



Outstanding challenges for urban conservation research and action



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ABSTRACT

Researchers, advocates and policymakers have proposed urban conservation as an emerging, integrative discipline that can contribute to sustainable cities by delivering co-benefits to human and non-human components of biodiversity. Given the recent growth in biodiversity-friendly designs and management schemes, there is an urgent need for a synthesis of this fragmented research base to inform planners and decision-makers. We conducted a systematic multidisciplinary literature review (787 papers) and found that the importance of urban areas for general conservation is not convincingly supported by empirical research. Only few studies demonstrated that cities can directly contribute to conservation efforts, by hosting viable populations of rare or endangered species, or by providing green corridors for the passage of natural populations. From a social perspective, while several studies demonstrated that green infrastructure could provide services for people (notably cultural services), only few studies explored the role of species diversity per se. Our review also shows strong geographical, location and taxonomic biases in urban biodiversity conservation research that make generalisations difficult. It is a disturbing paradox that while research in urban biodiversity conservation is rising exponentially, the main motivations for conserving urban biodiversity remain largely untested and unproven. We thus propose a framework for promoting integrative urban conservation research to bridge those gaps. Together, these findings warn against expanding cities under green planning and call for enhancing biodiversity experience by improving the quality of existing green spaces throughout the entire urban matrix. We provide a set of recommendations for practitioners and decision-makers to continue action.

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1. Introduction

Urban landscapes are rapidly expanding, replacing or degrading more natural environments and reducing the experience of nature for over half of the world's population (Miller, 2005). Today, there is increasing concern about how to design sustainable cities that reduce those detrimental impacts and provide multiple benefits to people and the environment. Urban biodiversity is increasingly viewed as an opportunity to combine multiple benefits, both locally through ecosystem services and globally for biodiversity conservation (Miller and Hobbs, 2002; TEEB, 2011). An evaluation of the potential of these co-benefits is currently hampered by the fragmented scientific knowledge on the benefits of urban

biodiversity to both global conservation and city dwellers. Understanding these issues would help decision-makers and planners determine how to allocate and manage the limited space and resources devoted to nature in the city.

Nature is an integral part of cities, historically shaped by city planners to enhance human well-being (Dubost and Lizet, 2003). Today, there is also a growing understanding that urban green spaces can harbour a rich diversity of species, which sometimes even exceeds that found in nearby less urban environments (reviewed by McDonnell and Hahs (2008); McKinney, 2008; Faeth et al., 2011). Over the past decades, biodiversity-friendly designs and management schemes have burgeoned, with some success at increasing local biodiversity (Sadler et al., 2010; Shwartz et al., 2013). But the effectiveness of these measures for global conservation and human well-being is still insufficiently understood. From an ecological perspective, management efforts to conserve urban biodiversity may not always be good for conservation per se. For instance, when these efforts are used to justify the spread of cities over more natural areas (Sushinsky et al., 2013), or when green

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infrastructure only hosts common urban adaptors and alien species (McKinney, 2010). From a social perspective, while the importance of urban green spaces and nature for individual well-being of city inhabitants is consensually recognized (reviewed by Tzoulas et al., 2007; Keniger et al., 2013), it is not yet clear to what extent people experience and benefit from the complexity of urban nature (i.e., biodiversity; Fuller and Irvine, 2010). Moreover, some management decisions concerning urban nature may sometimes trade-off against social benefits. For instance, while lawns are one of the city dwellers' favourite types of urban green space, it has been shown that well-maintained lawns offer poor conditions for many species (Gaston et al., 2005; Shwartz et al., 2008). It thus remains unclear which place should be awarded to biodiversity conservation in cities, given the many other competing demands in urban management (McDonnell and Hahs, 2013).

There is thus a need for systematic synthesis to aid future decision-making and research. Urban conservation is emerging as an interdisciplinary field that explores people, biodiversity and their interactions (Pickett et al., 2008). The increasing interest for this discipline over the past 20 years is reflected by the increase in the number of papers published yearly (Fig. 1). However, any evaluation of the importance of conserving urban biodiversity in cities, as in other disciplines, remains difficult for three main reasons: (1) published studies are disparate, across disciplines, geographical regions and locations within the urban environment, which creates a segmented, contextually-limited understanding of the issues (Alberti and Marzluff, 2004; Goddard et al., 2010; Cook et al., 2012); (2) studies are of different types, i.e. they focus on different taxonomic groups, target a range of ecological questions

(e.g. behaviour, urban–rural gradients, island biogeography) and use a mix of qualitative and quantitative methods (e.g. field observations, people's interviews, satellite information), which makes it difficult to pool data across studies (Cook et al., 2012). Yet, all these studies may contain relevant information to help understand the value of urban biodiversity; (3) knowledge is not expressed in a consistent terminology (McIntyre, 2000; Miller et al., 2008). As with any emerging interdisciplinary fields, a challenge is to create a common language, since currently studies often use different terms to refer to similar and overlapping concepts. For instance, ecologists typically refer to species richness or abundance, whilst social scientists talk about urban nature and green cover and economists about ecosystem services to express biodiversity-related issues. A mapping of the existing knowledge will help identify research gaps and needs, as well as prioritize conservation actions.

An important large-scale attempt to synthesize this research base was work by Dearborn and Kark (2010), who identified five testable motivations for conserving urban biodiversity. A first set of motivations is directly linked to global biodiversity conservation. It includes “target species conservation” (1), i.e. protecting important populations of unique, rare or endangered species (hereafter referred to as target species), and “corridors and stepping stones” (2), i.e. creating stepping stones or corridors allowing the passage of natural populations through the built environment (e.g., Cincotta et al., 2000; Jordan et al., 2003; Hodgkison et al., 2007). The second set of motivations is more social, concentrating on how conserving urban biodiversity could mutually benefit people and nature. These motivations include “ecosystem services” (3), i.e.

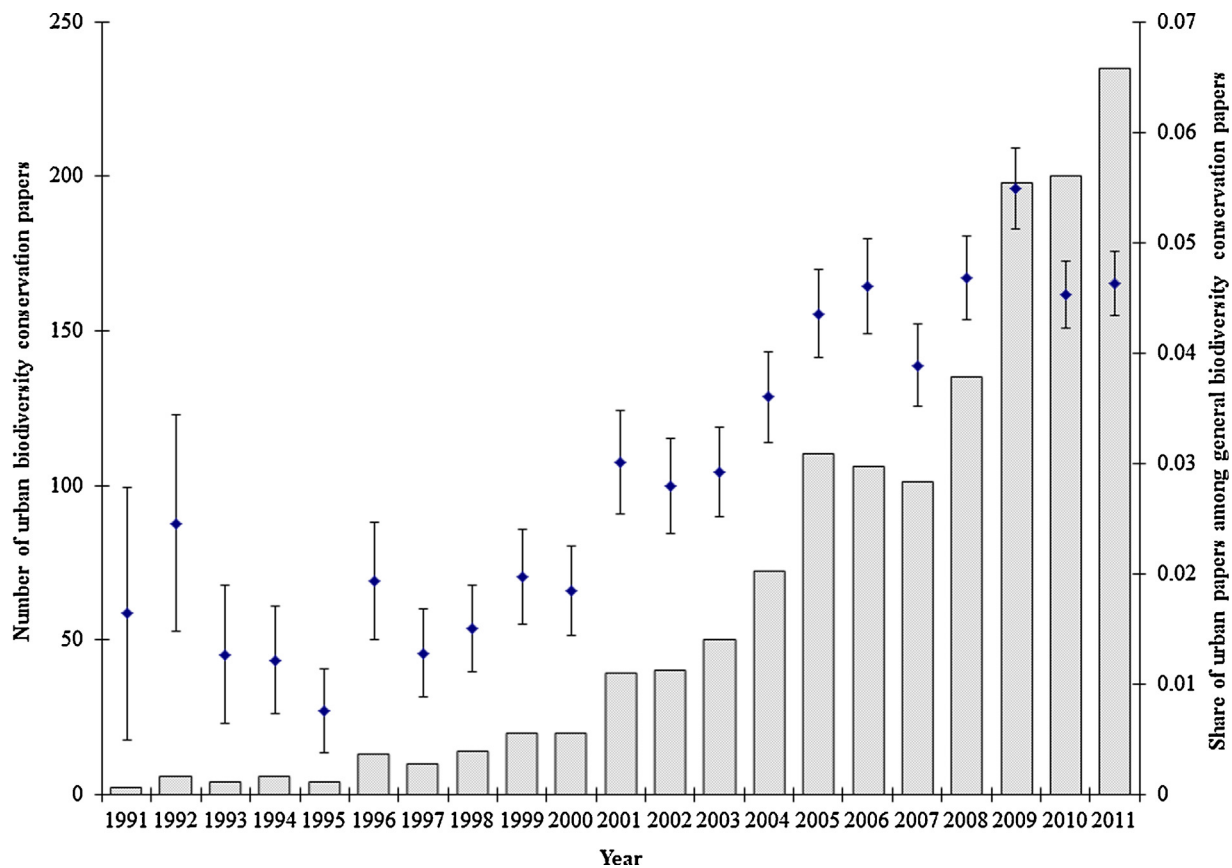


Fig. 1. The number of urban biodiversity conservation papers published between 1991 and 2011 (bars) and the proportion of urban biodiversity studies in the general biodiversity conservation literature (dots: proportion \pm SE) are presented. The number of urban papers was calculated using a search for the keywords urban and biodiversity and conservation in the ISI Web of knowledge database. The proportion of biodiversity studies was calculated by dividing the latter by the number of general biodiversity conservation papers (conducting a similar search excluding the word 'urban'), showing that the rate of increase in the number of urban biodiversity papers exceeds that of the general biodiversity conservation literature.

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