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Research Paper

Ecological outcomes of civic and expert-led urban greening projects using indigenous plant species in Cape Town, South Africa

P.M.L. Anderson[a,b,*], G. Avlonitis[a], H. Ernstson[b,c,d]

[a] Department of Environmental and Geographical Science, University of Cape Town, Private Bag X3, Rondebosch, 7701 Cape, South Africa
[b] African Centre for Cities, University of Cape Town, Private Bag X3, Rondebosch, 7701 Cape, South Africa
[c] KTH Environmental Humanities, Royal Institute of Technology, Stockholm, Sweden
[d] Department of History, Stanford University, California, United States

HIGHLIGHTS

- Measures of plant and insect diversity show the role of civic-led greening in linking conservation to the 'good and just city'.
- Civic-led interventions can contribute towards urban conservation agendas with the acknowledged exclusion of fire.
- How to integrate civic-led interventions into urban biodiversity planning remains an open question.

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ABSTRACT

Parks and private and public gardens do not exist in isolation, but form part of the urban fabric, contributing to ecological functioning. There is growing interest in how civil society shapes urban ecologies and vegetation patterns. This paper explores the ecological outcomes of a series of indigenous plant greening interventions in Cape Town. The six different sites were sampled: two civic-led intervention sites, one expert-led rehabilitation site, two conservation sites and one abandoned site. These sites are compared in terms of their plant and insect diversity and then discussed in relation to their contingent management arrangements and in relation to conservation and abandoned land. Plant and insect diversity measured at the civic-led greening intervention sites suggest these sites are similar to adjacent conservation sites, while floristic composition differs. The inclusion of a vacant lot with poor species and growth form diversity shows the significant role of intervention in the ecological reformation of urban green space. By emphasizing the ecological outcomes, this study highlights the importance of civil society in linking conservation goals to more broad-based notions of quality of life and the 'good and just city'. Our results indicate that civic-led efforts warrant attention in keeping with those of experts, both in relation to meeting indigenous conservation targets, as well as supporting functional groups and wider ecological processes, with the acknowledged exception of fire. How to integrate such civic-led interventions into urban biodiversity management planning is still an open question.

1. Introduction

1.1. Forging urban ecologies

Urban ecology is neither natural nor social, but rather a "recombinant ecology" (Barker, 2000). It has arisen from historical climatic and vegetation conditions and shaped by multifaceted urbanization processes of housing, transport, energy and telecommunication infrastructure, but also the allocation of 'green spaces' (Niemelä et al., 2011). Among the many heterogeneous urban land uses that support ecological functions, the broad category of 'green spaces' are crucial in several ways. For example, urban forests, park areas, sports fields, and water bodies and wetlands, have the capacity to support biodiversity often restricted to these areas, mitigate climate extremes, sequester carbon, provide educational opportunities, and facilitate the infiltration of storm water (Cadenasso & Pickett, 2008; O'Farrell, Anderson, Le Maitre, & Holmes, 2012). Studies have shown how such green spaces support critical functions and services, in particular when services cannot be acquired

* Corresponding author at: Department of Environmental and Geographical Science, University of Cape Town, Private Bag X3, Rondebosch, 7701 Cape, South Africa. Tel.: +27 21 650 5386.
E-mail address: pippin.anderson@uct.ac.za (P.M.L. Anderson).

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or bought from outside the city, but must be delivered in situ (Bolund & Hunhammar, 1999; O'Farrell et al., 2012; Tratalos, Fuller, Warren, Davies, & Gaston, 2007) and of particular significance is the high degree of social interventions and engagement in such spaces (Breuste, Niemela, & Snep, 2008; Ernstson, 2013a).

There is a growing interest to study how civil society groups play a part in shaping and forming urban ecologies and vegetation patterns through their capacity to support management and protect green spaces and habitats (Ernstson, 2013a; Ernstson, Barthel, Andersson, & Borgström, 2010; Ernstson & Sörlin, 2009; Tidball & Krasny, 2011). The bulk of this literature has however focused on the social features and factors that lead to and sustain such interventions, and less on their ecological or biophysical impacts. For instance, Tidball and Krasny (2011) link civil society efforts to environmental pedagogical issues through a notion of 'civic ecology'. Colding, Lundberg, and Folke (2006) used property rights theory to demonstrate the importance of non-protected green spaces to support biodiversity and ecological functioning, and the value of 'urban green commons', while Barthel, Folke, and Colding (2010) have theorized the importance of local ecological knowledge and social-ecological memory that these groups develop and sustain. These studies point towards a multifaceted socio-ecological role played by local civic groups. They demonstrate: (i) local ecological knowledge and social cohesiveness; (ii) support for environmental management; and (iii) the production of real biophysical changes on the ground in areas where they work (Ernstson, Barthel, et al., 2010; Ernstson, van der Leeuw, et al., 2010). Researchers have mainly focused on the former two with less work on ecological outcomes, which forms the focus of this paper.

This paper aims to measure the ecological outcomes or biophysical impacts of civic-led interventions of planting and green space protection. To do this we compare ecological measurements across three types of sites: civic-led intervention sites (2), expert-led rehabilitation efforts (1), and vacant lots with no historically recorded management (1). While the former two are in focus, the latter are used as sites for comparison. Although an increasing number of studies exist in urban conservation ecology of how management, intervention and experiments leads to ecological changes, these tend to focus either on controlled experiments (Aronson & Handel, 2011), or expert-led rehabilitation efforts (McPhearson et al., 2010). One study that looked at civic groups is that of Andersson, Barthel, and Ahrné (2007). They compared the ecological outcomes between different management regime practices at allotment gardens, cemeteries and urban parks in Stockholm. Measuring the abundance and diversity of bumble bees and birds and linked management regimes to the ecological functions of pollination, seed-dispersal and pest regulation. Our study builds on such efforts, but also contributes with a study from the global south, acknowledging the value of site specific knowledge production.

In doing this study we recognize the huge complexity that urban ecologies bring. Although it is difficult to identify causal mechanisms generally in ecology, this is even more difficult in urban ecologies since they are inherently produced, altered, and modified through a range of processes that we often refer to as social, economic, political and cultural (Alberti et al., 2003; Ernstson, 2013a, 2013b; Grimm et al., 2008; Pickett et al., 1997). Thus, all of our selected sites have a unique combination of factors and historical contingencies that have played out over time to influence their biophysical features, most notably with the settlement of this area over the last 100 odd years, and the nature of the interventions that have taken place more recently. Our task here is nonetheless important as we use established methods from ecology to describe biophysical and ecological patterns that can be attributed to socially constructed interventions in urban green spaces. There has been a bias in the emergent field of social-ecological studies to theorize 'the social' and leaving out 'the ecological', which we seek to bring to the fore here.

1.2. Cities and biodiversity: the City of Cape Town's conservation agenda

The conservation agenda for the Cape Town region is recognized as of global significance (Anderson & Elmqvist, 2012; Holmes, Rebelo, Dorse, & Wood, 2012; Myers, Mittermeyer, Fonseca, & Kent, 2000). The city falls within the Cape Floristic Kingdom and hosts exceptional biodiversity with some 3350 plant species, and 19 of 220 national vegetation types, all within the 2460 km^2 city area (Rebelo, Holmes, Dorse, & Wood, 2011). Of these 19 vegetation types, 11 are threatened accounting for 52% of all threatened vegetation types in the country (Rebelo et al., 2011). The region has a Mediterrannean climate and the indigenous vegetation, broadly termed Fynbos, is short scrubby and sclerophyllous vegetation that is both fire prone and fire adapted (Cowling, 1992). This study focuses on Cape Flats Sand Fynbos, one of these critically endangered vegetation types. Historically this was one of the most prevalent vegetation types in the City of Cape Town prior to its establishment and urban growth. Today it has the highest concentration of threatened plants per area of remaining vegetation in the world (Mucina & Rutherford, 2006; Rebelo, Boucher, Helme, Mucina, & Rutherford, 2006). Only 14% of its original area is left in fragmented remnant patches scattered around the city and only 5% is deemed conservation worthy (Mucina & Rutherford, 2006). Predicted climate change for the region, with higher temperatures and significant drying, is likely to have devastating effects on remnant flora (Midgley, Hannah, Millar, Thuiller, & Booth, 2003). Additional on-going threats posed come from agriculture, urban development, mining and degradation by invasive alien plants (Holmes et al., 2012).

Concerted efforts on the part of City management to address conservation concerns have seen the formulation of a conservation plan devised on the basis of biodiversity and connectivity metrics, which forms the basis of a biodiversity network plan (Rebelo et al., 2011). However, the actualization of this into formal protected conservation areas is challenging (Rebelo et al., 2011; Holmes et al., 2012). Continual development pressure, and limited budgets for conservation, thwart efforts to secure and appropriately manage remnant patches of biodiversity in the city (Holmes et al., 2012). Despite a good legislative environment, and support for conservation as demonstrated through international signatory agreements, implementation of local policies to support these international agreements is often slow (Holmes et al., 2012). Local government, to whom this conservation task falls, feel they are not viewed as important implementation partners.

The prohibitive cost of securing conservation areas in cities (where land prices and demand for land is high) and conservation planning theory in relation to size and connectivity, both point to the significance of the greater urban matrix, which includes built up land, private gardens, and public parks, in meeting urban conservation needs (Colding et al., 2006; Goddard, Dougill, & Benton, 2010; Pauw & Louw, 2012). Evidence that small conservation areas in cities fail to conserve species through time (Colding et al., 2006; Woodroffe & Ginsberg, 1998), and suggestions that this will become more critical in light of anticipated climate change (Cartwright, Oelofse, Parnell, & Ward, 2012), further support the relevance of the greater urban fabric in supporting urban conservation. The areas between formal conservation areas, the matrix, are vital to connectivity and function (Desmet, 1999). The nature of this matrix, both its texture and form, is critical, and needs to be given greater attention in urban planning. Indeed the permeability of the matrix is generally disregarded or unknown in urban ecology.