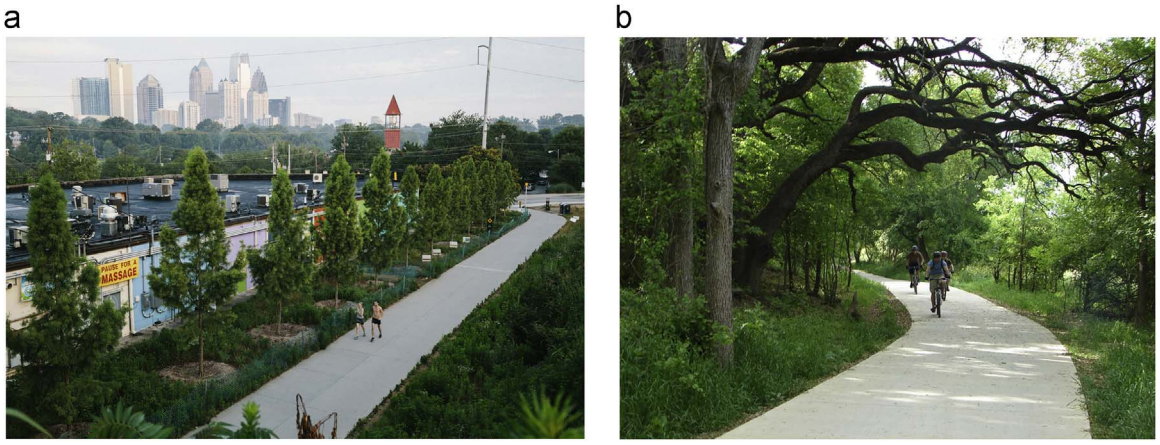


**Fig. 1.** Depiction of Greenway Context for the Eastside Trail in Atlanta, GA, USA (1a) and the Leon Creek Greenway in San Antonio, TX, USA (1b). Photo credits: Atlanta Beltline, Inc., and San Antonio Parks & Recreation.

explained (4 items, 44.5% of variance, Eigenvalue =4.45). These experiential benefits were derived from use of the trail, encompassing elements relating to the setting such as natural habitat, attractive scenery, and the opportunity for outdoor recreation participation. Some view experiential benefits as intermediate services or the human capital investment needed to generate final ecosystem services (Boyd and Banzhaf, 2007) though many scholars place these social benefits in the cultural ES category. Although factor loadings supported a three-factor structure (Table 1), strong correlations ($r \geq .517$, $p \leq .001$) among all ES categories highlighted the synergistic benefits that greenways can provide.

Overall, survey respondents recognized a number of benefits provided by local greenways (i.e., aggregate category score of 3.0 or higher). Experiential benefits were the most widely recognized benefits on both trails (acknowledged by 98.2% of respondents), followed by cultural (90.3%) and environmental benefits (74.1%) (Table 1).

Trail location was a significant predictor of experiential benefits, with Leon Creek Greenway users perceiving significantly greater experiential benefits than Eastside Trail users, $F(1,406)=9.497$, $p=.002$ (Fig. 2). Perceptions of experiential benefits did not differ significant by gender, race/ethnicity, distance to trail, or activity type..

Trail location was also a significant predictor of cultural benefits, but in this case users of the urban Eastside Trail were more likely to recognize cultural benefits, $F(1,406)=27.728$, $p < .001$ (Fig. 2). Differences for race/ethnicity were also significant, with Hispanic/Latino users more likely to perceive cultural benefits than white users, $F(3,406)=2.948$, $p=.033$. Users living within three miles of the trail perceived stronger cultural benefits than users living more than three miles away, $F(2,406)=5.371$, $p=.005$.

Perceptions of environmental benefits varied by trail as well, with Leon Creek Greenway users perceiving greater environmental benefits than Eastside Trail users, $F(1,406)=5.280$, $p=.022$ (Fig. 2). Significant differences in perceptions of environmental benefits based on distance to trail, gender, race/ethnicity, or activity type were not observed.

## 4. Discussion

Our findings support the assertion that greenways provide a number of diverse, interacting benefits to urban residents (Gobster, 1995; Shafer et al., 2000). Although the value of biophysical attributes and environmental benefits (e.g., provisioning, regulating and maintenance ES) associated with urban green space is widely acknowledged, researchers should not underestimate the importance of cultural and experiential benefits when attempting to account for public perspectives in urban ES frameworks (Martin-Lopez et al., 2012). Based on our PAF analysis for greenway users, it appears that traditional cultural ES as defined by the Millenium Ecosystem Assessment (2005) and many subsequent ES reports (TEEB, 2010; CICES, 2016) could be operationalized into two distinct categories: cultural and experiential. Following conventional thinking, cultural ES focus on intangible outcomes for people and communities, which may include social, spiritual, and economic values directly derived from ecosystems (Chan et al., 2012). In our analysis cultural benefits reflected a similar emphasis, focusing on connectivity of destinations, historical or cultural significance, and economic impacts. Experiential benefits, on the other hand, are based on the concept of intermediate ES, which require other

**Table 1**
Principal axis factor analysis with oblique (Promax) rotation depicting means, standard deviations, and pattern and structure matrix loadings for the experiential (A), cultural (B) and environmental (C) benefits (i.e., ecosystem services) associated with urban greenways (effective pooled n =433).

| | | | Pattern Matrix | | | Structure Matrix | | |
|---|---|---|---|---|---|---|---|---|
| **Ecosystem Service Categories** | **Mean** | **SD** | **A** | **B** | **C** | **A** | **B** | **C** |
| **A. Experiential Benefits** (4 items, Cronbach's α = .787) | **4.48** | **.56** | | | | | | |
| Provides a place for outdoor recreation activities | 4.70 | .60 | .647 | .125 | −.259 | .562 | .308 | .188 |
| Provides a place for people to experience nature | 4.50 | .66 | .635 | .182 | −.063 | .693 | .474 | .411 |
| Provides attractive natural scenery | 4.42 | .67 | .686 | .006 | .143 | .772 | .445 | .543 |
| Provides important habitat for urban plants and animals | 4.30 | .81 | .802 | −.220 | .173 | .788 | .296 | .507 |
| **B. Cultural Benefits** (3 items, Cronbach's α = .782) | **4.13** | **.74** | | | | | | |
| Creates economic benefits for the city | 4.22 | .87 | −.056 | .843 | −.029 | .364 | .798 | .432 |
| Helps connect people from different neighborhoods | 4.15 | .86 | .060 | .483 | .174 | .411 | .616 | .492 |
| Has cultural or historical significance in local communities | 4.01 | .93 | .086 | .718 | .033 | .477 | .782 | .432 |
| **C. Environmental Benefits** (3 items, Cronbach's α = .770) | **3.67** | **.80** | | | | | | |
| Helps protect the city's air quality | 4.06 | .86 | .138 | .224 | .427 | .501 | .545 | .638 |
| Helps protect the city's water quality | 3.59 | .95 | −.134 | .107 | .866 | .421 | .544 | .851 |
| Provides protection against extreme weather in the city (floods, heat waves, etc.) | 3.35 | 1.07 | −.011 | −.063 | .763 | .397 | .377 | .720 |

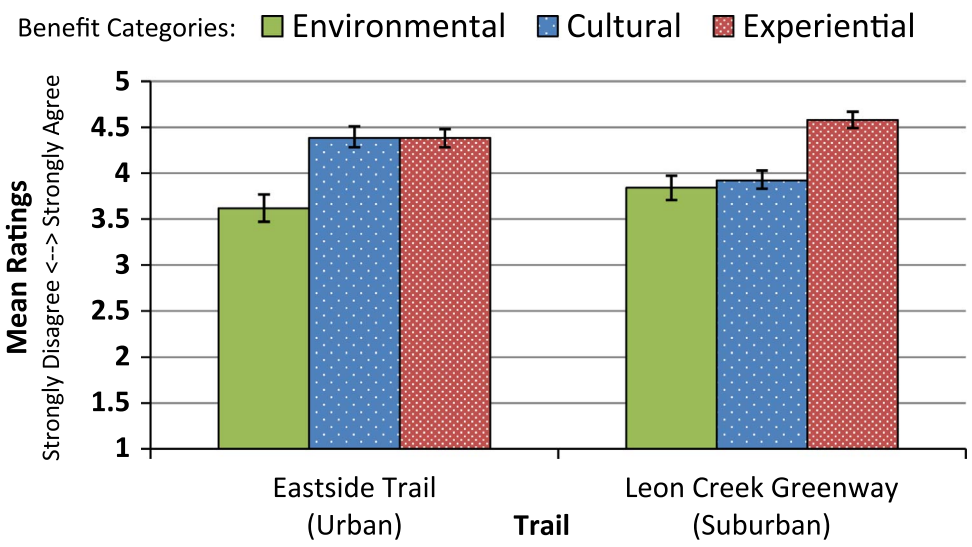


**Fig. 2.** Mean ratings for perceived greenway-related benefits (i.e., ecosystem services) among users on two urban trails: the urban Atlanta Beltline (in Atlanta, GA) and the suburban Leon Creek Greenway (in San Antonio, TX). [Scale: Ranged from 1="Strongly Disagree" to 5="Strongly Agree"; Error bars represent 95% confidence intervals; n =460.].

inputs such as human, social, and built capital to ultimately produce a final ES (Boyd and Banzhaf, 2007; Costanza et al., 2014). The value of these experiential benefits has both socio-cultural and physiological foundations that can be inferred from many disciplines, ranging from leisure theory (Lee and Shafer, 2002) and psychology of place (Stedman, 2003) to behavioral modeling (Moskell and Allred, 2013) and nature-based health promotion (Jennings et al., 2016a; Maller et al., 2006). Outdoor recreation, the most important greenway benefit noted by participants in our study, is a prime example of a cross-cutting intermediate ES. Boyd and Banzhaf (2007) contend that recreation itself, though highly valued by society, is not a final ES because it requires the combination of other human (e.g., someone to participate) and capital inputs (e.g., a place to do it). Similarly, Fisher et al. (2009) view recreation as a transformative element that translates basic ecological factors (e.g., urban green space) into tangible psychological and physiological health benefits (Manfredo et al., 1996). Whether or not these recreation-oriented experiences constitute "final" services or outputs, responses from our sample of trail users in two cities illustrate how greenways create a foundation for experiential benefits that could be explicitly incorporated into ES frameworks. Other studies examining public perceptions of urban ES have highlighted the importance of recreational connections, particularly among avid park users (Baur et al., 2014). Given these observed patterns, more research is needed to integrate interdisciplinary understanding of experiential benefits (particularly recreation-related benefits) into the evolving construct of cultural ecosystem services.

Results of this study also support previous research suggesting the general public acknowledges many of the ES that urban green space provides (Baur et al., 2016; Martin-Lopez et al., 2012). Different categories of benefits were recognized to varying degrees, however, and greenway location and context played a great role in determining perceptions of ES (Gobster, 1995; Shafer et al., 2000). Experiential benefits were most important to greenway users regardless of trail location, possibly because these benefits have a direct, tangible impact on the health and welfare of individuals interacting with nature (Bratman et al., 2012; Hartig et al., 2014). Cultural benefits may resonate with trail users for similar reasons, particularly in urban settings. The Eastside Trail's location near downtown Atlanta, connecting many residential areas, restaurants and stores, helps to foster social connections in communities adjacent to this unique linear park (Zelenski et al., 2015). This could explain why perceptions of cultural benefits were higher among Eastside Trail users when compared to people on the less developed Leon Creek Greenway. Environmental benefits were also highly regarded on both trails, but typically not to the same degree as experiential and cultural benefits. The Leon Creek Greenway's surrounding corridor, which encompassed a vegetated, creek-side flood plain, seemed to generate stronger perceptions of environmental benefits than the Eastside Trail, which featured a much narrower green corridor with densely developed surroundings.

Variation in public perceptions of ES might be expected given the heterogeneity of our samples. Assessments of ES generally depend on which service is being valued and who is doing the valuing (Fisher et al., 2009), and research has highlighted ethnic and location-related differences (e.g., urban vs. rural) with respect to ES valuation in other contexts (Cuni-Sanchez et al., 2016; Martin-Lopez et al., 2012). In our study, although socio-demographic factors did not appear to influence perspectives regarding environmental or experiential benefits, perceptions of cultural benefits varied. White users held significantly lower perceptions of cultural benefits than Hispanic/Latino users, possibly because Latinos place greater value on spending outdoor leisure time socializing in larger groups (Chavez, 2008; Shinew et al., 2004). Users farther from the trail were also less likely to acknowledge cultural benefits, perhaps because users living closer to the greenways enjoyed enhanced access that made them feel more connected to the social infrastructure of the communities in which they reside (Gobster, 1995; Shafer et al., 2000; Zelenski et al., 2015). Concern about distributional equity of urban green space, though not directly studied here, also raises doubt about the realization of cultural ES benefits in certain parts of cities – particularly low-income and racial/ethnic minority neighborhoods (Kabisch and Haase, 2014; Low, 2013). Such concerns should be answered before policy-makers can effectively integrate well-being and ES principles to make equitable and informed management decisions that reflect the needs, interests, and values of diverse constituents.

As ES-oriented thinking continues to expand and transcend disciplinary boundaries to impact human health and wellbeing (Jennings et al., 2016b), a thorough understanding of if and how people perceive the benefits associated with nature in cities will become even more critical. Cultural services, generally, and experiential services, specifically, might play a critical role in this process. Based on our findings, managers might consider marketing these social benefits of urban green spaces in an effort to boost public awareness of ES and to garner more support for them from diverse community stakeholders (Baur et al., 2016; Chiesura, 2004; Gobster et al., 2007; Martin-Lopez et al., 2012). There may also be opportunities for practitioners to educate the public about other services that green spaces provide, including

different types of environmental (e.g., provisioning services) and cultural benefits (e.g., environmental education opportunities, existence value) not assessed in this exploratory investigation. Such an approach would capitalize on observed correlations and synergistic interactions among the experiential, cultural, and environmental benefit categories. Future research should continue to explore the ways in which urban ES are conceptualized and operationalized across diverse populations, including those that may not regularly utilize green space for outdoor recreation purposes. Improved metrics for assessing the cultural and experiential benefits associated with integrated natural and built environments may help researchers and practitioners understand how the public values ES in urban settings.

## Appendix A-C. Supporting information

Supplementary data associated with this article (Appendices A-C) can be found in the online version at doi:10.1016/j.ecoser.2016.10.004.

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