Ecosystem Services 26 (2017) 17–26

Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser

Ecosystem services of collectively managed urban gardens: Exploring factors affecting synergies and trade-offs at the site level

Matthew Dennis[a,*], Philip James[b]

[a] University of Manchester, Room 1.033, Arthur Lewis Building, Oxford Road, Manchester M13 9PL, United Kingdom
[b] University of Salford, Room G46, Peel Building, Salford M5 4WT, United Kingdom

ARTICLE INFO

Article history:
Received 17 April 2016
Received in revised form 5 May 2017
Accepted 24 May 2017
Available online 7 June 2017

ABSTRACT

Collective management of urban green space is being acknowledged and promoted. The need to understand productivity and potential trade-offs between co-occurring ecosystem services arising from collectively managed pockets of green space is pivotal to the design and promotion of both productive urban areas and effective stakeholder participation in their management. Quantitative assessments of ecosystem service production were obtained from detailed site surveys at ten examples of collectively managed urban gardens in Greater Manchester, UK. Correlation analyses demonstrated high levels of synergy between ecological (biodiversity) and social (learning and well-being) benefits related to such spaces. Trade-offs were highly mediated by site size and design, resulting in a tension between increasing site area and the co-management of ecosystem services. By highlighting synergies, trade-offs and the significance of site area, the results offer insight into the spatially sensitive nature of ecosystem services arising from multi-functional collectively managed urban gardens.

1. Introduction

It is recognised that urban areas, now home to the majority of the global population, are at the nexus of understanding how ecosystem services contribute to human well-being and the challenges present in enhancing and safeguarding those services (Andersson et al., 2014; Luederitz et al., 2015). The TEEB (2011) *Manual for Cities* offers one of the first attempts at providing guidance on urban ecosystem services and, more recently, the Cities and Biodiversity Outlook project represents the first global assessment of the impacts of urbanisation on biodiversity and ecosystem services (Elmqvist et al., 2013). These evaluations demonstrate that vital ecosystem services benefiting human well-being can be produced within the city, such as noise pollution mitigation, surface water attenuation and regulation of air quality. Urban areas are characterised by spatial heterogeneity and can contain biodiverse habitats (Smith et al., 2006; Davies et al., 2009; Goddard et al., 2010; Cameron et al., 2012). Urban gardens contribute to ecological diversity in the urban mosaic (Goddard et al., 2010) but are largely overlooked in green infrastructure planning (Breuste, 2010; Middle et al., 2014). Furthermore, large-scale ecological assessments, such as those already cited, pay little attention to such spaces beyond the well-evidenced benefits as habitat provision for pollinators. Closer investigation of urban gardens, the ecosystem services they produce and factors affecting productivity, therefore, is needed to better integrate such spaces into wider planning considerations.

The current study will contribute to this process by exploring trade-offs in ecosystem service provision in a case study of collectively managed urban gardens (CMUGs). The multi-functionality (Pourias et al., 2015; Bell et al., 2016), varying levels of productivity (McClintock, 2014) as well as cultural and biological diversity (Barthel et al., 2013; Borysiak et al., 2016) associated with such spaces provide a promising basis for an exploration of trade-offs in ecosystem service provision. Furthermore, CMUGs comprise small but highly spatially variable green spaces and hence provide the opportunity to explore scale effects in service provision at this level. This represents an important consideration, given that green space in urban areas is a very limited and threatened resource (Reginster and Rounsevell, 2006; Schäffler and Swilling, 2013) and, therefore, its productivity in terms of ecosystem services is of critical importance. If CMUGs are to be effectively integrated into urban planning frameworks, through, for example, the creation of community gardens in public parkland as suggested by e.g. Middle et al. (2014), their capacity to be effectively "scaled up" will rely on an understanding of their performance at different scales of operation.

2. Collective approaches to urban green space management

Urban gardens, through their ability to produce important ecosystem services (Krasny and Tidball, 2015; Speak et al., 2015;

* Corresponding author.
E-mail addresses: Matthew.Dennis@manchester.ac.uk (M. Dennis), P.James@salford.ac.uk (P. James).

http://dx.doi.org/10.1016/j.ecoser.2017.05.009
2212-0416/

Kamiyama et al., 2016; Cabral et al., 2017), are not only a valuable source of natural capital, they also provide an interface for environmental learning and awareness (Andersson et al., 2014) and, particularly when managed collectively by stakeholders, an important medium for knowledge exchange (Barthel et al., 2014) and social cohesion (Okvat and Zautra, 2011). User participation in natural resource management has received support through international environmental policy (CBD, 2001; MEA, 2005) echoed by an acknowledged increase in stakeholder-led natural resource management, particularly in urban areas (Colding et al., 2006; Barthel et al., 2010, 2015; Rosol, 2010; UK NEA, 2011; Colding and Barthel, 2013). The civic ecological approach to natural resource management, and the potential benefits which may result, have been explored conceptually through an appreciation of management practices in urban green spaces of diverse or uncertain ownership (Rosol, 2010; Barthel and Isendahl, 2013; Bendt et al., 2013). Attempts to describe such diverse, and often transient spaces, have employed an equally diverse and burgeoning terminology including: *civic ecology* (Krasny and Tidball, 2015), *urban environmental movements* (Barthel et al., 2013), *social-ecological innovation* (Olssen and Galaz, 2012; Dennis et al., 2016a), *community-based urban land management* (Svendsen and Campbell, 2008), *urban greening* (Westphal, 2003), *community gardens* (Camps-Calvet et al., 2016) and *community agriculture* (Barthel and Isendahl, 2013). In this paper, we refer to such spaces as *collectively managed urban gardens* (CMUGs) in line with other studies which have placed similar emphasis on the collective nature of these sites as their defining attribute (e.g. Rosol, 2010; Barthel et al., 2013; Bendt et al., 2013; Andersson et al., 2014). Bendt et al. (2013) draw on the notion of *communities of practice* (Wenger, 2000) to describe the social mechanisms (namely, joint enterprise, mutual engagement and a shared repertoire of rules and resources) upon which collectively managed gardens are established and sustained. Herein, the centrality of communities of practice is likewise adopted in the definition, selection and discussion of the CMUGs investigated.

Examples of collectively managed urban gardens typically include community allotments (Colding and Barthel, 2013), gardens (Pourias et al., 2015) and orchards (Travaline and Hunold, 2010) as well as less traditional, highly improvised spaces such as green roofs and walls, and pocket parks (Dennis et al., 2016a). Much interest in CMUGs has stemmed from the potential benefits to be gained through local ecological stewardship (Colding et al., 2006), knowledge exchange (Ernstson et al., 2008; Barthel et al., 2014), cross-scale, participatory environmental decision-making (Ernstson et al., 2010; Andersson et al., 2014; Middle et al., 2014), and local adaptive responses to social-ecological stressors (Dennis and James, 2016a,b). For the most part, studies have focused on organisational structures (Connolly et al., 2013), social networks (Ernstson et al., 2008, 2010), modes of knowledge transfer (Barthel et al., 2010), value perception (Raymond et al., 2009), and spatial distribution (Dennis et al., 2016b). Although these studies together present a sound theoretical argument for CMUGs in promoting urban social-ecological resilience, without evidence of their capacity to maintain or enhance the production of ecosystem services (as the subject of resilience: see Brand and Jax, 2007; Biggs et al., 2012), such a position cannot be conclusively adopted.

3. Ecosystem service production from collectively managed urban gardens

Social-ecological benefits arising from CMUGs have been described in terms of ecosystem service provision, with microclimate regulation (Cabral et al., 2017), pollination (Speak et al., 2015), food production (Kamiyama et al., 2016), increased well-being (Husk et al., 2013; Wood et al., 2016), and learning benefits (Krasny and Tidball, 2009; Riechers et al., 2016) all being described in the literature.

The therapeutic benefits associated with exposure to nature are well documented (Pretty et al., 2005, 2007; Marselle et al., 2014; Carrus et al., 2015). Specifically, horticulture as a form of physical activity and gardening as a source of social interaction have received much attention on the basis of the well-being benefits derived by individuals (Francis, 1987; Hynes and Howe, 2004; Alaimo et al., 2008; Pudup, 2008) and communities (Okvat and Zautra, 2011; Krasny and Tidball, 2015). Similarly, CMUGs have been highlighted for their considerable and significant contribution to environmental education (Krasny and Tidball, 2009; Barthel et al., 2014) and social learning (Bendt et al., 2013; Krasny et al., 2014). Moreover, there is a recognised synergy between learning and well-being (Waage et al., 2010), and between these factors and connectedness to nature (Olivos and Clayton, 2017), the latter being enhanced by collective environmental stewardship (Andersson et al., 2014).

Although the evidence on a range of ecosystem services provided by such spaces is growing, few studies have explored site-specific trade-offs in service provision. Cabral et al. (2017), for example, provided a detailed assessment of six ecosystem services through site surveys of allotment and community gardens in Leipzig, Germany. Although a comparison was, thereby, allowed between the two types of CMUGs, trade-offs were not explored. Furthermore, the comparability of CMUGs studied was compromised by neglecting to account for site size, thereby precluding a relative evaluation of productivity. Dennis and James (2016a,b) have explored the effect of site management on participation, biodiversity and ecosystem services provision, but failed to address trade-offs between individual services. Similar studies into CMUGs in the form of allotment sites highlight the high performance of the latter compared to municipally managed parks in terms of biodiversity and related ecosystem services (Speak et al., 2015; Borysiak et al., 2016). Though providing evidence of ecosystem service provision, these studies offer little interpretation of the interaction between services in terms of synergies and trade-offs, nor the effect of scale and design on the latter.

Where trade-offs in ecosystem services have been evaluated, they have often been carried out at the landscape scale, largely overlooking locally important patches of green space. Indicators employed in such assessments assume a large degree of social-ecological consistency across study areas. To date, studies have employed coarse land-use classifications to map ecosystem services in fragmented landscapes (e.g. Larondelle and Haase, 2013; Baró et al., 2016) and applied proxy indicators across distant or contrasting urban areas (Elmqvist et al., 2013; Gómez-Baggethun and Barton, 2013; Larondelle et al., 2014; Alam et al., 2016). Such methods assume that ecosystem service assessment is inherently scalable. Given the known stochasticity of social-ecological systems (Abel et al., 2006; Vellend et al., 2014), the potential for large errors resulting from attempts to transfer assessment values from one spatial or geographical context to another is self-evident. Andersson et al. (2015) demonstrated conceptually that the performance of service-providing units (SPUs) in urban areas depends on both scale and context, though little empirical evidence exists to support this effect at the site level. Greater attention to the effects of scale, and the resulting trade-offs, on the productivity of green spaces in terms of their capacity to produce ecosystem services is, therefore, required.

Thus, if collective approaches to green space management are to be promoted as sources of resilience in social-ecological systems (as in Ernstson et al., 2008; Biggs et al., 2010; Colding and Barthel et al., 2013), an understanding of associated ecosystem service trade-offs and synergies remains a research imperative. A review