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Urban Growth and Biodiversity Conservation

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Definition

While there are certainly costs associated with urbanization that must be mitigated, responsible urban development also offers opportunities to manage human population growth and consumption in ways that can reduce pressures on natural landscapes and create new urban ecological niches. It is therefore imperative that societies take the connection between biodiversity and urbanization seriously in order to manage the impact of this new trend to ensure responsible and sustainable growth. The remainder of this chapter explores the current state of knowledge on the impacts of urbanization on biodiversity and recent trends in effective management.

Introduction

Since the middle of the last century there have been a series of important global changes on the planet, such as the disturbance of the cycles of the elements, the extinction of many species, and climate change. These changes are occurring very quickly with a rate that is calculated between 10 and 100 times higher than in pre-industrial times, known as the *Great Acceleration*. The causes of this acceleration, traceable to multiple human activities, include increased consumption of natural resources and derived products, changes in land use and land cover, and pollution. The dominance of human activity on the planet's landscapes, seascapes, and atmospheric conditions is now enshrined in the naming of a new geological epoch, called the *Anthropocene* (Steffen et al. 2015).

During this new period, changes to biodiversity and natural ecosystems due to human activities have been more rapid in the past 50 years than at any time in human history, increasing the risks of sudden and irreversible alterations to our global system. The United Nations estimates that today, half of the global population lives in cities and urban areas (United Nations 2018a), and that by 2050, city dwellers will equal today's total population (Wenzel et al. 2020, p. 1). These changes have paralleled a major shift in human migration and demographic patterns away from dispersed, low density rural settlements toward high density, geographically concentrated urban areas. More than coincidence, evidence increasingly shows that urbanization contributes either directly or indirectly to some of the most profound and urgent environmental challenges in the Anthropocene, including alarming impacts on biodiversity in the form of habitat loss, species

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extirpation and extinction, phenotypic and phylogenetic evolution, pollution, and more.

To better understand the linkages between urbanization and biodiversity, it is important to define more clearly terms that tend to be generalized and interchangeable. Following the scheme outlined by McDonald et al. (2020), the term "urbanization" refers to "the change in the proportion of a population living in an urban area," (p. 16) whereas "urban growth" is the "increase in the area of cities or towns," (p. 16). Where one term relates to demographic patterns, the other relates to the geographic or environmental footprint of urban areas. As these authors note, there is a debate over a precise definition of what constitutes an "urban" area, but broadly the term describes a spectrum of interrelated factors defined by population density, impervious surfaces like paved roads, and built-up structures including large-scale infrastructure and buildings. Finally, again in-line with McDonald and colleagues and the Convention on Biological Diversity (CBD 1992), "biodiversity" describes the variety of living organisms that range from genes to interconnected ecosystems and biomes.

From these definitions, the linkages of impacts begin to emerge. The process of urbanization leads to urban growth, and that urban growth initiates a cascade of changes across biological and geophysical systems (otherwise referred to as ecosystems) that may extend beyond the environs of simply the urban area itself. Those changes disturb system structure and function, leading to changes in the resources and ecosystem services from which humans derive the means necessary to meet their needs (Elmqvist et al. 2013). Aside from this broad description, the specific changes and impacts are highly context specific and must be managed in relation to the local social-ecological context. The question for resource managers, urban planners, and conservationists, then, is what are the important impacts of urbanization and urban growth on biodiversity, and how can societies mitigate any resulting damage to the world's natural and social systems?

While there are certainly costs associated with urbanization that must be mitigated, responsible urban development also offers opportunities to manage human population growth and consumption in ways that can reduce pressures on natural landscapes and create new urban ecological niches. It is therefore imperative that societies take the connection between biodiversity and urbanization seriously in order to manage the impact of this new trend to ensure responsible and sustainable growth. The remainder of this chapter explores the current state of knowledge on the impacts of urbanization on biodiversity and recent trends in effective management.

Growth of Area and Population, and the Factors That Determine Impacts on Biodiversity

While academic researchers and international policymakers utilize estimates of urban population (for modeling and planning purposes), there is no universally accepted and precise measure of urban area and urban population (McDonald et al. 2020). Despite the lack of precision, there is general agreement that recent decades have seen dramatic increases in urbanization and that humans are becoming an increasingly *urban species* (Elmqvist et al. 2018). As a result of this, cities are increasing in surface area, density, and in population. By 2015, urban area was estimated at 740,000 km^2 (McDonald et al. 2018). By some estimates two-thirds of the global population will live in cities by 2050 (United Nations 2018b), and the quality of city environments, both built and natural, will determine the quality of life for about five billion people living in urban areas. This is an unprecedented first in human history and carries important implications for the way societies relate to each other and for our relationship to the natural world.

The causes of this urbanization trend are varied, and among others include: (i) the migration of people from rural areas searching for better living conditions, and (ii) food scarcity, sometimes due to climate change and unsustainable land management (UNDP 2018). As human population continues to climb, and as climatic variability intensifies, climate-induced migration is poised

to become another driver of the urbanization trend.

While these coarse trends are alarming, not all urban growth impacts the surrounding landscape and biodiversity equally. Rather, the specific impacts depend on where and how this growth progresses. For instance, in areas of high population growth, urbanization serves to concentrate the direct impacts of human settlement in a relatively small geographic area, leading to high population density (measured as number of persons per square kilometer). If the same total population were distributed at a lower population density, much more land would be needed, leading to more dispersed impacts and a larger overall human footprint. Thus, one factor in understanding the impact of urbanization on biodiversity is the amount of land area disturbed by human settlement and the area, density, and topology or spatial arrangement, otherwise known as its urban form (Frey 2003).

A second factor is the character of the land that is being converted into urban area, and how much natural habitat for biodiversity will be lost. In developed countries in the global north, some of the urban growth is occurring in previously converted farmland, meaning that urban growth is not directly converting natural or previously undisturbed habitats and ecosystems. Rather, the original disturbance to ecosystem structure, function, and services had previously happened, and urban growth is a modification or intensification of that perturbation. Unfortunately, much of the recent urban growth has happened in previously natural areas including along coastlines and floodplains or in tropical forests. These areas are considered to be highly productive ecosystems and support much of the world's terrestrial biodiversity. Disturbance in these previously undisturbed areas will have a much different impact on biodiversity than in already disturbed systems. Considering population growth projections, most of the increase in urban growth will happen in either mangrove biome, tropical moist forest biome, and Mediterranean biome (McDonald et al. 2020). In contrast, the projections by McDonald et al. show that, due to their remoteness or extreme conditions, tundra, deserts, and boreal forests will see less disturbance directly from urban growth.

Land use change brings a third factor that defines the impact that urbanization has on biodiversity. Urban areas require intensive inputs of material and energy to feed and house their populations and power their infrastructure. They likewise produce large volumes of waste (physical, liquid, and gaseous) that must be disposed of in some way. Whereas the urban form describes the location and structure of settlements (their direct impacts), urban metabolism (Kennedy et al. 2011) describes these second-order impacts on source and sink areas for the energy and material consumed by an urban population. While certain biomes will incur the major direct impacts of urban growth in coming decades, urban metabolism will define from where the inputs come, and where the outputs are deposited. Thus, areas like deserts, tundra, and boreal forests will see indirect impacts as they are mined, logged, and converted to farmlands or waste repositories to satisfy growing resource demands.

The Impact of Cities on Biodiversity and Ecosystem Services

Although cities make up a small proportion of worldwide land cover, urban growth has a significant impact on biodiversity at multiple scales (McDonald et al. 2018), and there are important cross-scale dynamics in which action and decisions taken in one scale affect resources, communities (biological and social), and habitat at other scales. Moreover, most urbanization is occurring in regions identified as biodiversity hotspots (Seto et al. 2012). Considering the discussion on urban form, one of the principal impacts is on species richness and diversity in areas converted to urban land cover.

The global rate of species extinction is already at least tens to hundreds of times higher than the average rate (p. 4) over the past ten million years and is accelerating (Díaz et al. 2019). The last report from the Nature Conservancy alert us that the urban growth was responsible for the loss of 190,000 km^2 of natural habitat between 1992

and2000, equivalent to 16% of total natural habitat lost during that period. If this trend continues in the next years, urban growth could threaten 290,000 km^2 of natural habitat by 2030. The countries that are projected to suffer most natural habitat loss (> 10,000 km^2) are the United States, Brazil, Nigeria, and China, though there are many other countries projected to experience major habitat loss. In the meantime, government policies and institutions meant to regulate these impacts in these four contexts have shifted in recent years to encourage more development. With the election of the Bolsonaro and Trump regimes in Brazil and the United States respectively as prominent examples of internal policy shifts on one hand, and China's rapid domestic urbanization and international Belt and Road Initiative on the other, the global situation is becoming more and more extreme. While examples abound, there have been recent trends globally toward greater resource development at the expense of many previously undisturbed areas.

The urban form of a city includes the network of built-up surfaces that connect it to important resources such as but the expansions of roads, hydroelectric dams, and oil and gas pipelines. The design of the city and associated infrastructure can carry high environmental and social costs, including deforestation, habitat fragmentation, biodiversity loss, and population growth leading to greater population density and urban area. Thus, urban growth does not just reduce habitat area, it also fragments and affects the remaining habitat, often leading to a consequent decline of species richness and abundance (Haddad et al. 2015). As a result, fragmentation can affect the survival, reproduction, and mobility of multiple species. Likewise, urban expansion contributes substantially to the five key drivers that are considered to have the most effect in biodiversity change: habitat loss, climate change, excessive nutrient loads and pollution, overexploitation and unsustainable use, and invasive species (Duarte et al. 2006).

Broadly, then, urban growth tends to negatively impact species richness and diversity, particularly when natural habitat is converted to urban land. However, patterns of those impacts on diversity and richness can vary as some sensitive species and genes are unable to adapt and are outcompeted (Shochat et al. 2010), whereas other more tolerant species adapt quickly and assume a more dominant position in the ecosystem. Likewise, invasive or nonnative species often accompany new settlement, either opportunistically or through intentional introduction. Thus, new ecological niches can be created and filled, placing unanticipated and unpredictable stress on the system. This in turn can impact levels of species diversity and richness, as Faeth et al. (2011) show.

Urban Metabolism and the Impact of Cities Beyond Their Borders

As introduced above, the urban metabolism of a city implies that urban areas also have disproportionate environmental impacts at the local, regional, and global scales well beyond their borders (Grimm et al. 2008; Seto et al. 2012). Urban development causes habitat loss due to the permanent installation of the built environment, which often leads to more lasting impacts than other types of habitat loss and fragmentation of previously intact landscapes and habitat corridors. As a result, species richness of many taxa often declines along the gradient natural-rural-urban landscape, with the lowest richness to be found in the urban area (Mckinney 2002). These indirect impacts can be proximate as well as quite distant, depending on the sink and source location for resource and energy.

Importantly, the metabolism aspect of a city creates impacts both in the terrestrial and atmospheric realm as well as the aquatic (marine and freshwater). Cities have a significant impact on freshwater biodiversity, and on marine biodiversity. Freshwater ecosystems are only 0.8% of the Earth's surface, but harbor about 6% of all described species (McDonald et al. 2018). Across both freshwater and marine fish species, around 15% are listed as threatened on the IUCN Red List. Urban growth is associated with an increase in water pollution, which is the most common threat to freshwater fish species. The discharge of untreated sewage and other pollution to ocean

waters also impact many near shore marine ecosystems. Pollution of this sort is listed as a threat to one in three Red List marine fish species.

If current trends continue, urban growth could degrade the global network of protected areas and the benefits they provide. Literature reviews have established that negative impacts from cities on protected areas become more frequent when there is less than 50 km between a protected area and a city (McDonald et al. 2018). It has been reported that in 1992, 29% of strictly protected areas (International Union for Conservation of Nature-IUCN, categories I–IV) were less than 50 km from urban areas. The projection is that by 2030 the percentage will increase, with 40% of strictly protected areas within 50 km of an urban area. This contiguity will intensify the impacts on urban-adjacent protected areas.

Urban Green Infrastructure and Nature-Based Solutions Are Crucial for Biodiversity and Human Well-Being

As McDonald et al. rightly note, "Nature in and near cities is crucial not just for maintaining biodiversity but also for ensuring human wellbeing, which depends on the benefits that nature provides" (McDonald et al. 2018, p. 9). Urban green spaces provide multiple benefits, and public parks in particular have a key role in supporting ecological and social sustainability in cities, contributing to human-nature interactions (Vierikko et al. 2020). The parts of a city that support natural structures comprise the Urban Green Infrastructure (UGI) that links very directly to urban ecosystem services (Childers et al. 2019). In fact, the definition of UGI is "the network of green and blue spaces (water) such as forests, wetlands, parks, roofs and green facades that contribute to the well-being of people through ecosystem services" (Derkzen et al. 2017). The UGI concept has important implications for the future of cities, and is a critical bridge between nature and people, through the contribution of ecosystem services to improving the quality of life. For example, trees in a city park provide a number of benefits, including cooling via evapotranspiration, soil development, carbon sequestration, and stormwater management. Moreover, the same trees also provide shade for people and habitat for birds, insects, and other wildlife (Childers et al. 2019).

Past assessments have suggested that urban growth has a direct impact on biodiversity and human well-being (Elmqvist et al. 2013). In recent years, numerous studies have also shown the importance of urban green areas, both in mitigating the effects of climate change and in improving the quality of life of people (Derkzen et al. 2015), due to their contribution to delivery ecosystems services (Díaz et al. 2015). These include provisioning services such as food and water, regulating services such as floods regulation, and cultural services such as inspiration or aesthetical values. There is a consensus (p. 1) that urban natural spaces support well-being and health (Frumkin et al. 2017), improve biodiversity (Sadler et al. 2010), decrease the urban heat island effect, and contribute to adaptation to climate change (Matthews et al. 2015). Importantly, many of the services that intact ecosystems provide are irreplaceable and not substitutable at any practical scale. In this context, maintenance and restoration of urban ecosystems is more decisive for the future of human well-being.

Urban ecosystems contribute to improving people's quality of life by reducing the levels of air pollution (Derkzen et al. 2015), retaining rainwater and reducing runoff, reducing noise and high temperatures, and offering opportunities for recreational and cultural activities (Casado-Arzuaga et al. 2014). Moreover, as nature experience is associated with psychological and mental well-being, increasing of happiness, and positive social interactions (Jennings and Bamkole 2019), urban biodiversity and ecosystems offer much other benefits directly related to well-being.

These ecosystem services can play a significant role in connecting cities to nature (Gómez-Baggethun et al. 2013). In fact, clean air, safe drinking water, and protection from climate change effects are all relevant to human development, especially in urban areas. With rapid urbanization, human contact with nature declines, decreasing the positive influence of nature on

health, including mental health (Bratman et al. 2019). If urban growth and urbanization proceed unplanned or haphazardly, it can destroy natural habitat and impact biodiversity and erode human well-being. So, crucial decisions must be made about how to effectively govern these spaces to optimize for both ecological integrity and social well-being while building collaborative institutions to balance those trade-offs (Fisher et al. 2019).

While much is known regarding the impacts of urban infrastructure, namely transport or waste systems, much less is known about the urban green spaces, such as parks, gardens, open spaces, water catchment areas, and ecosystems and biodiversity in general. There are natural features that can be incorporated into urban areas, to the benefit of human well-being and biodiversity (McDonald 2015). Built natural spaces in cities can maintain biodiversity, not so much for rare or sensitive species, but can make the urban landscape more friendly for a large variety of species. Even if they contain nonnative habitat, they can be important for wild species movement and shelter by improving connectivity. For instance, many species of migrating birds use parks as resting places while migrating (McDonald et al. 2018). Urban parks often contain remnant forests and lawns that provide spaces for recreation, but also valuable habitat for some species. Street trees can shade roads, lowering the air temperature on hot days and containing suspended particulate matter (SPM) (Vailshery et al. 2013). Constructed wetlands can help manage stormwater. Green roofs and green walls can lower indoor temperatures during the summers and decrease the need for space heating in winter.

Given these advantages, urban key biodiversity areas should be safeguarded, and increased use of green infrastructure and other nature-based approaches can help to advance sustainable urban development. Some of the most useful ways to create an improved UGI in urban areas are creation of accessible vegetation spaces, water bodies, urban agriculture, and rooftop gardens. Green infrastructure in urban and peri-urban areas can also act as flood protection, temperature regulation, cleaning of air and water, treating wastewater, provision of energy, locally sourced food, and the health benefits of interaction with nature (Díaz et al. 2019).

There is general acknowledgment that nature can deliver solutions for dealing with environmental challenges such as climate change, hydrological resource degradation, food security, and disaster risk management. In this context, nature-based solutions (NBS) have emerged as a concept for integrating ecosystem-based approaches to address a range of societal challenges. NBS, such as creating green spaces that can help lower temperatures and pollution levels, involves planning and infrastructure approaches that are inspired by natural systems or supported by them and are intended to be cost-effective alternatives that provide social, economic, and environmental benefits and enhance resilience (Eggermont et al. 2015). The NBS approach provides significant possibilities for using nature for resilient solutions to urban challenges. Integration of NBS with built infrastructure can contribute to sustainable and equitable cities and make a significant contribution to adaptation and mitigation to climate change (Díaz et al. 2019). The literature is replete with analyses that demonstrate how NBS are more adaptive and flexible than hard-engineered solutions (Allenby and Chester 2018). Often, NBS are an alternative or a complement to other technological actions, and they are economically efficient and more profitable than other technologies.

Good Practices Toward Restoring Biodiversity in Urban Ecosystems

In the last decade, there are increasing numbers of examples of good practices in cities that have successfully developed projects to maintain and restore biodiversity and urban ecosystems. One remarkable case is the city of Toronto, which was the first city in North America to adopt a law to regulate the construction of green roofs, through the Green Roof Bylaw (2009) (https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/), which requires a certain ratio of

green roofing for new developments above a certain size. Toronto also offers subsidies for building owners willing to create green roofs with their Eco-Roof Incentive Program, something other cities already have imitated. *The Green Roof Bylaw* sets out a graduated green roof requirement for new development or additions that are greater than 2000 m^2 in gross floor area. Green roofs are required on new commercial, institutional, and residential development with a minimum gross floor area of 2000 m^2.

Another noteworthy project is the *MillionTreesNYC* initiative of the City of New York, (https://www.milliontreesnyc.org/html/about/about.shtml) which is a public-private program with an ambitious goal to plant and care for one million new trees across the city's five boroughs over the next decade. The City of New York will plant 70% of trees in parks and other public spaces, and the other 30% will come from private and community organizations. By planting one million trees, New York City can increase its urban forest (street trees, park trees, and trees on public, private and commercial land) by a 20%, while achieving the many quality-of-life benefits that come with planting trees. Street trees in NYC are valuable stormwater management infrastructure, intercepting almost 900 million gallons of stormwater annually, or an average of 1500 gal per tree. Urban trees can also improve air quality by removing dust and other pollutants, including those that cause asthma (Lovasi et al. 2008). While this is not a replacement for lost ecosystem services and biodiversity, urban tree cover does provide important mitigation for the disturbance of urban form and metabolism.

On the African continent, examples are increasingly prominent as well. For instance, faced with growing risk from climate change, population growth, and infrastructure choices that have long life spans and important biological, ecological, and social ramifications, the Future Resilience for African Cities and Lands (FRACTAL) project has been enabling peer-to-peer or city-to-city learning exchanges to share good practices, generate knew knowledge, and enable regionally driven approaches to decision making at the city regional scale in southern Africa (p. 4) (Ndebele-Murisa et al. 2020). This has led to new policies on climate smart development and implementation of biodiversity safeguarding in cities like Durban, Windhoek, Lusaka, and others. Likewise, African academics and urban planners in Nigeria have worked to assess the drivers of biodiversity loss in rapidly urbanizing areas and have shown viable pathways for mitigating some of the deleterious effects in rapidly expanding settlements (Oka 2009).

In the case of Europe, the European Commission has recognized the important role that local authorities play in improving the urban environment, and in this context, in 2008, there was conceived the initiative *European Green Capital Award*, to promote efforts of cities leading toward environmentally friendly urban living. The award targets to offer an incentive for cities to encourage each other and share good experiences.

The city of Lisbon in Portugal has been named the *European Green Capital* 2020, and it is a good example of major UGI building and NBS. Its programs for urban innovation have engaged a wide range of stakeholders, such as citizens, businesses, and universities. Lisbon has a strong commitment to protect and enhance natural areas with specific measures developed in the Biodiversity Action Plan, which includes a system for monitoring ecosystem services. One example is the management of the Monsanto Park, for which the city has received the Sustainable Forest Management Certification. Lisbon is also connecting its green areas through several green corridors, giving its citizens greater access to green spaces and improving biodiversity connectivity. Various NBS have been applied, such as planting 80,000 new trees to get resilience against the *Urban Heat Wave* and creating new green areas for noise reduction (76% of citizens are within 300 m of a quiet area). Another important action is the construction of retention basins in uptown areas to protect the city against flash floods (https://ec.europa.eu/environment/europeangreencapital/lisbon-is-the-2020-european-green-capital-award-winner/).

Vitoria/Gasteiz in northern Spain has also been named a *European Green Capital* in 2012 because of its progress in numerous measures to increase biodiversity and ecosystem services. Many of the

actions taken to improve the biodiversity of the city are grouped together in the Green Belt project, which has been ongoing for several years. The Green Belt is a set of peri-urban parks of high ecological value that offers a variety of natural ecosystems such as rivers, wetlands, meadows, field, and hedgerows. This is the result of a project initiated in the 1990s with the aim of improving and restoring natural areas, in order to generate a large green area for leisure activities around the city.

Other pioneering experiences are those taking place in the city of Singapore, a city state with the highest population density in the world (25,000 inhabitants/km^2). The aim of these initiatives is to transform Singapore into a city of gardens, parks, and water, for a better quality of life for people. Among the different projects taking place in the city, there is an innovative project called *Therapeutic Gardens Network* that aims to respond to the needs of elderly people including dementia patients (Andreucci et al. 2019). The first model of therapeutic garden was finalized in 2016 by the National Parks Board with the collaboration of the Psychological Health Department of the University of Singapore. Gardens include physical and emotional comfort, engagement with nature, maintenance and sustainability, and provide access to a vegetable garden and an orchard suitable for a variety of therapies, such as horticultural sessions. This is a good example of urban planning for quality of life that can be applied to other cities in Asia and elsewhere, and there is increasing empirical evidence that urban planners need to understand and design for those linkages. For instance, Chen et al. (2020) demonstrate that access to green spaces in urban areas in China is highly correlated with health outcomes and discuss how changes to the built environment can improve community health (p. 1). These linkages and positive feedback processes will be increasingly important as the world moves toward an increasingly urban population.

Cities Represent an Opportunity to Learn on the Road to Sustainable Management

In recent decades, societies have learned a great deal regarding the ways that human settlement impact biodiversity, particularly concerning the direct impacts of urbanization. There is an increasingly sophisticated body of knowledge and empirical data that demonstrates worrying trends in human demographic patterns and their impact on the world's natural systems. Yet, the impact of urbanization and urban growth on biodiversity is admittedly complex and care should be taken to not overgeneralize the underlying relationships. For instance, relationships depend on the urban form and metabolism of specific locations, as well as the measures taken at the household, neighborhood, municipal, and regional and national governmental levels. There continue to be important gaps and uncertainties that impede our ability to manage urban growth and its more deleterious impacts on the planet (McDonald et al. 2020). The social, ecological, political, and scientific complexity of modern systems invariably leads to incompatible interests and environmental conflicts (Fisher 2014). Thus, social questions of equity and justice also shape the responses to mitigate changes to ecosystem service delivery. In addition, such conflicts present not only challenges but also opportunities for learning, collaboration, and transformative problem-solving.

It is likely that half of the urban areas that will exist in 2050 have not yet been designed and built (Childers et al. 2019). This provides remarkable opportunities for improving urban sustainability, and the use of NBS will be critical to get more resilient solutions to urban challenges. Urban planners should find ways to preserve as much remnant natural habitat as possible and to restore with native plant species to allow ecological succession and enhance plant and animal diversity (Mckinney 2002). For instance, urban sustainable planning approaches may include designing nature responsive roads and building low impact infrastructure systems.

This process of change will need an agreement among stakeholders, across various scales. A major need is to promote collaboration among institutions, both across jurisdictions and across sectors. There is evidence that the coproduction of knowledge, designs, and solutions by urban practitioners, local communities, and researchers is a key to more sustainable future pathways for cities, the ones of today and the ones to be built (Elmqvist et al. 2018). Thus, achieving sustainability and resilience for cities must be high on any government's agenda, to make use of nature and its services to alleviate some of these problems. Governments around the world need to plan for an urban development where biodiversity and human well-being are protected. International institutions will also play a key role in influencing the design of cities of the future, as cities are globally interconnected through political, economic, and technical systems, and also through the Earth's biophysical life-support systems (Jansson 2013).

Moreover, given that most urban growth between now and 2030 will take place in the Global South, major sustainability challenges include addressing the lack of basic infrastructure (water, sanitation, and mobility), and the limited governance capacity and financing mechanisms (Díaz et al. 2019). These mechanisms of course are not unique to the global south. In the global north, similar challenges arise from aging infrastructure, political division and deadlock, and the challenge of redesigning already built infrastructure. However, the new waves of urban growth in the global south present opportunities to build differently. Major international funding sources should seek to directly appropriate funding to mitigate the impact of urban growth on biodiversity and ecosystem services. Some organizations, as ICLEI (Local Governments for Sustainability https://www.iclei.org), in collaboration with the IUCN, have created *CitiesWithNature* (https://cwn.iclei.org/), a global platform for cities that enhances the value of nature in and around cities. The platform provides an opportunity for cities to connect, share, and learn from each other.

From this review, it is clear that urban growth can create problematic impacts on biological diversity and associated shifting sustainable management challenges. At the same time, urban areas represent considerable opportunities to be leaders in the global sustainability agenda (Folke et al. 2011), in order to achieve recent international UN agreements, such as the Aichi Biodiversity Targets, the New Urban Agenda, and the 2030 Agenda for Sustainable Development, especially the Goal 11: *make cities and human settlements inclusive, safe, resilient and sustainable.* Urban areas are also relevant to the Goals for education, gender equality, reducing inequalities, and promoting peace, justice, and strong institutions (Sustainable Development Goals 4, 5, 10, and 16). It is therefore crucial that societies take a holistic approach to managing and governing urban and natural spaces by acknowledging cross-scale impacts of human decisions and actions on natural systems and the feedback processes that in turn impact human well-being and related resource demands.

Cross-References

- ▶ Biodiversity Erosion: Causes and Consequences
- ▶ Biological Diversity: Global Threats
- ▶ Cultural Ecosystem Services
- ▶ Desertification: Causes and Countermeasures
- ▶ Ecological Restoration and Ecosystem Services

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