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Knoxville's urban wilderness: Moving toward sustainable multifunctional management

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ABSTRACT

The Knoxville Urban Wilderness (KUW) in Eastern Tennessee is part of a larger global trend of acquiring vacant lands within urban landscapes for their natural habitat and recreation value. At 688 ha, the KUW is one of the largest urban wilderness areas in the United States, consisting of loosely-connected land parcels with multiple stakeholders including state, county, and city governments and private foundations. Here we use the KUW as a case study to address critical questions of management that arise for most urban wilderness projects globally: What should these areas be managed for, and how should they be managed? How can multiple stakeholders be efficiently organized to pool their resources most effectively. The KUW is currently used mainly for recreation and its potential for biodiversity conservation and education and ecosystem services is largely unutilized. As a way to promote and manage this unused potential, we began the first ecological inventory, compiling existing data and conducting biodiversity and invasive plant surveys with citizen scientists. We found that the KUW harbors a significant number of plant (250) and bird (193) species, with many other taxa also identified. We also found widespread infestation of invasive plants for which we provide management suggestions. A preliminary visitor survey shows that most visitors (about two-thirds) are from the immediate vicinity, mainly for walking (74.4%) or biking (19.9%). The vast majority (93.7%) of visitors do not want more vegetation management or removal and 98.3% of visitors would like to see the KUW expanded in area.

1. Introduction

Green infrastructure is increasingly seen as a vital component of sustainable and livable cities (Forman, 2008). Broadly defined, green infrastructure refers to urban environments that rely on natural elements, especially vegetation, to provide ecosystem services such as stormwater management, air temperature reduction and habitat provisioning (Birch and Wachter, 2008).

There are many kinds of green infrastructure, including highly managed ecosystems such as green roofs (Dunnett and Kingsbury, 2008) and bioretention ponds (Kazemi et al., 2009). However, many cities throughout the world have large areas of brownfields and other types of vacant land which are increasingly seen as usable components of a growing green infrastructure (Kim et al., 2015; Mathey et al., 2015). These vacant lands have great potential to provide ecosystem services, often exceeding those of traditional parks and other common urban green spaces (reviewed by Threlfal and Kendal, in press). In addition, vacant lands, if utilized as green space, can provide many social amenities, including recreation, aesthetic value, and psychological benefits (Danford et al., in press).

The use of vacant land for green infrastructure is also likely driven in many areas by what Burkholder (2012) has called the "new ecology of vacancy". Influenced by a variety of socio-political changes, at least one-sixth of the world's cities are shrinking (Haase, 2008). In regions such as the old industrial areas of the U.S. and Eastern Europe, population losses have led to widespread abandonment of urban land leaving many cities with large areas of vacant land. An estimate of 70 major U.S. cities found that about 15% of urban land was vacant (Pagano and Bowman, 2000). In extreme cases, such as Detroit, which has lost over 50% of its population since 1950, roughly one-third of the city consists of vacant land (Kim et al., 2015).

While these growing vacant lands are often an economic burden to cities, they are increasingly utilized in ways that provide monetary and other benefits to those cities. Indeed, the reuse of vacant urban land has become a significant policy field in urban planning (Johnson et al., 2014). Examples of different uses for vacant lands, especially in European cities, include: refuse tips, railway sites, road verges, and old town centers (Kim, 2016). In New York City, vacant lots are often utilized for community food gardens, wildlife gardens or recreational and playground areas (Kremer et al., 2013).

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However, for many vacant lands, "rewilding", i.e., using the land as "wilderness" may often be the most economically viable policy for local government and private stakeholders (Burkholder, 2012). Conversion of vacant land into wilderness often has a much lower economic cost/benefit ratio than maintaining that land for other uses. For example, the cost of mowing and trash removal on abandoned lands in eight Ohio cities is over $60 million per year and the city receives very little money in return for this land (Community Research Partners & ReBuild Ohio, 2008). Eliminating those activities and letting natural succession occur would save millions of dollars in maintenance costs.

Furthermore, the economic benefits of using vacant land as wilderness can exceed those where the land is managed more intensively. For example, the estimated economic benefit of the Knoxville Urban Wilderness, discussed below, is over $8 million per year and this is expected to grow substantially in coming years (Sims et al., 2015). Importantly, such major economic estimates of wilderness greenspace rarely incorporate ecosystem services, aesthetic and biodiversity benefits in which wilderness greenspace often provides significantly superior benefits than other urban greenspaces (Threlfal and Kendal, in press).

Given these several advantages, it is not surprising that urban wilderness areas are becoming popular, especially in Europe (Kowarik and Körner, 2005). In this paper, our focus is on the Knoxville Urban Wilderness (KUW). The KUW is of interest to the urban wilderness literature because, as discussed below, it illustrates many of the same management challenges facing urban wilderness projects throughout the world. It is also one of the largest and best-known urban wilderness areas in the U.S. (Sims et al., 2015). Indeed, in contrast to many European cities (Kowarik and Körner, 2005), we are aware of no other U.S. city that has such an extensive urban wilderness area, especially for the relatively small size of the Knoxville urban area. We will discuss our initial efforts to address emerging management issues, and efforts to expand both the size and the functionality of the KUW in coming years.

1.1. Background of the Knoxville urban wilderness

The Knoxville Urban Wilderness (KUW) is a collection of land parcels owned by city, county, and state government, non-profit foundations, and private landholders (Fig. 1, Zefferman and McKinney, 2015). These parcels comprise approximately 688 ha just south of the Tennessee River. Historically, these lands have been utilized for farming, homesteading, logging, mining, and quite a few Civil War entrenchments (Mahurin and Mahurin, 2012). However, for most parcels in the KUW, these land uses have been discontinued in the last several decades (Table 1 and references therein). Importantly, South Knoxville, where the KUW is located, has seen much less housing development (urban sprawl) compared to the rest of the city due to the hilly topography and its relative isolation on the opposite side of the Tennessee River from the main part of Knoxville (Mahurin and Mahurin, 2012). Consequently, these land parcels have undergone many decades of ecological recovery and represent the kinds of vacated lands that are characteristic of the urban wilderness movement (Zefferman and McKinney, 2015).

One of the most unique aspects of the KUW is the organizational and physical linkage of all of these parcels, which have disparate land use histories, ownerships, and management goals (hunting, nature park, city parks, private parks) into a single entity: the Knoxville Urban Wilderness (Sims et al., 2015;). This linkage has been championed by a local non-profit group, Legacy Parks Foundation, which began this process in the 1990′s (www.legacyparks.org). In addition to organizing these parcels under one moniker, there has also been an effort to physically link the parcels through greenways. Current plans are to expand the KUW to include two large state parks, House Mountain and Seven Islands Wildlife Refuge, by connecting the current parcels via the construction of more greenways (Zefferman and McKinney, 2015).

Until now, the major motivations for the creation and expansion of the KUW have been boosting economic activity by increasing the recreational opportunities and quality of life of local residents in this lower-income region of the city (Sims et al., 2015). The KUW is visited by many thousands of outdoor enthusiasts each year. With over 80 km of bike trails and a rolling topography that provides many jumps and ravines, the KUW is especially well known in the mountain biking community, serving as a destination for bikers from hundreds of miles away (http://www.outdoorknoxville.com/urban-wilderness). For example, the recently opened "Baker Creek Preserve" (formerly the "Wood property") is being developed with over 11 km of bike trails with funding from a biking helmet company. Indeed many of the trails in the KUW were developed and are maintained by volunteers of the local Appalachian Mountain Bike Club (AMBC-sorba.org).

1.2. Key management questions

Although urban wilderness areas are usually defined as ecosystems with a "high level of self-regulation" (Kowarik, in press) and "lack of management" or reduced human involvement in community assembly (Threlfal and Kendal, in press), it seems clear that some level of management is required in many urban wilderness areas, depending on how they are used. Here, we use the KUW as a case study to demonstrate three key management questions that need to be addressed in any urban wilderness project:

One, what is the wilderness area being used for? Urban wilderness areas are often multifunctional (Konijnendijk, 2005), providing many ecosystem services (Threlfal and Kendal, in press) and many recreational and amenity functions such as walking and biking (Bell, 2005; Keil, 2005). In the case of the KUW, we will discuss data we collected on current usage, and interest in expanding use beyond mainly recreational goals.

Two, what are the consequent management methods determined by these functional goals? Depending on which uses are most important to the stakeholders of the wilderness, management methods may vary. An area used mainly for biking will likely need different management goals and methods than an area utilized mainly for conservation of threatened species.

For the KUW, which is managed largely for recreation (walking and biking), the vast majority of management is focused on areas adjacent to walking and biking trails, and is largely limited to invasive plant removal to keep the trails clear and to a lesser extent for aesthetic goals (Knoxville Urban Forester, personal communication).

Here we will discuss our efforts to extend management beyond mainly recreational goals to include conservation, education and ecosystem services. This has focused on: 1) creating the first systematic ecological inventory based on the premise that we have to know what composes an ecosystem to effectively manage it, regardless of management goals, and 2) invasive species removal. This latter is based on the premise that monocultures of invasive species often negatively impact many urban wilderness uses and values such as ecosystem services (Vaz et al., 2017), biodiversity conservation (Simberloff, 2013) and recreation (Hughes et al., 2014).

Three, who is managing the area? Urban wilderness is often managed by several local community stakeholders such as the diverse coalition of stakeholders noted above for the KUW. These stakeholders typically include local non-profit groups focused on preservation or recreation and local government and city agencies (Davies, 2005). Coordinating cohesive management goals and methods among such multiple stakeholders can have many social and conservation benefits (Buijs et al., 2016; Dennis and James, 2016) but can also be very challenging (Lovell and Taylor, 2013). Here we discuss how this complex dynamic among several stakeholders is being implemented and is evolving for the KUW.

2. Methods

In January 2015, we initiated an ecological inventory of the KUW.

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