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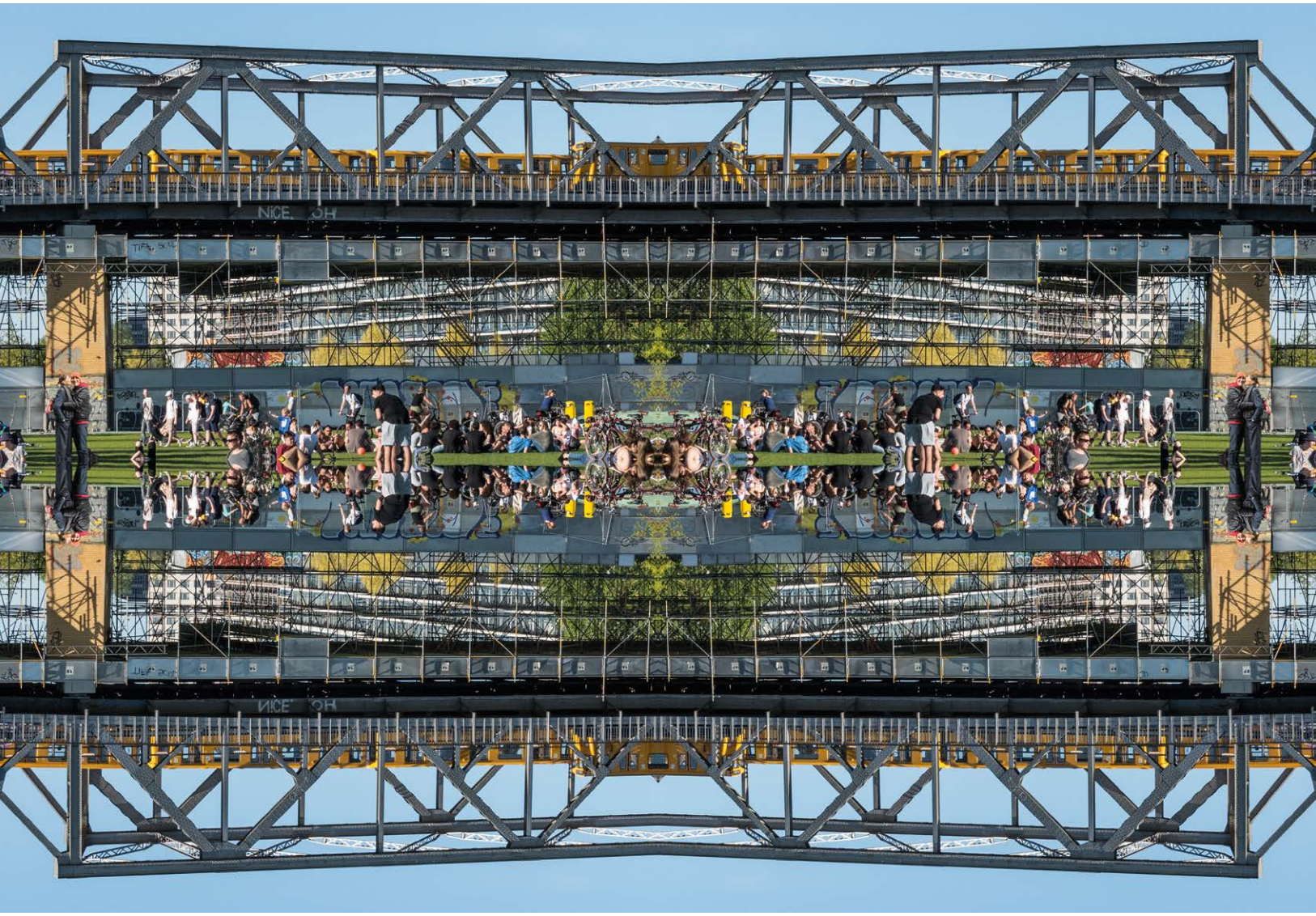

Hotspot cities: Identifying peri-urban conflict zones

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Sara Padgett Kjaersgaard University of New South Wales, Australia

Abstract

This article summarizes research regarding urban growth in the world's biodiversity hotspots. We examined 423 cities in the hotspots in order to identify the degree to which their forecast (2030) peri-urban growth is in direct conflict with remnant habitat and endangered species. As a subset of these 423 cities, we zoomed in on thirty-three of the biggest and fastest growing cities in the hotspots to ascertain the degree to which, as per the UN's Sustainable Development Goal 15, their local planning cultures are inclusive of 'ecosystem and biodiversity values'. This paper presents the results of this global analysis and also offers a brief discussion of how peri-urban landscapes have been, but can no longer be, overlooked or underestimated as peripheral territory.

Biodiversity / peri-urban / hotspots

Introduction

This article summarizes ongoing research that seeks to identify where peri-urban growth is occurring in direct conflict with endangered species on a global scale. It focuses on peri-urban growth in the world's thirty-six recognized biodiversity hotspots.[1] Biodiversity hotspots, as designated by Conservation International, are regions with unique biodiversity threatened with extinction, and peri-urban growth is defined as the urban growth occurring and likely to continue to occur at the edges of cities, in this case of the thirty-three largest cities in each of the world's biodiversity hotspots.[2] The purpose of the broader study is first to identify where this growth is happening, to understand why it is happening, and ultimately to develop ways to mitigate it, both in theory and in practice. This article pertains mostly to the 'where' and only partially to the 'why'. Having spatially identified the problem and conducted a thorough desktop analysis of each of these thirty-three cities, the descriptive phase of the research as explained here is now approaching conclusion and will, through a series of case study cities, soon move into a projective phase. This work seeks to bring urbanization and conservation into the same frame of reference and in doing so bring the fields of scientific conservation and urban design closer together. The research emerges from the authors' previous analysis of protected areas in the world's biodiversity hotspots and is aimed at helping to realize the ambitions of the United Nations' *New Urban Agenda and Sustainable Development Goals (SDGs)*.[3]

In the targets of the SDGs there are two statements that place biodiversity and urbanization in the same frame of reference.[4] The first, under Goal 11, declares support for 'positive economic, social and environmental

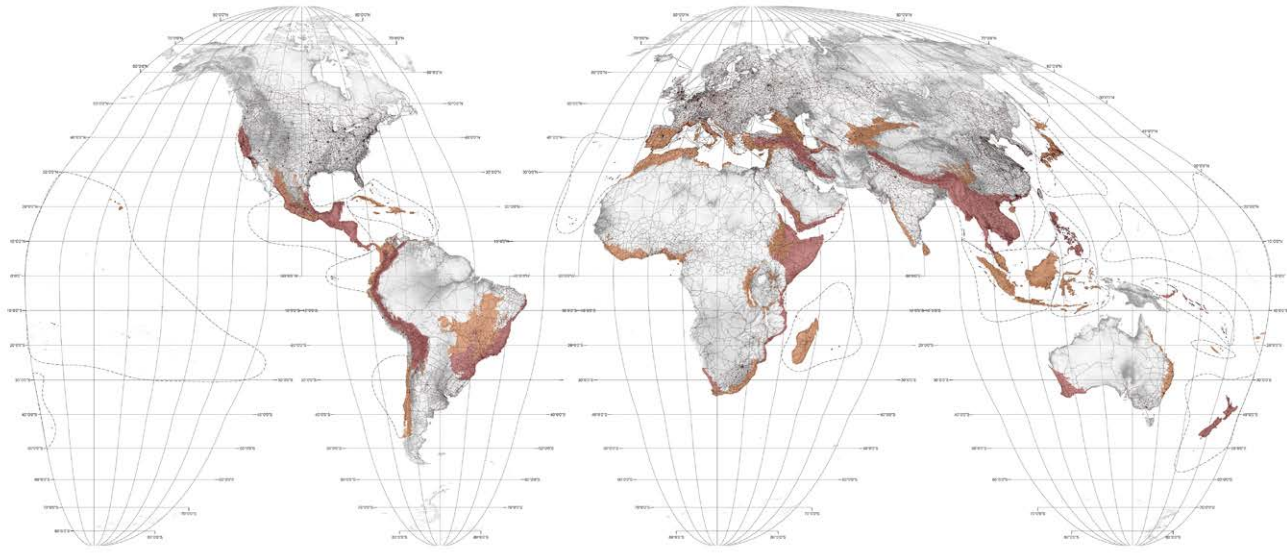


Figure 1 The world's biodiversity hotspots

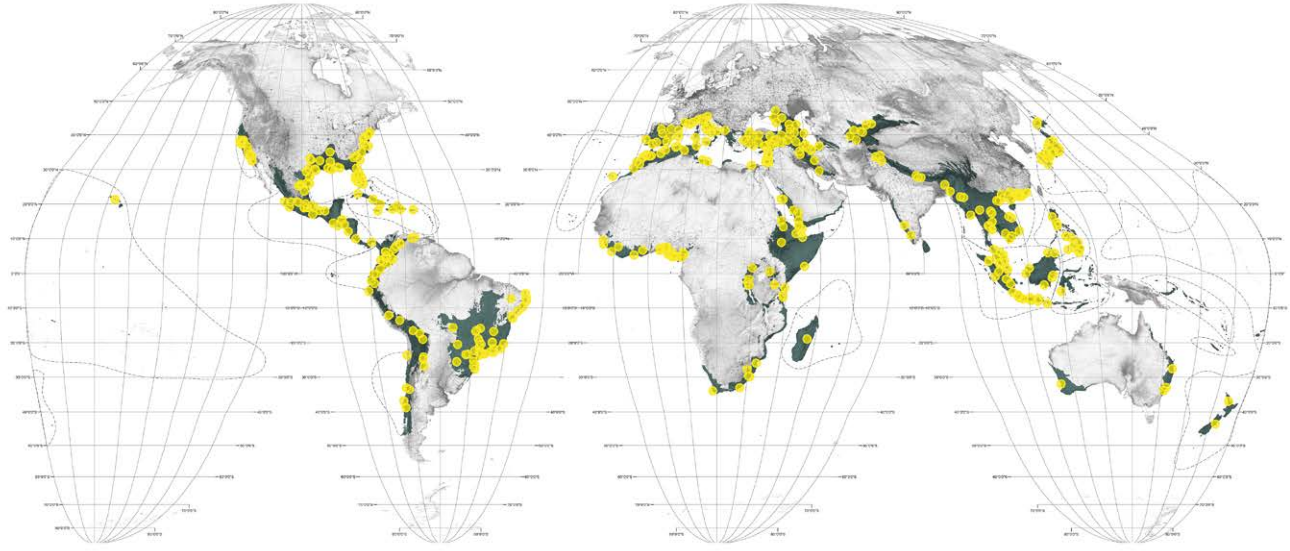


Figure 2 Cities in the world's biodiversity hotspots that are growing in conflict with biodiversity

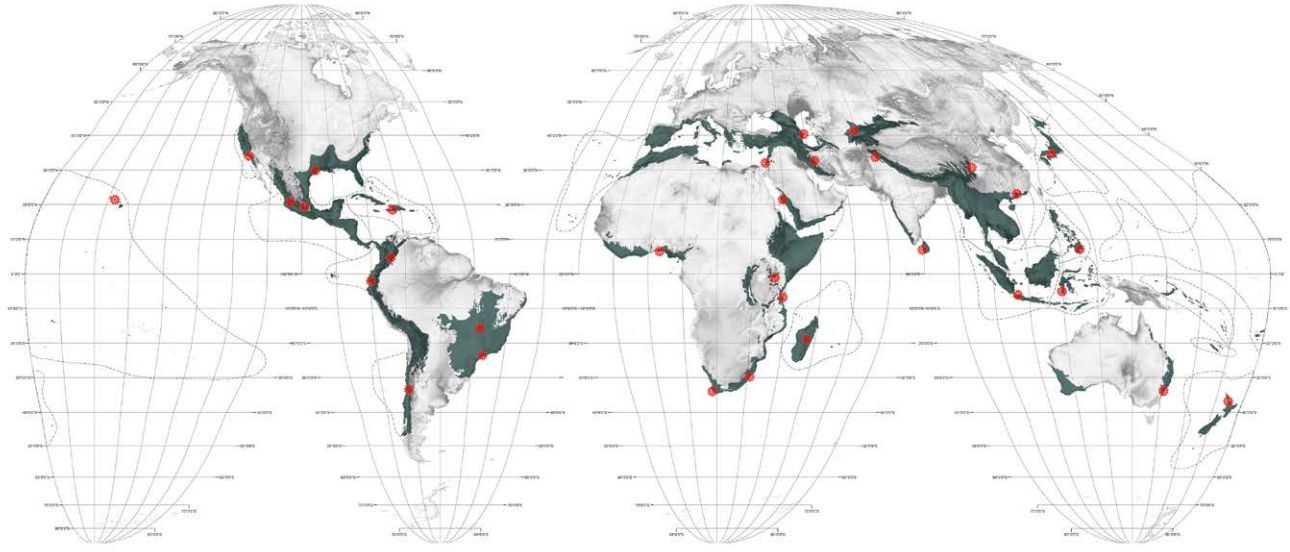
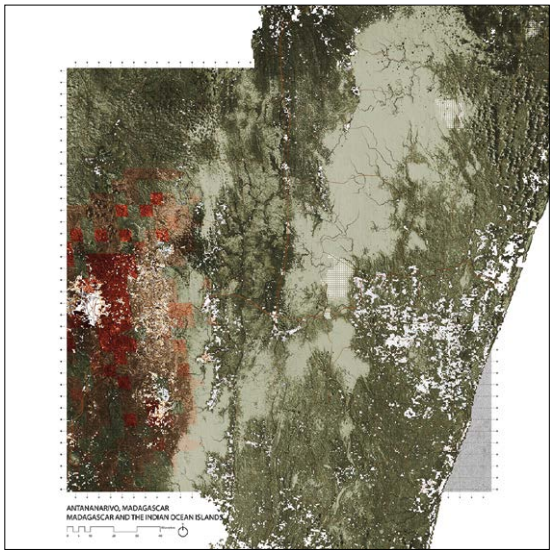


Figure 3 The locations of the thirty-three hotspot cities



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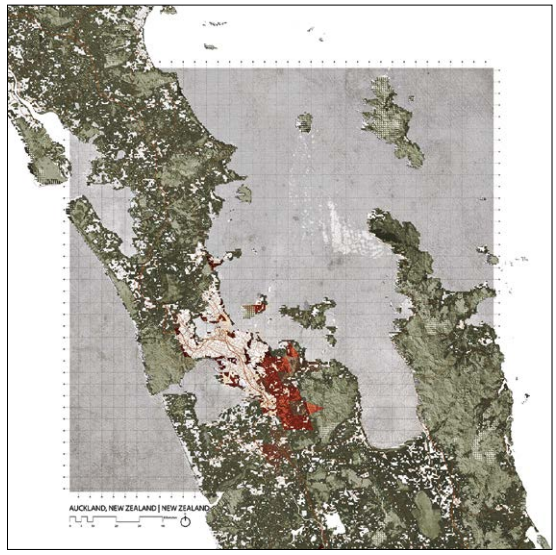

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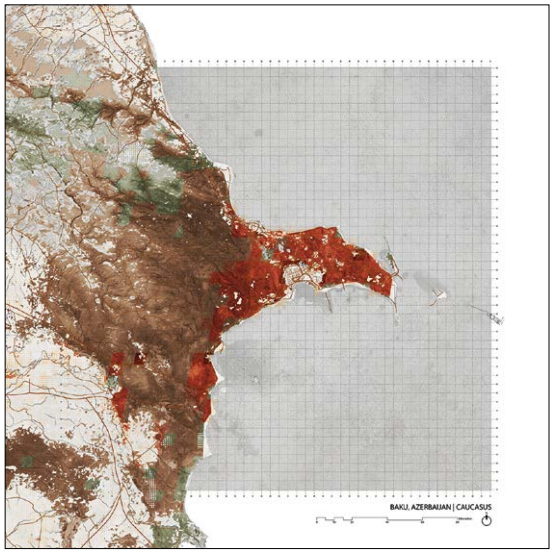
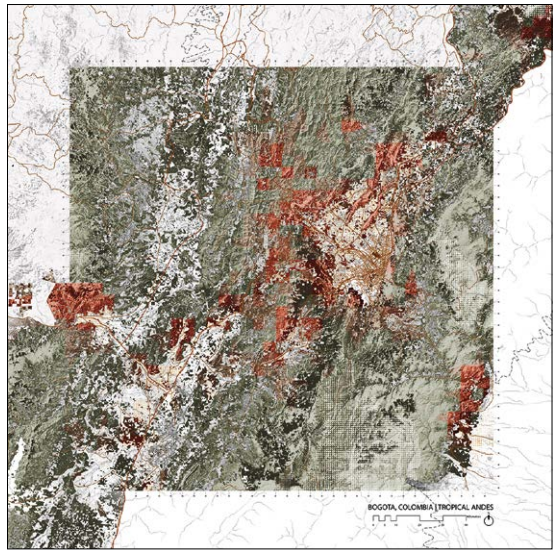
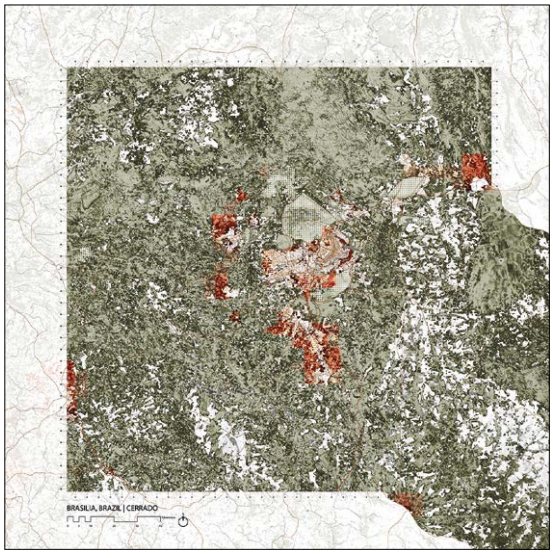


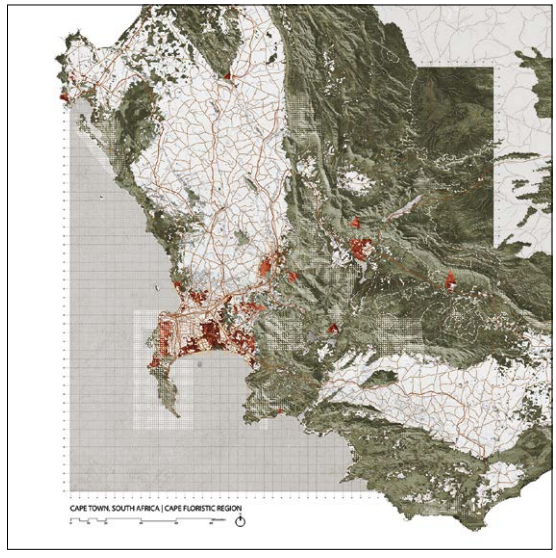
3 Baku, Azerbaijan



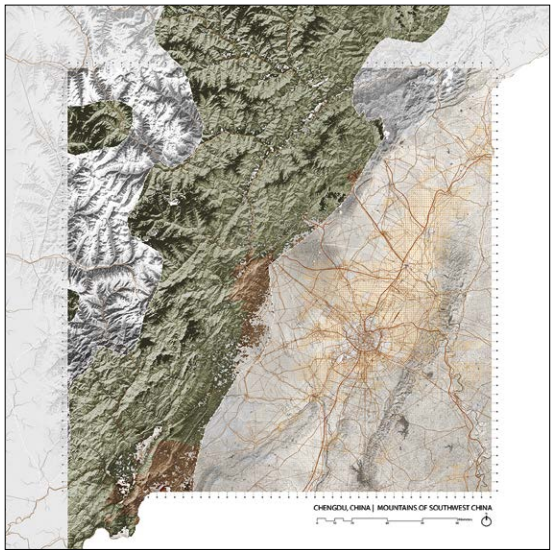
4 Bogotá, Colombia



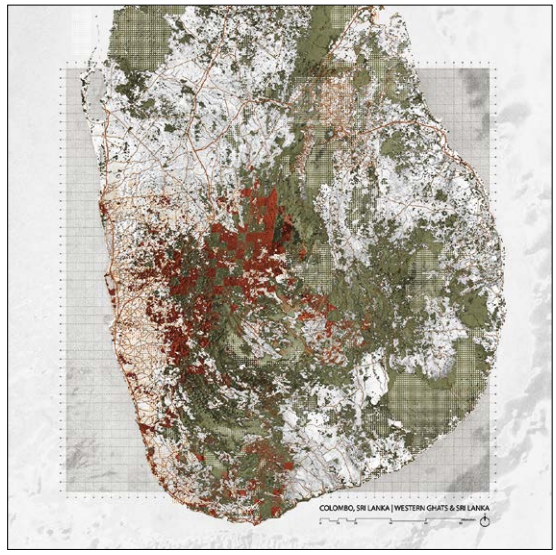
5 Brasília, Brazil



6 Cape Town, South Africa



7 Chengdu, China



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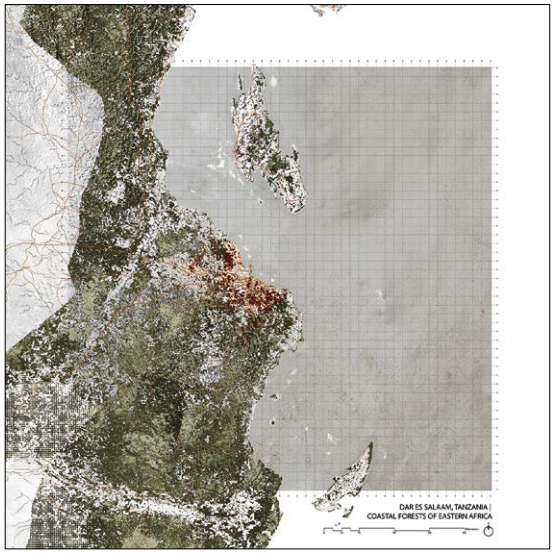
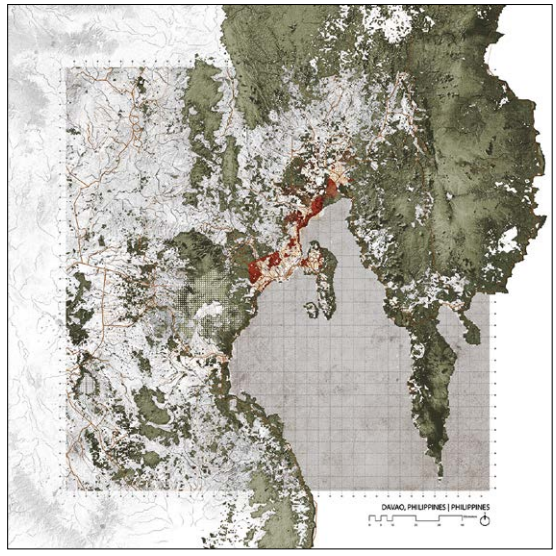
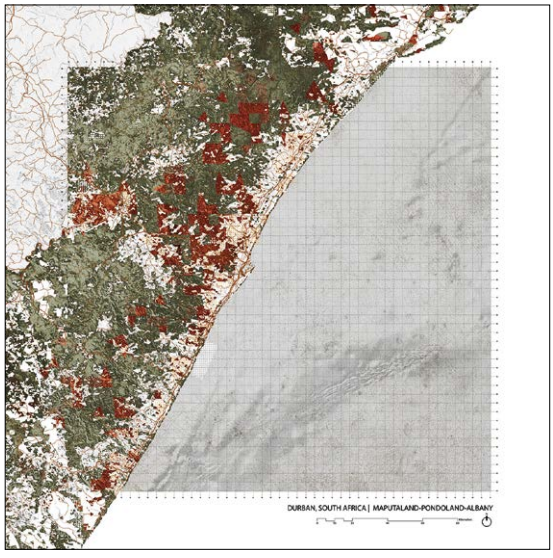


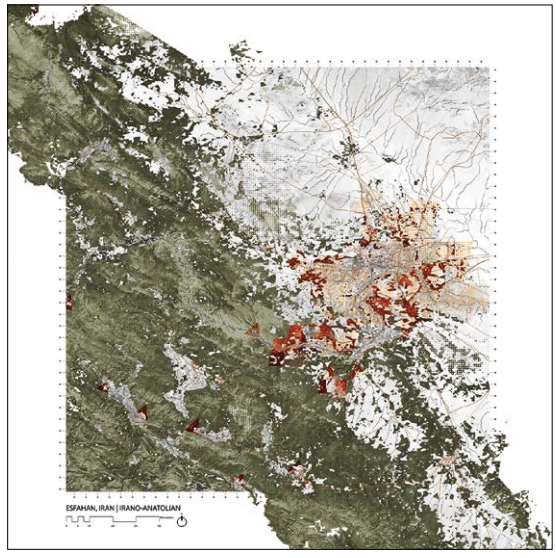
9 Dar es Salaam, Tanzania



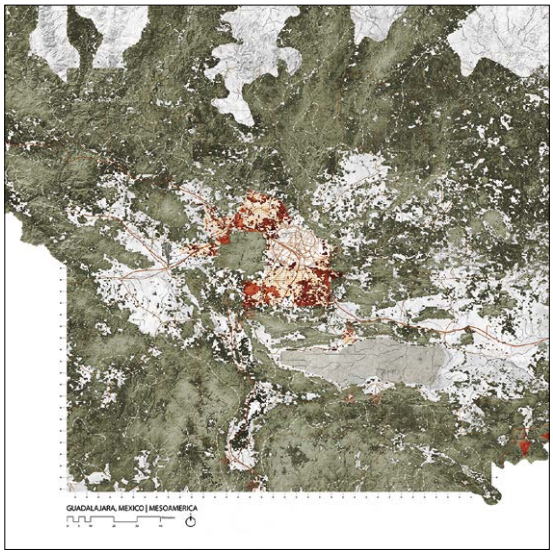
10 Davao, Philippines



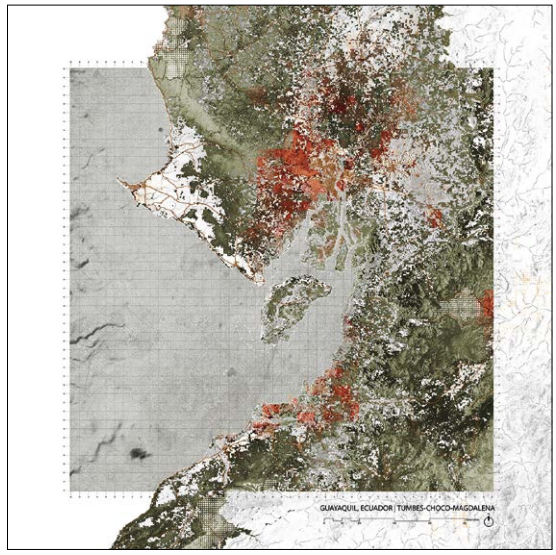
11 Durban, South Africa



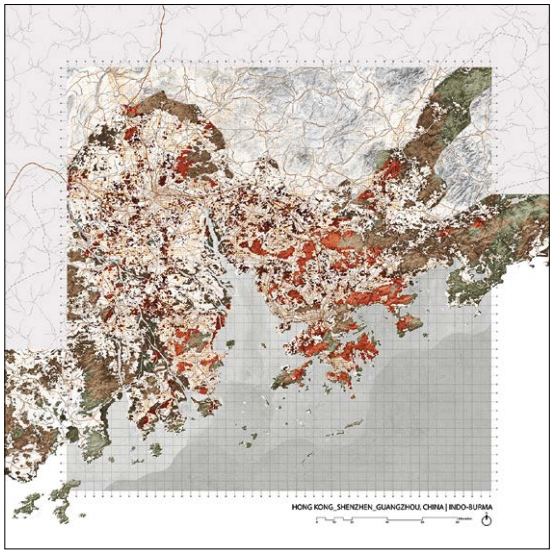
12 Esfahan, Iran



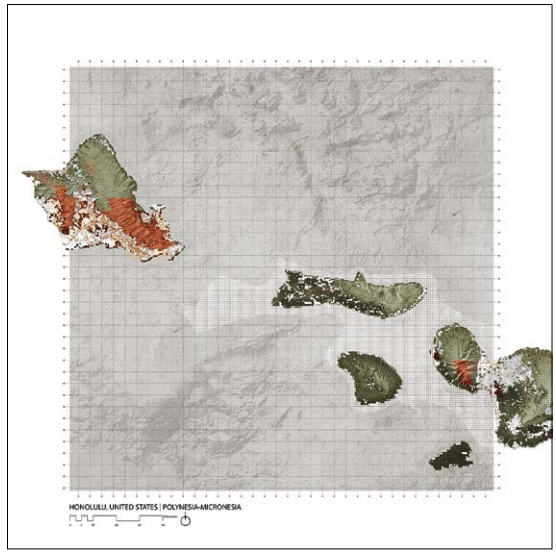
13 Guadalajara, Mexico



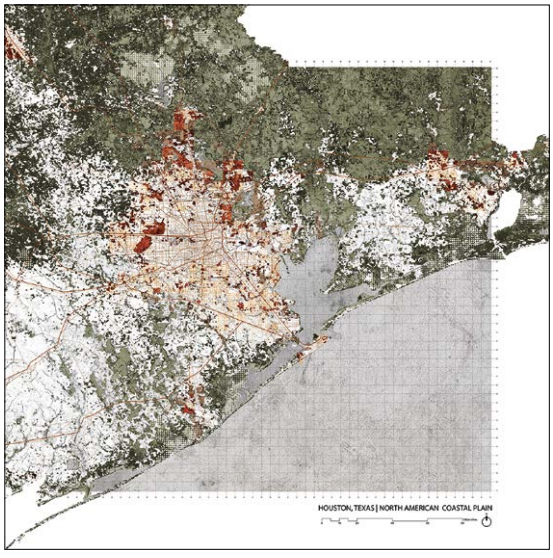
14 Guayaquil, Ecuador



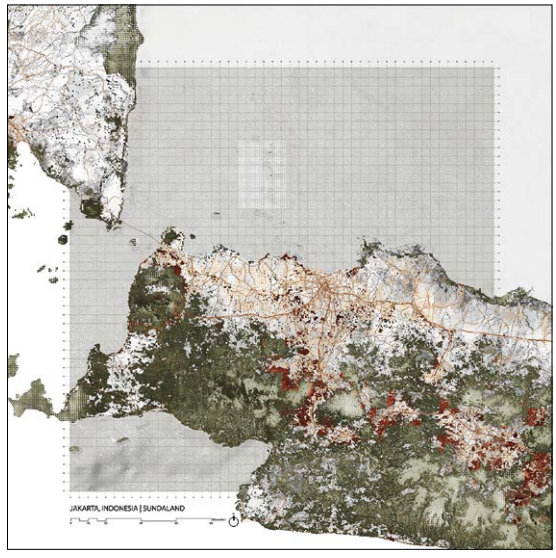
15 Hong Kong, Shenzhen, Guangzhou, China



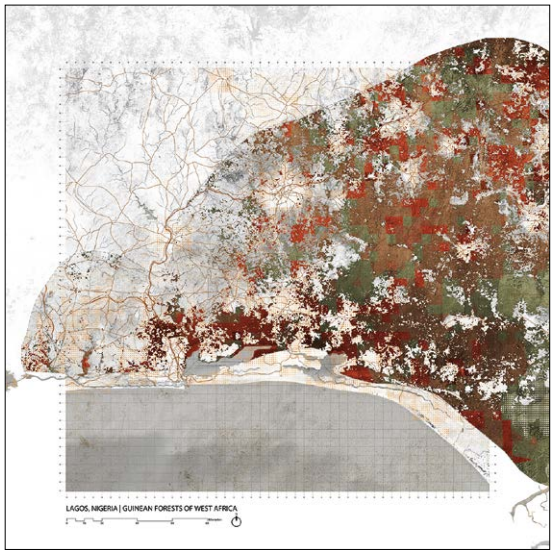
16 Honolulu, United States of America



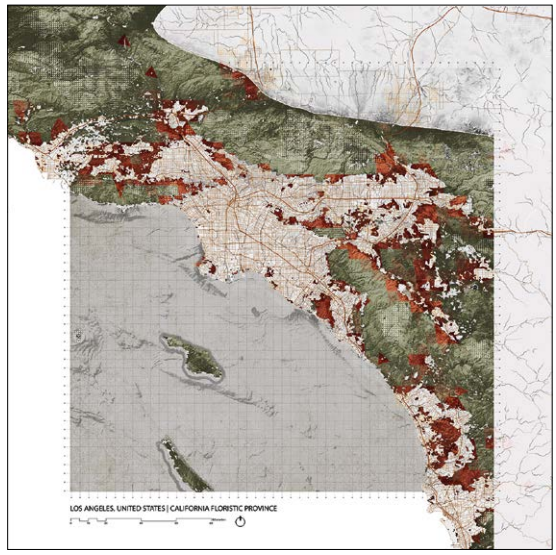
17 Houston, United States of America



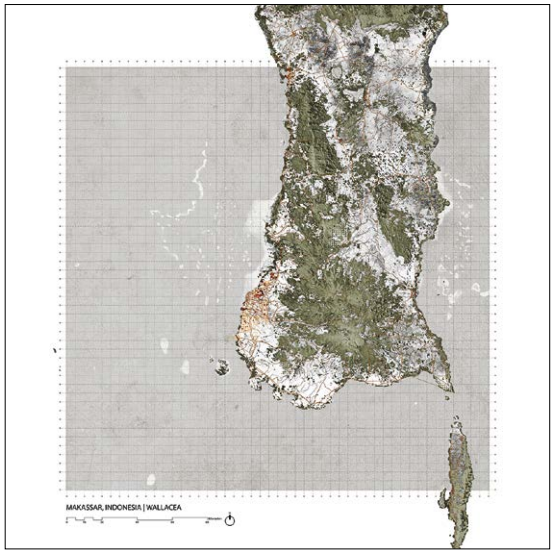
18 Jakarta, Indonesia



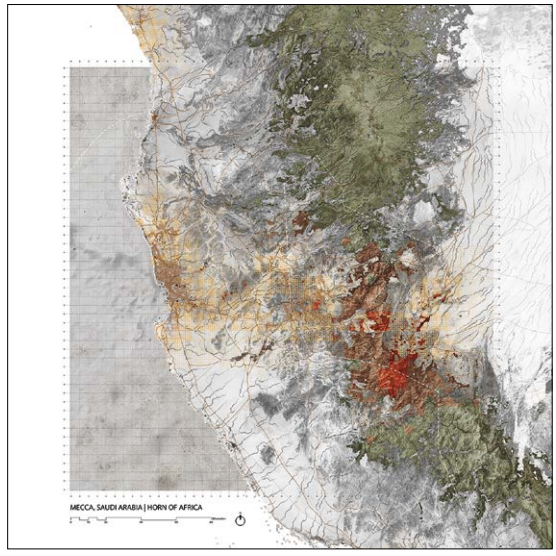
19 Lagos, Nigeria



20 Los Angeles, United States of America



21 Makassar, Indonesia



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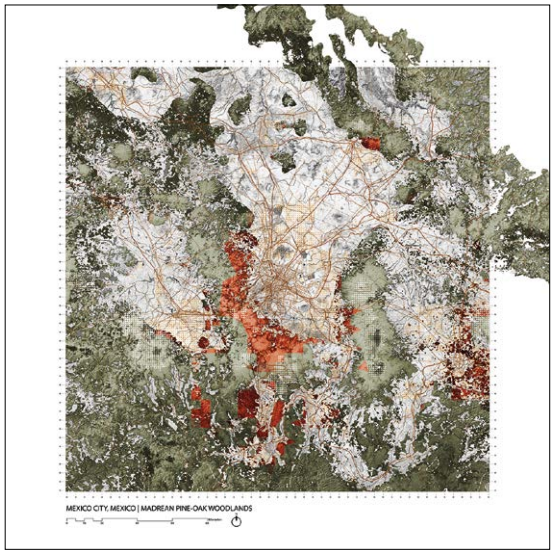

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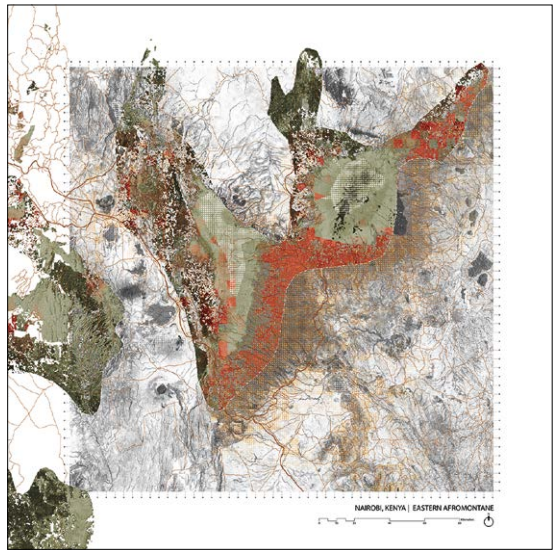
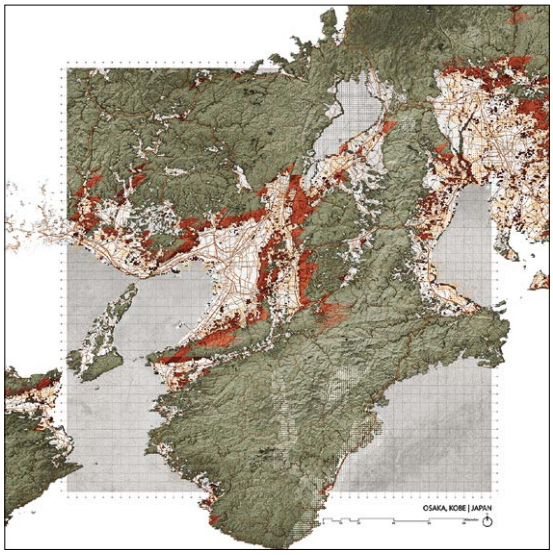
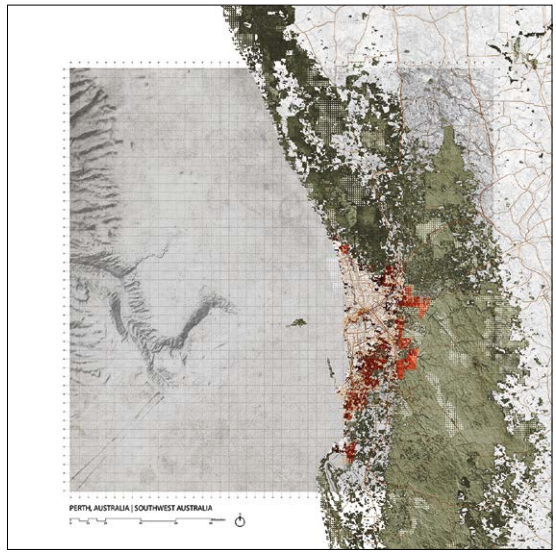


24 Nairobi, Kenya

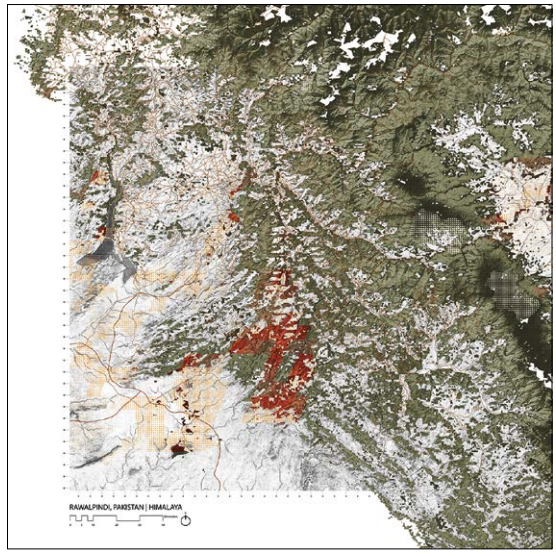


25 Osaka & Kobe, Japan

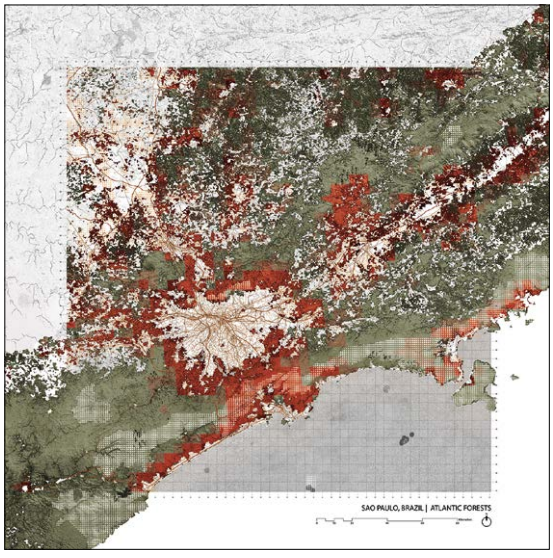


26 Perth, Australia

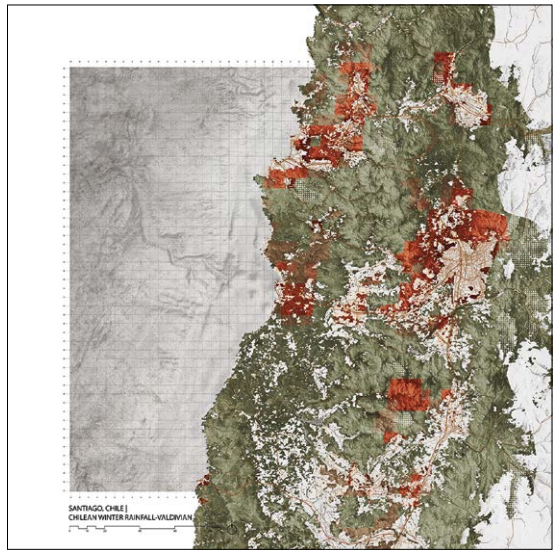
27 Port-au-Prince, Haiti



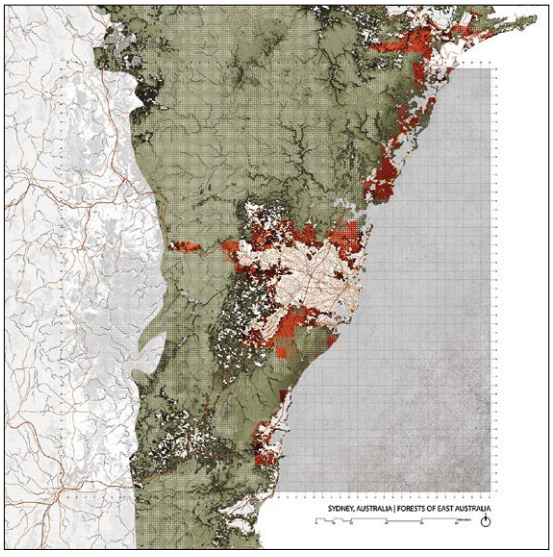
28 Rawalpindi, Pakistan



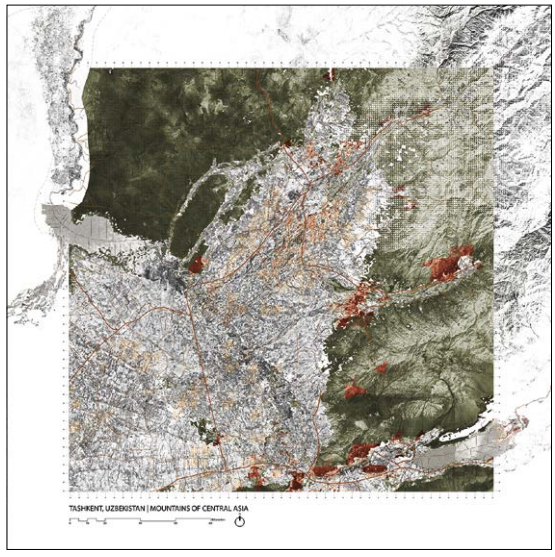
29 São Paulo, Brazil



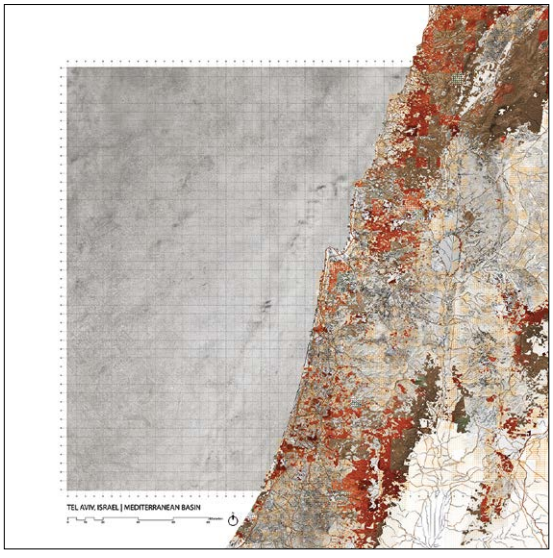
30 Santiago, Chile



31 Sydney, Australia



32 Tashkent, Uzbekistan



33 Tel Aviv, Israel

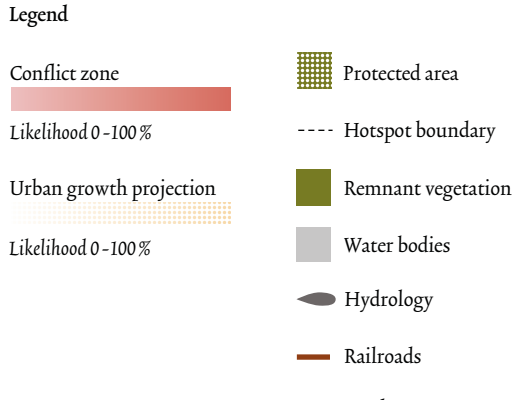


Figure 4 (pages 38-43) Examples of hotspot city maps identifying areas of conflict between urban growth and biodiversity

links between urban, peri-urban and rural areas by strengthening national and regional development planning' and the second, under Goal 15, seeks to 'by 2020, integrate ecosystem and biodiversity values into national and local planning and development processes'.[5] These lines of text are important because they specifically seek to transcend a history of Manichean dualism between urban development and conservation. If we are to realize the overarching ambition of the SDGs, then such text needs to not only be taken at its word but translated from theory into practice.

In accordance with the SDGs we are also placing urbanization and biodiversity in the same frame of reference. We have done this in two ways: the first is an analysis of land use in the world's thirty-six biodiversity hotspots (Fig. 1) to reveal conflicts between protected areas and other land uses, and the second is an analysis of the 463 cities in the hotspots so as to identify the degree to which their forecast (2030) peri-urban growth is in direct conflict with remnant habitat and endangered species (Fig. 2).[6] As a subset of these 463 cities, we have recently completed a second phase of research where we zoom in on thirty-three of the biggest and fastest growing cities in the hotspots to ascertain the degree to which, as per SDG 15, their local planning cultures are inclusive of 'ecosystem and biodiversity values'.[7]

This article presents the results of this analysis and offers a brief discussion of how peri-urban landscapes have been, but can no longer be, overlooked or underestimated as *peripheral* territory. The peri-urban landscape of cities is being urbanized faster and at a scale previously unseen,[8] and much of it is occurring in, or up against, the last vestiges of the world's

biological diversity.[9] It is the peri-urban landscape and its regional connections beyond, that can not only support biodiversity, but also provide cities with the essential ecosystem services they require. For the sustainable and resilient city, the periphery is for these reasons *front and centre*. As Harvard ecologist Richard Forman writes: 'You can have a small impact in a city center, but if you want to have a big impact, go out to this dynamic urban edge where solutions really matter for both people and nature.'[10]

Peri-urbanization

Derived from the etymological root of the Greek prefix *peri* (on or around) and located at the interface of urban and rural lands at the edge of the city, the peri-urban serves to establish the relationship of the (internal) city to its external parts (periphery).[11] As a noun, it describes the heterogeneous, fragmented territory of rural and suburban lands and as a verb, the dynamic socioeconomic processes that create this territory. Denominated as 'ex-urban',[12] 'rural-urban fringe',[13] 'peri-metropolitan',[14] 'edge city',[15] or even just 'open space', peri-urban territory is perceived as neither city nor country and accordingly has been largely overlooked in urban design and planning history. This lacuna is most recently reinforced by the Congress for the New Urbanism's (CNU) valorization of 'the transect' as an urban design tool.[16] Stretching from high-density urban cores at one end to wilderness at the other, the transect is a linear calibration of urban space into distinct typologies, the character of which should—as the new urbanists insist—be reinforced. According to the logic of the transect, territory at the edge of cities is either suburban (T3), rural (T2), or wilderness (T1), whereas in reality peri-urban territory can be all these things and more, simultaneously.[17] In a world where nature and culture are now so interwoven, we need a new language of urbanism that emphasizes symbiosis, not differentiation.

Whereas the liminal zone of the peri-urban defies categorization in the orthodox language of urban design and planning, in the fields of geography and landscape architecture it has begun to be recognized for its social and ecological complexity, and its potential productivity.[18] In these readings, the peri-urban is positioned as new territory in which culture and nature might yet co-exist in a more integrated weave.[19] This appreciation of the peri-urban landscape as a hybrid and constantly evolving landscape is a prerequisite for the serious inclusion of biodiversity in the urban planning and development process.

Method and findings

Our initial survey of all 463 cities of 300,000 inhabitants or more in the world's thirty-six biological hotspots revealed that 422 are rapidly sprawling directly into remnant habitat harbouring endangered species.[20] To reach this conclusion, we layered each city's (2030) projected growth trajectories sourced from the Seto Lab at Yale[21] over remnant vegetation data from the Global Land Cover Facility[22] and the IUCN Red List ranges for 3,245 mammal species that are either critically endangered or endangered.[23] Due to technical and time constraints, this first phase of mapping such a large number of cities was based only on the ranges of mammals and amphibians as an indicator of threatened habitat. For this mapping, we included only those areas of projected urban growth that the Seto Lab's analysis assessed as having a likelihood of urbanization by 2030 of 50 per cent or higher.[24]

The UN Convention on Biological Diversity (CBD), which administers global targets for protected areas, encourages what it refers to as 'biodiversity friendly city design' and 'holistic landscape management practices'.[25] Yet our review of the National Biodiversity Strategies and Action Plans (NBSAPs) of countries whose territories overlap hotspot regions indicated that there is a marked lack of such design and planning in most of the 463 hotspot cities.[26] Of course, planning for biodiversity at the city scale might not (and need not) be referred to in the NBSAPs that each nation is obliged to submit to the CBD, but this broad-brush conclusion was confirmed in a second level of analysis where we studied the set of thirty-three largest and fastest growing hotspot cities in greater detail (Fig. 3). Given that our initial mapping showed a general correlation between projected population growth and biodiversity loss, we chose to zoom in on the city in each hotspot with the greatest population growth and the largest projected destruction of biodiversity habitat. In a few cases, however, we chose alternative cities whose projected conflict zones appeared larger than those of the cities with the highest population growth.[27] In each case, we again superimposed 2030 growth forecasts from the Seto Lab onto updated remnant vegetation data from 2012.[28] We extended this analysis to include the ranges of all non-marine animals[29] included in the IUCN's Red List in the categories of Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), and Least Concern (LC) (Fig. 4).[30]

The 2016 UN-Habitat *World Cities Report* states that 'urban and environmental planning provides opportunities and formal legal mechanisms for biodiversity conservation through design guidelines, building codes, zoning schemes, spatial plans and strategic choices, all coupled with effective enforcement'.[31] Through detailed (desktop) analysis we sought to gauge the degree to which these sorts of mechanisms have been leveraged in the sample of the thirty-three hotspot cities.[32] Our conclusion is that the overwhelming majority of these cities have not adopted long-term planning visions that include biodiversity values or, if they have, then they have not made such planning documents available or referred to the existence of such documents online. A notable subset of cities (examples include Sydney, Perth, Cape Town, São Paulo, and Los Angeles) do, however, have transparent, readily available, variously integrated planning documents across levels of governance.[33]

We also found that cities with well-developed integrated governance at the national, regional, metropolitan/municipal, and local levels were far more likely to have appropriately scaled planning capacity. While cities that do not operate in relationship with regional planning or governance entities lack the ability to create plans that look beyond current legal municipal boundaries, cities with disempowered local or municipal governments were not able to turn big-picture visions from national, state, or regional plans into local spatial planning mechanisms or built interventions. The recent push for the creation of metropolitan levels of governance—as proposed in the failed Osaka Metropolis Plan referendum of 2015, which followed on the heels of a similar but successful bid for centralized metropolitan planning in Tokyo[34]—might have the potential to create a unified structure for conurbations that would be better able to engage with planning at the level of the entire urban and peri-urban footprint.

A survey of the cities' planning documents (where extant), promotional materials, popular press and institutional publications, and related academic literature also indicates a low degree of cultural association with being 'hotspot cities' or stewards of their regional landscapes. Typically, we find that a city's projected identity pertains to the characteristics of its

urban core rather than its peripheral landscapes. A few cities—notably Cape Town, Perth, São Paulo, and to a lesser degree Los Angeles—have a robust narrative of their unique biodiversity, and their responsibility to preserve it.

In the literature pertaining to the sample set of thirty-three cities, a major obstacle to the development of spatial biodiversity planning is the lack of baseline biodiversity data. Furthermore, this data, where it does exist, tends to focus on wildlife in the city rather than on ecosystem integrity at the periphery. If cities are to properly understand their relationships with biodiversity, there is a significant need to develop and share measurement and monitoring practices that relate to the peri-urban zone and how this zone functions as a filter and conduit for biodiversity both centripetally and centrifugally. Where particular cities have developed specific spatial assessments of biodiversity and long-term plans for biodiversity protection in their environmental departments, they still face significant challenges in finding common ground with other city agencies, especially in terms of allocating funds and resources towards biodiversity protection. Cape Town, arguably the city with the greatest biodiversity and greatest threats to that biodiversity in the world, is a leader in spatial, cross-municipal biodiversity planning. The city has developed a comprehensive, systematic, and spatially explicit biodiversity conservation network called Bionet that preserves critical areas for all remaining representative ecosystems in the city and that is being integrated into city planning policies.[35] Despite this commitment to planning for biodiversity across city departments, a Local Governments for Sustainability (ICLEI) case study report found that conducting a successful and integrated biodiversity and ecosystem services assessment did not correlate with the hoped-for increase in budget allocation for biodiversity conservation planning.[36] Additionally, some cities that adopt biodiversity protection measures with the primary goal of attracting biodiversity tourism have found that without effective management plans and sufficient staffing, these measures can erode the very biodiversity they set out to protect. For example, Wolong Nature Reserve, outside of Chengdu, China, which was established to protect giant pandas in 1975, has become more fragmented and less well-suited for panda habitat since its creation due in part to the huge number of tourists who visit the reserve each year.[37] In looking at cities' approaches to environmental planning and how biodiversity is viewed, we found that cities tend to prioritize environmental issues that have urgent human health consequences, for example solid waste removal and drainage in Lagos through the Cleaner Lagos initiative[38] and a major river water treatment in Guangzhou that the World Bank is funding to clean up the Pearl River.[39] In this context, we suggest that water resource protection can be a particular point of synergy between these basic environmental concerns and biodiversity preservation.

Conclusion

The overarching question to ask is whether the growth trajectories of these hotspot cities can be redirected to avoid the further destruction of biodiversity, and if so how? Having taken the first step of identifying likely conflict areas, it is important now to recognize and understand the true complexity of the problem. The conflict between urban sprawl and biodiversity cannot be approached reductively or simplistically as if sprawl (formal and informal) is only an outcome of economic and demographic growth, and conservation only a matter of fencing off areas in its path. As alluded to earlier, the peri-urban territory of cities is a complex mosaic of different and often contradictory land uses in high states of flux. Indeed, the alteration of peri-urban land is not caused solely by urbanization, but is also a consequence of extracting many of the resources required to support cities and their residents.[40] The often invisible and myriad forces shaping these landscapes are not yet well understood by the urban design and planning professions, just as the novel ecology of these lands is not yet well understood by the scientific community.[41]

The need is for comparative urban studies that approach the conflict between biodiversity and urban growth holistically. Epistemologically this means approaching the issue from both the sciences and the humanities. From a planning perspective it means appreciating that the small and large scales of urban geography are interconnected. On the basis of sound socioeconomic and ecological analysis, interdisciplinary teams can generate alternative urban growth scenarios that can be evaluated for their costs and benefits. It is not enough to just cast anti-sprawl platitudes or make mere recommendations in planning reports that pay lip service to the Convention of Biological Diversity and the Sustainable Development Goals. What is needed are realistic spatial plans for these conflict zones, tuned to local cultures, that concentrate urban growth in areas of least impact while simultaneously forging multiscalar landscape connectivity for biodiversity. Without new pathways for migration, biodiversity will not endure climate change, let alone urbanization. Simply designating islands of protected area presupposes an unchanging landscape whereas, in an era of rapid urbanization and climate change, the opposite is true.

As both the custodians and immediate beneficiaries of the unique biodiversity at their doorsteps, the hotspot cities described here have a global responsibility and leading role to play in integrating biodiversity with development. It is our belief that a better understanding of peri-urban territory, and the forces shaping it, is a prerequisite to the mitigation of further loss of biodiversity and that this is not only relevant to cities in the world's biodiversity hotspots, but to cities everywhere.

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MAPPING

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NOTES

1 In 1988, Norman Myers first identified ten global hotspots featuring exceptional concentration and endemism of plant species under unusual threat of destruction. According to Myers, E. O. Wilson has said hotspots were 'the most important contribution to conservation biology of the last century'. As found in Norman Myers and Russell A. Mittermeier, 'Impact and Acceptance of the Hotspots Strategy: Response to Ovadia and to Brummitt and Lughadha', *Conservation Biology* 17/5 (2003), 1449–1450. There are now thirty-six recognized hotspots. Together, these areas contain at least 50 per cent of the world's total plant species and 42 per cent of the world's terrestrial vertebrates as endemic. The original and unique habitat in these hotspots is at least 70 per cent depleted and is under imminent threat of total destruction due to habitat fragmentation related to urbanization, agriculture, and related economic activities. Originally representing 16 per cent of the earth's surface (excluding the thirty-fifth hotspot in North Eastern Australia, which was added in 2010, and the thirty-sixth hotspot of the North American Coastal Plain, which was added in 2016) the unique habitat of the hotspots has diminished to just 2.3 per cent. As found in Russell A. Mittermeier et al., *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions* (Washington, DC: Conservation International and Cemex, 2004).

2 We have mapped and researched cities in thirty-three of the thirty-six hotspots. Two hotspots—New Caledonia and the East Melanesian Islands—do not have cities with populations of over 300,000 people and the smaller cities that do exist in these hotspots are not projected to grow notably by 2030. Cape Town is the major growing city in both the Cape Floristic Province and Succulent Karoo hotspots. The thirty-three cities are listed here, following the format of Hotspot: City, Nation. 1) Atlantic Forest: São Paulo, Brazil; 2) California Floristic Province: Los Angeles, USA; 3) Cape Floristic Region: Cape Town, South Africa; 4) Caribbean: Port-au-Prince, Haiti; 5) Caucasus: Baku, Republic of Azerbaijan; 6) Cerrado: Brasilia, Brazil; 7) Chilean Winter Rainfall and Valdivian Forests: Santiago, Chile; 8) Coastal Forests of Eastern Africa: Dar es Salaam, United Republic of Tanzania; 9) Eastern Afromontane: Nairobi, Kenya; 10) Forests of East Australia: Sydney, Australia; 11) Guinean Forests of West Africa: Lagos, Nigeria; 12) Himalaya: Rawalpindi, Pakistan; 13) Horn of Africa: Mecca, Saudi Arabia; 14) Indo-Burma: Guangzhou, China; 15) Irano-Anatolian: Esfahan, Iran; 16) Japan: Osaka, Japan; 17) Madagascar and the Indian Ocean Islands: Antananarivo, Madagascar; 18) Madrean Pine-Oak Woodlands: Ciudad de México, Mexico; 19) Maputaland-Pondoland-Albany: Durban, South Africa; 20) Mediterranean Basin: Tel Aviv, Israel; 21) Mesoamerica: Guadalajara, Mexico; 22) Mountains of Central Asia: Tashkent, Uzbekistan; 23) Mountains of Southwest China: Chengdu, China; 24) New Zealand: Auckland, New Zealand; 25) Philippines: Davao, Philippines; 26) Polynesia-Micronesia: Honolulu, USA; 27) Southwest Australia: Perth, Australia; 28) Sundaland: Jakarta, Indonesia; 29) Tropical Andes: Bogotá, Colombia; 30) Tumbes-Choco-Magdalena: Guayaquil, Ecuador; 31) Wallacea: Makassar (Ujung Padang), Indonesia; 32) Western Ghats and Sri Lanka: Colombo, Sri Lanka; 33) North American Coastal Plain: Houston, USA.

3 Richard J. Weller, Claire Hoch, and Chieh Huang, 'Atlas for the End of the World', http://atlas-for-the-end-of-the-world.com, accessed 10 August 2017.

4 Stemming from the United Nations 2030 Agenda for Sustainable Development adopted by the Heads of State and Governments in 2015, and under the auspices of the Secretariat for the High Level Political Forum on Sustainable Development, the Sustainable Development Goals (SDGs) are a set of seventeen goals and 169 targets designed to catalyze and guide policy and action in the member states.

5 United Nations, 'Sustainable Development Goals', www.un.org/sustainabledevelopment/sustainable-development-goals/, accessed 10 August 2017.

6 Weller et al., 'Atlas for the End of the World', op. cit. (note 3).

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12 Arthur C. Nelson and Kenneth J. Dueker, 'The Ex-Urbanization of America and Its Planning Policy Implications', *Journal of Planning Education and Research* 9/2 (1990), 91–100; Peter Calthorpe, *The Next American Metropolis: Ecologies, Communities, and the American Dream* (New York: Princeton Architectural Press, 1993); Ian H. Burnley and Peter A. Murphy, 'Exurban Development in Australia and the United States: Through a Glass Darkly', *Journal of Planning Education and Research* 14 (1995): 245–254; Fiona McKenzie, *Beyond the Suburbs: Population Change in the Major Exurban Regions of Australia*. Bureau of Immigration, Multicultural and Population Research (Canberra: AGPS, 1996).

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14 See John Fraser Hart, 'The Perimetropolitan Bow Wave', *Geographical Review* 81/1 1991, 35–51.

15 See Joel Garreau, *Edge City: Life on the New Frontier* (New York: Anchor Books, 1992).

16 See Center for Applied Transect Studies website: transect.org.

17 For a succinct overview see David Simon, 'Urban Environments: Issues on the Peri-Urban Fringe', *Annual Review of Environment and Resource* 33 (2008), 167–185.

18 See Joan Iverson Nassauer, 'Messy Ecosystems, Orderly Frames', *Landscape Journal* 14/2 (1995), 161–169; Marc Antrop, 'Why Landscapes of the Past are Important for the Future', *Landscape and Urban Planning* 70/1–2 (2005), 21–34; C. J. van Riper et al., 'Incorporating Sociocultural Phenomena in Ecosystem Services Valuation', *Bioscience* 67/3 (2017), 233–244; Erik Swyngedouw, 'Metabolic Urbanization: The Making of Cyborg Cities', in: E. Swyngedouw, M. Kaika, and N. C. Heynen (eds.), *The Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism* (New York: Routledge, 2006), 21–40.

19 This appreciation of the peri-urban as a hybridization of rural and urban is partially captured by the Bhasha (Indonesian) term *desakota* (literally meaning at once village and town), which is used to describe the diverse rural-urban spatial structures extending from peri-urban interfaces within Asia, consisting of high population density between major cities, with a mix of rural agriculture and manufacturing. See T. G. McGee, 'The Emergence of "Desakota" Regions in Asia: Expanding a Hypothesis', in: N. Ginsberg, B. Koppel, and T. G. McGee (eds.), *The Extended Metropolis: Settlement Transition in Asia* (Honolulu: University of Hawaii Press, 1991), 3–26.

20 Weller et al., 'Atlas for the End of the World', op. cit. (note 3). Low-resolution mapping of these 463 cities can be found here: atlas-for-the-end-of-the-world.com/hotspots_main.html.

21 See: urban.yale.edu.

22 Institute of Environment and Sustainability at the Joint Research Centre of the European Commission, 'JRC in Brief' (2014) ec.europa.eu/jrc/en/about/institutes-and-directorates/jrc-ies, accessed 1 May 2015.

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25 Convention on Biological Diversity, 'National Biodiversity Strategies and Action Plans' (2017), www.cbd.int/nbsap/, accessed 1 June 2017.

26 Convention on Biological Diversity, 'COP 10 Decision X/22' (2017), www.cbd.int/decision/cop/default.shtml?id=12288, accessed 1 June 2017. For related facts and figures see: atlas-for-the-end-of-the-world.com/facts.html#indices.

27 There are a multitude of possible reasons why a city with the greatest potential growth may not have the greatest potential for habitat destruction in its hotspot, including: the city and/or its projected growth may not be fully located within a hotspot; urban expansion rates are not directly linearly correlated with population growth; in some areas urban spatial expansion rates outpace population growth rates.

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29 These are sourced from the IUCN's data for Terrestrial Mammals, Amphibians, Birds, Reptiles and Freshwater Groups.

30 IUCN, *The IUCN Red List of Threatened Species*, op. cit. (note 23).

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40 Timon McPhearson et al., 'Resilience of and through Urban Ecosystem Services', *Ecosystem Services* 12 (2015), 152–156.

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