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Vacant lots: An underexplored resource for ecological and social benefits in cities

Elsa C. Anderson*, Emily S. Minor

University of Illinois at Chicago, Department of Biological Sciences, 845 W. Taylor, M/C 066, Chicago, IL 60607, United States

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ABSTRACT

Vacant lots make up a large proportion of urban land and are of interest to many stakeholder groups. While they are often viewed as dangerous or unsightly, they can be an economic, social, and ecological resource. Here we present a literature review focused on restoring biodiversity in vacant lots, emphasizing the intersection of human and wildlife needs. We focus on the benefits, challenges, and processes of restoration in vacant lots and synthesize ecological, social, and economic information across these domains. We suggest that fast, inexpensive restoration techniques could be implemented in vacant lots and would be well suited to increasing greenspace in low-income areas. Furthermore, we emphasize that land managers, ecologists, sociologists, urban planners, and local communities must work together to conceptualize, carry out, and monitor restoration projects, as these projects are often characterized by disparate goals and insufficient follow-up. Vacant lot restoration is best addressed by an interdisciplinary approach that combines economic, social, and environmental needs and concerns into a holistic urban land use paradigm.

1. Introduction

As cities grow, development often occurs outwards. Without corresponding net population growth, this can leave vacant buildings and land in the dense urban matrix (Bowman and Pagano, 2004; Bontje, 2004). These vacant spaces come in many forms and sizes, and include everything from severely contaminated brownfields to foreclosed residential properties where buildings may have been partially or completely demolished. Sometimes called greenfields, wastelands, or abandoned, derelict or uncultivated land, these spaces comprise an extensive network in urban areas. While these various classes of land have subtle differences, they are often lumped together because there is no single, broadly accepted definition for vacant land (Bowman and Pagano, 2000; Bowman and Pagano, 2004; Kremer et al., 2013).

Cities with more than 250,000 inhabitants generally have between 12.5-15% vacant land by area at any given time (National Commission on Urban Problems, 1968; Bowman and Pagano 2000). These vacant lots do not occur randomly throughout the urban matrix but tend to be concentrated in low-income neighborhoods (Brulle and Pellow, 2005; Kremer et al., 2013). Vacancy is usually perceived negatively and typically correlates with increased crime and reduced property values (Hoffman et al., 2012). In extreme cases, the negative connotations of high vacancy can overshadow positive community assets (Garvin et al., 2013). However, studies in New York City demonstrate that vacant lots can also be viewed as a valuable resource for local economies, communities, and environments (Bowman and Pagano, 2004; Kremer et al., 2013). For this reason, there has been interest in transforming these spaces into informal greenspace (Burkholder, 2012; Rupprecht and Byrne, 2014) within the urban matrix. Such transformations could increase urban sustainability, by improving the balance among environmental protection, economic development, and social well-being (Wu, 2010), and promoting development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1985).

2. Objective and approach

This review was motivated by the three pillars of sustainability (i.e., environmental, economic, and social; UN, 2002; Andersson, 2006) to take an interdisciplinary approach to evaluating vacant lot restoration. We seek to synthesize ecological, economic, and social motivations, methods, and outcomes of restoring biodiversity to vacant lots and to pose recommendations for future projects. We focus specifically on vacant lots as they are fundamentally different

* Corresponding author.
E-mail address: eholden2@uic.edu (E.C. Anderson).

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from other kinds of urban green space (e.g., community gardens, parks, etc.) in terms of human involvement. Other reviews have explored biodiversity (Bonthoux et al., 2014) and potential to provide ecosystem services (Kim, 2016) in vacant lots, and tools for evaluating brownfield restoration projects (Pediaditi et al., 2010). Relatedly, a recent brief produced by the Vacant Property Research Network (Heckert et al., 2015) highlights benefits of the broader field of 'urban greening'. However, no paper focuses specifically on restoring biodiversity in vacant lots. Furthermore, while there is certainly multi-disciplinary interest in restoring vacant lots, true interdisciplinary work bridging ecological, economic, and concepts in restoration is limited.

In this review, we seek to synthesize ecological, economic, and social literature on the following topics: (1) benefits of restoring vacant lots, (2) challenges associated with restoration, and (3) evaluating success of restoration projects. We end the review with some recommendations for future restoration and research efforts. We selected these topics to span the conceptual and practical realms of restoration, to provide distinct points for comparing interdisciplinary perspectives, and to present empirically-based recommendations for sustainable use of this land resource.

To find literature, we performed searches using Web of Science© and Google Scholar© that included combinations of key terms "vacant lots" "greenfields", "biodiversity", "urban", and "restoration" along with discipline specific terms including "public health", "value", "ecosystem services", "greening", and "cost". Using these search terms, we found 24 papers focused specifically on biodiversity and restoration in vacant lots. From these initial resources, we utilized bibliographies and searches of other publications by relevant authors to compile an interdisciplinary works cited that includes 117 sources focused mostly on Europe (n = 22) and the United States (n = 34) when they were geographically explicit. Many papers were interdisciplinary, but over half (n = 64) addressed aspects of ecology, 35 addressed social sciences, 21 urban planning, 18 economics, and 8 public health. Because there is not a large body of literature specifically on restoring biodiversity in vacant lots, we also draw from other relevant bodies of literature when helpful, but maintain a focus on peer-reviewed literature.

For consistency with the restoration ecology literature, we define "restoration" as a process of assisting recovery of an ecosystem that has been degraded, damaged, or destroyed (SER, 2004). However, we want to emphasize that goals for restoration are site-specific and the traditional mentality of returning to pre-development conditions is generally unrealistic in urban ecosystems (Hourdequin and Havlick, 2016). Instead, we refer to measures that increase biodiversity or ecosystem functioning without the end goal of recreating historic site (Balnerva et al., 2006).

2.1. Ecological, economic and social benefits of restoring vacant lots

Several common uses exist for vacant lots. Although they are often used for parking, makeshift athletic fields and play areas, or junkyards, they are occasionally incorporated into the ecological fabric of the city via community garden development or habitat restoration (Kremer et al., 2013; Németh and Langhorst, 2014). In this section, we review the potential benefits of restoring habitat in vacant lots from ecological, economic, and social perspectives, each in turn.

Biodiversity conservation in the face of global urbanization is a critical concern for ecologists (Chapin III et al., 2000). For many taxa, particularly birds, urban areas have fewer species than nearby natural areas or suburbs (Blewett and Marzluff 2005; McKinney 2006; Garaffa et al., 2009). These trends are caused by multiple factors, including reduced habitat (Le Roux et al., 2014), changes in predator-prey dynamics (Fischer et al., 2012), novel threats such as collisions with buildings (Bayne et al., 2012) or vehicles (Gunson et al., 2011), pesticide inputs (Fry 1995; Savard et al., 2000), and non-native competitors and predators (Rebele 1994; Loss et al., 2014). On the other hand, some generalist taxa do very well in cities worldwide, even while their historic-range populations decline (Shaw et al., 2008). This is especially true for generalist birds like pigeons (*Columba livia*), European Starlings (*Sturnus vulgaris*) and House Sparrows (*Passer domesticus*). There has been a recent interest in native species resurgence in urban areas as well. Evidence suggests that raccoon (*Procoyon lotor*) and coyote (*Canis latrans*) populations are increasing in urban areas of the United States (Gehrt 2004). Vacant lots that are allowed to grow wild (unmowed) or that are restored have the potential to increase urban biodiversity and may even contribute to conservation of rare and endangered species (Harrison and Davies, 2002; Muratet et al., 2007). They can act as refuges for endangered plants (Vessel and Wong, 1987), and can provide suitable habitat for some species of small mammals (Magle et al., 2010), insects (Uno et al., 2010; Gardiner et al., 2013; Gardiner et al., 2014), and birds (Ortega-Álvarez and MacGregor-Fors, 2009). Additionally, a diverse belowground community has been shown to thrive in vacant lots in Cleveland and Akron, Ohio, USA (Grewal et al., 2011; Yadav et al., 2012). These habitat patches can also contribute to the overall connectivity of urban ecosystems (Herbst and Herbst, 2006) and provide stepping stones for species such as migratory birds or butterflies travelling between larger habitat preserves (Angold et al., 2006).

Restored vacant lots also have potential to offer economic benefits to urban residents through the provision of ecosystem services, primarily from increased plant abundance (Pimentel et al., 1997; Kim, 2016). Increased vegetation and biodiversity can contribute to a number of ecosystem services with direct economic value (Bolund and Hunhammar, 1999), such as stormwater retention (which can reduce basement flooding; Walsh, 2000), increased pollination services (which can increase crop yield of home gardens; Lowenstein et al., 2015), and bio-remediation of contaminated sites (which can reduce public health concerns such as lead exposure; Weitzman et al., 1993). Because vacant lots tend to be in low-income neighborhoods, restoration could also potentially increase property values and draw in local businesses in areas where need is arguably the strongest (Accordino and Johnson 2000; Groot et al., 2013). A study in Pittsburgh, Pennsylvania (USA) showed that homes near untended vacant land can appraise for up to 20% less than homes further away from these spaces, and that this is almost completely reversible when lots are planted and maintained (Wachter and Gillen, 2006). Furthermore, business opportunities exist in terms of green job creation and infrastructure development in and around vacant lots. Schilling and Logan (2008) suggest that lots that meet specific ecological requirements could feasibly be used for biofuel production, municipal CO_2 sequestration plants, or small-scale for-profit agriculture.

There have also been recent efforts to better understand the social dimensions of biodiversity (e.g., Sharma and Ruud, 2003; Paloniemi and Tikka, 2008; Riechers et al., 2016). Cultural ecosystem services, as defined by the Millennium Ecosystem Assessment (2003), acknowledges cultural benefits of biodiversity such as spiritual attachments, recreation experiences, and aesthetic values. Broadly speaking, exposure to nature and real or perceived biodiversity may provide many benefits to people, including improved psychological well-being, physical health, and cognitive function (Brown and Grant, 2005; Maller et al., 2006; Fuller et al., 2007; Shin et al., 2010), although Keniger et al. (2013) recognize the cultural implications and Western biases of the literature on this matter. While there are some discrepancies about the relationship between biodiversity and human well-being (Dallimer et al., 2012; Schwartz et al., 2014), Keniger et al. (2013) explicitly examine the evidence