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Ecosystem services in cities: Towards the international legal protection of ecosystem services in urban environments

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ABSTRACT

Biodiversity provides many ecosystem services in cities that are beneficial to human well-being including adaptation to the effects of climate change and positive effects of nature on human health. Rapid urbanization however is causing an adverse impact on biodiversity and the ecosystem services they provide. Protecting and restoring urban biodiversity and ecosystem services can increase human well-being of the rapidly increasing urban population. Today, however, the international biodiversity conservation practice mainly focuses on rural areas, and not on urban conservation and restoration. Within city scale, there are several opportunities to green urban living, such as green infrastructure and urban parks and nature reserves. This paper investigates the current scientific practices for promoting and protecting ecosystem services in urban areas. Secondly, the authors review and assess the legally binding instruments on biodiversity at the international and EU level in order to see if there are sufficient existing mechanisms for protection of ecosystem services in urban areas. Thirdly, the paper elaborates on the Aichi Targets in order to explore whether or not these targets are enough to facilitate the protection and enhancement of ecosystem services in urban areas as swiftly as they are needed.

1. Introduction

Biodiversity in cities can provide many ecosystem services beneficial to human well-being and human health. Rapid urbanization creates both challenges and opportunities for biodiversity and ecosystem services. Conserving and restoring biodiversity in cities is a key element for reaching sustainability goals and can help reverse the ongoing biodiversity crisis. This paper examines the international legal and policy framework for the protection of biodiversity and ecosystem services in cities. The paper first analyses why biodiversity and ecosystem services in urban environments are of utmost importance, and why they should be conserved or restored (Section 2). The protection of urban biodiversity and ecosystem services is situated at multilevel scales and includes legal and policy commitments ranging from the international global, regional, national to a local city level. This paper will focus on international global commitments and will briefly mention some international regional examples as well. Rapid urbanization and the impact it has on biodiversity is a worldwide concern, and although the answers to solving this challenge can have regional and local differences, global commitments are the main starting point. In general, urban ecosystems are not explicitly excluded from international legal binding documents. In recent years they have become a focus of attention in several non-binding soft law documents, such as the decisions from the Conference of Parties (COP) to the Convention on Biodiversity and other multilateral or regional environmental agreements. Section 3 will examine the legal commitments under the Convention on Biodiversity and the Ramsar Convention. It will also briefly look into two regional examples, namely the European Bern Convention and EU law. Section 4 of this paper will examine the Aichi Targets to the Biodiversity Convention with regards to their relevance to urban nature conservation and restoration. Specifically, the paper will elaborate on Targets 14 and 15 in relation to urban biodiversity and ecosystem services, and provide the results of an analysis of the national biodiversity strategy and action plans (NBSAP) under the Convention, specifically relating to urban biodiversity.

2. The importance of urban biodiversity and urban ecosystem services

Biological organisms are the central agents in the functioning of ecosystems, and the diversity of these organisms (biodiversity hereafter) has profound influence of this function (Hooper et al., 2005). This biodiversity, along with the stocks of abiotic materials and their disposition and interactions are known as “Natural Capital”, which is

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dependent on biodiversity (Balvanera et al., 2006) and delivers human well-being (Millennium Ecosystem Assessment, 2005). There are several compelling reasons for preserving and restoring biodiversity which go beyond simple utility (Pearson, 2016) and continuing losses will have adverse effect on ecosystem function and therefore degrade ecosystem service flows (Cardinale et al., 2012).

Urban areas are usually developed in areas of high biodiversity, as humans tend to establish settlements around where most natural resources are (Cincotta et al., 2000; Luck, 2007; Macdonald et al., 2008) and consequently management for the conservation of biodiversity, especially with regards to expansion and new developments (e.g. Pauchard et al., 2006) is crucial if we are to avoid further biodiversity loss (McKinney, 2006) as well as increased effects of climate change in urban areas. Urbanization is a major cause of biotic loss and homogenisation, maintained for centuries in a state by suppression of natural processes. The import of non-native species can replace native flora and fauna, which is particularly acute if the species are invasive (McKinney, 2006). However, urban species are very often abundant and diverse – allowing for effective conservation and restoration interventions. The current world urbanization prospects stipulate that 66% of the global population will live in cities by 2030 (UN, 2014). Continuing rapid urbanization will be a major challenge to protected areas and biodiversity conservation, and require thoughtful planning, monitoring and regulation (Mcdonald et al., 2008; Haaland et al., 2015). Even those cities with an explicit "Green" agenda in their planning regulations have struggled to maintain green to built infrastructure ratios with appropriate character and fragment sizes (e.g. Tan et al., 2013). This is important as green infrastructure is where most of the Natural Capital of urban areas is to be found, in terms of the primary producers (plants) upon which ecosystem function is based. It is from this that the principal "ecosystem services" are derived – supporting, regulating, provisioning, and cultural. The situation in urban areas is complex as, for example, tall buildings can provide nesting sites for top level predators (e.g. peregrine falcons) and built structures can provide regulation services (e.g. flood control). Also, there are urban areas where there are large "hybrid" urban-rural components (e.g. European Parliamentary Research Service, 2016). It has been suggested that there is a distinct biogeochemistry (Kaye et al., 2006) and that there are complex mixes of the natural-unnatural spectrum dependent on each cities' layout. Clearly, the natural components of urban areas, delivered by biodiversity, can provide ecosystem services *in situ*, such as carbon sequestration, flood mitigation, aesthetic pleasure and pollination. Ziter (2016) has reviewed the role of biodiversity in delivering ecosystem services in urban areas and has found that most studies have focussed on the relationship between biodiversity and regulating services – which were found to be dependent on composition of species, functional groups, or their inter-relationships in communities.

Nature can play a significant role in maximising the benefits and minimising the negative effects of urban living, and the Natural Capital–ecosystem services framework has provided a basis for understanding these benefits and has been used to inform decisions as to which policy options (e.g. urban planning, green infrastructure) might maximise well-being outcomes (e.g. Salmond et al., 2016), and increase resilience to environmental risks (e.g. Kabisch et al., 2016). Nature and biodiversity in cities provide numerous ecosystem services (Szlavecz et al., 2011). Stimulating or restoring ecosystem services in cities can be effective solutions for both climate change adaptation and mitigation (Dover, 2015; European Commission, 2015). Urban ecosystem services do this by providing cool air to cities which leads to reduction in energy consumption particularly in the summer. Restoring local wetlands can result in the prevention of disease and natural disaster to a great extent (SCBD, 2012a). Urban ecosystem services improve the air and water quality and thus provide a more resilient urban living to locals. Urban ecosystem services can also improve the social inclusion in a city and provide public space for activities and leisure (Millennium Ecosystem Assessment, 2005). Chiesura (2004) identified the crucial role that urban parks play in securing sustainability, through both direct biophysical links to health, and to psychological well-being through exposure to nature (e.g. Shanahan et al., 2015; Soga et al., 2015). In a recent systematic review, van den Berg et al. (2015) demonstrated strong evidence for significant positive associations between the quantity of greenspace and perceived mental health and all-cause mortality, and moderate evidence for an association with perceived general health. Haase et al. (2014) have carried out a quantitative review of how ecosystem services are assessed in urban areas. They conclude that although a wide range of approaches have been taken, covering many studies including biophysical models, geographical information systems (GIS), and valuation, there is little evidence that there has been significant take up in land use policy.

The empirical evidence for this and the wider benefits of urban nature has been steadily accruing in recent years and a clearer picture is emerging as to not only the importance of individual elements of Natural Capital but also how the integration, feedbacks and interdependencies of the grey-green-blue infrastructure of our urban areas are essential for securing sustainability. Certainly, it has been possible to demonstrate that the presence of "natural" features (such as trees, hollow and decaying logs, ground and mid-storey vegetation) are beneficial and their loss leads to degradation of well-being (Le Roux et al., 2014). Urban habitats may contain, in addition to alien species, many endemic, rare and endangered species but in pockets of refugia disconnected from the wider landscape. Still there are opportunities for providing ecosystem service and biodiversity benefits beyond the city (Kowarik, 2011). In particular, large old trees need special protection in urban areas, as single specimens in isolation, but also as part of parks and reserves (Lindenmayer et al., 2014). There are many active research programmes aimed at mapping the ecosystem services arising from these interactions, and the models being produced are increasingly accurate at mapping multiple services (e.g. Grafius et al., 2016): this is essential if decision making at the scale of the level of the street and household are to be made (Grêt-Regamey et al., 2015).

There are undoubtedly challenges to securing and enhancing urban ecosystem services, which have been clearly outlined by Luederitz et al. (2015). These are:

1. *Comprehensive spatial and contextual coverage of research* – most work is currently concentrated in the developed countries of the northern hemisphere, whereas some of the most acute problems of rapid urbanization occur in Low and Middle Income Countries (LMICs), with tropical climates, and very different natural ecosystem starting points. Often studies also give no population size/area context, making transferability and generalisation difficult or impossible.
2. *Clarification of definitions* – particularly around the definition of "urban" which requires unambiguous description of the environmental, spatial and socio-economic context. This includes the problem of "city limits" – you can have a large "green city" by extending the city limits to include "natural" areas, but with no benefits for urban dwellers at the core.
3. *Limited transferability of data* – global estimates of services and values cannot easily be transferred to local contexts, due to differences in biomes and socio-economic circumstances.
4. *Stakeholder engagement* – few studies involve stakeholders (20% or fewer according to Luederitz et al.'s findings), leading to the danger that the process could become technocratic, and there is an urgent need for engaging stakeholders in ecosystem service research.
5. *Integrated research effort* – there is a need for trans-disciplinarity in the research effort, otherwise it will be impossible to capture the full diversity and richness of ecosystem service provision by green infrastructure (Potschin and Haines-Young, 2011).
6. *Closing the feedback loop between urban ecosystem service appropriation and the management of urban ecological structures* –