MedCrave
Step into the World of Research

Biodiversity International Journal

Mini Review

Open Access

CrossMark

The importance of urban biodiversity – an ecosystem services approach

Abstract

Background: Biodiversity loss is an urgent global problem that is both caused by and has impacts on humans. Because most humans now live in cities there is a need to understand how cities impact biodiversity and how urban biodiversity impacts people. Ways of integrating biodiversity concerns into urban planning and architectural design are urgently needed. This mini review communicates the basis of a developing design and policy making strategy for urban environments that is based on an ecosystem services model.

Keywords: urban biodiversity, ecosystem services, regenerative design, cities, habitat provision

Volume 2 Issue 4 - 2018

Maibritt Pedersen Zari
School of Architecture, Victoria University of Wellington, New Zealand

Correspondence: Maibritt Pedersen Zari, School of Architecture, Victoria University of Wellington, PO Box 600, CBD, Wellington 6011, New Zealand, Tel +64 4 4636901, Email maibritt.pedersen@vuw.ac.nz

Received: July 19, 2018 | **Published:** August 07, 2018

Introduction

Human survival is dependent on biodiversity; that is, the diverse range of organisms inhabiting the planet.[1] This is because they affect ecosystem processes and functions, and therefore ecosystem services.[2,3] The drivers and feedback mechanisms between biodiversity and ecosystem services are complex, non-linear and can be synergistic,[4] but it is clear that species diversity can affect ecosystem processes and services.[5] Ecosystem services are the benefits that humans derive, either directly or indirectly from the functions of ecosystems.[6] The Millennium Ecosystem Assessment[7] estimates that more than 60% of global ecosystem services are degraded or unsustainably managed. This, along with the fact that there is a positively reinforcing feedback loop between biodiversity loss and climate change,[5,8] is why biodiversity loss is an urgent issue for humans to address.[9]

At the same time that global biodiversity loss has accelerated,[10] humanity has become an urbanised species. More than half of all people now live in cities, and this proportaion is rapidly increaing.[11] This has three important biodiversity-human relationship impications. Firstly, cities must be taken into account in terms of the large negative impact they have on biodiversity.[12] Secondly, because people are dependant on ecsystem services, which in part are supported by biodiversity, the abundance or lack of urban biodiversity directly impacts the majority of humans.[13] Finally, as urbanisation increases, cities become more dense, and pressure on urban green spaces occurs, there is a risk that urban populations will experience negative psychologcal impacts due to a 'extinction of nature experience'.[14,15]

The impact of cities on biodiversity

Although cities only account for approximately 3% of the Earth's surface,[16] they are often located at important ecosystem junctions or in areas of high pre-development biodiversity.[9] This is another factor determining the high impact cities have on biodiversity, and why high levels of biodiversity can be found in many cities, though in a much altered state.[12] Urban areas, with their highly transformed landscapes and rapid human-caused changes to local ecosystems are accepted as a major driver of biodiversity change.[17] Key anthropogenic drivers of biodiversity change are generally summarised as:

i. Land-use and land cover change, including urbanisation,[18–20]

ii. Climate change,[21,22]

iii. Nitrogen deposition and acid rain,[23] and

iv. The introduction of invasive species to ecosystems (biotic exchange).[5,24,25]

Cities contribute to each of these drivers (Figure 1).

The impact of biodiversity on people in cities

Just as people impact biodiversity, so too does biodiversity loss impact on people in terms of increased climate changes, decreased resilience to changes, and reduced quality or quantity of ecosystem services. Conversely, increased urban biodiversity can have positive consequences in cities.[13] Biodiversity-human interactions can be complex and indirect particularly in urban settings,[8] and the biodiversity-human impacts field of enquiry is still developing.[14,26] Despite this, research indicates that urban biodiversity has clear impacts on:

a. Human physical health,[27,28]

b. Human psychological health,[29,30]

c. Societal and cultural health,[14,31] and

d. Economic health and stability.[25,32]

Figure 2 illustrates some of these relationships.

Incorporation of biodiversity into cities through ecosystem services provision

Ecosystems services analysis (ESA) is a means by which the concept of ecosystem services is specifically applied to urban areas. ESA was developed to quantitatively measure past and current ecosystem services provision on a given site (predominantly cities) in order to compare these figures and determine site specific design or policy goals that are based on the healthy ecological functioning of the site.[33] The impetus behind developing ESA was that one way to reduce or to reverse the negative ecological impact of the built environment may be to create or re-design cities so that they provide, integrate with, or support ecosystem services, and therefore reduce pressure on both local and distant ecosystems and biodiversity pressures.

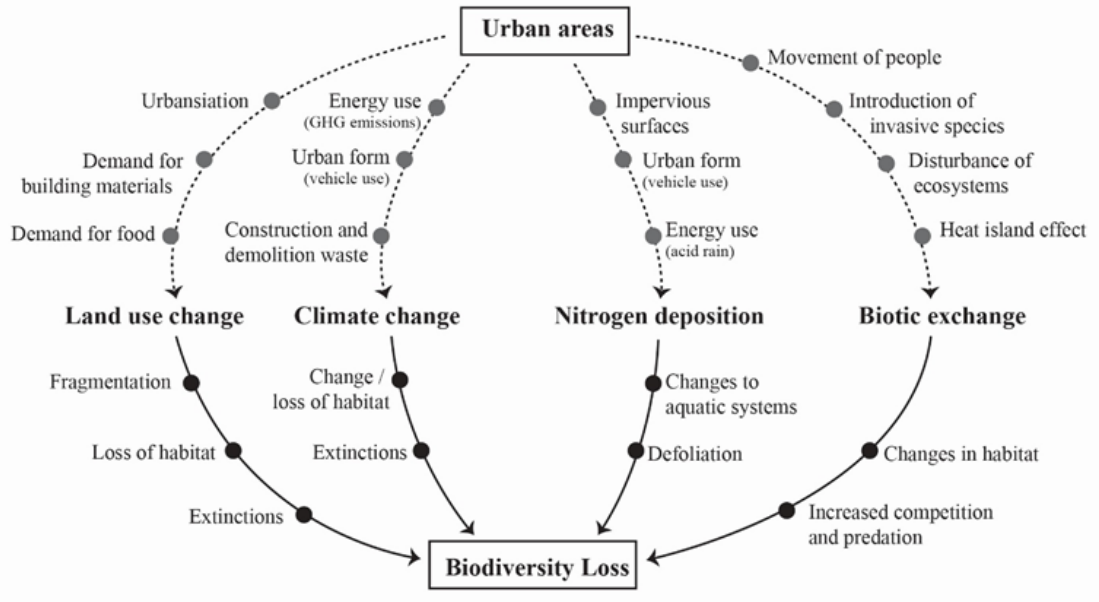

Figure 1 Built environment drivers of biodiversity loss (adapted from[8]).

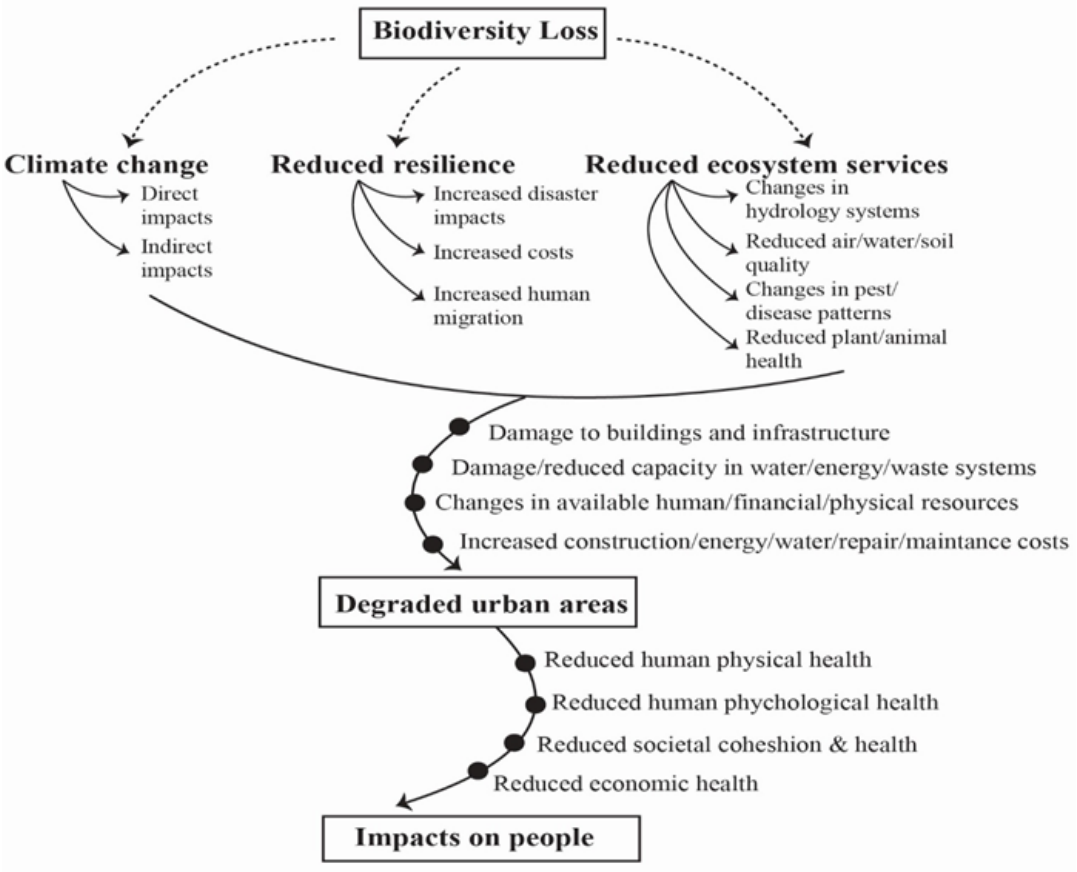

Figure 2 Impacts of biodiversity loss on cities and people.

Citation: Zari MP. The importance of urban biodiversity – an ecosystem services approach. *Biodiversity Int J.* 2018;2(4):357–360.
DOI: 10.15406/bij.2018.02.00087

ESA draws targets for future ecological performance from the healthy functioning of ecosystems on a given site, using quantifiable ecosystem services metrics. Ecological baselines in ESA are determined by site specific ecological history or comparable ecosystems research. ESA enables tangible ecological bench marks to be devised over different time periods and lends itself to long term spatial planning or decision making. Emulating ecosystem services rates possible on a particular site makes the performance of specific design interventions easier to measure or compare over time,[34] and could lead to the potential development of built environments that integrate with the habitats of other species in a mutually beneficial way[35] and adapt more readily to climate change.[36] The ESA process is explained in depth along with case studies of three existing cities by Pedersen Zari.[33] The same publication expands upon the details of the ESA process and provides tables of ecological indicators and calculation processes. Initial results indicate that despite trade-offs and conflicts that must be understood and planned for when designing for ecosystem services provision in cities, the strategic inclusion of ecosystem services into urban planning is likely to have significant long-term benefits for both people and other living organisms.[33]

Conclusion

Cities must become a key player in global efforts to conserve and restore biodiversity. At the same time if the goal of urban design is to create or retrofit cities so that they support the wellbeing of people, the support and regeneration of urban biodiversity must be integrated into design decision making and interventions. This may help to reframe the essential human-nature relationship and may be of use to designers or policy makers working to create highly sustainable or even potentially regenerative urban areas. In order to progress this agenda, urban design concepts and methods that enable cites to produce ecosystem services in greater volume is needed. The ecosystem services analysis concept is one such method.

Acknowledgments

None.

Conflict of interests

The author declares that there is no conflict of interest.

References

1. Bastian O, Haase D, Grunewald K. Ecosystem properties, potentials and services–The EPPS conceptual framework and an urban application example. *Ecological Indicators*. 2012;21:7–16.
2. Brook BW, Ellis EC, Perring MP, et al. Does the terrestrial biosphere have planetary tipping points? *Trends in Ecology & Evolution*. 2013;28(7):396–401.
3. Norberg J, Urban MC, Vellend M, et al. Eco-evolutionary responses of biodiversity to climate change. *Nature Clim Change*. 2012;2(10):747–751.
4. Brook BW, Sodhi NS, Bradshaw CJA. Synergies among extinction drivers under global change. *Trends in Ecology & Evolution*. 2008;23(8):453–460.
5. Chapin FS, Zavaleta ES, Eviner VT, et al. Consequences of changing biodiversity. *Nature*. 2000;405(6783):234–242.
6. Potschin M, Haines-Young R. Defining and measuring ecosystem services. Potschin M, Haines-Young R, editors. *Routledge Handbook of Ecosystem Services*. Routledge, London, New York; 2016. p. 25–44.
7. Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: Current State and Trends*. Washington, DC: Island Press; 2005.
8. Pedersen Zari M. Ecosystem Services Analysis in Response to Biodiversity Loss Caused by the Built Environment. *SAPIENS*. 2014;**7**(1).
9. Rastandeh A, Brown DK, Pedersen Zari M. Biodiversity conservation in urban environments: a review on the importance of spatial patterning of landscapes, in Ecocity World Summitt. Melbourne, Australia; 2017.
10. Ceballos G, Ehrlich PR, Barnosky AD, et al. Accelerated modern human–induced species losses: Entering the sixth mass extinction. *Science Advances*. 2015;1(5):1–5.
11. Eigenbrod F, Bell VA, Davies HN, et al. The impact of projected increases in urbanization on ecosystem services. *Proceedings of the Royal Society B: Biological Sciences*. 2011;278(1722):3201–3208.
12. Aronson MFJ, La Sorte FA, Nilon CH, et al. A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. *Proceeding of the Royal Society B*. 2014;281(1780):20133330.
13. Taylor L, Hochuli DF. Creating better cities: how biodiversity and ecosystem functioning enhance urban residents' wellbeing. *Urban Ecosystems*. 2015;18(3):747–762.
14. Botzat A, Fischer LK, Kowarik I. Unexploited opportunities in understanding liveable and biodiverse cities. A review on urban biodiversity perception and valuation. *Global Environmental Change*. 2016;39:220–233.
15. Louv R. Last child in the woods: Saving our children from nature-deficit disorder. Algonquin Books; 2008.
16. Ruth M, Coelho D. Understanding and managing the complexity of urban systems under climate change. *Climate Policy*. 2007;**7**(4):317–336.
17. Nielsen A, van den Bosch M, Maruthaveeran S, et al. Species richness in urban parks and its drivers: A review of empirical evidence. *Urban Ecosystems*. 2014;17(1):305–327.
18. Seto KC, Güneralp B, Hutyra LR. Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences*. 2012;109(40):16083–16088.
19. Lambin EF, Turner BL, Geist HJ, et al. The causes of land-use and land-cover change: moving beyond the myths. *Global Environmental Change*. 2001;11(4):261–269.
20. Huang CW, McDonald RI, Seto KC. The importance of land governance for biodiversity conservation in an era of global urban expansion. *Landscape and Urban Planning*. 2018;173:44–50.
21. Barnosky AD, Hadly EA, Bascompte J, et al. Approaching a state shift in Earth/'s biosphere. *Nature*. 2012;486(7401):52–58.
22. Gitay H, Suárez A, Watson RT, et al., *Climate change and biodiversity*, in *IPCC Technical Paper*. IPCC; 2002.
23. Röckstrom J, Steffen W, Noone K, et al. A safe operating space for humanity. *Nature*. 2009;461(7263):472–475.
24. Bellard C, Bertelsmeier C, Leadley P, et al. Impacts of climate change on the future of biodiversity. *Ecology Letters*. 2012;15(4):365–377.
25. Walsh JR, Carpenter SR, Vander Zanden MJ. Invasive species triggers a massive loss of ecosystem services through a trophic cascade. *Proceedings of the National Academy of Sciences*. 2016;113(15):4081–4085.
26. Soulsbury CD, White PCL. Human–wildlife interactions in urban areas: a review of conflicts, benefits and opportunities. *Wildlife Research*. 2016;42(7):541–553.

27. Aerts R, Honnay O, Van Nieuwenhuyse A. Biodiversity and human health: mechanisms and evidence of the positive health effects of diversity in nature and green spaces. *British Medical Bulletin*. 2018:ldy021.

28. Kilpatrick AM, Salkeld DJ, Titcomb G, et al. Conservation of biodiversity as a strategy for improving human health and well-being. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2017;372(1722):20160131.

29. Frumkin H, Bratman GN, Breslow SJ, et al. Nature Contact and Human Health: A Research Agenda. *Environmental Health Perspectives*. 2017;125(7):075001.

30. Beatley T. *Biophilic cities: integrating nature into urban design and planning*. Island Press; 2011.

31. Vierikko K, Elands B, Niemelä J, et al. Considering the ways biocultural diversity helps enforce the urban green infrastructure in times of urban transformation. *Current Opinion in Environmental Sustainability*. 2016;22:7–12.

32. Elmqvist T, Setälä H, Handel SN, et al. Benefits of restoring ecosystem services in urban areas. *Current Opinion in Environmental Sustainability*. 2015;14:101–108.

33. Pedersen Zari M. *Regenerative Urban Design and Ecosystem Biomimicry*. Oxon: Routledge; 2018.

34. Pedersen Zari M. *Mimicking ecosystems for bio-inspired regenerative built environments. Journal of Intelligent Buildings International*. 2016;8(2):57–77.

35. Pedersen Zari M. Utilizing relationships between ecosystem services, built environments, and building materials, in Materials for a Healthy, Ecological and Sustainable Built Environment: Principles for Evaluation. Petrović EK, Vale B, editors. Woodhead: Duxford, UK; 2017. p. 1–28.

36. Pedersen Zari M. *Can Biomimicry be a Useful Tool in Design for Climate Change Adaptation and Mitigation?* in Biotechnologies and Biomimetics for Civil Engineering. Pacheco-Torgal F, editors. Springer International Publishing: Cham; 2015. p. 81–113.

Citation: Zari MP. The importance of urban biodiversity – an ecosystem services approach. *Biodiversity Int J.* 2018;2(4):357–360.
DOI: 10.15406/bij.2018.02.00087