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User participation in urban green commons: Exploring the links between access, voluntarism, biodiversity and well being

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ABSTRACT

Polycentric governance and stakeholder participation in natural resource management have potential benefits for both human and environmental well-being. Researchers and decision-makers have attempted to conceptualise the ecological, social and political potential of such semi-formal approaches to urban green space management. However, few studies have quantified the actual benefits in terms of biodiversity and associated ecosystem service provision, or the factors that mediate levels of participation.

The links between biodiversity potential, site access and user participation were explored in a case study comprising ten established examples of organised social–ecological initiatives in the inner-city area of Greater Manchester. At the micro-scale, the case study quantified the levels of community involvement (measured in volunteer hours month^{-1}) in local green commons and the biodiversity potential (assessed using floristic and structural diversity as a surrogate) of the ten sites. Descriptive analysis identified that site spatial and design characteristics affected all three measures and subsequent correlational analyses revealed a high degree of synergy between site use and biodiversity.

The study thereby provides quantitative evidence of the synergistic relationship between green space use and urban biodiversity and, importantly, the positive feedbacks which should result between volunteer input and the local generation of ecosystem services. The study provides support for the promotion of a highly decentralised, stakeholder-led stewardship of green space as a valid consideration in the management of urban ecosystem services.

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1. Introduction

Biodiversity loss can have highly detrimental consequences for human well-being (MEA, 2005; Haines-Young and Potschin, 2013). The rise and promotion of stakeholder-led environmental stewardship has produced many examples of a decentralised approach as an adaptive response to environmental degradation (Gunderson and Holling, 2002; Krasny and Tidball, 2012). The urban environment in particular, as home to most of the world's inhabitants (United Nations, 2007) and the centre of rapidly occurring land-use change associated with biodiversity loss (Marzluff, 2008; McKinney, 2008) presents opportunities for studying the relationship between citizen involvement in natural resource management and levels of local biodiversity. Although such involvement is recommended through policy (CBD, 2001; MEA, 2005) and research (Ernstson et al., 2008, 2010) alike, without empirical evidence of the positive link between user participation in natural resource management and local biodiversity, the benefits of stakeholder involvement have remained largely unconfirmed (Krasny et al., 2014; Fors et al., 2015). This study explored the links between user participation in community-run urban green spaces and their floristic and structural diversity, and as a result highlights the influence of access and design as a mediating factor in this relationship.

1.1. Biodiversity and human well-being

The Ecosystem Approach set out by the Convention on Biological Diversity (CBD, 2001) emphasised the importance of global biodiversity for human well-being. The Millennium Ecosystem Assessment (MEA, 2005) developed this link further with a focus on Principle 5 of the Ecosystem Approach, i.e. the salience of ecosystem services. The latter concept encompasses the benefits arising from ecosystem functions and processes across spatial and temporal scales which contribute to human well-being and quality of life (MEA, 2005). The Millennium Ecosystem Assessment classifies ecosystem services into four categories: (1) provisioning services, providing direct concrete goods such as wood or food; (2) regulating services, for example, flood prevention, climate control, or

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water quality; (3) cultural services, the less tangible recreational, educational, or spiritual benefits; and (4) supporting services in the form of primary production, nutrient cycling, and soil formation. Other versions of the framework have offered alternative classification such as those used in The Economics of Ecosystems and Biodiversity (TEEB, 2008), the Common International Classification of Ecosystem Services (see Haines-Young and Potschin, 2013).

In all of the various systems of classification, the key tenet of biodiversity as the foundation of all ecosystem services, being the basis of life on Earth, is asserted. This global view of social–ecological well-being has been supported by findings in the scientific literature which identify the importance of biodiversity across various scales, habitats and taxonomic groups for ecosystem service production (e.g. von Shirnding, 2002; Burls and Khan, 2005; Worm et al., 2006; Costanza et al., 2007; Pudup, 2008; Niemelä et al., 2010; Mace et al., 2012; Wall and Nielsen, 2012; Haines-Young and Potschin, 2013).

Both the Ecosystem Approach and the Ecosystem Services Framework acknowledge the role of societal choices and action in the preservation of healthy ecosystems and conservation of the biodiversity which supports them. Principle 2 of the Ecosystem Approach requires that management of ecosystems is always decentralised to the lowest appropriate level (CBD, 2004) and the MEA likewise insists on an integrated approach to ecosystem management which promotes stakeholder involvement in decisions relating to environmental management (MEA, 2005).

This concern that human well-being should be related to the integrity of global ecosystems is accompanied by an acknowledgement of the rise of anthropogenic influences on the natural environment which have led to greater changes in ecosystem function during the second half of the twentieth century than any other period in history (MEA, 2005). Such a shift has been associated with unprecedented levels of biological diversity loss (Foley et al., 2005), primarily due to patterns of land-use change associated with a dramatically rising global population (Satterthwaite, 2009; Falloon and Betts, 2010). Such population increase has driven a surge in land-use change through the process of urbanisation, with the majority of the world's population now dwelling in towns and cities (United Nations, 2007).

1.2. Urbanisation: Implications for biodiversity and human well-being

Urbanisation is a key driver of land-use change associated with the appropriation of disproportionate levels of ecological resources (Folke et al., 1997). Habitat loss due to urbanisation can result in high extinction rates for native species (Kowarik, 1995; Marzluff, 2008), with lasting consequences not generally witnessed for other land-use change scenarios (Stein et al., 2000). Urban areas generally contain poorer species richness and diversity across all taxonomic groups (Kuhn and Klotz, 2006; McKinney, 2008; Aronson et al., 2014) with increasing population density associated with local extinction of plant species (Thompson and Jones, 1999). Moreover, the process of urbanisation can often be catastrophic for species assemblages, with the resulting land-use types suiting non-native, generalist species (DeCandido et al., 2004; McKinney, 2006; Pauchard and Shea, 2006). Biodiversity loss occurs at the local, regional and global scales directly and indirectly due to human-induced urban sprawl (Grimm et al., 2008).

Such consequences also have a direct impact on the inhabitants of urban areas. The social, environmental, and health-related stresses associated with urban living can be summarised as:

1. *Social*: lack of safe, accessible communal and recreational spaces; high crime rates; and increased deprivation.
2. *Health-related*: increased levels of pollution; poor diet; stress; heightened anxiety; little access to outdoor activities; and lack of natural, open spaces.
3. *Environmental*: loss of biodiversity; land contamination; flood risk; high ecological footprint; climate change; and food security (CABE, 2010; Coutts, 2010).

These factors are all interrelated, and so aligned are human and environmental states of health in the urban setting that they are being increasingly viewed as synergistic, reciprocal phenomena (MEA, 2005; WHO, 2005; Coutts, 2011).

The benefits to urban dwellers arising from the presence of green infrastructure are significant and varied. Studies have shown key gains, through indicators of physical health, mental well-being and longevity, for residents living in proximity to quality urban green space (Kaplan, 1995; Jackson, 2003; Maas et al., 2006; Maller et al., 2006; Gidlöf-Gunnarsson and Öhrström, 2007) as well as for those who seek interaction with nature in urban settings (Pretty et al., 2005, 2007; Bird, 2007; Tzoulas et al., 2007; Marselle et al., 2014; Carrus et al., 2015). Socio-economic factors have been highlighted as factors which mediate the strength of the relationship between green space and health (de Vries et al., 2003; Mitchell and Popham, 2007) but, for all sectors of the urban demography, the association between biodiverse green space and human health is consistently demonstrated as a positive one (Tzoulas et al., 2007; Hartig et al., 2014). Further, research has demonstrated that interaction with green spaces can be, as well a general boon to well-being (Maas et al., 2009; Barton and Pretty, 2010; Coon et al., 2011; Ward Thompson et al., 2014) restorative with respect to specific health conditions. Faber Taylor and Kuo (2011) found that nature exposure had a positive effect on the reduction of symptoms in children suffering from attention deficit disorder, giving support to Kaplan's (1995) Attention Restoration Theory. Similarly, outdoor green spaces have been shown to offer stress and pain relief to users (Hansmann et al., 2007) and in Australia research has been undertaken which puts forward woodland management as an effective remedy for depression (Townsend, 2006). Increasingly biodiverse spaces in urban areas have been associated with higher measures of subjective well-being (Carrus et al., 2015) and floristic biodiversity specifically has been identified as contributing in a direct linear fashion to urban psychological well-being (Fuller et al., 2007). Such findings are further supported by studies into therapeutic landscapes where structural and vascular plant diversity demonstrate particular efficacy in comparison with non-biodiverse environments (Marcus and Sachs, 2013).

Sense of place has been cited as a key element in fostering community identity and well-being (Williams and Stewart, 1998; Davenport and Anderson, 2005; MEA, 2005), and studies have demonstrated that naturalistic spaces and healthy urban environments can be instrumental in creating a positive sense of place among communities (Stedman, 2003; ODPM, 2004; Kudryavtsev et al., 2012; Tidball and Stedman, 2013).

Given the pressures placed on ecosystem functioning by urbanisation, existing green space within cities, and the management thereof, have become vitally important for biodiversity conservation (Kong et al., 2010; Kowarik, 2011; Barrico et al., 2012; Tscharntke et al., 2012; Rupprecht et al., 2015) and the associated production of ecosystem services (Niemelä et al., 2010; Kaczorowska et al., 2015; Sandifer et al., 2015; Speak et al., 2015). Although studies of biodiversity have often taken a landscape-scale approach (Waldhardt, 2003; Kim and Pauleit, 2005; Tscharntke et al., 2005, 2012; Nelson et al., 2009; Chalker-Scott, 2015), the significance of individual, small pockets of green space in urban areas for biodiversity is receiving increasing support (Smith et al., 2006; Davies et al., 2009; Goddard et al., 2010; Cameron et al., 2012). Domestic gardens in particular have been championed as

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