Cities and Biodiversity Outlook

Action and Policy

A Global Assessment of the Links between Urbanization, Biodiversity, and Ecosystem Services

Convention on Biological Diversity

Stockholm Resilience Centre
Research for Governance of Social-Ecological Systems

Stockholm University

ICLEI Local Governments for Sustainability

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The full text of *Cities and Biodiversity Outlook* is available online at www.cbd.int/en/subnational/partners-and-initiatives/cbo.

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Foreword by the UN Secretary-General

By 2050, an estimated 6.3 billion people will inhabit the world's towns and cities -- an increase of 3.5 billion from 2010. Our planet will have undergone the largest and fastest period of urban expansion in human history. The area directly transformed in the next four decades will be roughly the size of South Africa, and the new demands of cities will reshape most landscapes, both built and natural. Urban growth will have significant impacts on biodiversity, natural habitats and many ecosystem services that society relies on.

The challenges of urbanization are profound, but so too are the opportunities. The outcome of the Rio+20 UN Conference on Sustainable Development emphasizes that "if they are well planned and developed, including through integrated planning and management approaches, cities can promote economically, socially and environmentally sustainable societies." Well-designed cities can sustainably accommodate large numbers of people in a relatively small amount of space, offering improved quality of life and allowing for greater resource efficiency and the preservation of larger intact natural areas.

The Cities and Biodiversity Outlook combines science and policy in a global assessment of the links between urbanization, biodiversity and ecosystem services. It showcases best practices and provides key advice on the conservation and sustainable use of biodiversity. The principal message is that urban areas must offer better stewardship of the ecosystems on which they rely, including by generating multiple ecosystem services through design and restoration and reducing their environmental impact through improved efficiency of material and energy use and by making productive use of waste. Cities can reconcile human society and biodiversity by creating environments that are ecologically sustainable, economically productive, socially just, politically participatory and culturally vibrant. I commend this study to policy-makers, planners and all who have a stake in creating ecologically sustainable urbanization for the benefit of humanity and the planet.

Ki Moon Ban

Ban Ki-moon
Secretary-General, United Nations

Message from the Executive Director of UNEP

Cities give rise to a diversity of views and emotions, from places of pollution and social divisions to centers of ancient and popular culture and crossroads of innovation and new ideas. Today they are also increasingly recognized for their role in conserving biodiversity and are providing exciting opportunities for making the transition to an inclusive green economy in both the developing and developed world.

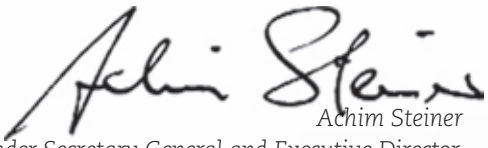
This is among the key points of this new report. *Cities and Biodiversity Outlook* (CBO) brings into sharp focus not only the extraordinary wealth of urban biodiversity but also its role in generating ecosystem services upon which large and small urban populations and communities rely for their food, water, and health. It makes a strong argument for greater attention to be paid by urban planners and managers to the natural or nature-based assets within their metropolitan boundaries as one way toward realizing a range of targets established both pre- and post-Rio+20.

In partnering with cities, the CBD has also recognized their potential for assisting in meeting the 20 strategic Aichi Biodiversity Targets by 2020 that were agreed upon by governments at the 2010 meeting of the Convention in Nagoya, Japan.

Among the many fascinating findings here are the range of species found in cities of all kinds and complexion. Brussels, for example, contains more than 50 percent of the floral species found in Belgium. Cape Town is host to 50 percent of South Africa's critically endangered vegetation types and approximately 3,000 indigenous vascular plant species.

CBO also underlines the health benefits of urban biodiversity. Studies in the United States, for example, show that cities with more trees have lower rates of asthma among young children. It also showcases how policymaking by local government can bring food and health security to citizens, citing Kampala, Uganda, where regulations have allowed close to 50 percent of households to produce safe, quality produce within the city's limits.

More than half the global population already resides in cities. Cities represent major opportunities for delivering a low-carbon, far more resource-efficient world. This report brings to the fore their increasing relevance with respect to biodiversity and the natural systems that underpin the wealth of all nations.



Achim Steiner
United Nations Under-Secretary General and Executive Director,
United Nations Environment Programme

Preface by the Executive Secretary of the CBD

Cities and Biodiversity Outlook – Action and Policy stems from Decision X/22 requesting the Executive Secretary of the CBD to prepare an assessment of the links and opportunities between urbanization and biodiversity, based on the concept of our flagship publication *Global Biodiversity Outlook*. The primary goals of *CBO* are to:

- Serve as the first comprehensive global synthesis of researched scientific material on how urbanization affects biodiversity and ecosystem dynamics.
- Provide an overview, analysis, and response to knowledge gaps in our understanding of urbanization processes and their effects on social-ecological systems.
- Address how biodiversity and ecosystem services can be managed and restored in innovative ways to reduce the vulnerability of cities to climate change and other disturbances.
- Serve as a reference for decision- and policy-makers on the complementary roles of national, sub-national, and local authorities in preserving biodiversity.

Ours is an increasingly urban world. The 20 ambitious Aichi Biodiversity Targets set by the CBD for 2020 cannot be achieved without coherent governance at global, regional, national, sub-national, and local levels. The habits of urban dwellers will largely determine the health of our ecosystems and the survival of biodiversity. As the pages that follow make abundantly clear, sustainable urbanization is essential for maintaining human well-being. Cities—their inhabitants and governments—can, and must, take the lead in fostering a more sustainable stewardship of our planet's living resources. Many already are, in ways that are innovative, exciting, and inspiring—but so much more remains to be done. This publication is a new and valuable tool for steering urban development onto a sustainable path. I hope you will read it, share it, and together with others, take action to save life on Earth.

Braulio Ferreira de Souza Dias
Assistant Secretary-General and
Executive Secretary Convention on Biological Diversity

Overview of Cities and Biodiversity Outlook —Action and Policy

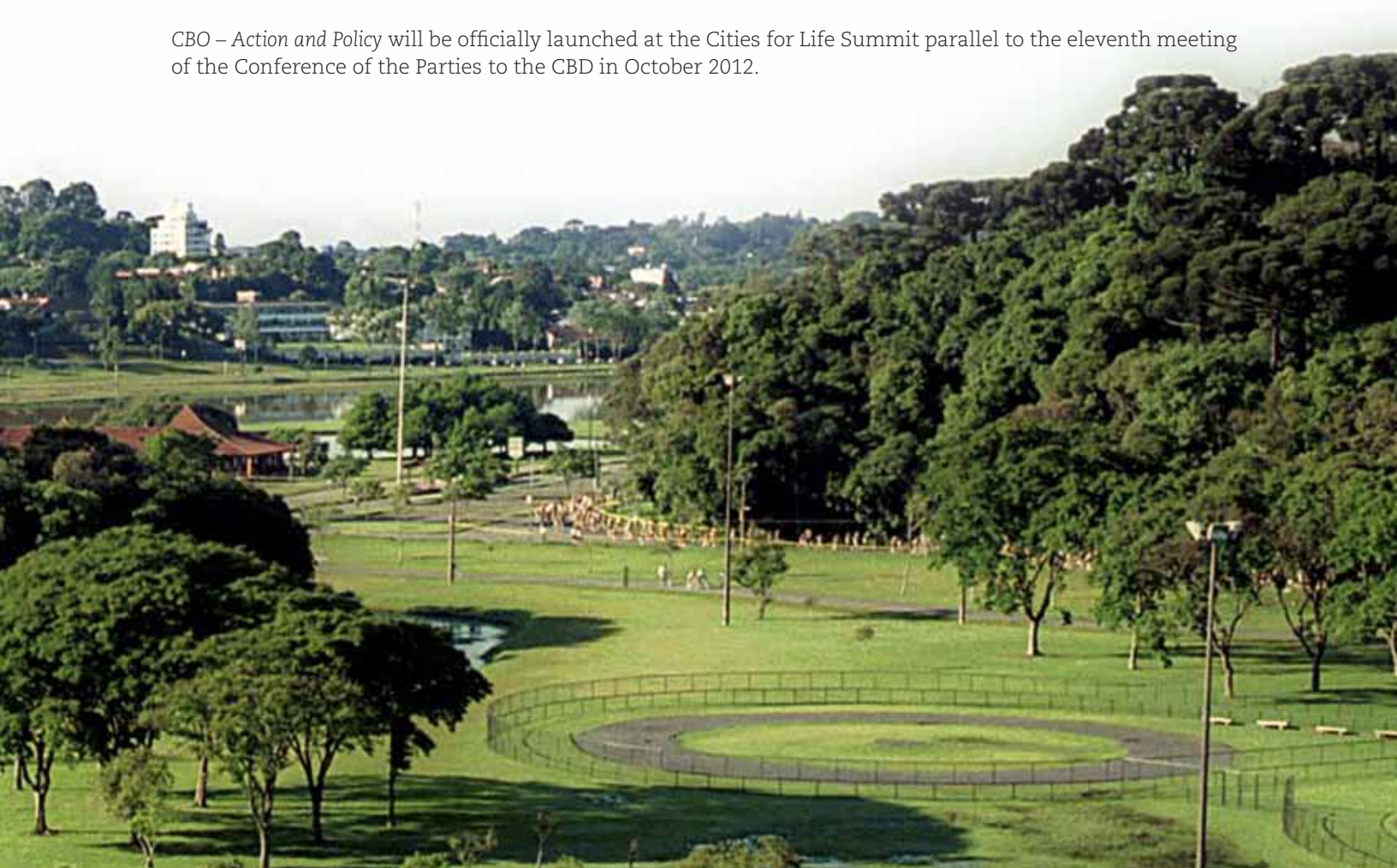
CBO – Action and Policy provides the summary of a global assessment of the links between urbanization, biodiversity, and ecosystem services. Drawing on contributions from more than 120 scientists and policy-makers from around the world, it summarizes how urbanization affects biodiversity and ecosystem services and presents 10 key messages for strengthening conservation and sustainable use of natural resources in an urban context. It also showcases best practices and lessons learned, and provides information on how to incorporate the topics of biodiversity and ecosystem services into urban agendas and policies. *CBO – Action and Policy* emphasize challenges and opportunities in rapidly urbanizing developing countries. A workshop in Cape Town in February 2012 was specifically organized to bring together urban planners, policymakers and scientists from many different African countries to inform about current and future urban developments in Africa.The Aichi Biodiversity Targets (see Appendix 1) highlighted throughout the key messages reinforce the mission of the CBD's Strategic Plan to "take effective and urgent action to halt the loss of biodiversity."

This volume was developed in parallel with and builds upon the more detailed scientific analysis and assessment titled *Global Urbanization, Biodiversity, and Ecosystems – Challenges and Opportunities*, scheduled to be published in 2013. Both publications are a collaborative effort of the CBD and the Stockholm Resilience Centre of Stockholm University, with significant input from ICLEI – Local Governments for Sustainability.

The material reviewed here is evidence-based, tested, and in the public domain. For ease of readability, references are limited. A more complete list of references along with a glossary will be found in the scientific analysis and assessment (core chapters available at www.cbd.int/en/subnational/partners-and-initiatives/cbo).

Modeled upon the CBD's flagship publication, *Global Biodiversity Outlook*, the production of *CBO – Action and Policy* has been highly inclusive. Two separate drafts were widely circulated for review before publication. An Inter-Agency Task-Force and an Advisory Group (see p. 62), as well as the Global Partnership on Local and Sub-National Action for Biodiversity, provided valuable oversight of the entire process.

CBO – Action and Policy will be officially launched at the Cities for Life Summit parallel to the eleventh meeting of the Conference of the Parties to the CBD in October 2012.



SECTION I

Summary of *Global Urbanization, Biodiversity, and Ecosystem Services – Challenges and Opportunities*

The following is a summary of the* CBO Global Urbanization, Biodiversity, and Ecosystem Services —Challenges and Opportunities, *the scientific assessment edited by Thomas Elmqvist, Michail Fragkias, Burak Güneralp, Peter Marcotullio, Robert McDonald, Susan Parnell, Marte Sendstad, Karen Seto, and Cathy Wilkinson. Chapter references below refer to the core chapters available online, with full references, at www.cbd.int/en/subnational/partners-and-initiatives/cbo.

Urban Expansion

The world is increasingly urban, interconnected, and changing. If current trends continue, by 2050 the global urban population is estimated to be 6.3 billion, nearly doubling the 3.5 billion urban dwellers worldwide in 2010 (Chapter 7). More than 60 percent of the area projected to be urban in 2030 has yet to be built (Chapter 7). Most of the growth is expected to happen in small and medium-sized cities, not in megacities (Chapter 7).

Five major trends in the urbanization process have implications for biodiversity and ecosystem services:

- The total urban area is expected to triple between 2000 and 2030, while urban populations are expected to nearly double, increasing from 2.84 to 4.9 billion, during this period. In other words, urban areas are expanding faster than urban populations (see Figure 1) (Chapter 7).
- This urban expansion will heavily draw on natural resources, including water, on a global scale, and will often consume prime agricultural land, with knock-on effects on biodiversity and ecosystem services elsewhere.
- Most future urban expansion will occur in areas of low economic and human capacity, which will constrain the protection of biodiversity and management of ecosystem services (Chapter 7).
- Urban expansion is occurring fast in areas adjacent to biodiversity hotspot (see Figure 1) and faster in low-elevation, biodiversity-rich coastal zones than in other areas (Chapter 7).
- Urbanization rates are highest in those regions of the world where the capacity to inform policy is absent and where there are generally under-resourced and poorly capacitated urban governance arrangements (Chapter 10).

However, all projections have uncertainties, and several factors or events—for example, a deep and protracted world economic crisis, accelerating fossil-fuel prices, or a global pandemic—could considerably decrease the projected rate of global urbanization.

Even under scenarios of considerably slower urbanization rates, urban areas all over the planet are currently facing severe challenges, among them (i) shortages of natural resources (including water) and environmental degradation; (ii) climate change, as manifested by rising sea level, higher temperatures, variation in precipitation, and more frequent and severe floods, droughts, storms, and heat waves; (iii) demographic and social changes associated with urbanization and population growth, such as the contradictory tendencies of increased wealth and the absolute increase in the numbers of poor; and (iv) management of the transition to a more technologically sustainable future that will reduce ecological impacts, including minimizing carbon footprints. Challenges related to climate change are particularly complex, and despite the fact that the world is increasingly urban, the ways in which cities influence and are influenced by climate change have been considerably less explored than other areas of research on global warming (Chapter 8). The situation is particularly alarming for Africa, where greater temperature increases than the global average are expected. This will have adverse effects on human well-being, particularly in cities, through dramatic changes in areas such as water availability, health, and sanitation.

In Africa, China, and India, where the combined urban population is expected to grow by more than 1 billion people, the next two decades will be particularly challenging but will also present vast opportunities. Even though urban patterns of population growth—and social and economic activity—vary, all cities rely on and have a significant impact on biodiversity. This impact is likely to be greatest in Asia, where by 2030 nearly one-third of the world's urban inhabitants will live in China or India (Chapter 7). This is a massive change in where humans live on the planet, both in terms of the rural–urban shift of populations and in the geographical locus of settlement, and there will be inevitable local and global ecological consequences.

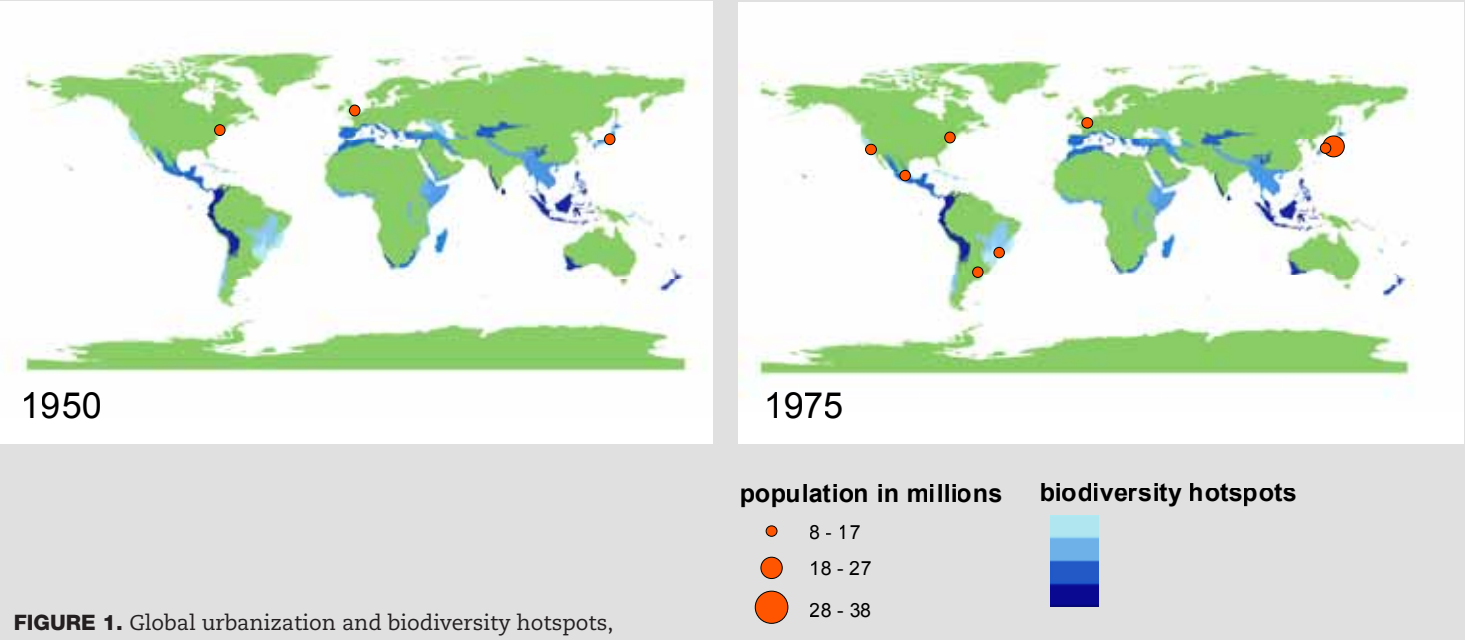


FIGURE 1. Global urbanization and biodiversity hotspots, 1950–2025. For explanation of biodiversity hotspots see p. 22.

There is therefore a particular need for enhanced focus on governance capacity to deal with the challenges related to urbanization both within and outside city boundaries. This will require action at multiple scales, from the local to the international. Maximizing the biodiversity potential through improved urban governance globally will require more comprehensive local knowledge, especially of under-researched cities in the Global South (Chapter 10).

Many of the world's cities are located in biodiversity-rich areas such as floodplains, estuaries, and coastlines (Chapter 3). Urban expansion and habitat fragmentation are rapidly transforming critical habitats that are of value for the conservation of biodiversity across the globe —so-called biodiversity hotspots—among them the Atlantic Forest Region of Brazil, the Cape of South Africa, and coastal Central America. The direct impacts of urban growth will clearly affect biodiversity in many biomes; about 10 percent of terrestrial vertebrates are in ecoregions that are heavily affected by urbanization (Chapter 2). If current trends in population density continue, by 2030 urban land cover will expand between 800,000 and 3.3 million square kilometers, representing a two- to fivefold increase from 2000. This would result in considerable loss of habitats in key biodiversity hotspots, including the Guinean forests of West Africa, tropical Andes, Western Ghats,

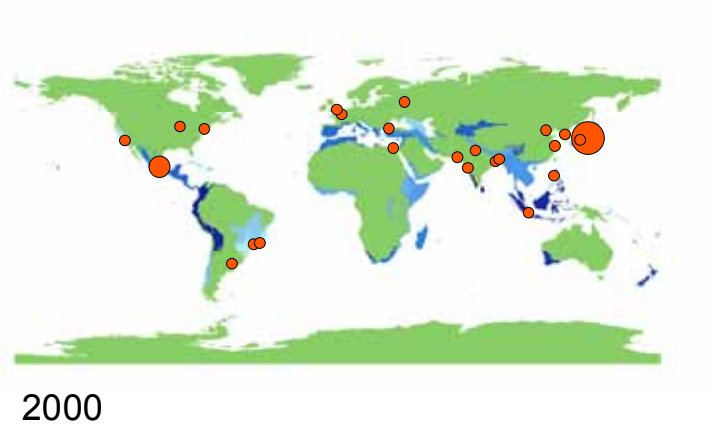
URBANIZATION AND EFFECTS ON BIODIVERSITY

Urban biodiversity is the variety and richness of living organisms (including genetic variation) and habitat diversity found in and on th e edge of human settlements. This biodiversity ranges from the rural fringe to the urban core. At the landscape and habitat level it includes:

- Remnants of natural landscapes (e.g. leftovers of primeval forests).
- Traditional agricultural landscapes (e.g. meadows, areas of arable land).
- Urban–industrial landscapes (e.g. city centers, residential areas, industrial parks, railway areas, formal parks and gardens, brownfields).

Diversity of plants and animals in the urban landscape shows some interesting patterns:

1. The number of plant species in urban areas often correlates with human population size—more so than it does with the size of the city area.
2. The age of the city affects species richness; large, older cities have more plant species than large, younger cities.
3. Diversity may correlate with economic wealth. For example, in Phoenix, USA, plant and bird diversity in urban neighborhoods and parks shows a significant positive correlation with median family income.
4. Twenty percent of the world's bird species and 5 percent of the vascular plant species occur in cities.
5. On average, 70 percent of the plant species and 94 percent of the bird species found in urban areas are native to the surrounding region.



Data sources: UN, Conservation International
Map maker: Femke Reitsma (femke.reitsma@canterbury.ac.nz)

and Sri Lanka (Chapter 7). Mediterranean habitat types are particularly affected by urban growth because they support a large concentration of cities as well as many range-restricted endemic species—species that occur nowhere else in the world.

Urban expansion also affects freshwater biodiversity. Predictions of the effects of global urban demographic growth and climate change on water availability suggest that freshwater biodiversity impacts would be greatest in places with large urban water demands relative to water availability, as well as where there is high freshwater endemism (Chapter 2). Of particular conservation concern is the Western Ghats of India, which is expected to have 81 million people with insufficient water by 2050 but which also has, among a high diversity of other taxa, 293 fish species, 29 percent of which are endemic to this ecoregion (Chapter 2).

Many cities contain sites of special importance for conservation because they protect threatened species and habitats. Many are remnants of native vegetation that survived because their topography, soil, and other characteristics are unsuitable for residential, industrial or commercial development. Other sites remain protected because their ownership or their use and management have remained unchanged for decades (sometimes centuries), they are important sites of cultural heritage, or have remained unused for a long time (Chapter 3). Remarkable examples of such remnants include the forests of the Mata Atlantica in Rio de Janeiro, Brazil; the evergreen forests of the Botanical Garden in Singapore; the National Park El Avila with its rock faces in Caracas, Venezuela; remnants of bushland in Perth, Sydney, and Brisbane, Australia; remnants of natural forests in York, Canada, and in Portland, USA; Sonoran desert parks in Tucson and Phoenix, USA; the Ridge Forest in New Delhi and the semi-evergreen forest of Sanjay Gandhi National Park in Mumbai, India; and rock faces and outcrops in Edinburgh, Scotland (Chapter 3).

Urbanization increases the number and extent of non-native invasive species by increasing the rate of introduction events and creating areas of disturbed habitat for non-native species to become established (Chapter 2). There is a suite of "cosmopolitan" species, skilled generalists that are present in most cities around the world. At the same time, urbanization often leads to the loss of "sensitive" species dependent on larger, more natural blocks of habitat for survival. The net result is sometimes termed "biotic homogenization." Nevertheless, it is remarkable that the number of native species in cities, especially the Northern Hemisphere, is relatively high. Studies across many taxonomic groups have shown that 50 percent or more of the regional or even national species assemblage is found in cities. For instance, more than 50 percent of the flora of Belgium can be found in Brussels, and 50 percent of vertebrates and 65 percent of birds in Poland occur in Warsaw (Chapter 3). While some cosmopolitan urban species are indeed found worldwide, concerns about overall biotic homogenization may be somewhat unfounded. A recent global analysis of flora from 112 cities and birds from 54 cities found that on average two-thirds

of plant species occurring in urban areas tend to be native to the region of each city; the proportion of native bird species is considerably higher (94 percent) than that of other taxa (Chapter 3). Clearly, many cities continue to retain a significant proportion of native biodiversity.

Although some non-native species become invasive, dominating entire ecosystems and causing significant economic loss, other introduced species actually may replace functions of lost species and enhance specific ecosystem services in cities, such as soil mineralization, climate-change adaptation and mitigation, and cultural/aesthetic benefits.

HOW URBANIZATION AFFECTS EVOLUTION AND ADAPTATION

Urbanization directly transforms the local biophysical environment and changes the conditions for organisms living there, generating new selection pressures and adaptations. The main changes are:

1. Changes in abiotic factors: altered incident sunlight exposure, humidity, precipitation, wind speed and direction, noise levels, water routing, and soil characteristics. In cities, the increase in ambient air temperature, which is often 2–5°C higher than in surrounding rural areas, is known as the urban heat island (UHI) effect, currently exacerbated by climate change. Elevations in atmospheric concentrations of carbon dioxide, methane, and ozone and in nitrogen deposition also occur. In cities there is often an accumulation of phosphorus, nitrogen, and metals, which can infiltrate surface water and groundwater. Urban runoff containing nutrient pollution from organic sewage, vehicle effluent, and plant fertilizer enters waterways and leads to eutrophication.

2. Changes in biotic factors: the rate of succession is influenced, and often urban ecosystems are intentionally kept in early to mid- successional stages and with greatly altered disturbance regimes. The trophic structure is often changed, with a lack of top predators and a dominance of generalists and omnivores.

Organisms that have survived such changed conditions in urban areas have been able to do so for at least two reasons: (1) they evolved rapidly or (2) they were largely preadapted to this environment. There are several documented cases of rapid evolution in urban areas, involving, for example, tolerance to toxic substances and heavy metals in plants, such as lead tolerance in urban roadside narrowleaf plantain (*Plantago lanceolata*). Among insects there are many cases of rapid evolution in urban areas. One of the most notable is the case of industrial melanism among moths and butterflies (*Lepidoptera*) in the UK, in which the insects became darker in color in response to heightened levels of air pollution. This phenomenon has also been documented in the USA, Canada, and elsewhere in Europe. Parks and green spaces are often highly fragmented, leading to rapid genetic differentiation among less mobile species, for example, white-footed mice (*Peromyscus leucopus*) in New York City. Urban low-frequency noise has also been observed to induce changes at the population level of calls of several species of birds and frogs, such as white-crowned sparrows (*Zonotrichia leucophrys*) in San Francisco. Also of interest are the specific urban and rural types identified within well-studied *Drosophila* (fruit fly) species.

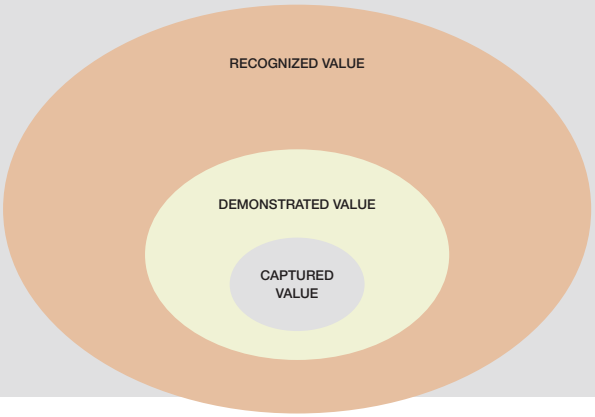
Urbanization and Ecosystem Services

Ecosystem services are the direct and indirect contributions of ecosystems to human well-being (Chapter 4). Cities depend on ecosystems both within and beyond the urban environment for a wide variety of goods and services that are essential for economic, social, and environmental sustainability. Ecosystems have the potential in cities to regulate climate, protect against hazards, meet energy needs, support agriculture, prevent soil erosion, and offer opportunities for recreation and cultural inspiration. In many urban areas, particularly in brownfields and other non-used urban land, there are ample opportunities to create novel functioning ecosystems that generate services that enhance the well-being of urban inhabitants. Urban ecosystem services are treated in detail in Key Messages 3 though 8; here we give a few examples of their role and value.

Examples of urban ecosystem services

The supply of water from catchment areas, often located just beyond or even within city boundaries, is a good example of a localized service. The conservation of wetlands (including rivers) and their biodiversity enables natural reservoirs or channels to store and provide water. The management of habitats on Mount Kenya, for example, is estimated to save the Kenyan economy more than US$ 20 million a year by protecting the water catchment area of two of Kenya's main river systems and ensuring a regular supply of water. Another example of a provisioning service is urban and peri-urban agriculture, which can augment food security and generate income for vulnerable urban households (see Key Message 6).

FIGURE 2. The value of ecosystem services can be expressed as (1) recognized value, the bulk of which includes cultural and aesthetical values that are often possible to express only in non-monetary terms; (2) demonstrated value, where it is possible to calculate a potential substitution cost in monetary terms (e.g. the replacement cost of wild pollinators); and (3) captured value, where there is a market that determines a value, often priced in monetary terms (water, food, fiber, etc). (Modified after TEEB 2010.)



Ecosystems regulate not only the supply but also the quality of water, air, and soil. Urban parks and vegetation reduce the urban heat island effect. There is additional potential for lowering urban temperatures through construction of green roofs and green walls. Data from Manchester, UK, show that a 10 percent increase in tree canopy cover may result in a 3–4°C decrease in ambient temperature and save large amounts of energy used in air conditioning. Urban green spaces can contribute to climate regulation by reflecting and absorbing solar radiation, filtering dust, storing carbon, serving as windbreaks, improving air quality (by oxygen emission and moistening), and enhancing cooling by evaporation, shading, and the generation of air convection (see Key Message 5).

Extensive areas of impermeable surfaces in urban areas result in large volumes of surface-water runoff and increase urban vulnerability to climate-change effects, such as increased frequency and intensity of storm events. Interception of rainfall by trees, other vegetation, and permeable soils in urban areas can therefore be critical in promoting infiltration and interception, thereby reducing pressures on the drainage system and lowering the risk of surface-water flooding. Urban landscapes with 50–90 percent impervious ground cover can lose 40–83 percent of incoming rainfall to surface runoff, whereas forested landscapes lose only about 13 percent of rainfall input from similar precipitation events. Urban mangroves and other wetlands also serve as biofiltration systems for treatment of sewage, storm water, and other water-vectored wastes and help reduce downstream pollution.

Ecosystems in urban areas also serve as habitats for species and as storehouses for genetic diversity. Nutrient cycling and soil formation processes are often driven by non-iconic species, such as bacteria or invertebrates; the contribution of biodiversity to these vital ecosystem services often goes unacknowledged or unprotected.

Biodiversity in cities exposes people to nature and thereby facilitates an appreciation of nature. It also provides opportunities for recreation, health and relaxation, and community cohesion. Green-area accessibility has been linked to reduced mortality and improved perceived and actual general health. It has been shown that the psychological benefits of green space increase with biodiversity, and that a "green view" from a window increases job satisfaction and reduces stress (see Key Message 4). This can have a strongly positive effect on economic productivity and hence regional prosperity. The distribution and accessibility of green space to different socioeconomic groups, however, often reveals large inequities in cities, contributing to inequity in both physical and mental health among socioeconomic groups. Several studies have shown that property values (as measured by hedonic pricing) increase with greater proximity to green areas.

Many tools for monetary valuation of ecosystem services are already available (Chapter 4), but these need to be complemented with non-monetary valuation methods and with planning tools based on multiple criteria that help to distinguish valuation tradeoffs. The total value of multiple services generated by ecosystems can be divided in different parts as illustrated in Figure 2, depending on whether there is a market and whether the value can be expressed in monetary or only in non-monetary terms. Ecosystem service science still lacks a robust theoretical framework that allows for consideration of social and cultural values of urban ecosystems on an equal basis with monetary values in decision-making processes. Developing such a framework involves synthesizing the large but scattered body of literature that has dealt with non-monetary values of the environment, and articulating this research into ecosystem service concepts, methods, and classifications. Key Message 3 discusses several examples of implementation at the local level.

Urban impacts on natural ecosystems can have unforeseen effects on the health and well-being of city-dwellers. Understanding how ecosystems deliver services, who benefits from them, what happens when an ecosystem changes, and how ecosystems may contribute to greater resilience is therefore important for developing sustainable cities (Chapter 4).

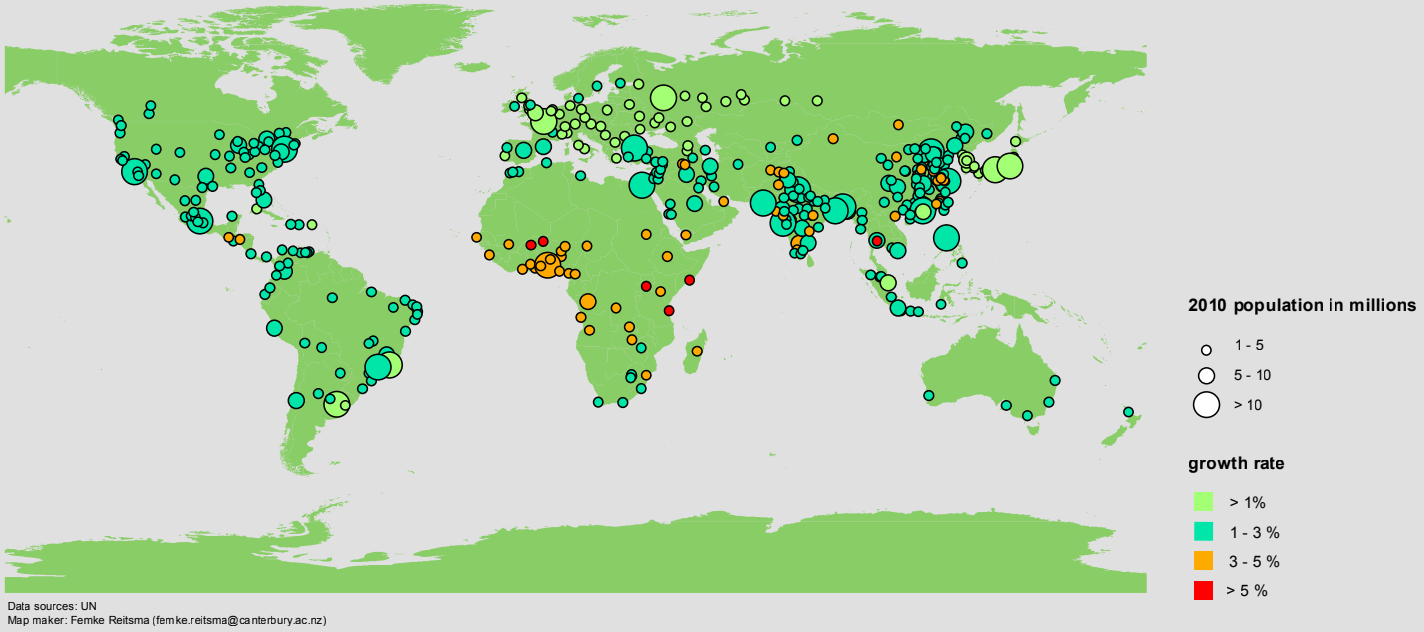


FIGURE 3. Predicted urban growth from 2010 to 2025 for cities that have a population of greater than 1 million in 2010.

Regional Analyses of Urbanization and Its Impacts on Biodiversity

The rate and ways in which the planet is urbanizing vary both across and within regions and countries. The following highlight some general trends for the main UN regions.

AFRICA

Although there is large spatial variation in rates of change across the 55 nations of Africa, the combined impact of high natural population growth and rural-to-urban migration means that Africa is urbanizing faster than any other continent (see Figure 3). Overall the urban population is expected to more than double from 300 million in 2000 to 750 million in 2030. Population expansion and a tradition of low-density settlement mean that the rate of increase in urban land cover in Africa is predicted to be the highest in any region in the world: 700 percent over the period 2000–2030. Expansion is expected to be focused in five main areas: the Nile River, the Guinean coast, the northern shores of Lakes Victoria and Tanganyika, the Kano region in northern Nigeria, and greater Addis Ababa, Ethiopia. All except the latter are very sensitive ecological zones.

For the most part, the urbanization in Africa is taking place along the lines of past and current patterns elsewhere in the world; however, it is also unfolding in ways that are distinctly African. Based on current projections for 2010–2020, 74.2 percent of Africa's total population growth will occur in cities of less than 1 million. These are settlements with weak governance structures, high levels of poverty, and low scientific capacity regarding biodiversity. More than 43 percent of Africa's urban population lives below the poverty line, higher than in any other continent, making socioeconomic development a priority. The generally weak state control, the presence of a feeble formal economic sectors, and the scarcity of local professional skills places constraints on handling the complex biodiversity challenges faced by rapid urbanization. Because of the high level of informality and competing governance arrangements in Africa, especially around land-use management, conventional policy and regulatory measures used successfully to promote biodiversity in cities elsewhere in the world may not be very effective. However, the wide range of custodians of the rich biophysical resources and the relatively undisturbed resource base of Africa, and the high level of informality may also represent opportunities for local and rapid adaptation to changing conditions in the urban landscape.

The effects of urbanization on land cover in Africa appear to be unique. In the neotropics and Southeast Asia, urbanization and agricultural export markets are currently the strongest drivers of deforestation. In contrast, in much of sub-Saharan Africa old

patterns of rural consumption of wood are still the major drivers of forest loss. However, there are significant variations within the continent. For example, in several West African cities, rapid population growth has increased incentives for farmers to convert forests into fields for crops to sell in urban markets. The recent land grab to secure African fuel and food production opportunities for urban citizens in other parts of the world is a stark reminder that cities draw not only on their immediate hinterlands for ecosystem resources.

It has been suggested that increased rates of rural–urban migration in Africa would relieve sources of pressure on old-growth forests and allow marginal agricultural lands to return to forest. However, given the continued expansion of the rural population, albeit at a lower rate than urban growth, it has been questioned to what extent this is a general pattern. It is likely that increased local and international demand for biofuels and other cash crops may result in a new export-driven mode of deforestation, just as in Asia and the neotropics.

African cities are not readily defined. This is more than a classificatory and census issue, though there are real problems in the lack of consistent and comparable definitions and in the paucity of current and robust figures on urban populations. Africa has generated ambiguous settlement forms: as well as more conventional dense urban agglomerations, there is commonly a large peri-urban population and a cyclical pattern of rural and urban migration. While a foothold in the rural environment is retained, the shift to urban livelihoods means that rural land-use patterns no longer retain the same degree of focus on production, but become instead landscapes infused with cultural and familial significance. Low levels of formal employment in African cities put a high level of dependency on the provision of ecosystem services, such as water, fuel, and food production, from areas within cities as well as nearby natural areas. In adjacent rural areas, biodiversity resource harvesting feeds into an extensive rural economy focused on supplying cities, mainly with food and agricultural products.

Addressing urbanization and biodiversity challenges in Africa will require governance responses across the continent. In a Cities and Biodiversity Outlook workshop that brought together African researchers, local government authorities, and planners in February 2012, participants discussed common governance challenges and identified eight key themes of specific relevance to urban biodiversity concerns on the continent:

1. Many governments are still struggling with colonial legacy and the structures (or lack thereof) that withdrawal and transition have left in the wake of new government.
2. High political instability often exists, and may be accompanied by varying levels of corruption. This can result in high informality of tenure and economy. Particularly at the city level, lack of financial and human resources, and consequently technical capacity, can prevent biodiversity and environmental issues from being recognized or addressed.
3. In many instances, biodiversity concerns are seen as independent of and less important than other urban pressures such as poverty, unemployment, and access to food, energy, water, sanitation, and housing. These pressures are principally the ones prioritized by politicians, who must act swiftly and expediently to meet the demands of their constituencies and who are mindful to receive good press to this end.
4. Where urban biodiversity interventions are implemented, they are generally undertaken with a single ecosystem service in mind, and multiple benefits are often neglected.
5. Even in governments where environmental-management issues receive recognition and support, it may be difficult to generate continued political momentum and action.
6. Barriers to integrating the environment with other issues may also be educational. Resources to inform those in government may be inaccessible or nonexistent, and academic terms and concepts that have been developed in other parts of the world may be difficult to translate into other languages and knowledge systems.
7. There is often a disconnect between scales of government, with lack of effective communication between local and national levels, disenfranchisement or mismanagement of local government by higher levels of government, and failure of national policy to be applied and implemented properly on the local scale. Fiscal decentralization needs to match political decentralization, municipal boundaries may need to be extended for greater control over land-use change in peri-urban areas, and accompanying management tools must have area-wide (i.e., metropolitan or even regional) reach.
8. While international resources and funds exist, there is a lack of access and transparency of process on how local governments procure these opportunities.

Ultimately, how biodiversity is managed or integrated into African cities will depend on whether it is positioned institutionally and topically as a priority in governance agendas, and whether the co-benefits provided by ecosystems are integrally recognized across general policy and action.

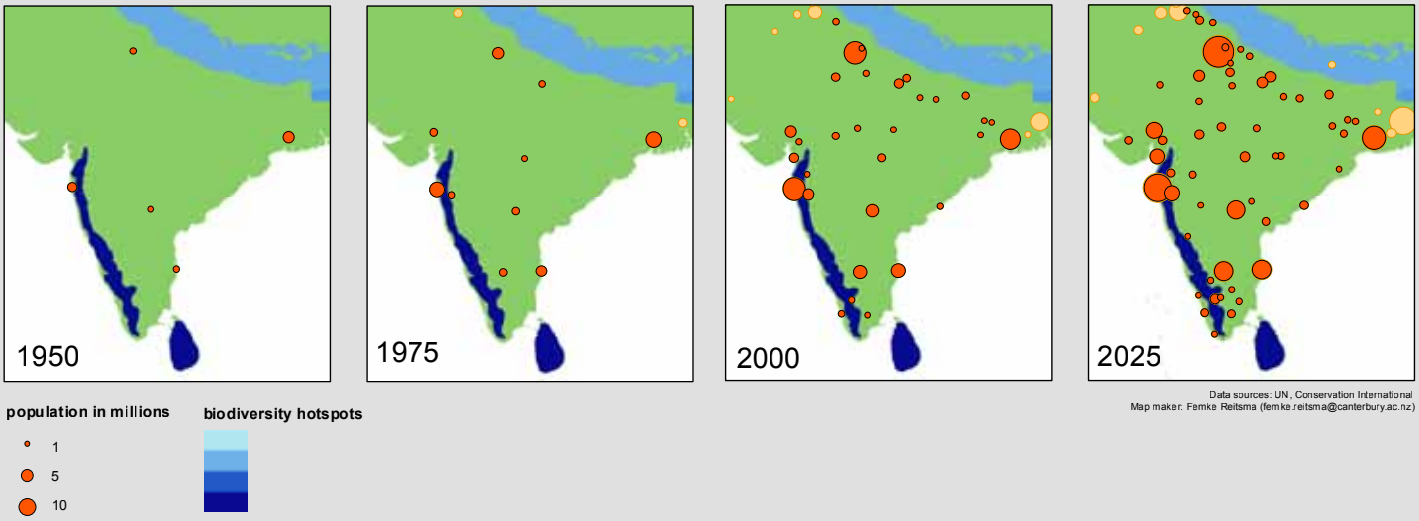


FIGURE 4. Urban population centers (red circles) and biodiversity hotspots in India, 1950–2025 (yellow circles refer to population centers outside India). For explanation of biodiversity hotspots see p. 22.

ASIA

Asia is home to 60 percent of the world's population, and there are large variations in the region with regard to urbanization levels and urban growth rates. While some countries have populations that are predominantly urban (Singapore, 100 percent; Malaysia, 72 percent; Japan, 67 percent; Indonesia, 54 percent), others have populations that are predominantly rural (Bangladesh, 28 percent; Vietnam, 29 percent; India, 30 percent Lao People's Democratic Republic, 33 percent; Thailand, 34 percent). Despite these variations, three characteristics define the region.

Many countries that are largely rural are undergoing massive demographic and economic transitions, resulting in a growing percentage of their populations living in urban areas. For example, the combined populations of Kolkata and Dhaka in the Ganges–Brahmaputra Delta increased from 4.9 million in 1950 to more than 30 million in 2010. The changing demography of these mega-deltas is also changing their economies, landscapes, and biodiversity.

Half the increase in urban land across the world over the next 20 years will occur in Asia, with the most extensive patterns of change expected to take place in India and China (Chapter 7).

The influx of large-scale capital to many Asian deltas has transformed the local economic base from a primarily agricultural one to a manufacturing and processing economy, bringing about fundamental changes in landscapes and their ecologies. For example, the Irrawaddy Delta economy in Myanmar was traditionally intensive rice cultivation, fishing, and forestry, supported by mangrove swamps. However, as Yangon, the largest city in Myanmar and the economic, financial, and trading hub of the country, increases in size on the periphery of the delta, it is affecting the coastal mangrove ecosystems. Urbanization and associated land practices—the damming of rivers, seasonal flood control, water diversions, agricultural practices, and construction of the built environment—have also transformed the supply and routing of sediments and changed the basic geomorphology and ecology of the delta.

India

India's population (see Figure 4) is currently about 30 percent urban and is expected to become 50 percent urban by about 2045. This will have significant implications for the country's environment, ecology, and sustainability. India already contains 3 of the world's 10 largest cities—Delhi, Mumbai, and Kolkata—as well as 3 of the world's 10 fastest growing cities—Ghaziabad, Surat, and Faridabad. Urbanization in India is unevenly distributed, with about half the country's urban population living in smaller urban agglomerations with populations under 100,000.

The rate of urban land expansion in India during the next 20 years is expected to be high, in part because the country is investing heavily in large-scale infrastructures such as roads, telecommunications, water networks, and power and electricity grids. Such development will put new pressures on ecosystems and biodiversity. At the same time, India has a cultural tradition of respect for wildlife, as well as for deliberative political processes, which in most cities include civil society groups and non-governmental organizations. This may offer a window of opportunity for adjusting development to accommodate biodiversity.

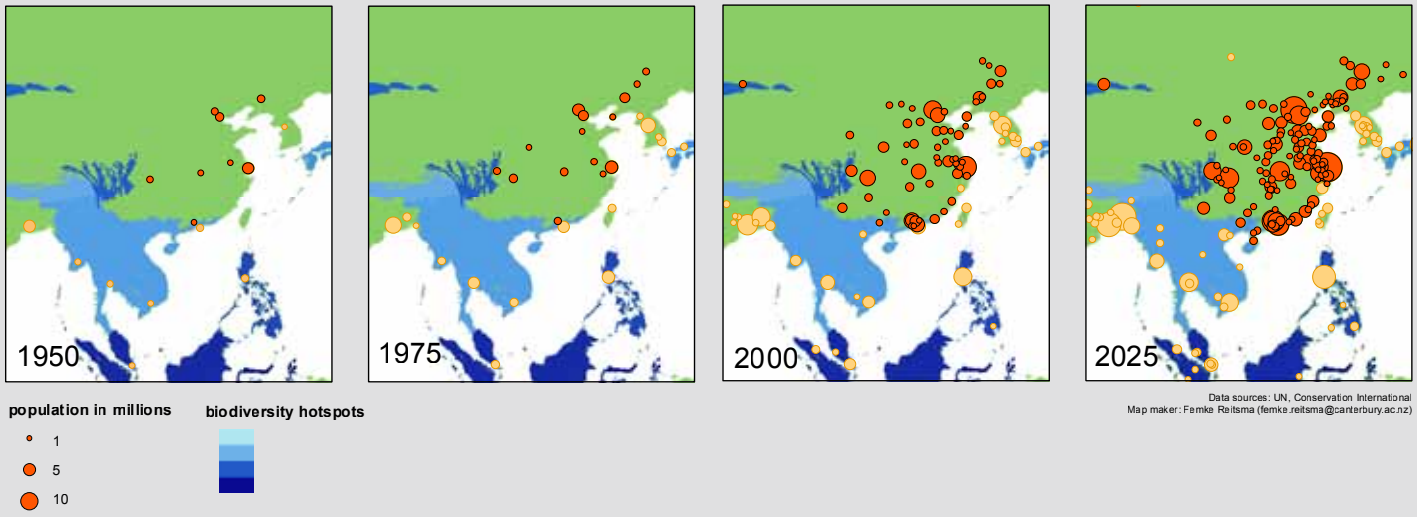


FIGURE 5. Urban population centers (red circles) and biodiversity hotspots in China, 1950–2025 (yellow circles refer to population centers outside China). For explanation of biodiversity hotspots see p. 22.

Until recently, rural development was a major focus in India. This changed in 2005, when the launch of the Jawaharlal Nehru National Urban Renewal Mission shifted the focus to development of 63 urban centers throughout the country. Reforms in India and national policies now treat urbanization as central to economic and industrial development, and there is an explicit strategy to develop cities. One of the largest examples is the developing Mumbai–Delhi industrial corridor, which is approximately 1,500 kilometers long and connects two of the country's megacities. The government is also establishing special economic zones, industrial and technology parks, and free-trade zones that will further focus urban expansion in specific locations. These urban clusters are likely to transform entire regions, with significant impacts on habitat and biodiversity.

Urban expansion in India is accompanied by complex effects on local and regional biodiversity, ecosystem services, and forest cover because of a combination of socio-demographic and lifestyle changes in urban areas. Urban growth, especially in areas adjacent to forest land and protected areas, increases pressures on these ecosystems through habitat fragmentation, poorly regulated development and recreation, and spillover of air and water pollution. At the same time, lifestyle changes that are due to urbanization may decrease pressures on some forest resources such as fuelwood and charcoal. Urbanization has promoted a transition in household energy use for cooking, from fuelwood to liquefied petroleum gas. Between 1993 and 2005, urban fuelwood demand in India declined from 30 to 22 percent of households, despite significant population growth in urban areas; during this same time, rural fuelwood demand dropped only from 78 to 75 percent. Overall, forest cover remained unchanged or increased slightly in conjunction with this change in fuel type in urban households. While forest cover does decline with urban development, the effects are not homogeneous. For example, relatively unregulated housing and industrial development has significantly diminished mangrove forests in Mumbai. Yet just across the Thane Creek in Navi (New) Mumbai, where urban development was a planned process starting in the 1980s, mangrove forests have shown a remarkable recovery in the past two decades.

Even the largest Indian cities retain a high proportion of native plants, birds, butterflies, and other taxa, especially in parks and forest fragments that are protected or still undeveloped. For instance, Kolkata, one of the largest cities in the world, provides habitat for 273 bird species, all of them native to the region. As urban regions expand, there is an increase in the incidence of leopards, elephants, and other large mammals encountering people in the expanding urban fringes. Traditional cultural and religious practices have often encouraged wildlife such as primates to inhabit towns and cities, but changing lifestyles are challenging this coexistence. At the same time, highly adaptable species such as the leopard show a remarkable ability to persist in urbanizing habitats. Other, rarer species continue to colonize habitats in urban areas, such as the sizeable population (10,000–13,000) of Lesser Flamingos that since the mid-1990s have been wintering at Thane Creek in Mumbai. Finding ways to minimize conflicts with some species and improve habitats for others is challenging, but it is also presents opportunities to engage the public in understanding and managing local biodiversity.

Urbanization constitutes a process with great potential but also significant challenges for India. Inequality has increased in Indian cities over time, and challenges such as climate change effects are faced disproportionately by the urban poor. Loss of agricultural land to urbanization, combined with insufficient planning of infrastructure for supplying food to cities, places a severe constraint on future food security for India's growing population. India is in a favorable position to address its formidable challenges of sustainable urban development through innovative collaborations among municipal governments, civil society groups, community groups, researchers, and other sectors of society. Such collaborations are being tried in several large cities, including Bangalore, Delhi, and Chennai, as well as in cities such as Surat and Indore. It is essential and urgent that India finds ways to balance economic growth with reduction of pressure on ecosystems to ensure a secure, equitable, and sustainable future.

China

China is in the middle of its urbanization transition. Compared with the last three decades, the urbanization rate in the coming three decades will be slower, with urban expansion moving from the coastal areas to the interior. By 2030 China's urban population is expected to exceed 900 million, an increase of more than 300 million from today. While there are uncertainties around these projections, there is even greater uncertainty about the location and extent of future urban expansion. China has been urbanizing rapidly since the early 1980s. This has been manifested by large rural–urban population migrations and by the expansion of the built environment. In particular, urban expansion is predicted to create a 1,800-kilometer coastal urban corridor from Hangzhou to Shenyang.

One consequence of urban expansion has been the loss of fertile agricultural land. Another, less noticed, has been the urban expansion within biodiversity hotspots. Throughout China, and especially along the coast, urban areas are increasingly encroaching on protected areas. As urbanization progresses toward the western regions of the country, biodiversity-rich areas such as Himalaya, Indo-Burma, Mountains of Central Asia, and Mountains of Southwest China (see Figure 5) are likely to be affected by development and land conversion. Urban development policies in the future thus need to focus on biodiversity: how to conserve the places that are most biologically diverse and yet relatively unaltered by humans and how to bring back biodiversity into the cities that are already built. China's development has had, and is expected to increasingly have, an impact on ecosystems well beyond its national boundaries.

In addition to the preliminary forecasts reported here, a recent literature review identified China as having 2,541 nature reserves, covering more than 15 percent of the country's territory. The proximity of urban areas to these reserves will increase dramatically by 2030. Therefore there is a critical window of opportunity in the next few decades for China to implement more proactive approaches to guiding urban expansion in ways that have the fewest negative effects on biodiversity and ecosystem services.

Minimizing habitat and biodiversity loss and limiting degradation of ecosystem services will require appropriate urban planning and reformation of the current land market system. Urban planning activities in China are carried out under three central government agencies as well as under provincial and municipal governments. Overlapping authorities among the agencies is an opportunity for strong action and directed urban development, but it also puts a high demand on coordination. In a simultaneous process, as the country becomes increasingly market-oriented, the planning profession needs to evolve, as planners' roles are rapidly evolving into those of brokers and creative designers.

LATIN AMERICA AND THE CARIBBEAN

More than 80 percent of the population in Latin America lives in cities, and by 2050 it is expected to reach 90 percent, thus making it the most urbanized of all world regions. The region includes megalopolises such as Mexico City, São Paulo, and Buenos Aires, whose populations exhibit significant social and economic differences. The number of cities in the region has grown sixfold in the past 50 years (although growth rates have been slowing), while rural areas are being abandoned. Today, the deforestation "frontier" is advancing, along with cities founded less than 20 years ago, the Amazon basin from the Southeast in Brazil, and along major roads and rivers.

In the Caribbean, the percentage of the population living in cities is somewhat smaller (around 65 percent), with significant sub-regional differences (from 21 to 90 percent). Historically, urban areas in the Caribbean have been predominantly characterized by capital port cities, many of which were founded during the sixteenth and seventeenth centuries. However, it is only since the Second World War that this region has experienced rapid rates of urban growth. The biggest capital cities (such as Havana, Santo Domingo and Port-au-Prince) are still below 3 million, but urbanization growth rates overall are steeper than in the rest of Latin America (with Haiti and Trinidad and Tobago exhibiting the highest annual urbanization rates). Capital cities often house a significant part of the entire population.

With few exceptions (such as Curitiba, Brazil, and Bogota, Colombia), management of and planning for biodiversity and ecosystem services in Latin American cities are uncommon. More urgent considerations, such as providing housing for rural immigrants, are prioritized over environmental and biodiversity values. Urban sprawl caused by housing for low-income inhabitants often occurs in areas that are mistakenly considered to be of marginal value, such as floodplains and wetlands. In much of Latin America, the urbanization pattern is defined by inefficient land use, poor planning, and land prices that do not reflect the biological value of the land. Many areas that are considered to be of marginal value have important conservation values for ecosystem services and biodiversity.

Research on the rapid urbanization of Latin America and the Caribbean is poorly developed. More detailed information is needed about the effects of rapidly increasing housing density on ecosystem functions, how ecosystem services are linked to the availability of different types of urban green spaces, and how socioeconomics, urban morphology, and natural as well as anthropogenic hazards affect ecosystem provisioning over time. Such information would be enormously valuable in helping Latin American and Caribbean cities guide their urban planning and conservation biology policies.

EUROPE

In Europe, the current urbanization level is 70–80 percent, and urban growth in recent decades has been mostly in the form of urban land expansion rather than population growth. Indeed, in some areas in Eastern Europe, many cities are shrinking in population, creating new opportunities for innovative use of former residential and industrial areas.

Most of the areas occupied by present cities were settled already by people in Neolithic times, when Europe was colonized by agriculturalists (9500 B.C.). From the point of view of biodiversity, it is important to recognize that the recolonization of European plants and animals after the last Ice Age—which covered large areas of Europe—was not completed before human influence began to cause local disturbances, so that the evolution of native biodiversity overlapped with human influence. The long history of urban development in

Europe is one reason why its cities often are characterized by higher species richness of plants and animals than the surrounding rural areas are. This long history may also be one factor explaining why European plants and animals worldwide tend to successfully establish in areas with dense human population.

The long-lasting urban expansion combined with alteration of the natural environment may also explain why severe environmental changes caused by urbanization were recognized for the first time in Europe. Thus the roots of urban ecology, environmental protection, and sustainable urban development can be found in Europe.

Researchers in Berlin started to investigate extensively its biodiversity (plants, animals, and habitats) and to use this data for urban planning in the 1970s. Berlin was one of the first cities in the world to do this in a systematic way. Beginning in 1980, this example of "biotope mapping" was followed by many European cities, and today many large cities have long-term data on vascular plants, different animal groups, and habitats that are used for city planning and nature conservation. Many cities have a long tradition of designating areas for nature conservation within their borders because of the numerous ecological services they provide for dwellers. Today the European Union requires its member states to allocate at least 10 percent of their area for nature conservation. Most of the bigger European cities have a higher percentage of nature reserves, which contain species and habitats of national importance.

NORTH AMERICA

Cities in the USA and Canada share a complex pattern of shrinking and/or shifting patterns of population in central parts of the cities coupled with sprawl in outer suburbs and exurban areas. This pattern creates unique challenges for biodiversity conservation. Metropolitan areas in both countries often include significant amounts of natural and semi-natural remnant habitats that are under threat of development or impaired by habitat changes tied to changes in land management practices; vacant lands in inner cities and older suburbs that are awaiting redevelopment or that will remain vacant because of economic policies and planning decisions; and a diverse range of habitats created and managed by home owners, property managers, and local governments. Biodiversity conservation programs in North American cities are enhanced by a long tradition of urban wildlife and urban forestry programs run by state/provincial and local governments. These programs have resulted in habitat conservation and restoration projects, tree planting and urban greening efforts, and efforts to involve local residents in conservation projects near where they live. Non-governmental organizations have also been involved in biodiversity conservation programs in North American cities. Their efforts include volunteer-led monitoring and restoration projects, programs promoting conservation practices in yards and gardens, and education and advocacy programs. In the USA, extension programs run by state universities provide information on conservation practices to urban residents and to local governments.

Even though more than 90 percent of all urban ecological studies so far have been conducted in cities in Europe or North America, there is still a lack of experimental approaches, and most studies have focused on either birds or plants. There is also a lack of long-term data, but two Long-Term Ecological Research (LTER) sites in North America, Baltimore and Phoenix, are generating valuable information on the dynamics of the urban landscape from an ecological and biodiversity perspective.

OCEANIA

Oceania is defined by the United Nations as the islands within Polynesia, Micronesia and Melanesia, Australia and New Zealand. Urbanization came late to the islands in the Pacific Ocean, typically following independence, but has increased rapidly since the 1970s. Excluding the population of Papua New Guinea, more than half of all Pacific Islanders now live in urban areas. In some atoll states, urban growth has produced very high population densities, comparable to those in densely populated Asian cities.

Both Australia and New Zealand have highly urbanized populations, where 85 percent of their populations live in urban areas, but at relatively low densities. Australia is one of the world's least densely populated countries, with fewer than three people per square kilometer.

Presently 10,450 square kilometers of Oceania is urban area. By 2030, it is predicted with high likelihood that the urban area will double in Oceania, concentrated around existing urban centers. This expansion will significantly affect biodiversity, particularly in New Zealand, Micronesia, Melanesia, and Polynesia, as their entire land area is comprised of biodiversity hotspots.

The importance of managing the ecosystem services of this biodiversity, and of mitigating the impact of urban growth and associated agricultural expansion, is increasingly recognized. Much of the research in Australia and New Zealand on ecosystem services has an agroecosystem focus, with the goal of changing agricultural practices to enhance rather than erode ecosystem services.

The Way Forward

The broad picture presented in this section demonstrates that patterns of urbanization have significant global implications for biodiversity and ecosystem services. In particular, urbanization is one of the major drivers of habitat conversion, especially in coastal and island systems, and is an important driver of biodiversity loss in freshwater systems.

Since urbanization is fundamentally changing the nature of our planet, preserving biodiversity on this new urban world requires going well beyond the traditional conservation approaches of protecting and restoring what we think of as "natural ecosystems," and trying to infuse or mimic such elements in the design of urban spaces. Cities already represent a new class of ecosystems shaped by the dynamic interactions between ecological and social systems. As we project the spread of these ecosystems across the globe, we must become more proactive in trying not only to preserve components of earlier ecosystems and services that they displace, but in imagining and building entirely new kinds of ecosystems that allow for a reconciliation between human development and biodiversity.

While urbanization displaces many species, we also know that other species have evolved adaptive responses in behavior and physiology to not only survive but thrive under urban selection pressures. Novel plant and animal communities have evolved in urban areas, often with active management by human society, and some of these now provide important services extending beyond urban boundaries. Residential gardens and parks, for example, have become important reservoirs for populations of bees and other pollinators that provide valuable ecosystem services for agriculture, but that find it difficult to survive under the conditions of modern intensive agriculture. Even some endangered species find suitable habitat in urban ecosystems when their original habitats have disappeared. Innovations such as rooftop gardens and vertical forests, and human interventions such as supplementary feeding and watering, have the potential to offer novel habitats and niches for species that may be quite different from those in more natural ecosystems. Novel species and their assemblages that evolve under urban conditions may well represent what the future holds for much of Earth's terrestrial biodiversity.

We emphasize that addressing urbanization and biodiversity challenges will require improved governance responses across multiple scales. Particularly at the city level, a lack of financial and human resources, as well as technical capacity, can prevent issues on biodiversity and environmental from being recognized or addressed. In many instances, biodiversity concerns are seen as independent of and less important than other pressures such as poverty, unemployment, and access to food, water, sanitation, and housing. This perception needs to change, because biodiversity interacts with and often underlies urban development directly as well as indirectly. Therefore, more ecologically sensitive approaches may lead to innovative solutions for many of the perceived ills of urbanization.

Governance of biodiversity and ecosystem services is intertwined with several other management agendas, and like all sustainability aspirations requires local knowledge and governance capacity. The implications of urban expansion are both local and global, as ecosystems do not follow municipal or national boundaries. The displaced ecological impact of increased urban consumption highlights the importance of moving away from narrow place-based solutions to more broadly addressing concerns on ecological degradation and urban biodiversity concerns. It is time to recognize the overarching impact of an increasingly urbanized world and to design appropriate governance responses. Coordination is essential to avoid the mismatch between governance systems and ecosystem functioning. Not all interventions or institutional initiatives are going to be formal or formally recognized; local informal initiatives can also have important benefits and should be not ignored (see Chapter 10 and Key Messages 7, 8, and 9).

Finally, as emphasized in several places throughout this document, rapid urbanization provides multiple opportunities to ensure basic human welfare and a viable global environment. The opportunities lie in that urban landscapes are also the very places where knowledge, innovations, and human and financial resources for development of solutions to current and future challenges of sustainability are likely to be found. More than 60 percent of the area projected to be urban in 2030 has yet to be built (Chapter 7). This presents unprecedented opportunities to vastly improve global sustainability through designing systems for increased resource and water efficiency, as well as for exploring how cities can be responsible stewards of biodiversity and ecosystem services within and outside city boundaries.

There are no global panaceas to urban biodiversity and ecosystem management, or to sustainability. However, there is much to be gained from questioning current trajectories and values while learning from others, producing better evidence and sharing information and experiences. No city can solve the current challenges alone.

SECTION II

Key Messages

The 10 key messages in this section highlight how planners, engineers, architects, policy-makers, politicians, scientists, and citizens alike can take on the challenges of reducing the loss of biodiversity and thus contribute to the implementation of the Aichi Biodiversity Targets of the CBD (see p. 60). Although many of the actions described are local and will have local effects, cities are embedded in the biosphere and increasingly influence sustainability on the planetary scale, far beyond the limits of individual cities. These key messages are meant to inspire. As readers will quickly discover, there are vast opportunities for people and organizations all over the world to facilitate sustainable growth patterns while managing native biodiversity and safeguarding ecosystem services.

KEY MESSAGE 1: *Urbanization is both a challenge and an opportunity to manage ecosystem services globally.*

With increasing globalization, materials and energy are drawn in great quantities from all over the world—often from large distances—to the primarily urban locus of consumption and waste generation. The connection of urban regions to globally dispersed areas of production is illustrated by the global, spatial analysis of the link between plant production required for food, feed, fiber, and bioenergy supply and the location of the consumption of these products.

Insights are provided by analyses of the global reach of resource use by highly urbanized countries such as The Netherlands. To supply the food and fiber needs of its population, this small country requires an area four times its own size. This emphasizes the dependence that many populations have on rural land and communities in other countries. The distal flows and connections between urban and non-urban regions are important drivers of land-use change. Some countries and corporations are now even attempting to ensure their food and energy security via land-lease arrangements in other countries (e.g. in several countries in Africa). This has impacts on land use, biodiversity, and ecosystem services, and potentially negative implications for local investments, infrastructure, development, and livelihoods.

Recent studies suggest that the global food supply will need to roughly double by 2050 to meet the dietary needs of the primarily (approximately 70 percent) urban global population. A doubling of the global food supply without extensive additional environmental degradation to non-urban areas will present major challenges. However, there are also untapped opportunities in cities that may contribute to achieving this goal. For example, cities can use a combination of measures to decrease waste and reduce meat consumption while at the same time they invest in protecting biodiversity, water quality, local food production and key carbon-sequestering ecosystems.

Ecosystem management requires a multi-scale approach

Since the ecosystem services that benefit urban populations are generated at multiple scales, it is necessary to take a comprehensive, integrated, and multi-scale approach to their management. It is not just the built capital of cities that we need to consider—it is the full spectrum of assets, including social and natural capital at local, regional, national, and global scales. This also means that institutions responsible for the stewardship of our assets need to extend their reach to these more distant scales.

One tool for analyzing complex urban–rural relationships is the Ecological Footprint Analysis. The ecological footprint is the amount of land necessary to sustain each citizen's lifestyle, considering not only food but also materials, energy, and water and other natural resources. It compares per capita footprint (the equivalent, in hectares, of the area needed to produce all the resources consumed per capita) and biological capacity (the average equivalent productive area available per capita). The method began at the national level and has recently been explored for analysis by economic sector, demand category, and sub-national area or socioeconomic group. To date, more than 100 cities or regions (see Figure 1.1) have used the Ecological Footprint Analysis to help develop policies. In 1995 London's footprint was 125 times the size of the city—requiring an area the size of the UK's entire productive land surface to provide needed resources. In 2000 the city commissioned a report on London's footprint and later engaged in a project called "Toward Sustainable London: Reducing the Capital's Ecological Footprint."

Figure 1.1. Photo of Montserrat Mountain in Catalonia, Spain, In 2009 the autonomous community of Catalonia, commissioned an extensive report on its footprint in preparation for its own biodiversity law. The report is framed within the Convention on Biological Diversity and its related European Union directives. It speaks not only of footprints but of international "anti-cooperation" and ecological debt, the negative consequences of trade, and exchanges with its partners. The report estimates the effects of overseas direct investment of Catalonian companies on biodiversity and considers the landscape impacts of resort development by Catalonian hospitality groups in the region and elsewhere.

The application of the concept and the management of footprints remain intensely challenging. How do the various sectors involved assign responsibilities and share costs? What are the specific contributions and roles of each player (private sector, government agencies, NGOs and major groups, international organizations, and multilateral agreements)? It is relatively easy to measure footprints at the local level, but it is very difficult to address and manage them unless actors are involved at the landscape level whose mandate goes beyond the city boundaries. An interesting emerging area is the attempt to develop the ecological footprint concept as a component of the planetary boundary concept and make it possible, at least for some of the variables, to identify regional boundaries.

Cities have a vital role to play in managing planetary resources

It is important to point out that while actions at the city level capture important opportunities and result in contributions towards the reduction of footprints, actions by a consortium of municipalities or state governments operating at larger scales are likely to accomplish even more. Cities are already engaging in cooperative partnerships and beginning to take an active role in the management of resources and impacts on the regional or even global scale. Additional cooperative partnerships among urban and non-urban places are needed, and these must extend to multiple global environmental issues, and address their interconnections and impacts on our planet. A global system of cities must also operate within a framework of other actors such as national, regional, and local governments, multinational corporations, and civil society. Each of these actors has important roles to play in managing planetary resources.

Effective stewardship must consider the multi-scale, interconnected resource chains and their diverse actors. Urban regions must take increased responsibility for motivating and implementing solutions that take into account their profound connections with and impacts on the rest of the planet. This responsibility includes implementing the ecosystem approach of the Convention on Biological Diversity in the urban landscape and encouraging local governments to start a process for addressing the Aichi Biodiversity Targets (see p. 60). How this can be done is exemplified in the remaining key messages.

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KEY MESSAGE 2: *Rich biodiversity can exist in cities.*

It is commonly assumed that cities and rich biodiversity are incompatible, but the fact is that many cities have high species richness and several are even located within globally recognized "biodiversity hotspots." Some notable examples of cities with rich biodiversity are found on nearly all continents and latitudes—Berlin, Bonn, Brussels, Cape Town, Chicago, Curitiba, Edmonton, Frankfurt, Freiburg, Helsinki, Kolkata, Mexico City (see Figure 2.1), Montreal, Mumbai, Nagoya, New York City, São Paulo, Seattle, Singapore, Stockholm, and Vienna, to name but a few. This often has historical roots; areas with rich and diverse ecosystems are also rich in natural resources and therefore have long been magnets for human settlement and commerce.

Urban habitats can be surprisingly diverse. Forests, mountains, grasslands and shrublands, savannas, peat swamps, mangroves, rivers, lakes, rocky shores, coastal habitats, dunes, seagrass meadows, intertidal mudflats, and coral reefs are examples of habitats found in cities. Such richness of habitats also results in the generation of multiple ecosystem services, which can contribute significantly to human well-being (see also Key Messages 4 and 6).

While intact natural ecosystems harbor the richest biodiversity, remnants of pristine natural landscapes (e.g. relicts of primeval forests), traditional agricultural landscapes (e.g. meadows and satoyama), restored landscapes, and managed and industrial landscapes (e.g. industrial parks, railway tracks, residential and city centers, parks, gardens, and brownfields) are increasingly becoming refugia for biodiversity in cities.

Several factors influence urban biodiversity

Urban biodiversity is influenced by the status of the original surrounding ecosystems and by the planning, design, and management of the built environment, which in turn are influenced by the economic, social, and cultural values and dynamics of human populations. Conserving native ecosystems in urban areas is increasingly important, especially given the current rate of urbanization. Brussels, for example, contains more than 50 percent of the floral species found in Belgium. Berlin has 22 habitats of global importance. As natural areas previously outside urban boundaries are incorporated into cites and developed, the displacement of biodiversity and ecosystem services becomes increasingly problematic worldwide.

Biodiversity Hotspots

Conservation International defines a biodiversity hotspot as having at least 1,500 endemic plant species and having lost at least 70 percent of its original habitat area. Of the 34 biodiversity hotspots identified globally, all contain urban areas—many of them significant in size and population. Cities in biodiversity hotspots have a vital role to play in the conservation of these critically threatened ecosystems. ICLEI and several partners recently established the Cities in the Hotspot program (see p. 53), to secure ecosystem services in such areas.

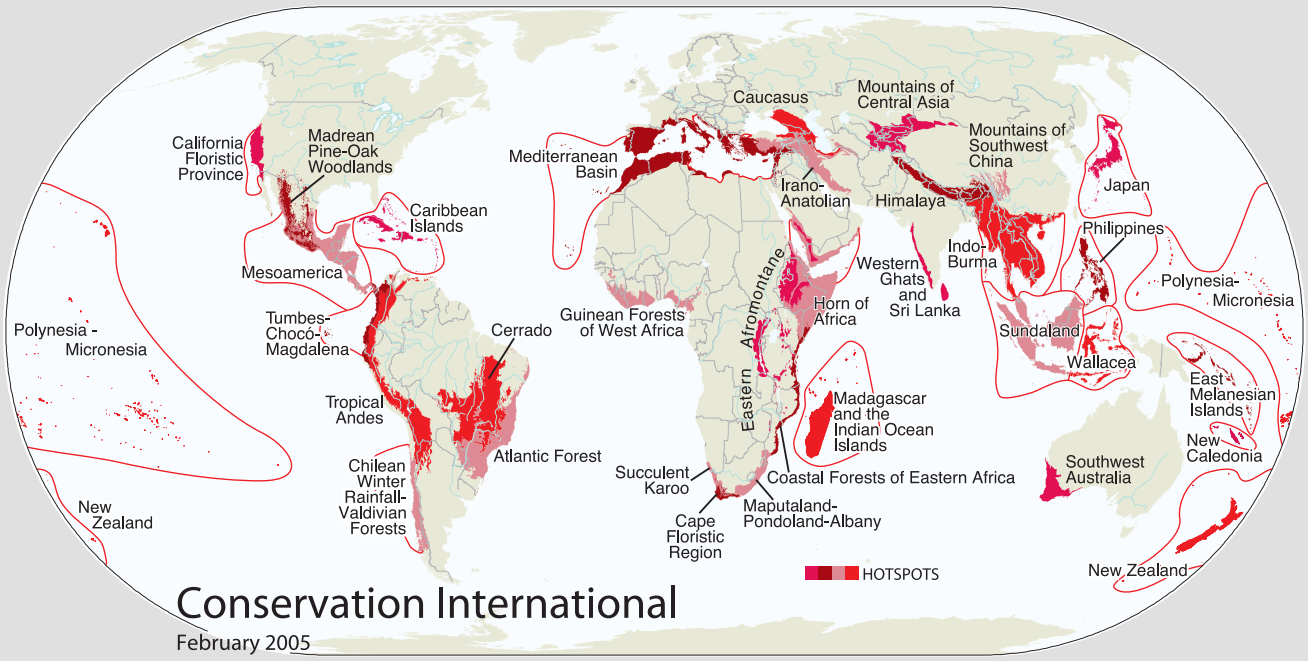

Figure 2.1. Photo of the Mexican jaguar (*Panthera onca hernandesii*). One of the world's largest cities, Mexico City has 8.8 million inhabitants in the city proper and about 22 million in the metropolitan area. The city supports about 2 percent of all the known species in the world, including 3,000 species of plants, 350 species of mammals, 316 species of birds, and many species of aquatic plants and animals.

URBAN NATURE FACTS

- Even backyard gardens can harbor significant biodiversity: a study of 61 gardens in the city of Sheffield, UK, found 4,000 species of invertebrates, 80 species of lichen, and more than 1,000 species of plants.
- Cities can be important habitats for a diverse bee fauna. Bees in urban and suburban settings have a richer, healthier diet than bees in modern intensive farmland settings.
- Medium-sized carnivores such as the red fox, coyote, Eurasian badger, and raccoon living in or around urban areas may achieve higher population densities than they do under natural conditions.

Many cities contain protected areas within or just outside their borders that provide important contributions to biodiversity. In Cape Town, Table Mountain National Park, an iconic landmark extraordinarily rich in endemic plants and animals, is entirely surrounded by the municipality. In Mumbai, Sanjay Gandhi National Park—known for its dense semi-evergreen forests, 280-plus species of birds, 150 species of butterflies, and 40 species of mammals, including a small population of leopards—protects 104 square kilometers entirely within a megacity. In Stockholm, the National Urban Park comprises 2,700 hectares with high biodiversity, right in the city center. In Kenya, Nairobi National Park (see Figure 2.2), just 7 kilometers from the center of Nairobi, is home to lions, giraffes, cheetah, rhinos, buffalo, and more than 400 species of birds. In the western USA, Saguaro National Park lies just outside the City of Tucson and protects about 40,000 hectares of the unique Sonoran Desert ecosystem.

These examples show that with proper planning and management, cities can retain substantial components of native biodiversity.

Biodiversity includes common species too

Biodiversity does not have to be rare to be valuable—it refers to common and widespread species too. Monitoring the status of common species is important because fluctuations in their populations can indicate environmental problems. A case in point is the quintessentially urban House Sparrow (*Passer domesticus*) whose populations have recently declined drastically in Eurasian cities throughout its native range, for reasons that are not yet entirely clear. Understanding the ecology of common species may help us improve habitats for them as well as for rarer species. Furthermore, ecosystem services may be delivered even by ecosystems that are degraded or that contain low biodiversity. While pristine ecosystems typically provide a greater number of ecosystem services than those that are degraded or altered, many ecosystems that are significantly altered from their pristine state can still provide useful goods and services (e.g. carbon storage, clean air and water).

Connecting fragmented ecosystems is likely to increase ecological functionality as a whole and therefore to maximize the ecosystem services offered. There are diverse and innovative ways to connect natural ecosystems. Planting trees with overarching canopies can help small mammals, birds, and insects cross roads and highways (see Figure 2.3). Roadside planting that mimics the multilayering of forests—for example, a composite of tall trees, medium-sized trees, shrubs, and understory vegetation—can cater to a diversity of animal users. Ecolinks such as underground tunnels and vegetated overhead bridges can help connect natural areas. All of these efforts can complement the important roles played by protected areas in cities. Of course,

AICHI TARGET 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

Cities can help preserve forests and wetlands of critical biodiversity by ensuring the connectivity of existing and future protected areas. Managing footprints (best done at the provincial, state, or regional level) can also make a difference.

Figure 2.2. Nairobi National Park, 7 kilometers from the center of Nairobi, is renowned for its wildlife. More than 100 species of mammals and 400 species of birds occur in the park.

Figure 2.3. Rua Gonçalo de Carvalho in Porto Algre, Brazil, is a stunning example of a natural urban ecolink. When this tree-lined street was threatened by development, local residents and environmental groups mobilized to protect it. In June 2012, Porto Alegre passed a law protecting this and more than 70 other "green tunnels" in the city. Although the trees occasionally cause power outages when it rains (because electrical wires pass through the canopy), residents value the many benefits they provide. In addition to serving as an ecolink, the trees help reduce the urban heat island effect, improve air quality, minimize the impact of rain and flooding, and increase property values.

Cape Town

Photo of the flowering plant king protea (*Protea cynaroides*). With a population of just under 3.7 million people and a land area of 2,500 square kilometers (0.2 percent of South Africa's total land area), Cape Town supports 50 percent of South Africa's critically endangered vegetation types and about 3,000 indigenous vascular plant species. Cape Town falls within the globally recognized biodiversity hotspot known as the Cape Floristic Region; of the 18 vegetation types in the city, 11 are critically endangered and 3 are endangered. Although this statistic in part reflects severe land-use pressure, it also disproves the common assumption that cities cannot have high levels of biodiversity. What's more, many of the plant species found in metropolitan Cape Town are endemic—found nowhere else on Earth.

São Paulo

Photo of the Brazilian cougar (*Puma concolor capricorniensis*). São Paulo, Brazil, is the most populous city in the Southern Hemisphere and the third largest city in the world, with more than 11 million inhabitants. This megacity contains biodiversity from the Brazilian Atlantic Rainforest, a globally recognized biodiversity hotspot. Twenty-one percent of the city is covered by dense forest in various stages of ecological succession, but these remnants are under severe threat from the unrestrained occupation of both low-income housing and luxury condominiums. An impressive 1,909 plant species and 435 animal species have been recorded in the city, with 73 of the animal species endemic to the Brazilian Atlantic Rainforest. The city's Green Belt Biosphere Reserve, part of UNESCO's Mata Atlantic Biosphere Reserve, protects remnants of this rainforest as well as associated ecosystems.

CITY BIODIVERSITY INDEX

The City Biodiversity Index, or CBI (see p. 53), also known as the Singapore Index on Cities' Biodiversity, is a self-assessment tool that encourages cities to monitor and evaluate their progress in conserving and enhancing biodiversity. More than 50 cities around the world are in various stages of testing the CBI and providing data for it. It currently comprises 23 indicators in three components: native biodiversity, ecosystem services provided by biodiversity, and governance and management of biodiversity. Stakeholders such as universities and civil society can assist in providing data. A platform for cities to share their experiences in applying the index has been particularly useful to cities considering using the CBI.

Other applications for the CBI have also surfaced. For example, information from it can be used in the decision-making and master planning of cities; it can assist policy- and decision-makers in allocating resources and prioritizing projects; good practices can be made into case studies for sustainable development; and some of the indicators can form the basis for calculating the economic value of biodiversity and ecosystem services. The CBI is also a useful public communication tool for city authorities. With ongoing refinement and improvement, it is continually becoming more valuable.

Stockholm

Stockholm, the most populous city in Scandinavia, comprises 216 square kilometres and includes 160 kilometres of waterfront and 14 islands. More than 14 percent of the city consists of aquatic environments. Among terrestrial environments, lush parks and residential areas with old, densely vegetated gardens complement protected areas and remnant patches of trees and grassland. Although the twentieth century saw a significant homogenization of Stockholm's hinterlands, the city still supports a rich and diverse flora and fauna. More than 1,000 species of vascular plants have been recorded. Of 69 species of mammals known to breed in Sweden, 43 reproduce in or near Stockholm, including, somewhat controversially, wolves (*Canis lupus*) only a few tens of kilometers from the city. This rich biodiversity can be attributed in part to the city's radial layout of infrastructure, which has left several green wedges connecting Stockholm to its hinterlands, and to a history of environmental efforts that date to the late 1800s. More than 40 percent of the city's land area still consists of green spaces.

AICHI TARGET 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

Campaigns by scientific institutions, zoos, museums, and aquaria—where city and regional authorities often have a managing interest—can raise critical attention and funds and provide technical assistance for the conservation of threatened species, even across the globe.

linkages can also provide pathways for invasive non-native species to spread into the native ecosystems, so care must be taken to minimize such adverse impacts.

Cities can enhance their native biodiversity

With the growing awareness of the value of biodiversity and ecosystem services, cities with rich native biodiversity should ensure that their biodiversity is conserved. Cities with impoverished biodiversity should pursue enhancement, restoration, and reintroduction efforts to increase native biodiversity. Biodiversity can thrive in cities if (1) appropriate land-use planning is enforced, (2) ecosystems are valued and conserved, and (3) monitoring of biodiversity is undertaken.

In just about any city, local interventions can increase native biodiversity. For example, cities can identify the habitats that used to exist locally and restore them. Gradual enrichment or reintroduction of plant and animal species will increase the complexity of ecosystems and the services they provide. Planting native plants in parks, roadsides, gardens, vertical and rooftop gardens, and other such areas will diversify the environment to support native mammals, birds, reptiles, amphibians, and insects. Creating small wetlands, such as ponds or marshes, will support the provision of a range of ecosystem services. Recent studies highlight the importance of even small urban gardens in providing habitat for native pollinators such as bees, which have declined alarmingly in recent years. Two often-used strategies are the creation of biosphere reserves (see São Paulo case study) or green belts around cities, and the "green" reengineering of major highways and infrastructure projects.

It is often said that we cannot manage what we do not measure. Many tools exist to help cities manage their biodiversity. One such tool is the City Biodiversity Index. This and many other initiatives (see Section III) can help cities conserve and manage their biodiversity.

With concerted efforts, the proliferation of biophilic cities can become a worldwide phenomenon, making city living a wondrous experience connected with biodiversity.

Singapore

By virtue of its geographical location, Singapore has a rich natural heritage. More than 10 ecosystems are found in this highly urbanized city–state of 5 million people. Although much of its biodiversity disappeared during the British colonization, Singapore still has a wealth of flora and fauna. Among the native species recorded are 2,145 vascular plants, 52 mammals, 364 birds, 301 butterflies, 127 dragonflies, 103 reptiles, 400 spiders, 66 freshwater fishes, and 255 hard corals. Between 2000 and 2010, intensive surveys found more than 500 species of plants and animals new to Singapore, of which more than 100 were new to science. Nestled in the heart of Singapore and not more than 15 kilometers from the busiest shopping areas are the Central Catchment Nature Reserve and Bukit Timah Nature Reserve. A network of parks and park connectors permeate the island, allowing easy access to varied habitats rich in plant and animal life.

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KEY MESSAGE 3: *Biodiversity and ecosystem services are critical natural capital.*

Natural capital can be defined as the stock of goods and services that are provided by ecosystems and are often essential to humankind. Quantifying the value of ecosystems in both monetary and non-monetary terms and/or attaching qualitative values are important tools for mainstreaming ecological considerations into the management of a city. Unfortunately, the value of natural capital is not often appreciated by society, and until recently, few attempts have been made to quantify it. One of the earliest attempts was made in the UK, where the government agency Natural England determined a subgroup of natural capital termed Critical Natural Capital (CNC). CNC comprises environmental assets that are (1) essential for human health or the functioning of life support systems and (2) irreplaceable or practically un-substitutable. The UK Government uses this classification system to inform policy-making and to ensure that CNC is afforded the strictest protection.

ACHI TARGET 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

Mainstreaming of biodiversity needs to be done at national as well as sub-national and local levels to be effective. Biodiversity values are different for each level of "vertical" (i.e., national, provincial, and local) and "horizontal" (i.e., divisions such as environment, planning, transportation, education, finance, and nutrition) government.

TEEB—THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY

TEEB (see p. 55) is a major international initiative to integrate the valuation of ecosystem services and biodiversity—appropriately referred to as "natural capital"—into governance and management, including at the city level. TEEB draws attention to the global economic benefits of biodiversity, highlights the growing costs of its loss and of ecosystem degradation, and draws together expertise from science, economics, and policy to enable practical actions.

The impetus for TEEB came from the growing recognition that the benefits of nature mostly bypass markets, thus escaping pricing and defying valuation—and that this lack of valuation is an underlying cause for ecosystem degradation and loss of biodiversity. TEEB has made a compelling economic case for the conservation of natural capital. Its many reports evaluate the costs of the loss of biodiversity worldwide and compare them with the costs of effective conservation and sustainable use.

TEEB's "Local and Regional Policy Makers Report" illustrates how dependent municipalities are on nature, and that nature has cost-effective solutions to local problems such as drinking-water supply and air-pollution control. "TEEB Manual for Cities" helps urban and regional policy-makers and planners assess the value of natural systems and consider opportunities and trade-offs of their policy and planning options. Other TEEB reports with a focus on the business sector, national government, and citizens are available for download at the TEEB website.

Ecosystem services can be captured in economic terms

Since policy and planning decisions are driven by trade-offs and utility, predominantly expressed in economic terms, decisions on land uses are often made to the detriment of non-market-valued ecosystem services. The recognition, demonstration, and capturing of ecosystem services in both a simple acknowledgement of value and in more detailed economic terms is therefore essential. This approach has been aptly described in the global study "The Economics of Ecosystems and Biodiversity" (TEEB).

If we fail to incorporate both monetary and non-monetary values of ecosystems into urban planning, then the conventional market alone will dictate the allocation of resources. The result of "business as usual" is environmental degradation and erosion of natural capital, incurring economic costs to either recover the natural capital or provide artificial alternatives.

Using the ecosystem valuation approach (including both monetary and non-monetary valuation) requires good background understanding and careful handling, in part because the complexities of ecosystems far exceed those of accounting systems. Ecosystem services that can be identified and quantitatively valued may be expressed in non-monetary terms—for example, the number of crops that depend on natural pollination—or in monetary terms. For monetary valuation, several methods exist: direct market price, replacement cost, damage cost avoided, production function (value added), hedonic price (extra

URBAN NATURE FACTS

- In the USA, city parks increase the value of nearby residential properties by an average of 5 percent; excellent parks can provide a 15 percent increase.
- In 2007, park-derived tourist spending in San Diego, California, amounted to $144.3 million—$40,033,000 of which was estimated to profit the local economy.
- In Lanzhou, China, a 2,789-hectare urban forest area provides climate regulation —cooling and evapotranspiration —valued at RMB 85,800,000 (US$14,000,000) annually.
- Table Mountain National Park in Cape Town contributed R377 million to South Africa's GDP between 1998 and 2003. The park also provides numerous employment opportunities in conservation.

amount paid for higher environmental quality), travel cost (cost of visiting a site), and willingness-to-pay surveys. Non-monetary valuation methods include preference values, scenic beauty models, studies to determine preferred choices, and visitor numbers. Choice of method depends on the characteristics of the concerned ecosystem service, the characteristics of the relevant management structure, the desired accuracy of valuation, and the availability of time, resources, and expertise.

Valuating ecosystem services facilitates good decision-making

Almost any ecosystem generates a "bundle" of ecosystem services, but not all of these services can be translated into numbers. Hence it is notoriously difficult to attach a comprehensive economic value to an entire ecosystem. Attaching monetary values to ecosystem services can nevertheless be enormously useful to those concerned with biodiversity management. The City of Cape Town, South Africa, for example, recently calculated that for every unit of currency (one South African Rand, ZAR) the municipality spends on the environment, at least 8.30 ZAR of ecosystem goods and services is generated. It was found that the return this of municipal expenditure on the environmental sector is considerably higher (between 1 and 1.2 times) than that of return on municipal expenditures (in terms of money generated in the City economy). This kind of knowledge underscores the importance of treating ecosystems as natural capital and is very useful in making the argument for spending on ecosystem management.

By illustrating that natural capital contributes to job creation, saves money, and complements services already provided by municipalities such as disaster-risk management and food security, municipal leaders can be encouraged to make decisions that favor the environment rather than harm it. At the same time, such efforts can gain broad public support for conservation, and even attract public and private investments. Payment for ecosystem services (PES) schemes can be established, which offer incentives to landowners and farmers to manage their land sustainably. In Curitiba and Belo Horizonte, Brazil, private landowners are rewarded with tax breaks for managing their land sustainably. New York City has made substantial payments to upstream land managers in the Catskill/Delaware watershed to improve land-use practices and thereby ensure the provision of high-quality drinking water and avert the need to build costly water-purification facilities. Thus citizens can enjoy the direct benefits provided by nature and avoid paying to restore or replace degraded ecosystems.

The Value of Restoring Biodiversity: Mayesbrook Park, London

A partnership of public and private organizations in a densely urban area of East London has transformed a formerly rundown 45-hectare park into a showcase of how public green space can help a community cope with the risks from climate change, such as increased flooding and higher summer temperatures, while also providing socioeconomic uplift. The project involved rehabilitating the Mayes Brook, creating a new floodplain that can naturally and safely store floodwater, planting new shrubs and trees to provide shade and enhanced habitats for wildlife, and adding new footpaths and signage so the public can better use the park. A 2011 assessment of the project's economic benefits demonstrated that an investment of £3.84 million in restoring degraded habitats and enhancing the green infrastructure will yield a lifetime benefit-to-cost ratio of approximately 7:1. The gross annual benefit delivered by the ecosystem services is estimated at approximately £880,000. The cultural services—including recreation, social relations, and education—return a gross annual value of approximately £820,000, demonstrating how the restoration of biodiversity can provide economically robust climate-change adaptation and also enhance the well-being of city-dwellers.

Water Purification through Wetlands: Nakivubo Swamps, Uganda

The Nakivubo Swamps are adjacent to Uganda's capital city, Kampala. The local government had proposed draining the swamps to make way for agriculture, but when a study revealed that this ecosystem was providing a valuable service by filtering organic waste and other effluent derived from Kampala, the proposal was promptly dropped. The study indicated that a water-purification facility capable of performing the same service would cost several million US dollars to construct and US$ 2 million a year to maintain. In this case, the value of converting land for agriculture would be offset by the cost of lost sewage-treatment capacity. Direct investment to maintain the wetland was a cost-effective measure to uphold the purification service. This example demonstrates how detailed information and cost estimates can better inform planning decisions.

By highlighting costs and benefits related to biodiversity preservation, valuation exercises also facilitate decision-making processes, for example regarding infrastructure development and planning proposals. Ignoring the value of ecosystems runs the risk of permanently losing the benefits that nature provides us, taking them away from the hands of future generations.

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Wetlands and Floodplains Protect Coastal Cities: New Orleans

Flooding has always been hazardous for the City of New Orleans in the southern USA. Extensive levees were built to mitigate flood risk, and surrounding wetlands were drained to combat disease such as mosquito-borne yellow fever and to open the way for further urbanization. In losing water, peaty soils compressed, subsided, and steadily sank below sea level. The levees prevented sediment-rich waters of the Mississippi River from adequately replenishing the floodplains and wetlands. Today more than 3,000 kilometers of levees line southern Louisiana's waterways, and intensive engineering has rerouted vast volumes of water. Numerous upstream dams trap sediment, further depriving the delta of silt. This rapid disappearance of coastal wetlands has undermined the region's capacity to absorb storm flow. In 2005, New Orleans paid dearly for this spectacular loss of green infrastructure when the city was devastated by the disastrous flooding of Hurricane Katrina. One of the few positive outcomes of that tragedy is a growing realization that restoration of green infrastructure is necessary to counter future storms, especially in the face of projected sea-level rise.

Tree Planting in Canberra

In Canberra, Australia, local authorities plant trees to generate a wealth of benefits. More than 400,000 trees can be found within the city limits. This urban forest helps mitigate the urban heat island effect, thereby reducing the need for energy-intensive air-conditioning and ventilation. The trees also improve air quality, intercept and absorb storm water, and sequester carbon. In terms of value generated or savings incurred, these services were valued at approximately US$ 20–67 million for the period 2008–2012. The valuation has helped inform planning and budget allocations.

Ecosystem Valuation in Cape Town

The City of Cape Town, South Africa, recently undertook an intensive assessment of the value of ecosystem services generated by natural areas in the city. These areas include nature reserves, coastal areas, wetlands, and rivers. Using valuation methods such as "willingness to pay," the study estimated the net present value of the city's natural assets as US$ 5.13–9.78 billion. The study has helped leverage funding for the environment from across departments by revealing the considerable contribution of ecosystem services to human welfare and underscoring the need to account and pay for their maintenance.

KEY MESSAGE 4: *Maintaining functioning urban ecosystems can significantly improve human health and well-being.*

Biodiversity is a foundation of human health. The twentieth-century advent of antibiotics, however, has largely masked the relationship between human health and biodiversity. Clean water and air, effective sanitation, and the healthy management of livestock are core elements of urban public health that we ignore at our collective peril. More positively, the health benefits that we derive from direct contact with ecosystems range from improving immune function, mood, and concentration to reducing stress and enhancing the benefits of physical exercise.

The interlinkages between human health and our environment extend beyond the mere absence of disease or infirmity; rather, they require a holistic view of health, which the World Health Organization (WHO) defines as "a state of complete physical, mental and social well-being."

Cities play a major role in determining human health

Cities play a major role in providing services and built facilities, tackling inequities, and managing environments that help determine human health. With proper planning and resources, several urban health concerns can be addressed to achieve mutual benefits for human and environmental health.

Non-communicable diseases (NCDs), specifically heart disease, diabetes, cancer, and chronic respiratory illnesses, are now a global health epidemic. More than 36 million people die every year from NCDs, and that number is projected to be 44 million by 2020. Urbanization can increase exposure to common risk factors for NCDs, such as changes in physical activity and diets. Urbanization is also generally accompanied by increased air pollution, which causes significant mortality as a result of cardiovascular and respiratory disease. The consequences of NCDs are especially hard felt among vulnerable and economically disadvantaged populations; almost 80 percent of NCD deaths now occur in low- and middle-income countries.

Current evidence suggests that NCDs can be largely prevented by lifestyle decisions, some of which can also benefit urban biodiversity. Developing urban spaces that improve air quality, promote active living, and facilitate good nutrition and dietary diversity, for example, can enhance human health and biodiversity. Better public-transport practices and bicycle/pedestrian pathways can lead to increased physical activity and reduced greenhouse gas emissions (see Figure 4.1). Urban agriculture can promote dietary diversity and improve nutrition and food security while also supporting agricultural species conservation and limiting the urban food-supply "footprint."

Understanding the complex interactions between urban populations and infectious disease is also paramount, particularly since approximately 1 billion people currently live in squalid, slumlike conditions. Cholera, influenza, dysentery, and malaria are all tightly intertwined with ecological processes. Such diseases can often be curbed with a combination of measures, including adequate sanitation and sewage systems, as well as the conservation and restoration of local wetlands (see Figure 4.2). Urban agriculture can lower the pressure for food supplies from surrounding rural regions, and this in turn can conserve natural ecosystems and support their ability to regulate wildlife-related infectious diseases. High species diversity has been found to reduce the risk of disease transmission to humans by diluting pathogens among a large type of potential hosts. However, frequent interactions between humans and wildlife may lead to increased spread of pathogens, and this risk also needs to be incorporated in urban planning.

URBAN NATURE FACTS

- In Sacramento, California, city residents who exercise in parks tend to have lower medical costs; in 2007, the average medical cost difference between active park users and inactive users was $250 for adults under age 65 and $500 for adults 65 and older.
- In the UK, the option to exercise in natural settings helps people achieve more than the recommended amount of weekly physical activity.

Figure 4.1. In Bogota, Colombia, physical activity has increased significantly and greenhouse gases have been curtailed by closing 97 kilometers of a major road to traffic on Sundays and during holidays, improving the bus transit system, using cleaner buses, and creating a 334-kilometer bicycle path around the city.

Figure 4.2. Worker emptying a latrine pit, a rudimentary sanitation system, in Dar es Salaam, Tanzania. The Sustainable Cities Programme uses a participatory bottom-up planning approach to manage fecal waste discharged into the environment. This program aims to reduce serious health risks posed by wastewater and to support the coastal habitats on which the city depends for its natural resources.

Figure 4.3. Photo of the Central Market in the city of Belo Horizonte, Brazil. The Belo Horizonte Food Security Program, hailed as one of the most comprehensive policies to tackle hunger and secure a healthy food supply for the future, was very successful in improving nutrition and reducing poverty and mortality. It won the Future Policy Award in 2009.

Another health challenge that cities are well placed to consider is that of mental illness. WHO estimates that mental illness affects more than 450 million people worldwide. Mental illness is often associated with rapid social change, stressful work and living conditions, unhealthy lifestyles, physical illness, and more recently, changes in the urban environment. Making biodiversity a priority for development policies can provide mental health benefits such as reduced stress, better resilience in times of adversity, improved mental concentration, and enhanced recovery time from sickness and injury. Some researchers argue that ecosystem services such as food production and air quality also play important roles in mental health.

Integrated urban planning is essential for achieving healthy cities

As the number of people living in cities continues to rise, so will the challenges associated with achieving healthy cities. In this light, integrating urban biodiversity planning with public education and the work of health experts is essential. This can be achieved with urban policy and initiatives such as urban reforestation and wetland creation; the establishment of urban parks and outdoor gyms, paths, and trails; the promotion of urban and peri-urban agriculture; the development of ecological sanitation and water infrastructure; and the design and location of community facilities that use the benefits of nature as a setting for other activities, such as healing and wellness (hospitals, elderly, or disabled care) and learning (schools and childcare facilities).

It can be helpful to consider urban health issues in two diametrically opposed categories: those linked with poverty and those linked with affluence. Both frequently coexist in the same city. As noted in the

Curitiba's Innovative Approach to Waste Management

The population of Curitiba, Brazil, exploded from 120,000 to more than 1.7 million between 1942 and 2012, challenging the city to provide food, water, and sanitation services to its residents. By the early 1970s, poverty, waste, and disease were rampant in the city's slums. Today, with 46 protected areas and 64.5 square meters per inhabitant, Curitiba is known as "Brazil's green capital" and is hailed as a prime example of a green economy in a developing country. Among its innovations is the Green Exchange Programme, which encourages slum dwellers to clean up their surroundings and improves public health by offering fresh fruit and vegetables in exchange for garbage and waste brought to neighborhood centers. As of 2012, Curitiba has 96 exchange sites. Each month more than 6,500 people are exchanging an average of 255,416 kilos of collected garbage for 92,352 kilos of fruits and vegetables.

joint WHO and UN-Habitat report "Hidden Cities," and in the FAO publication "The Double Burden of Malnutrition," the least affluent members of society are also those most likely to be struck by the double burden of communicable and non-communicable diseases.

Local governments are usually well placed to achieve human health and biodiversity co-benefits, given their understanding and proximity to local conditions. While they sometimes lack resources and infrastructure, they generally have better knowledge of and more immediate access to stakeholders and potential partners, and are often better placed to mobilize and adjust resources necessary for local circumstances.

Our knowledge and application of the determinants of human health and their interlinkages continue to expand in city policies and programs. Although each city and situation clearly requires the development of specific solutions, the following examples highlight some of the urban human health and biodiversity interlinkages that planning and initiatives can consider:

1. Land use change, urban and peri-urban food production, food security, nutrition, and dietary diversity.
2. Water quality, wastewater management, sanitation, and disease.
3. Physical activity, preventative actions to address NCDs, and environmental benefits from lifestyle choices.
4. Local knowledge, traditional knowledge and medicines, poverty reduction, and development.
5. Energy consumption, public transportation, and climate-change adaptation, including the urban heat island effect.

Greenery in Slums: A Valuable Source of Traditional Medicine

In many slums, the presence of trees and plants that heal is extremely crucial, as traditional medicine is typically the most economical, trusted, and readily available form of health care in such settlements. In Bangalore, one of India's fastest growing cities, an estimated 30–40 percent of the population lives in 550-plus slums. Surveyed slums in Bangalore have an average of 11 trees per hectare, versus 28 per hectare in other residential areas. The species that dominate are of high medicinal and nutritional value and are sources of primary health care. The trees also offer many socio-cultural services. Daily chores such as cooking and washing are carried out under tree cover. Trees act as pillars of support in such settlements—figuratively and literally by bearing tents, clotheslines, wires, and so on. The variety of roles that plants play in slums is critical to people's health and well-being.

Healthy Parks, Healthy People

Parks Victoria, a park management agency of the State Government of Victoria, Australia, launched the "Healthy Parks, Healthy People" (HPHP) approach in 2000. The goal was to emphasize the value of visiting parks and natural open spaces for the benefits they provide as healthy places for body, mind, and soul. Similar approaches have now developed around the world, including in Canada, the UK, and the USA. The Melbourne initiative that emerged from the first International HPHP Congress declared that parks are "integral to healthy people and a healthy environment" and that "human health depends on healthy ecosystems." The Congress was also the springboard to a partnership with a national health insurance provider, which is now funding public preventative health activities and establishing a network of health professionals to encourage people to increase their physical activity by engaging in activities in parks.

Healthy Parks, Healthy People – Nepal

The Healthy Parks, Healthy People concept is also being adapted to developing countries, beginning with HPHP Nepal, a partnership involving the International Union for Conservation of Nature, Parks Victoria, and the Nepalese government. A 2010 workshop in Kathmandu highlighted that HPHP and resulting lessons learned could indeed be applied in countries with different socioeconomic contexts. As Dr. Chhatra Amatya, chairman of Chhahari Nepal for Mental Health, explained, "HPHP is all the more needed in a country like Nepal. Our children do not have space to play a game in a city."

The increasing number and diversity of urban policies and programs on human health and biodiversity interlinkages are providing a rich source of knowledge for cities to use and build on (see Figure 4.3). Given the unique position of cities at the implementation interface between people and biodiversity, we must widely share our understanding, predictions, and lessons learned through local, regional, and global collaboration networks. By looking at biodiversity through the lens of health and also looking at health with an eye for biodiversity, we can achieve mutual health benefits for cities and biodiversity.

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More Trees, Less Childhood Asthma: New York City

Rates of childhood asthma in the USA increased by 50 percent between 1980 and 2000, with the highest rates reported in poor urban communities. In New York City, where asthma is the leading cause of hospitalization among children under age 15, researchers at Columbia University studied the correlation between numbers of trees on residential streets and incidences of childhood asthma. They found that as the number of trees rose, the prevalence of childhood asthma tended to fall, even after data were adjusted for sociodemographics, population density, and proximity to pollution sources. How might trees reduce the risk for asthma? One explanation is that they help remove pollutants from the air. Another is that trees may be more abundant in neighborhoods that are well maintained in other ways, leading to lower exposure to allergens that trigger asthma. Yet another is that leafy neighborhoods encourage children to play outdoors, where they are exposed to microorganisms that help their immune systems develop properly. Further studies will provide a clearer picture of whether street trees really do make for healthier children: New York City is currently in the midst of planting a million new trees by 2017.

The Many Benefits of Urban and Peri-Urban Agriculture

Raising local crops and livestock can increase knowledge of and interest in the biophysical and food-growing processes, empower citizens to influence sources of food production, strengthen links to local food systems, and encourage healthier lifestyle choices. Greater food self-reliance, cheaper food prices, greater accessibility to fresh and nutritious products, and poverty alleviation are all key benefits that can arise from urban agriculture with sound decision-making and planning of the cities' ecosystems. The advantages of urban and peri-urban agriculture have been noted by the UN Food and Agriculture Organization (FAO) and by the World Health Organization's Healthy Cities Programme, which appeals to local governments around the world to include urban and peri-urban agriculture in their urban plans.

From Open Dump to Greenery: Mumbai's Gorai Dump Closure Project

The city of Mumbai, India, generates about 6,500 tons per day of municipal solid waste and about 2,400 tons per day of construction waste. For almost 40 years, all of that waste went to Gorai Dump—a 20-hectare open site in Mumbai's western suburbs. Situated next to a creek and close to residential areas, the dump had caused significant environmental damage and long been known as one of the unhealthiest places in Mumbai. Closure of the site in 2009 involved leveling and reforming the heaps of garbage (their average height was 26 meters), covering them with impermeable surfaces, and converting them into a high-quality green area. The next step will be installing a power plant at the site that will run on methane gas from the decomposing garbage—thereby producing electricity as well as reducing greenhouse gas emissions. The project has already yielded many public-health and lifestyle benefits that have transformed the lives of local residents. They have a beautiful new green space to enjoy, air and water quality have improved, breeding flies and rodents have been eliminated, and property values in the area have increased fivefold.

Figure 5.1. São Paulo's Green Belt Biosphere Reserve, established in 1994, helps counteract the urban heat island effect by reducing the ambient temperatures of adjacent areas by up to 10°C.

KEY MESSAGE 5: *Urban ecosystem services and biodiversity can help contribute to climate-change mitigation and adaptation.*

The Intergovernmental Panel on Climate Change warns that at current greenhouse gas emission rates, average global temperatures will likely increase by 4°C by 2030, the catastrophic effects of which are beyond our ability to predict. Efforts to mitigate CO_2 emissions are urgently required. However, even with concerted action, the planet will still experience more frequent and intense heat waves, drought, storms and flooding, and sea-level rise. Cities are poised to bear the brunt of these effects, as they concentrate more than half of humanity in some of Earth's most vulnerable locations along coasts and rivers. At the same time, cities contribute 60–70 percent of global greenhouse gas emissions. Therefore cities—and urban biodiversity and ecosystem services in particular—can play important roles in mitigating and adapting to climate change.

AICHI TARGET 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

No other level of government does as much restoration as local governments. Many "brown" and transition (ex-industrial) areas under city governments are either in the process of being restored or could be. City governments can also promote the use of green infrastructure and roofing.

URBAN NATURE FACT

✤ **In 2005, the trees of Washington, D.C., removed 244 tons of carbon dioxide, nitrogen dioxide, ozone, particulate matter, and sulphur dioxide, at a savings value of $1,130,000.**

Green spaces offer numerous ecosystem services

Urban green spaces, ranging from parks and agriculture to residential lawns and roof gardens, contribute to climate-change mitigation in three principle ways:

1. Green spaces can increase carbon storage and uptake. Although there is considerable variation in green space across cities, there is overwhelming consensus that urban green spaces offer numerous ecosystem services, among them shade provision, rainwater interception and infiltration, and pollution reduction. More green space generally means more vegetation that can act as a carbon sink for partially offsetting urban emissions. Urban brownfields present exceptional opportunities for carbon sequestration.
2. Trees can contribute indirectly to climate-change mitigation by providing more shade and cooling, thereby reducing overall energy consumption. The total amount of energy savings depends on many factors, including the species, size, abundance, and location of trees. In most cities around the world, there is abundant opportunity to increase urban vegetation.

3. Green spaces can significantly reduce the urban heat island (UHI) effect, where urban areas are warmer than surrounding regions (see Figure 5.1). The UHI varies spatially, geographically, and temporally. Some of the key factors that determine its intensity include the relative amount of green vegetation versus buildings and paved surfaces, energy consumption within cities, and the types of materials used for building construction and their heat-absorption capacities. Some of the key strategies for using urban green space to mitigate the UHI include green roofs (see Figure 5.2), shade trees, and urban landscape design. For example, green roofs can significantly reduce both peak flow rates and total runoff volume of rainwater by storing it in plants and substrate and releasing it back to the atmosphere through evapotranspiration. Such roofs can retain 70–80 percent of rainfall in summer and 10–35 percent in winter, depending on their build-up, thus supporting an improved microclimate. Green roofs can also insulate buildings, thereby reducing the need for energy-intensive heating and cooling. By providing a mosaic of urban microhabitats that help mitigate habitat loss and fragmentation, green roofs also provide many direct benefits that enhance local biodiversity.

Functional watersheds also play a crucial role in mitigating and adapting to climate change. Watersheds provide access to safe water for drinking and irrigation, which is especially critical given how climate change is disrupting precipitation cycles and historical river flows and groundwater levels. Preserving rather than draining and paving over wetlands can allow for the absorption of excess rainfall and buffer against coastal flooding.

As the effects of climate change intensify—putting unprecedented pressure on urban infrastructure such as storm drainage, seawalls, and levees—ecosystem-based adaptation is worth far more than the nominal cost of ecosystem preservation.

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Mitigating Local Climate Change in Yokohama

In 2007 the administrative district of Yokohama, Japan, emitted almost 20 million tons of CO_2. Aiming to become a low-carbon city, it set a goal to reduce CO_2 emissions per person by at least 60 percent, relative to the 2004 level, by 2050. With a population of almost 3.7 million, Yokohama has been continuously degrading and converting its forests and farmland. The consequence has been a demonstrable impact on the city's microclimate, above that associated with global climate change, resulting in an urban heat island effect. The increase in buildings and paved surfaces has enhanced the city's heat-absorption capacity and increased its reflective heat, thereby raising temperatures. At the same time, the decrease in forests and farmland has reduced evapotranspiration, thereby slowing cooling. Recognizing the importance of biodiversity in stabilizing the local climate, the city introduced a new tax system and a mechanism to use the revenue to conserve privately owned green areas. It also decided to expand green areas with rooftop and wall greening and to work with citizens to reduce residential CO_2 emissions. It set a minimum target for effective evapotranspiration from green areas at 30 percent of the total city land area.

Figure 5.2. Green roofs can be used not only to enhance targeted ecosystem services, such as storm-water retention and food production, but also to improve biodiversity in general. For example, using local seed mixes and substrates can mitigate habitat loss and fragmentation and also enhance habitat provision and connectivity, when placement and height of the green roofs complement and support existing ecological communities in the surrounding landscape. Wildflower meadows (Salt Lake City, USA), nesting sites for birds (Basel, Switzerland), and invertebrate-rich "brownfields"—well-drained, nutrient-poor environments on previously developed lots (London)—are just a few examples of ecological environments created by green roofs. Large-scale rooftop agriculture initiatives already exist in many cities around the world, among them New York, Chicago, Singapore, and Montreal (see p. 38). Shown here is the roof of The Church of Jesus Christ of Latter-day Saints Conference Center in Salt Lake City, Utah.

Action on Climate Change in Mexico City

Mexico City was the first Latin America city to implement a Climate Action Program. Three components of the overall program place biodiversity at their core: (1) The Green Roof Program aims to create 10,000 square meters of new green roofs annually, to improve air quality, regulate humidity, reduce temperatures, and provide new biodiversity resources across the city. By increasing environmental awareness among citizens, the program also plays an important educational role. (2) Focusing on pollution risks, the Recovery of the Rivers Magdalene and Eslava program is improving environmental conditions in two important tributaries and their surrounding neighborhoods. Additional funding in 2011–2012 helped secure a water supply for the city and reduce the energy and economic costs associated with traditional water treatment. (3) Almost 60 percent of Mexico City is represented by Land for Conservation, which provides environmental goods and services essential to the entire city. The two-pronged Program of Restoration of Ecosystems and Compensation for Maintaining Environmental Services rewards landowners in this area both for protecting essential natural resources and for restoring degraded habitats. It also encourages communities to actively protect and restore natural ecosystems.

KEY MESSAGE 6: *Increasing the biodiversity of urban food systems can enhance food and nutrition security.*

There is a direct relationship between biodiversity and food security in cities. Biodiversity in urban food systems plays a critical role in the fight against hunger and diet-related health problems and is key in developing resilient food systems. Yet the rapid growth of cities is challenging the provisioning capabilities of agriculture and modifying food systems at local and global levels. The globalization of food production and consumption alongside increasing industrialization of agricultural systems undermines the biodiversity of our food systems. Conflicts, economic and social turmoil, rising energy prices, climate change, and scarce or polluted water supplies are among the factors that further elevate the volatility of food supplies and prices and put millions of people at risk, particularly the poorest. At the same time, a shift in urban diets to less diverse and more processed foods has increased the incidence of non-communicable diseases such as obesity and diabetes (see Key Message 4).

In cities everywhere around the world, people are experiencing increases in hunger and poverty. Food and nutrition security entered global and urban political agendas to an extent previously unseen in 2007–2008, when food prices soared and cities in more than 20 countries experienced food riots. Current food prices are again skyrocketing (see Figure 6.1).

URBAN NATURE FACT

❖ Urban demands for specialized foodstuffs, such as tuna and shrimp, can affect fish stocks halfway around the globe.

Food security depends directly on functioning ecosystems

Global food systems contribute to food and nutrition security, ensuring the provision of food when local food crises occur and supporting the local consumption of a greater diversity of foods. However, the expansion of urban populations will dramatically increase global demand for food of a non-subsistence nature. Urbanization will put pressure on existing food production, potentially increasing land-cover change and threatening biodiversity unless carefully managed.

Increasing biodiversity in our existing food systems is key to maintaining global food systems and the ecosystem services they depend on, and to improving global food security. That biodiversity is found not only within *ecosystems*; the genetic diversity found within *species* is also important.

Local food systems have historically, and more recently in the case of Cuba, proved to be critical to a city's survival in the face of food security crises. Efforts to ensure urban food security through local food systems, from production to consumption and distribution, depend directly on functioning ecosystems in the city and in its hinterlands. In developing local food systems, the objective is not to constrain the global supply chains that contribute to food and nutrition security for many countries, but to provide local and sustainable alternatives that enhance local agricultural biodiversity. Local

Figure 6.1. The FAO Food Price Index measures monthly changes in international prices of a basket of food commodities.

alternatives can also reduce vulnerability to global shocks and counterbalance price and supply volatility.

Sound biodiversity underpins robust and diverse agriculture. If urban agriculture is to contribute to food security without compromising biodiversity, practices need to be devised to be sensitive to local ecological conditions, such as rainfall and soils, and to avoid the introduction of invasive species. The capacity of urban, peri-urban, and rural areas for developing greater food self-reliance needs to be carefully considered within a local biodiversity context, and investments are needed to document and protect local plant and animal species, particularly traditional foods used by indigenous peoples.

Agriculture and food biodiversity is a key component of sustainable diets that are nutritious, culturally acceptable, and contribute to long-term ecosystem management and economic vitality. However, the demand for energy-intensive foods such as meat, and for refined products such as coffee and wine, from increasingly wealthy urban populations is escalating. This will have a significant impact on biodiversity and associated ecosystem services such as water. Furthermore, these urban-generated impacts may be displaced to other regions of the world because of the global character of the food system.

Developing resilient food systems requires planning at many scales

Food systems cross political boundaries and encounter a complex mix of jurisdictions, and this poses significant challenges. The development of resilient local and global food systems needs to be considered at various scales: at local scales such as neighborhoods, at city and city–region scales, and also at global scales. The integration of food systems and biodiversity at the various levels of government needs to be supported by urban, metropolitan, and regional or national measures and incentives. Special attention needs to be paid to diversification of food varieties, especially to traditional foods and eating habits and to local plants and trees, livestock, fisheries, and aquaculture. Attention must also be paid to storage and processing of food, land legislation, land-tenure systems, use of vacant land, access to water, and education of consumers about the dietary importance of consuming a greater diversity of foods—for example, through food labeling that increases awareness of food plant varieties and food animal subspecies, and that indicates the origin of the food. Educating urban populations on the relationship between diet, biodiversity, and health can support increased nutrition security and agricultural practices that support biodiversity.

Guiding Healthy Urban Agriculture in Kampala

Uganda's largest city is well suited to agriculture: it has a tropical climate, good soils, water, and abundant rainfall. Although the city is growing rapidly, agriculture remains highly visible, even in densely populated areas. In 2002, 49 percent of households were farming within city boundaries—the vast majority of them for food security or survival, not commercially. About half were raising livestock as well as crops. The recognition that urban agriculture was so widespread generated serious health concerns among Kampala's City Council. Many people were farming in hazardous or unsuitable places—roadsides, wetlands, and contaminated sites. When an extended research project started on urban farming and public health, the city joined the effort. Between 2002 and 2005, the project researched the benefits and risks of urban agriculture in Kampala. As a result of this and other research, Kampala changed how it regulates urban food production. In December 2006 it passed five new ordinances defining how urban agriculture can be carried out in the city. The effort—among the first serious legislative reforms to support urban agriculture—was designed to encourage self-reliance among urban dwellers and safe and healthy food production while also ensuring public health.

Urban Agriculture in Cuba

Since 1987 Cuba has focused on urban and suburban agriculture to counter its crisis of lack of imports as well as malnutrition and iron deficiency in the population. More than 54,000 hectares are currently dedicated for urban agriculture, including vegetables, fruits, apiculture, and livestock. Havana alone supports one of the most extensive urban agriculture networks in the world: 4 million tons of vegetables are grown each year in more than 200 urban organic farms, known as *organiponicos*. Urban agriculture produces 90 percent of Havana's fruits and vegetables while reducing the city's carbon footprint by trading the produce in local markets. Biodiversity is considered a key element for sustainable production, and a priority is placed on improving the gene bank in the country. More than 650 species are grown in Cuba, including more than 100 livestock breeds. Compost, biopesticides, and seeds are produced by cooperative producers, who receive technical support from a national organization. The products are then made available to urban farmers through local kiosks. Recent research is focused on improved soil and plant management, developing new vegetable varieties, greenhouse production, and small agro-industry development to increase resilience in the face of climate change.

To assist food security through local food systems, agricultural land surrounding cities needs to be protected from urban encroachment, and within cities, land needs to be protected or made available to support urban farming. New urban agricultural landscapes, such as green roofs, also need to be developed. To ensure that a local food system supports increasing biodiversity and improves food and nutrition security, education opportunities and policies need to be in place to encourage the use of appropriate food-production practices that maintain necessary ecosystem services.

In considering nutrition security, it is also important to ensure the inclusion of vulnerable groups, with special attention to gender, youth, and migrant workers, in the design and implementation of food and biodiversity policies. While many consumers are able through their daily food purchases to influence the food system and support biodiversity, vulnerable groups are typically less able and less likely to participate in sustainable diets that contribute to food and nutrition security. Local governments and agencies can support community involvement in local food systems through their procurement policies, educational programs, and social services. In 2010 the city of Rome adopted a Green Procurement Policy for food and canteens with more than 144,000 meals (70 percent of which include organic food) served daily in 550 nursery, primary, and secondary schools, with a consideration for biodiversity.

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Rooftop Gardening in Montreal

Rooftop gardening is catching on all over the world. In Montreal, Canada, where local fruits and vegetables can be hard to find except during the brief summer growing season, a 31,000-square-foot greenhouse known as Lufa Farm sits atop an office building. It grows more than 25 varieties of vegetables year-round, and it does so without using any artificial pesticides, fungicides, or herbicides. The use of controlled-environment agriculture enables the operation to yield as much as a conventional farm 10 times its size. Mohamed Hage, Lufa's founder, hopes that someday Montreal will be full of rooftop gardens. As he explains on the farm's website, rooftop gardens do "more than grow vegetables." They allow land previously lost to development to be farmed again; minimize the distance, time, and handling of food between grower and consumer; allow for the production of highly nutritious foods "instead of only semi-tasteless varieties that ship and store well"; and directly involve consumers with local farmers. Rooftop gardens also keep buildings cooler, save energy, improve air quality, and help mitigate the urban heat island effect. Lufa Farm distributes its produce at more than 30 drop-off points around Montreal. It also provides products from local Quebec farms.

Urbanization Encourages Food Biodiversity in Northern Vietnam

The urbanization rate in Vietnam is still low compared with that in other Southeast Asian countries, but it is growing steadily. Cities increasingly offer a significant market for food products. Traditionally, food in Vietnam has been distributed through street vendors and fixed market retailers, but in the last 10 years modern distribution has developed in the form of supermarkets and shops. Urban consumers are concerned with the origin and quality of food, and they readily establish a relationship between a place of production and specific taste features, which are due to soil and climate characteristics as well as traditional production methods. Thanks to various farmer organizations, as well as public and international research organizations, several protocols have been developed to stabilize production of the traditional *hoa vang* sticky rice and to have it labeled and packaged so it can fetch a premium price. Similar experiences relate to Thanh Ha litchi fruit, Bac Kan seedless persimmon, the *dai hoang* variety of banana, H'mong beef, and various indigenous vegetables.

Curitiba's Biocity Program

Combining public and private initiatives, the Biocity Program in Curitiba, Brazil, is a leading example of urban planning integrated with biodiversity conservation. The program has brought together multiple departments and stakeholders in an effort to reduce local biodiversity loss and contribute to global biodiversity conservation targets. Biocity concentrates its actions in five main areas: (1) planting ornamental indigenous plant species in the city, to promote familiarity with the region's indigenous flora; (2) establishing protected areas; (3) preserving water resources, through a plan for revitalizing the Barigui River basin; (4) planting indigenous tree species in the city; and (5) improving both air quality and transportation through the Green Line Project, a major transportation corridor with special lanes for bicycles and pedestrians as well as a linear park. Since its launch in 2007, the Biocity Program has improved ,the city's green spaces and green infrastructure and thus the quality of life for residents.

Figure 7.1. The city of Edmonton, Canada, has taken the "trickle-down" approach with its city-wide plan "The Way We Green," which ensures that biodiversity is considered at all municipal levels.

KEY MESSAGE 7: *Ecosystem services must be integrated in urban policy and planning.*

Urban and environmental planning provide consultative opportunities and formal legal mechanisms to integrate the protection of biodiversity into the design, building codes, zoning schemes, spatial plans, strategic choices, and enforcement of city management. There are different traditions of urban planning. Some cities have strong traditions of state-led development and control; others focus more on strategic planning; and still others, especially in the Global South, operate almost without any formal planning directions or support. The practice of urban planning is widely recognized, however, as a vehicle for securing the long-term public good at the city scale. Especially in fast-growing, low-income cities, there is a widespread call to strengthen urban-planning capacity. In all cities, biodiversity- and ecosystem-related decisions generally have to be made in the public or collective interest, which implies staving off the demands of particular interest groups. Thus strengthening the ability of urban planners to navigate biodiversity concerns is critical.

Local Biodiversity Strategy and Action Plans are valuable tools

To integrate urban biodiversity and ecosystem services into local governance, the key elements of a Local Biodiversity Strategy and Action Plan (LBSAP) can be incorporated into overarching city-wide plans. Such city-wide plans are visible and can trickle down to guide each of the sector-specific plans that fall beneath them (see Figure 7.1). The "trickle-down" model of integrating biodiversity consideration is potentially applicable to any city-wide plan. Depending on local needs and priorities, and on political and

AICHI TARGET 17: By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

Cities are encouraged to develop local strategies and action plans on biodiversity in support of national strategies.

Figure 7.2. "Lisbon Biodiversity 2020" aims to protect and enhance Lisbon's biodiversity. Eighteen percent of the city's area is semi-natural. Of its 2,800 plant species, fewer than 10 percent are native, but so are 26 of its 28 mammals. At least 148 species of birds can be found in the city, including 14 threatened species.

Figure 7.3. Photo of Iguaçu Falls in the state of Paraná, Brazil. Bioclima Paraná aims to conserve biodiversity and restore ecosystems.

administrative contexts, a range of instruments and tools can be used by urban and regional practitioners and policy-makers to mainstream biodiversity.

The Strategic Plan for Biodiversity of the Convention on Biological Diversity (CBD) and associated Aichi Biodiversity Targets provide a basis upon which to establish this alignment. By adopting the Strategic Plan for Biodiversity and Aichi Biodiversity Targets, all 193 parties to the CBD committed themselves to achieving a set of biodiversity goals by 2020. If local governments align their objectives with those of their national governments, the potential for collaboration, support, and attainment of those objectives is increased.

In 2010 the City Council of Lisbon cooperated with the municipal agency for energy and environment (Lisboa E-Nova), the Institute for Nature Conservation, Lisbon University, and the Secretariat of the CBD to produce Portugal's first LBSAP, called "Lisbon Biodiversity 2020" (see Figure 7.2). Launched in 2012, it is the first local action plan in Portugal's National Biodiversity Strategy and Action Plan (NBSAP). The proposed strategy includes a specific item to foster cooperation among national, regional, and local authorities and to involve decision-makers and stakeholders to implement it,

URBAN NATURE FACTS

- **Regulation and enforcement have decreased sulphur dioxide and black smoke emissions in London by more than 95 percent since 1962.**
- **Decision-making that supports investment in natural capital can create jobs, underpin economic development, and secure untapped economic opportunities.**

which is in turn based on a European Union–wide strategy. Lisbon's LBSAP includes a full application (developed in cooperation with Curitiba, Brazil) of the City Biodiversity Index (see pp. 24 and 53).

A compelling example of integration combining top-down and bottom-up approaches is that of London. The creation of the London Biodiversity Partnership in 1996 brought key public and private stakeholders to agree on a set of objectives aligned with the UK government strategies and action plans. Together they came up with London's Biodiversity Action Plan, which identifies priority actions regarding important wildlife habitats and several key species. The success of this strategy, which is also aligned with international objectives, has depended on ensuring its acceptance as a normal part of the planning process. Another good example is the launch in April 2012 of Bioclima Paraná (see Figure 7.3), the Brazilian state of Paraná's biodiversity strategy and action plan, developed in support

AICHI TARGET 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.

City authorities have key mandates on this target. Strategies include facilitating licensing of green businesses, enforcing environmental regulations, providing incentives for new (and greener) technologies (such as tax breaks or free land/infrastructure), promoting and attracting green investors, and mainstreaming of "payment for ecosystems services" mechanisms.

AICHI TARGET 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

In the USA, out of $81 billion invested in biodiversity (most of it in the design, establishment, and operation of protected areas) in 2007–2008, $61 billion came from local authorities. Parkways, corridors, and municipal and provincial parks (public and private) arguably can make the difference in reaching this target.

of the Brazilian national biodiversity and action plan and the Aichi Biodiversity Targets. Bioclima proposes climate-change mitigation and adaptation measures through new mechanisms of environmental management and financial incentives, including payment for ecosystem services (PES). One of the modalities of PES will be the Biocredit, a set of public and private financial resources intended to compensate landowners who preserve forest areas beyond the requirements determined by existing national and state environmental laws. Bioclima's stakeholders include NGOs, scientific and technical institutions, the private sector, and multilevel government implementation agencies.

Local governments can help turn policy into practice

Not all urban planning is spatial, and identifying strategic entry points can have a significant effect on the way business is done. For example, by influencing the way procurement is practiced, municipalities can promote "green" products and services and create incentives for service providers to work toward ecosystem integrity. Local governments also have some control over the goods that transit through their boundaries, and they can develop and enforce legislation and control over these goods in an ecologically appropriate manner. For example, the city of São Paulo, Brazil, through which great quantities of timber pass en route to various parts of the world, has had a substantial impact by ensuring that only legally harvested timber trade is permitted within city boundaries. Illegal merchants find this difficult to circumvent because São Paulo remains the region's most efficient trade route.

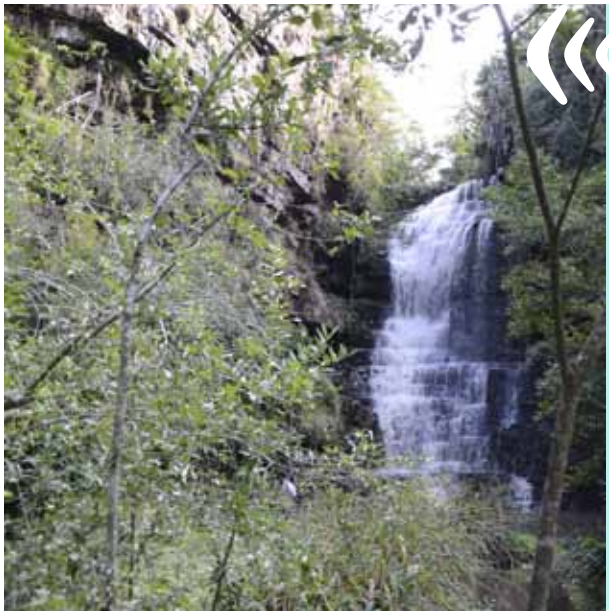
By demonstrating the value of ecosystems and integrating measures such as subsidies, bylaws, certification programs, and codes of conduct to promote and preserve biodiversity, local governments can bring different departments together to harmonize their policies and ultimately enhance service delivery to residents. For example, incentive measures related to green infrastructure can bring together departments in charge of housing, roads, parks, water, and even finance to realize gains for the city as whole. By constructing and preserving eco-corridors, pocket wetlands, permeable pavements, urban forests and gardens, green parks, connections between urban and rural areas, and green walls and roofs, cities can significantly

How Accra Benefits from Its Wetlands

Accra is Ghana's largest city and economic center. It has three major wetlands, and according to Ghana's Environmental Protection Agency, they provide residents with "unimaginable benefits"—among them erosion and flood control, clean water, and a greenbelt that regulates the city's microclimate. As important sites for eco-tourism and as scenic spots for the city's hotels and beach resorts, the wetlands support commerce and employment. They also support the city's poorest residents, who use the wetlands for fishing, crabbing, the provision of raw materials such as raffia and salt for cottage industries, traditional medicines, and dry-season vegetable farming. As Accra has grown, however, its wetlands have been threatened by development, pollution, overexploitation, siltation, and loss of biodiversity and aesthetic values. The city has managed these problems by instituting integrated management strategies that recognize the value of wetlands and ensure enforcement of building regulations and pollution control. The approach has included the designation of two Wetlands of International Importance (Ramsar sites); management systems on the sites; development of Coastal Sensitivity Mapping; delineation of greenbelts to stop urban sprawl; and the creation of awareness programs to encourage residents to help conserve the wetlands.

Growth Corridor Plans in Melbourne

Melbourne is Australia's second-largest city, with a current population of more than 4 million. It is growing rapidly and expected to reach 6 million over the next 30 years. In response to this growth, a metropolitan planning strategy is being prepared that will not only manage growth but ensure that Melbourne sustains its broadly valued infrastructure, services, cultural attractions, and diverse natural settings. The city's Growth Area Authority—an independent body that works in partnership with local councils, developers, and the Victorian Government to help create sustainable, well-serviced communities—is developing four Growth Corridor Plans. Each plan will create new communities planned around housing, jobs, transportation, town centers, open spaces, and key infrastructure, taking into account impacts on biodiversity and how to plan for better integration of nature and people. New communities will benefit from an integrated plan that provides for a distinctive character and amenities and that preserves and enhances existing biodiversity values. By guiding development in a sustainable manner, the plans aim to reduce carbon and other footprints.



Durban's Metropolitan Open Space System – D'MOSS

Durban, South Africa, is located in a global biodiversity hotspot and has been committed to sustainable development for decades. The Durban Metropolitan Open Space System (D'MOSS) is a plan that identifies key areas that support biodiversity and supply ecosystem services. Although D'MOSS was initiated in the 1970s and has appeared in strategic plans since the early 1990s, Durban's town planning schemes were developed with little environmental input and often conflict with strategic plans, environmental policy, and law. To address this problem, D'MOSS was included in the schemes in 2010 as a controlled development layer, a first for a South African city. Despite the underlying zoning, development may not occur within D'MOSS without first obtaining environmental authorization or support from the municipality, which may or may not be given. Where it is given, it may be subject to significant controls to ensure that biodiversity and ecosystem services are not degraded. This effort has been seen by some as curtailing property rights, but others see positive spin-offs—for example, the city's Treasury and Real Estates Departments can now consider potential environmental restrictions when property taxes are calculated on vacant land.

reduce the costs of delivering certain services such as storm-water management. Green infrastructure can also boost municipal tax revenues by stimulating green economic activity, attracting high-caliber professionals and businesses, and increasing real-estate value. According to a literature review completed by the City of Montreal in 2010, proximity to parks generally increases property value. The increase varies from 5 to 20 percent, depending on park and neighborhood characteristics. Owing to the multifunctional characteristics of green infrastructure, local government and residents can also benefit from, among other things, reduced soil erosion, improved soil fertility, increased aesthetic values, and lower heating, ventilation, and air-conditioning requirements.

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KEY MESSAGE 8: *Successful management of biodiversity and ecosystem services must be based on multi-scale, multi-sectoral, and multi-stakeholder involvement.*

Cities are centers of ecosystem-service demand as well as sources of global environmental impact. They thus have an important role in environmental governance, focused both on the urban landscape and on the more remote ecosystems affected by urbanization. The efficiency of these governance efforts depends on collaboration of multiple jurisdictions as well as involvement of stakeholders to address the multiple drivers of biodiversity loss. Involved actors should come from all sectors and levels of decision-making. Cooperation is important to synchronize and harmonize actions "vertically" (i.e., at international, national, sub-national, and local levels) and "horizontally" (e.g. across divisions such as environment, planning, transportation, education, finance and nutrition). Adding to this, various levels of public institutions can increase their capacity and support by cooperating with other actors such as citizen groups, scientists, NGOs, businesses, and UN and other international organizations. Different actors are sources of different knowledge and management capacity.

There is significant diversity in the way parties can approach vertical and horizontal governance of biodiversity and ecosystem services. Federally managed governments such as that in the UK decentralize many of the mandates on biodiversity governance to their national and sub-national authorities, and these in turn commission much of the implementation at lower government levels. This is also the case in Germany and Canada. Other nations, such as Japan, South Africa, Mexico, and Brazil, provide guidelines for biodiversity governance and encourage their sub-national and local governments to develop strategies and action plans in line with their national ones. In the case of small island states and more centrally managed nations, communication is more direct, and responsibility for local implementation is shared at all levels of governance.

INDIGENOUS PEOPLES IN URBAN AREAS

According to an estimate in a 2010 UN-Habitat report, at least 40 percent of the world's indigenous peoples now live in urban areas. For example, an estimated 40 percent of Latin America's indigenous peoples, 54 percent of Canada's aboriginal peoples, and 84 percent of New Zealand's Maori population live in cities. In Chile almost 65 percent of the indigenous population resides in cities, and in Tanzania 90 percent of Masai men have migrated to the city. Several factors have prompted such migrations: land dispossession, displacement, military conflict, natural disasters, the overall deterioration of traditional livelihoods coupled with the absence of viable economic alternatives, and the prospect of better economic opportunities in cities. For many indigenous peoples, migrating for work—both within and beyond national borders—is perceived as a way out of poverty.

Despite finding a few benefits, such as proximity to social facilities, many indigenous peoples encounter substantial difficulties in urban areas. Lack of employment and income-generating opportunities, racism and other forms of discrimination, limited access to education and health services, and inadequate housing are the main challenges they face. In general, disrespect for a wide range of human rights is often the main underlying cause for persisting poverty among urban indigenous communities. In most cases, indigenous communities try to organize themselves to better cope with their new economic and social conditions.

There are, however, examples where urban indigenous peoples have opportunities to improve their lives and to contribute to the sustainable development of cities. The increasing efforts of many local authorities to preserve biodiversity and local culture have revealed unique opportunities to integrate indigenous traditional knowledge into biodiversity conservation strategies and action plans. As indigenous peoples often have profound connections to the land and the goods and services it provides, cities can benefit by engaging indigenous peoples in urban planning and policy. Traditional knowledge can help cities reduce project costs—for example, by improving resource management—and thus contribute to the conservation and sustainable use of natural resources.

Top: In response to a growing awareness of the needs and aspirations of aboriginal peoples residing in Edmonton, in 2005 the City Council adopted the declaration "Strengthening Relationships between the City of Edmonton and Urban Aboriginal People." Later that year it also developed the Edmonton Urban Aboriginal Accord, and two years later it created an Aboriginal Relations Office. As a result of these efforts, Edmonton is bringing aboriginal perspectives to city projects, among them land-use review of a portion of Whitemud Park, the redesign of Walterdale Bridge in Rossdale, and the Boyle Street redevelopment plans.

Bottom: Auckland, the largest city in New Zealand, has a sense of place that has been shaped by the shared experiences of Maori and European peoples. Maori see themselves as belonging to the land, as opposed to the land belonging to them, and the natural environment plays a significant role in defining the Maori sense of place. With the participation by Maori in local government decision-making, the Auckland City Council developed the urban design framework, in which its goal number one is to reflect the city's tangata whenua—Maori, Pacific, and multicultural identity—and to be visibly recognized as a place of the South Pacific. The use of Maori values in urban design and development is entirely consistent with low-impact urban design and development.

Good governance benefits from a diversity of approaches

Good governance is the process of steering or guiding societies toward collective outcomes that benefit all levels of society. Processes of decision-making need to balance a mix of centralized and decentralized structures, which in turn need to adapt and change with prevailing circumstances. There is no "silver bullet" for best governance. Good environmental governance in cities is likely to benefit from a diversity of approaches. Patterns of good governance at the global level are beginning to emerge, but we still need to understand how to assess their effectiveness.

Writing in *Science* in 1999 about new insights into managing common resources, the American political economist and Nobel laureate Elinor Ostrom and her colleagues concluded that "Institutional diversity may be as important as biological diversity for our long-term survival." They may well be right, but there is little understanding of this diversity and how it can lead to patterns of good governance that cut across scales—from local to global—in different ecosystems, including the urban. Thus there is a need for experimenting, fostering a diversity of institutions and approaches as well as generating more knowledge about governance of biodiversity and urban ecosystem services. Such an approach points to a need for enhanced capacity among public institutions to coordinate activities, manage multiple stakeholder partnerships, and apply scientific and other sources of information.

New governance structures for land management for biodiversity have emerged that do not rely solely on traditional market and government interventions, but on other institutional arrangements. Often, local citizens make these arrangements themselves, and they involve private, common, and public land to protect ecosystem services that cannot always be assessed by monetary values. These are governance mechanisms that can provide new forms of thinking about spatial planning and interventions from different perspectives. They are particularly useful for understanding the role

AICHI TARGET 18: By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

At least 40 percent of the world's indigenous peoples now live in cities. Traditional knowledge and the importance it bestows to biodiversity therefore need to be integrated into urban planning. Cities in Panama, Guatemala, Bolivia, Venezuela, Fiji, Samoa, and Indonesia, among many others, possess significant indigenous populations that should be engaged in sustainable urbanization and city management.

AICHI TARGET 4: By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

Means of production and modes of consumption are dictated by norms, regulations, and negotiations happening in cities. City governments—by their business licensing and law-enforcement mandates, close relations with large corporations, and landscape management tools they have at close range—are arguably THE level of government that can achieve this target.

Biodiversity Recovery in Greater Sudbury

The Canadian city of Greater Sudbury, the most populated city in northern Ontario, is an important mining center and home to one of the largest nickel ore bodies in the world. Past smelting activities contributed to high levels of atmospheric sulphur dioxide and resulted in the disappearance of most of the area's vegetation: by the 1960's, an estimated 84,000 hectares were barren or semi-barren. In 1978 the city initiated an environmental clean-up and re-greening program. Based on a partnership among community groups, citizens, government agencies, educational institutions, and the local mining companies, Vale and Xstrata Nickel, the program has resulted in the planting of millions of trees and shrubs on tens of thousands of hectares. Together with the mining companies, the city also developed a Biodiversity Action Plan. This long-term commitment to ecological recovery and biodiversity was developed with considerable community input. The plan outlines the actions needed for ecological recovery, highlights the need for education and citizen engagement, and also addresses issues such as watershed protection, food biodiversity, climate change, and at-risk species. With these efforts, the City of Greater Sudbury and its partners continue to showcase the extent to which a community can transform itself through ecological recovery.

Generating Green Jobs in Durban

The Buffelsdraai Landfill Site Community Reforestation Project in Durban, South Africa, was initiated in 2008 in anticipation of creating a carbon sink to help offset the CO_2 emissions associated with Durban's hosting of several World Cup soccer matches in 2010. The project involves "reforestation" of a 757-hectare buffer zone of a municipal landfill site. Indigenous trees are grown by "Treepreneurs," local community members who establish small-scale tree nurseries at their homes. Tree seedlings are exchanged for credit notes, which can be traded for food and other basic goods, or even used to pay school fees. To date, the project has engaged nearly 600 Treepreneurs—75 percent of them women and 19 percent of them youth—who have planted more than 276,000 trees on 240 hectares. The project has created more than 300 jobs for community members, demonstrating that reforestation can provide direct socioeconomic benefits to communities as well as enhance biodiversity and ecosystem functioning. In 2011 the Buffelsdraai Landfill Site Community Reforestation Project was recognized by the United Nations as one of 10 "lighthouse projects"—projects in developing countries that help put the world on a more climate-resilient and low-carbon path while also improving people's lives.

of different actors. They can also address concerns that local populations may be losing control of their landscape to higher levels of governance. Giving local people more voice and control is one step toward finding sustainable solutions to managing their resources.

Many solutions for preserving biodiversity emerge at the local level

There is an urgent need to create governance mechanisms that facilitate the dynamic exchange of knowledge and resources. Such exchanges can generate innovative solutions for urban biodiversity from the local to the global level. They are also necessary for building local capacities that can scale up innovations. As many of the solutions to global concerns such as biodiversity emerge at the local level, we need local and global efforts to create the capacity to innovate locally and diffuse those innovations globally to those who need them. Local groups have to be able to adopt the best solutions for their local needs, absorb new practices, and be able to create the institutional mechanisms to support these efforts.

Local authorities should map the possibilities of collaboration. Initially they should try to align their work on biodiversity with other formal and informal local processes that can affect biodiversity positively or negatively. In so doing, local governments must create a forum for interaction among the relevant stakeholders within and beyond the city. This can be done in three steps:

1. Decisions should be based on transparency, accountability, and inclusiveness, in order to create trust among stakeholders and a collaborative environment.
2. Local authorities should create the rules and organizational capacity to make collaboration effective and efficient. Many collaborations stop midstream, and stakeholders lose interest in continuing. A contact person (or department/organization) for each action can help determine responsibilities and flow of information.

Linking Biodiversity and Traditional Crafts in Kanazawa

Kanazawa, Japan, is famous for its gardens, old architecture, literature, cuisine, and traditional crafts. The city was designated a UNESCO City of Crafts and Folk Art in 2009 and hosted the global launch of the UN Decade on Biodiversity in 2011. Local businesses have traditionally been linked to the city's ecosystems. In recent years, city policies, community involvement, and local entrepreneurship have reinforced this cultural and ecological richness through various initiatives. In agriculture, an innovative branding scheme for traditional varieties of local vegetables—Kaga vegetables—has helped preserve agro-biodiversity while incentivizing the local economy, from seed companies to farmers, retailers, and the hospitality industry. These efforts have also revitalized the traditional Kaga cuisine and the locally made porcelain and lacquerware on which it is served. Approximately half of the city's current vegetable production—valued at more than $US 16 million in 2008—corresponds to the Kaga brand. Kanazawa currently has about 900 manufacturing companies related to traditional craft industries. Its efforts highlight the importance of aligning cultural considerations in the design of local strategies that ensure sustainable use of local biodiversity.

3. Collaboration should reflect realities on the ground, in both biodiversity and social dimensions. Clear mechanisms of assessing the direction in which local biodiversity is moving, such as the City Biodiversity Index (see pp. 24 and 53) and other indicators, are also necessary.

Sub-national governments can play a critical role in protecting biodiversity

Sub-national governments—be they provincial, state, or regional—have a critical role to play in helping cities protect biodiversity. Local governance of biodiversity typically requires landscape-level coordination and thus can benefit greatly from the cooperation of sub-national governments. This is particularly true when (a) urbanization has happened through smaller cities, where economies of scale apply; (b) coordinated efforts are needed to protect watersheds and other ecosystem features; and (c) there is a need to quantify the footprint of urbanization beyond city borders. Sub-national governments also hold critical mandates in terms of tax and infrastructure-investment distribution to cities that are essential for any green municipal budget to work.

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A Public-Private Partnership in Iloilo City

The Iloilo River has played a significant role in the development and economy of Iloilo City, Philippines. By 2000, however, unrestricted development, siltation, overfishing, commercial exploitation, and dumping of waste had brought the river to a critical state. Facing further urbanization and alarming degradation of the river and the biodiversity it supported, in 2003 the city government partnered with the Iloilo Business Club (IBC) to develop a planning process and 10-year master plan for restoring the river. Realizing the need for multisector and integrated approaches, the city and IBC convened consultative groups composed of NGOs, private businesses, academia, religious organizations, villages, and youth groups. A multiagency coordinating body—the Iloilo River Development Council—was established to institutionalize and implement the master plan. The plan has prevented the destruction of mangroves, stemmed aquatic pollution, and established community watch groups to facilitate environmental protection. It has also resulted in measures to conserve and protect biodiversity. This approach demonstrates how multiple stakeholders, including those with commercial interests, can work together to integrate the protection and enhancement of important natural resources into both a sustainable urban master plan and actions on the ground.

Water Supply, Sewerage, and Environmental Clean-Up in Cartagena

A 20-year project (2005–2025) to rehabilitate and expand the water supply and sewerage for the city of Cartagena, Colombia, is providing opportunities to sustainably dispose of wastewater, restore an important coastal wetland, and improve sanitary conditions and access to clean water for the city's poor. The approach includes restoration of degraded habitats, improved protection of a legally protected area, use of a cumulative environmental impact assessment (the first of its kind in Colombia), and establishment of a multidisciplinary expert panel to oversee the design and site-selection process. This project demonstrates the importance of considering biodiversity as part of a project's initial goals. By adopting this approach, the issues surrounding the disposal of 145,000 cubic meters per day of polluted wastewater are being overcome. By integrating the views of local stakeholders, perceptions have been changed and landscapes once thought of as degraded or unattractive are becoming economic, aesthetic, and ecological assets. Not only are sanitary conditions being improved, but the expansion of water-supply services is increasing land values. The holistic thinking applied in Cartagena demonstrates how the needs of infrastructure, biodiversity, and local communities can be integrated in a mutually beneficial and sustainable manner.

Figure 9.1. The City of Nagoya, Japan, founded Nagoya Biodiversity Center in September 2011 to promote activities that preserve biodiversity. Working with citizens and local community groups, the center carries out activities such as field surveys of plants and animals, control of invasive alien species, and exchange of information among relevant organizations. Here, a group surveys the birds of Shonai Green as part of a citywide bird survey.

KEY MESSAGE 9: *Cities offer unique opportunities for learning and education about a resilient and sustainable future.*

As important hubs for diversity, creativity, and innovation, cities are a testing ground of our capacity to live together and create environments that are socially just, ecologically sustainable, economically productive, politically participatory, and culturally vibrant. Education is vital to the task of acquiring that capacity. Schools are an important means of establishing the connection between local life and global issues, including the challenges posed by the loss of biodiversity. Local authorities can play a crucial—and growing—role in integrating biodiversity into the urban educational agenda (see Figure 9.1). At the same time, the capacity to live sustainably in urban settings is not acquired only within the walls of formal educational establishments; it is also generated through a wide range of informal modalities of learning. Cities are themselves the sites of continuous exchanges of practical, traditional, and scientific knowledge and information through which people's thinking, understanding, and perceptions are transformed. Such transformations may ultimately lead to corresponding changes in urban planning and policies.

Education for Sustainable Development (ESD) is a key strategy

Over the last few decades the variety of urban environmental education programs has grown significantly, with the aim—among other things—of raising awareness about the benefits provided by ecosystem services in general and biodiversity in particular. Approaches range from outdoor-adventure programs to programs focused on environmental action; while some seek to teach ecological science through hands-on inquiry or research activities, others integrate art, green jobs, or social justice. Recently, increased attention has been given to programs that take place within the context of communities, including in cities, so as to better foster learning about social as well as ecological processes. Prominent examples are programs that are nested within and linked to community-based stewardship or civic ecology practices, such as community forestry, streamside restoration, and community gardening. Incorporation of traditional knowledge and practices is critical for the success of such community-based initiatives. These and similar educational approaches are part of the UN-promoted Education for Sustainable Development (ESD), which seeks to "encourage changes in behavior that will create a more sustainable future in terms of environmental integrity, economic viability, and a just society for present and future generations."

Considering that by 2030 urban dwellers will account for 70 percent of the world's population, and that a similar percentage of these urban residents will be under age 18, ESD should be viewed as a key strategy for enabling individuals to make informed decisions at all levels of urban life while promoting lifestyle changes that integrate the multiple values of biodiversity.

It is also important to stress the role of formal education. Continuous professional development and life-long learning offer opportunities to introduce new ideas, the latest science, and values about urban biodiversity to professionals, politicians, and practitioners. Current curricula for professionals (including planners, health professionals, and architects) need

AICHI TARGET 1: By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

No level of government can reach citizens for education, communication, and awareness-raising as regularly, clearly, and effectively as city officers. National governments need to help cities achieve this target.

to be reformed to continually introduce new information. This is particularly urgent in areas that are urbanizing most rapidly.

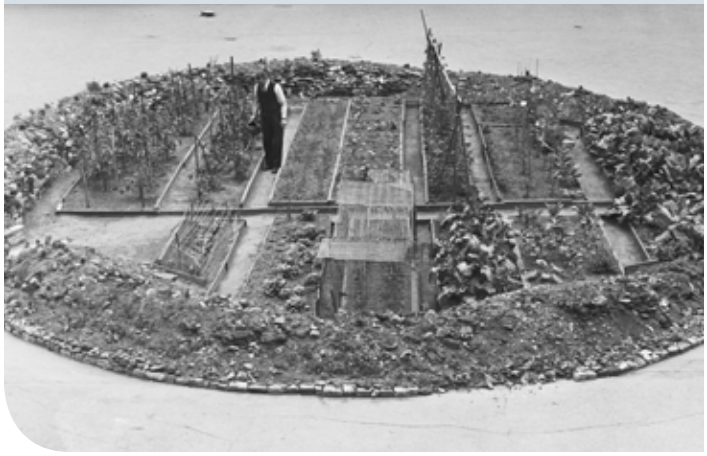
While urban ESD strategies need to be adapted for different learners—for example, professionals, students, communities, practitioners, and policy-makers—their principal components should encompass:

- *An innovative and holistic vision of education, professional development, and lifelong learning* that encompasses various forms of training, information, awareness-raising, and learning for all ages.
- *A cross-disciplinary approach* that promotes urban biodiversity and sustainable urban development and that allows the environmental, social, economic, and cultural dimensions of biodiversity to be addressed in a comprehensive manner.
- *Values and a vision of the future* to guide individuals toward an attitude of respect, social cohesion, sharing, solidarity, and intergenerational responsibility.
- *A dynamic and participatory pedagogical framework* that is adapted to local contexts and places individuals at the heart of education for urban citizenship and respect for the values of biodiversity.
- *A cooperative process* that involves multiple stakeholders—including students, teachers, decision-makers, civil society, the private sector, the media, and all cultural communities—at the community, national, and international level.

GREENING IN THE RED ZONE

Stories are emerging from communities around the world of people who turn to greening during the most difficult of times—periods of violent conflict and collapse of the social and economic fabric of their community, and in the aftermath of earthquakes, hurricanes, and other disasters. They range from post-apartheid actions in South Africa to re-greening symbolically poignant landscapes to revisioning open space after a massive earthquake in Haiti and after an earthquake and tsunami in Japan. These examples of post-catastrophe, community-based stewardship of nature serve as sources of social-ecological resilience and are referred to as "Greening in the Red Zone."

The Civic Ecology Lab at Cornell University has collected such stories in a book and a related website (www.greeningintheredzone.blogspot.com) in an effort to understand how local greening practices can become a source of resilience during difficult times. Because of the rapid growth of cities globally and their ever looming importance as sites of conflict and disaster, many of the case studies are from urban settings (e.g. the Berlin Wall, New Orleans post-Katrina, Monrovia after the Liberian civil war), although more rural examples (Korean village groves, community-based wildlife and park management in Kenya and Afghanistan) and region-wide examples (e.g. Cyprus Red Line, Korean Demilitarized Zone) also are of interest.



Biodiversity Education in Mexico City's Zoological Parks

Mexico City operates three zoological parks: Chapultepec Zoo, San Juan de Aragón Zoo, and Los Coyotes Zoo. In recent decades these parks have evolved into modern conservation centers of local, national, and exotic wildlife species. Considering education as an essential task for biodiversity conservation, the parks have developed a wide array of innovative educational programs and activities, among them rotating exhibits, interactive educational activities, and educational courses and school tours. Activities may focus on a specific species and its recovery, or they may be directed toward biodiversity-related themes such as climate change, water conservation, or habitat protection. The great majority of the 9 million people who visit these parks every year live in cities and have limited exposure to nature. Mexico City's zoological parks thus have the opportunity to heighten public awareness of the importance of conserving biodiversity for a resilient and sustainable future.

The application of the UNESCO Biosphere Reserve concept developed under the Man and the Biosphere Programme is particularly relevant here as it can help bridge city, municipal, and regional boundaries, thereby creating platforms for politically neutral collaboration for enhanced resilience and sustainability. This can facilitate learning and education by providing "one-stop" integrated learning platforms based on the participation of all relevant learning and education stakeholders (e.g. schools, universities, research institutions, etc.) as well as other key stakeholders (e.g. local communities, authorities, private sector, NGOs, etc.). Other examples include URBIS (see p. 57) and the Transboundary Conservation Specialist Group (www.tbpa.net) of the IUCN World Commission on Protected Areas (WCPA).

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URBAN NATURE FACT

- **Hands-on activities, compared with textbook-based curricula, significantly increase children's knowledge about plants and eco-centric attitudes.**

UNESCO's Education for Sustainable Development – ESD

UNESCO is the lead agency for the UN Decade of Education for Sustainable Development 2005–2014. ESD aims to enhance cities' roles as places for good governance, proper planning and landscape considerations, multicultural expression, and social inclusion. It focuses on creating a quality learning and educational environment for sustainability, promoting lifelong learning opportunities, teaching tolerance and mutual understanding, enabling youth to learn to participate in urban life, and creating inclusive societies. Biodiversity education is an integral part of ESD, which promotes mainstreaming biodiversity and ecosystem services into all forms of learning as a critical contribution to sustainable development. This includes organizing thoughtful consumption and production behaviors that are sustainable from local to global levels.

Five Million Trees in Five Years: The Harare Greening Project

The Harare Greening Project in Zimbabwe is an ambitious effort to reverse deforestation, help mitigate the effects of climate change, and beautify Harare's roadways. The project began in 2010 when a few Harare residents convened a stakeholders meeting. Among the key players they invited were NGOs working in sustainable development and climate change, government workers with responsibility for trees, tree nursery owners, and municipal representatives. The group set a target of planting 5 million trees over a 5-year period. They encouraged participation at many levels and invited supporters to plant trees on their own land or on public land, or to buy trees for others to plant. Half a million trees were reportedly planted in the first year. Although the project has encountered many challenges, it has continued to expand. What's more, the concept has been adopted on a larger scale: a partnership of companies that formed an organization called Friends of the Environment Trust is championing a nationwide effort to plant 500 million trees in Zimbabwe.

Restoring a River and Empowering Youth: New York City

Year-round, the nonprofit organization Rocking the Boat in New York City offers opportunities for disadvantaged local youth to learn about the natural and social history of the Bronx River and to help restore it. Planting *Spartina* grasses, mapping the riverbed's topography, building and installing bird boxes along the riverbank, taking field notes and collecting data, and learning to identify plants, birds, fish, and other wildlife are just a few of the activities students undertake. Getting out on the river in hand-built wooden boats, the students also learn about water safety, teamwork, and how to row a boat. As Rocking the Boat says on its website, this hands-on environmental education program gives urban youngsters "the chance to learn about their own community, their own river, and their own possibilities for the future."

KEY MESSAGE 10: *Cities have a large potential to generate innovations and governance tools and therefore can—and must—take the lead in sustainable development.*

Cities are sites of creativity, innovation, and learning. Fostering these attributes is essential if the global challenge of preserving biodiversity in the face of unprecedented urbanization is to be met. Local authorities will carry the leadership role of cities in promoting the biodiversity agenda, but they cannot be effective acting alone.

There are potential barriers to cities assuming a stronger and more direct leadership role in promoting sustainable development. These include the following:

1. Working at the city scale involves coordinating many different voices. Unleashing the potential of cities, their elected officials, and community and business partners to become local as well as global players in biodiversity means acknowledging the diverse roles of different stakeholders in building greater urban resilience.
2. National political, administrative, and fiscal systems are not always designed to support innovations in cities. For some national governments, the idea that cities might act independently or require greater powers and resources to drive the biodiversity agenda is frightening. Yet if sustainability is to be advanced through city-scale innovations, an assessment of the distribution of responsibilities and authority within a national system may be necessary.
3. For international agencies wedded to national systems of representation, the imperative of increasing the scope for city leadership and innovation in order to protect ecosystems will require reform of global forums, processes, and structures.
4. For local community groups and activists wanting to have a bigger, more global impact on urban biodiversity and ecosystem services, it will be important to ensure that local lessons can be scaled up and made transferable or comparable.
5. Corporate interests are generally not interested in the well-being and biodiversity of a city per se. However, their core business rests on well-functioning ecosystems within and beyond the city, and they typically have significant expertise in managing the interface between their activities and the ecosystem services on which they depend. Getting corporations to share this knowledge with urban managers would foster innovation.

Cities have a central role to play in promoting global sustainability

To some extent, these points about the centrality of cities in the change process were made in the early 1990s with respect to sustainable development and the launch of Local Agenda 21 (LA21). There are important lessons to be gleaned from LA21 from a biodiversity perspective.

Local Agenda 21, launched in 1992 at the Earth Summit in Rio de Janeiro, attempted to assist local authorities in tackling many of the global sustainability challenges typically considered beyond their control. LA21 emphasized mainstreaming participatory processes in which

The Way of the Future: Urban Eco-Areas

Photo of the master plan of the city of Masdar, United Arab Emirates. Some cities are starting to change their ways. They are taxing wastes, encouraging renewable energies, promoting car sharing, and optimising natural sources of light. The best examples are in urban eco-areas such as Copenhagen's Vesterbro (Denmark), London's Beddington Zero Energy Development (UK), Vauban in Freiburg im *Breisgau* (Germany), and the Eva Lanxmeer quarter in the City of Culemborg (The Netherlands). These areas are designed to be carbon neutral and to promote concepts of eco-citizenship, encouraging people to improve their own well-being by preserving the environment. "Cities of tomorrow" are also beginning to emerge—cities that are ecological and technological at the same time. For example, the energy-independent city of Gwanggyo in South Korea will be a verdant acropolis of organic "hill" structures, with eight buildings that mix housing, offices, entertainment areas, and other facilities, thereby reducing transportation needs while also building a strong sense of community. In the United Arab Emirates, the planned city of Masdar will rely entirely on solar energy and other renewable energy sources, with a zero-carbon, zero-waste ecology. Located just south of Abu Dhabi, this eco-city will eventually comprise 6.5 square kilometers and by 2020 be home to 90,000 inhabitants. Transport will be based only on citizen's feet, bikes, and for further distances, a rapid electric tramway.

Montreal's Urban Ecoterritories

In 2004, to halt the annual loss of 75 hectares of woodlands, the Canadian city of Montreal identified 10 areas larger than 15 hectares in which to prioritize the protection and enhancement of natural spaces. These "ecoterritories" comprise core zones (pockets of biodiversity), protective buffers, and ecological corridors (see map) and include a mix of existing protected areas and other natural spaces, in private as well as public hands. With public consultation and the cooperation of landowners, the city has engaged in several conservation initiatives in the ecoterritories. For example, in exchange for tax benefits, landowners can donate their land to the city, exchange it for publicly owned brownfields, or confer protected status on it for a period of 30 years. The ecoterritories concept has been seen as a win-win for everyone involved and is now recognized in several borough chapters of the Montreal Master Plan.

Green Urban Policies in Montpellier

Montpellier, France, provides an outstanding example of how green urban policies can attract investments in sustainable development and technologies. Montpellier has an extensive "green network" of protected areas that link the city's ecosystems. Investing in biodiversity has paid off for the city: in 2011, Montpellier was named the European and French Capital for Biodiversity. This image, in turn, has attracted green businesses and even international scientific organizations. Several research institutions, including Bioversity International, CIRAD-Agriculture for Development, the National Institute for Health and Medical Research, and the Institute for Research and Development, work in Montpellier through Agropolis International, a network of researchers in 13 institutions. The city also reaches out for scientific and technical cooperation. Cooperating with cities in the USA, Germany, Spain, China, Israel, Morocco, and Algeria, Montpellier took the lead in establishing MEDIVERCITIES, a network of cities focused on biodiversity around the Mediterranean Basin.

local stakeholders set their own priorities while at the same time more effectively engaging higher levels of governments. However, in 2005, frustrated by the failure of the U.S. Government to ratify the Kyoto Protocol, more than 140 U.S. cities pledged to meet the protocol's targets themselves. That same year 18 large cities around the world formed the Large Cities Climate Leadership Group (C40) to address the causes and consequences of climate change where national-level inaction had typically prevailed. Twenty years after the start of LA21, there is a perceptible tension between process and results, with many national governments ignoring local engagement processes when faster results can be obtained.

Conserving biodiversity, using it sustainably, and sharing its benefits equitably is the threefold challenge of the Convention on Biological Diversity. Human society everywhere must take a more active role in promoting solutions that take into account our profound connections with and impacts on the rest of the planet. Nowhere is this more critical than in cities. As centers of human innovation, and perhaps the most active frontier of our impact on the planet, cities offer enormous opportunities to reimagine and invent a different kind of future with room for humans and other species to thrive. Cities may well be the ground where we secure a globally sustainable future—one that establishes responsible environmental stewardship at the heart of human well-being.

AICHI TARGET 20: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011–2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

Innovative financing is one of the solutions that will be found at provincial and municipal levels. Most Payment for Ecosystem Services mechanisms (for watersheds or temperature regulation, for example) and examples of tourism revenues accruing to park systems through concessions, for instance, come from sub-national or local governments.

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SECTION III

Resources

Cities, sub-national and national governments, academia, and international organizations have developed a vast toolbox of policy instruments, guidelines, projects, and institutions that promote the preservation of biodiversity. This section lists some of the most important ones; it is by no means complete, but opens doors for further contacts and research.

Aichi Biodiversity Targets

www.cbd.int/sp/targets

Twenty ambitious goals that make up part of the CBD's Strategic Plan for Biodiversity 2011–2020 (see below), adopted in Nagoya, Japan, in 2010. Organized under five main goals, the targets provide a framework for action by all stakeholders—including cities—to save biodiversity and enhance its benefits for people. A complete list of the targets can be found in Appendix 1.

CBD Programmes of Work

www.cbd.int/programmes

The Conference of the Parties of the CBD established seven thematic programmes of work which correspond to some of the major biomes on the planet. Each programme establishes a vision and basic principles to guide future work, and parties periodically review their state of implementation. The COP has also initiated work on key cross-cutting issues that provide links between the thematic programmes. All of these efforts contribute to meeting the Aichi Biodiversity Targets (see above).

CEPA – Biodiversity Communication, Education and Public Awareness

www.cbd.int/cepa/about.shtml

Communicates the scientific and technical work of the CBD in language that is accessible to many different groups, integrates biodiversity into education systems, and raises public awareness of the importance of biodiversity. ICLEI and IUCN's Local Action for Biodiversity (LAB) program (see below) and the City of Cape Town collaborated to produce an "Evaluation Design Toolkit for CEPA" (available at www.iclei.org/biodiversity or www.capetown.gov.za/environment) to assist managers, practitioners, and partners in the planning and evaluation of CEPA programs.

Cities in the Hotspots – ICLEI

www.hotspotcities.org

A program being developed by ICLEI to secure ecosystem services in biodiversity hotspots in ways that result in tangible benefits for the people and economies of cities and their regions. The program aims to mobilize a network of local governments that will reduce biodiversity loss and increase social, economic, and ecological resilience to global change, contributing to implementation of the CBD Strategic Plan and attainment of the Aichi Biodiversity Targets. It will be run in partnership with the Secretariat of the CBD, IUCN, UN-Habitat, Ramsar, and Conservation International. Technical assistance and training will be provided to participating cities with a view to building local capacity for ecosystem management.

City Biodiversity Index (see p. 24)

www.cbd.int/en/subnational/partners-and-initiatives/cbi

A tool to help cities manage their biodiversity conservation efforts and integrate biodiversity considerations in urban planning and governance. Also serves as a platform through which cities can share solutions for conserving biodiversity and overcoming problems of urbanization. The user's manual can be downloaded at www.cbd.int/authorities/doc/User's%20Manual-for-the-City-Biodiversity-Index27Sept2010.pdf.

EU CoR – European Union Committee of the Regions

www.cor.europa.eu/en

A consultative body of the EU that provides regional and local authorities with a voice in EU policy development, including on biodiversity. Its 344 political members, including governors and mayors, work to secure harmonious and sustainable development across all European territorial areas.

European Capitals of Biodiversity

www.capital-biodiversity.eu/2.html

A project to highlight the efforts of European municipalities to protect their biodiversity and to provide healthy and livable communities for current and future generations.

FAO – Food and Agriculture Organization of the United Nations

www.fao.org

Serving as a knowledge network and providing policy expertise and technical know-how, FAO works to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations, and contribute to growth of the world economy. By promoting city–region food systems, urban–rural linkages, and urban and peri-urban agriculture and forestry, it contributes to more nutritious and safe food and better management of natural resources.

German Alliance of Municipalities for Biodiversity

www.kommunen-fuer-biologische-vielfalt.de/70.html

Launched as an outcome of the Global Partnership, this new alliance implements nation-wide projects and encourages local authorities to preserve biodiversity. The working language of the alliance is German, so that small municipalities with no English skills can participate.

Global Biodiversity Information Facility

www.gbif.org

Encourages and facilitates free and open access to biodiversity data via the Internet, with a view to enhancing decision-making and advancing scientific research. The *GBIF-ICLEI Best Practice Guide for Biodiversity Data Publishing by Local Governments* (www.gbif.org/orc/?doc_id=4661) increases awareness and understanding of the tools and protocols available for data management as part of local government planning processes.

Global Ecological Footprints

www.footprintnetwork.org/en/index.php/GFN

An international nonprofit working to advance sustainability through use of the Ecological Footprint, a resource accounting tool that measures how much nature we have, how much we use, and who uses what. (See Key Message 1 for a detailed discussion of ecological footprints.)

Global Partnership on Local and Sub-National Action for Biodiversity

www.cbd.int/en/subnational/partners-and-initiatives/global-partnership

Facilitated by the Secretariat of the CBD to help subnational governments and cities sustainably manage their biodiversity resources; implement practices that support national, regional, and international strategies; and learn from existing initiatives. Partners include the UN, national and city governments, NGOs, and academic and research organizations. A separate Advisory Committee on Cities and Biodiversity and an Advisory Committee of Sub-national Governments and Biodiversity have been established, as well as a network of scientists (URBIO; see below) and a Task Force of International Organizations led by UN-Habitat (see below).

Green Wave

www.greenwave.cbd.int/en/home

A global biodiversity campaign to educate children and youth about biodiversity. Each year, Green Wave contributes to worldwide celebrations of the International Day for Biological Diversity (see below). In participating schools, students plant a locally important or indigenous tree species in or near their schoolyard on 22 May at exactly 10 AM, thereby creating a figurative "green wave" starting in the far east and traveling west around the world.

ICLEI – Local Governments for Sustainability

www.iclei.org

An international association of local governments and governmental organizations committed to sustainable development. Members come from 70 different countries and represent more than 570 million people. ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and help local governments implement sustainable development.

ICLEI–IUCN Local Action for Biodiversity (LAB) Project

www.iclei.org/lab

A global biodiversity project coordinated by ICLEI Cities Biodiversity Center in partnership with IUCN (see below). LAB encourages local governments to integrate biodiversity considerations into urban planning and policy. It guides cities in biodiversity and ecosystem management while developing and refining biodiversity "tool kits" and establishing a global network for the exchange of best practices. Participation in LAB entails an assessment, a political pledge at various levels, preparation of a Local Biodiversity Strategy and Action Plan (LBSAP) that aligns with the national equivalent, and implementation of three biodiversity projects. LAB cities receive support in the form of technical assistance, networking opportunities, training workshops, and advocacy.

International Day for Biological Diversity (IDB) – May 22

www.cbd.int/idb

An annual event to increase awareness of biodiversity issues, promote practical action, and showcase the biodiversity work being done in different countries. IDB celebrates a different theme each year. Also see Green Wave, above.

IUCN – International Union for Conservation of Nature

www.iucn.org

The oldest and largest global environmental organization, with more than 1,200 government and NGO members and almost 11,000 volunteer experts in some 160 countries. IUCN works on biodiversity, climate change, energy, human livelihoods, and greening the world economy by supporting scientific research, managing field projects all over the world, and bringing together stakeholders from all levels of society to develop policy, laws, and best practices. Cities and sub-national governments are active members. The Urban Specialist Group of the IUCN World Commission

on Protected Areas (www.interenvironment.org/pa) works to strengthen the ability of the conservation community to serve the needs of cities and inform urban residents about the benefits of protected areas and nature conservation generally. Information and several excellent publications are available at the group's website.

LEED – Leadership in Energy and Environmental Design

www.usgbc.org

An internationally recognized certification program that provides a framework for implementing practical and measurable green building solutions—from individual buildings and homes to entire neighborhoods and communities. LEED certification provides independent, third-party verification that a building, home, or community was designed and built using strategies aimed at achieving high performance in nine key areas of human and environmental health. LEED continually updates its rating system, ensuring that it promotes state-of-the-art strategies for the built environment. LEED projects are in progress in 120 different countries.

NALAS – Network of Associations of Local Authorities of South East Europe

www.nalas.eu

Represents roughly 9,000 local authorities. The NALAS Secretariat, based in Skopje, Macedonia, organizes task forces on themes important to local governments. The primary focus is on local finances, urban planning, waste management, institutional development, and energy efficiency.

Natural Capital Project

www.naturalcapitalproject.org

A joint venture of Stanford University's Woods Institute for the Environment, the University of Minnesota's Institute on the Environment, The Nature Conservancy, and World Wildlife Fund that develops software for quantifying the values of natural capital. Science–policy interface tools enable users to integrate scientific and economic understanding of natural assets into real land-use and investment decisions. Natural Capital seeks to transformation how governments and businesses factor the values of nature into policy and decision-making.

nrg4SD – Network of Regional Governments for Sustainable Development

www.nrg4sd.org

A non-profit established in 2002 to represent sub-national governments at the global level. It now totals some 50 sub-national governments from 30 countries and 7 associations of sub-national governments. The network seeks wider recognition of the crucial role of sub-national governments in sustainable development and encourages understanding, partnerships, projects, and expertise exchange among its members and with other major international stakeholders. It focuses on three main areas: climate change, biodiversity, and water and sanitation.

Plan of Action on Sub-National Governments, Cities and Other Local Authorities on Biodiversity (2011–2020)

http://www.cbd.int/en/subnational/get-involved/plan-of-action

Adopted in 2010 to provide suggestions to parties to the CBD on how to mobilize local actions on biodiversity, take CBD issues to urban residents, and bring national strategies and plans into the urban context. Includes a set of objectives, monitoring and reporting guidelines, and suggested activities for implementation. Dissemination of best practices helps promote local efforts and facilitates communication among all levels of government.

Ramsar Convention on Wetlands

www.ramsar.org

An intergovernmental treaty, adopted in the Iranian city of Ramsar in 1971, that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The convention has worked in collaboration with UN-Habitat, CBD, ICLEI, and others. In 2012 it adopted a resolution on the principles for the planning and management of urban and peri-urban wetlands. An essential element of the principles is recognition of the importance of wetlands as key water-management infrastructure and providers of vital ecosystem services in urban areas.

Stockholm Resilience Centre

www.stockholmresilience.org

A leading research institution that develops innovative approaches on how to govern social-ecological systems and build resilience for long-term sustainability. It aims to understand the complexity and interdependence between people and nature and to enhance our capacity to deal with change.

Strategic Plan for Biodiversity 2011–2020

www.cbd.int/sp

A 10-year framework for action adopted by 193 countries through the CBD and by its stakeholders to inspire broad-based action in support of biodiversity. The plan comprises a vision and mission, implementation guidelines, and the 20 Aichi Biodiversity Targets (see above).

TEEB – The Economics of Ecosystems and Biodiversity (see p. 26)

www.teebweb.org

An international initiative that draws attention to the global economic benefits of biodiversity, highlights the growing costs of biodiversity loss and ecosystem degradation, and draws together expertise from the fields of science, economics, and policy to enable practical actions. TEEB for Citizens (www.teeb4me.com) draws on information from TEEB reports and uses social media to create a global conversation with people interested in reflecting the value of biodiversity in their daily lives and decisions.

UCEG – Urbanization and Global Environmental Change Project

www.ugec.org

A core project of the International Human Dimensions Programme on Global Environmental Change (IHDP) that seeks to provide a better understanding of the interactions between global environmental change and urbanization at the local, regional, and global scales. UGEC facilitates collaboration among academics, political decision-makers, and practitioners.

UNEP – United Nations Environment Programme

www.unep.org

UNEP sets the global environmental agenda, promotes implementation of the environmental dimension of sustainable development within the UN system, and serves as an authoritative advocate for the global environment. UNEP has offices around the world and works in a broad array of thematic areas, including a Built Environment Unit (in Paris; see www.unep.org/urban_environment) whose aim is to integrate the urban dimension in UNEP's work, with a focus on environmental issues, resource-efficient cities, and sustainable buildings. UNEP also supports the Cities Alliance (www.citiesalliance.org), which it joined in 2000. More recently, UNEP concluded a Memorandum of Understanding with the EU's Committee of the Regions, to strengthen the role of local and regional authorities in the policy-decision-making process, and to emphasize the importance of placing sustainable cities at the heart of the global strategy on sustainable development. Its implementation will involve a broad spectrum of UNEP divisions; more information can be obtained through UNEP's Regional Office in Europe (www.unep.ch/roe). At the Rio+20 meeting in June 2012, UNEP launched the Global Initiative for Resource Efficient Cities which will consider biodiversity and the ecosystems approach in the assessment of material flows to, within, and from cities.

Through its Major Groups and Stakeholder Branch (www.unep.org/civil-society) in the Division of Regional Cooperation, UNEP works closely with the Local Authorities Major Group, which as one of the nine Major Groups participates in UNEP activities at policy and programatic levels. UNEP's International Environmental Technology Centre contributes to urban sustainability as it promotes the application of environmentally sound technologies, with an emphasis on waste management, in developing countries (www.unep.org/ietc). UNEP also hosts some multilateral environmental agreements relevant to local and sub-national authorities, such as the Mediterranean Action Plan (MAP), linked to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (also called Barcelona Convention). As the first-ever plan adopted as a Regional Seas Programme under UNEP's umbrella, MAP links Mediterranean countries and the European Community to protect the Mediterranean marine and coastal environment while boosting regional and national plans to achieve sustainable development (www.unepmap.org).

Finally, the World Conservation Monitoring Centre (UNEP – WCMC; see www.unep-wcmc.org) is UNEP's associated biodiversity assessment arm and has also been involved as a contributor to the CBD Global Partnership on Local and Sub-national Action on Biodiversity.

UNESCO – United Nations Educational, Scientific, and Cultural Organization

www.unesco.org

Contributes to the building of peace, eradication of poverty, sustainable development, and intercultural dialogue through education, the sciences, culture, communication, and information. The broad goals of the international community, including the Millennium Development Goals, underpin all of UNESCO's activities. Its World Heritage Convention, and Man and Biosphere Programme, work regularly with city and regional governments, which are key players in both multilateral agreements.

UN-Habitat – United Nations Human Settlements Programme

www.unhabitat.org

The main UN agency covering human settlements and urban planning, UN-Habitat promotes socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all. Among the many resources available on its website are reference materials and links to online learning programs for local leaders.

United Nations Decade on Biodiversity 2011–2020

www.cbd.int/2011-2020

Launched in November 2011 to support implementation of the UN's Strategic Plan for Biodiversity 2011–2020, adopted at COP 10 in Nagoya, Japan, and supported by the UN General Assembly. Promotes an overall vision of living in harmony with nature and aims to mainstream biodiversity at different levels. Website offers information about biodiversity, events around the world, and how everyone can make a difference.

United Nations University – Institute of Advanced Studies (UNU – IAS)

www.ias.unu.edu

Conducts research, postgraduate education, and capacity development, both in-house and in cooperation with an interactive network of academic institutions and international organizations. Research focuses on the interaction of social and natural systems and is aimed at developing informed policy-making that addresses global concerns.

Urban Planet

www.urbanplanetatlas.org

An interdisciplinary, onsite learning environment with interactive data, maps, and innovative solutions for more sustainable urban regions. Initiated by the Stockholm Resilience Centre (see above), Urban Planet emphasizes the close interdependence of social and natural systems and the fundamental role of ecosystem services for human well-being. The site is continually updated with new case studies and welcomes suggestions from all over the world.

URBES

www.urbesproject.org

A transdisciplinary collaboration among nine European and American research institutes, IUCN, and ICLEI – Local Governments for Sustainability. URBES aims to bridge the knowledge gap on urbanization processes and urban ecosystem services for human well-being. It helps cities build capacity for adapting to climate change and reducing ecological footprints; is pioneering development of the TEEB approach in the urban context and is innovative in integrating monetary as well as non-monetary valuation techniques; and is exploring governance implications and developing guidelines for implementation in urban landscapes. URBES will run from 2012 until 2014 and is funded by BiodivERsA.

URBIO – International Network in Urban Biodiversity and Design

www.fh-erfurt.de/urbio; www.hss.iitb.ac.in/urbio2012/

A worldwide scientific network for education and research founded in 2008 to promote urban biodiversity through a continuing dialogue with the CBD Global Partnership for Cities and Biodiversity. It represents all disciplines involved in research, planning, design, and management of green urban environments and currently has more than 700 members from more than 50 countries. URBIO maintains a website, distributes regular newsletters, and organizes international scientific conferences prior to COP meetings.

URBIS – Urban Biosphere Initiative

www.urbis.org

An open global network connecting scientists, researchers, policy-makers, architects, planners, and environmental practitioners around the world with local and sub-national governments to share, develop, and implement ideas for creating more resilient, equitable, and sustainable urban regions. It serves to transcend the science–policy interface, catalyze knowledge-exchange, spur collaborative action, and ultimately forge harmony between cities and the ecosystems of which they are part. URBIS has several components: (i) a learning community with an online resource hub, case studies, and dedicated newsletters; (ii) *URBIS Dialogues*, comprising periodic meetings, workshops, and webinars; (iii) a recognition process whereby local and sub-national governments are formally recognized for their achievements; and (iv) an aperture to excellence, essentially a gateway to various other programs, projects, and initiatives. The URBIS Secretariat is hosted by the ICLEI Cities Biodiversity Center, a role that is executed in close partnership with the Stockholm Resilience Centre as scientific coordinator and the Secretariat of the Convention on Biological Diversity as a facilitator between local, sub-national, and national governments.

World Resources Forum

www.worldresourcesforum.org

A global science-based platform for sharing knowledge about the economic, political, social, and environmental implications of global resource use. Promotes innovation for resource productivity by building bridges among researchers, policy-makers, business, NGOs, and the public. Its flagship activity is the annual WRF Conference, which includes full life-cycle analysis of products and services and the promotion of Sustainable Consumption and Production.

Evolution of the CBD's Cities and Biodiversity initiative

Although responsibility for implementing the 1992 Convention on Biological Diversity rests primarily with subscribing national governments, Parties have always been aware of the need to coordinate plans and actions with sub-national and local governments. That need has grown increasingly urgent with the recognition that more than half the world's population now lives in cities.

The CBD's initiative on cities and biodiversity has evolved in three phases.

I. Leading Cities and Pioneers (2006–2008)

The journey toward a cities and biodiversity initiative began in 2006 in Cape Town, when 300 local authorities at the ICLEI General Assembly called for a pilot project on Local Action for Biodiversity (now a full-scale program; see p. 54). It continued in March 2007, when then mayor of Curitiba, Beto Richa, convened the Curitiba Meeting on Cities and Biodiversity. The Curitiba Declaration, adopted at that meeting, stated that biodiversity issues are addressed most efficiently through local actions, and that urbanization can contribute positively to human development as cities offer many social and economic opportunities. The declaration called for a global partnership of cities, national governments, development agencies, private-sector partners, non-governmental organizations, knowledge and research institutions, and multilateral organizations.

Acting on the recommendations of the Curitiba Declaration, in 2008 ICLEI and IUCN—supported by the Secretariat of the CBD and participating cities and agencies—launched the Global Partnership on Sub-national and Local Action for Biodiversity at IUCN's World Conservation Congress in Barcelona. A few months later, at COP 9 in Bonn, a Mayor's Conference was organized on the issue of cities and biodiversity and contributed to the adoption of the CBD's first decision on the issue (IX/28). A scientific meeting of URBIO, the International Network in Urban Biodiversity and Design, was convened in Erfurt, Germany, just prior to the COP and also contributed to the deliberations. Later the mayors of Curitiba, Bonn, Nagoya, and Montreal, respectively hosts of COPs 8, 9, and 10 and the Secretariat, formed an Advisory Committee of Cities under the Global Partnership. This committee, which later expanded to include Montpellier, Mexico City, and Hyderabad, has addressed every subsequent COP.

II. CBD Plan of Action for Sub-national Governments, Cities and Other Local Authorities (2008–2012)

Although Decision IX/28 proposed some voluntary activities for parties and sub-national governments, a more systematic and expanded approach was clearly needed to mobilize all levels of government in implementing the CBD. Several parties and the Global Partnership proposed the formulation of a global Plan of Action in preparation for COP 10 in Nagoya in 2010. More than 600 local and sub-national government officers met at the City Biodiversity Summit parallel to COP 10 to indicate support for the CBD and their potential to help implement it. On 29 October 2010, the Plan of Action on Sub-national Governments, Cities, and other Local Authorities for Biodiversity was endorsed by 193 CBD parties through Decision X/22. The plan provides suggestions on how to mobilize and coordinate local and sub-national actions on biodiversity, take CBD issues to urban residents, and bring national strategies and plans into the urban context.

Sub-national governments responded to the global challenge by establishing, at the 2011 General Assembly of their Network of Regional Governments for Sustainable Development (nrg4SD), a Working Group on Biodiversity.

III. The Road Ahead

Efforts now focus on scaling up the successful experiences of the Global Partnership. One of the core instruments for parties to implement the CBD is their National Biodiversity Strategies and Action Plans (NBSAPs). In January 2011 the city of Montpellier, France, hosted a meeting for CBD parties and regional and local authorities, with an innovative approach to integrate these tools with sub-national/municipal strategies, taking the Mediterranean basin as a target. A network of Mediterranean cities on biodiversity, called MEDIVERCITIES, was proposed and will be further defined in future meetings. The Montpellier meeting also produced a portfolio of projects such as city exhibitions and cooperation platforms for sub-national networks of protected areas. The concept of local and sub-national government networks will be expanded to other regions (e.g. the Amazon and Caribbean) and themes (e.g. marine and coastal biodiversity).

To further support parties in implementing the Plan of Action, for COP 11 the Global Partnership is proposing the development of four specific Implementation Plans for the major categories of players. The Implementation Plans will be launched at the Cities for Life Summit parallel to COP 11 in Hyderabad, India, in October 2012.

Building on the example of the Advisory Committee of Cities and further consolidating the Global Partnership, the Brazilian State of Paraná, in collaboration with the Secretariat of the CBD and nrg4SD, hosted the first meeting of the Advisory Committee of Sub-National Governments in April 2012 in Curitiba. With the objectives of advising Parties in partnering with their sub-national governments, addressing landscape-level connectivity of natural spaces, and promoting decentralized cooperation on biodiversity, the committee will have a geographically balanced structure that includes host sub-national governments of COPs as well as representatives from Africa, Asia, the Americas, Europe, Oceania, the Secretariat of the CBD, and nrg4SD. The meeting also created a Memorandum of Understanding between the Government of the State of Paraná and the CBD Advisory Committee and UN entities focusing on decentralized cooperation between sub-national governments in areas related to biodiversity, climate change, and land management.

Appendix 1: Aichi Biodiversity Targets

The Aichi Biodiversity Targets are 20 ambitious goals that make up part of the CBD's Strategic Plan for Biodiversity 2011–2020, adopted in Nagoya, Japan, in 2010. The targets provide a framework for action by all stakeholders—including cities—to save biodiversity and enhance its benefits for people. Many of the targets are referenced in the key messages in Section II of this report. The CBD is preparing a set of informal "Quick Guides" to all of the targets, available at www.cbd.int/nbsap/training/quick-guides.

Target 1: By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

Target 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

Target 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.

Target 4: By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

Target 6: By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

Target 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

Target 8: By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

Target 9: By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

Target 10: By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

Target 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Target 16: By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

Target 17: By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

Target 18: By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

Target 19: By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

Target 20: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

CBO Inter-Agency Task-Force and Advisory Committee Members

CBO Inter-Agency Task-Force

CBD	Braulio Ferreira de Souza Dias, Montreal, Canada; Executive Secretary
FAO	Julien Custot, Rome, Italy; Facilitator, Food for the Cities
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Ten Key Messages

1

Urbanization is both a challenge and an opportunity to manage ecosystem services globally.

2

Rich biodiversity can exist in cities.

3

Biodiversity and ecosystem services are critical natural capital.

4

Maintaining functioning urban ecosystems can significantly enhance human health and well-being.

5

Urban ecosystem services and biodiversity can help contribute to climate-change mitigation and adaptation.

6

Increasing the biodiversity of urban food systems can enhance food and nutrition security.

7

Ecosystem services must be integrated in urban policy and planning.

8

Successful management of biodiversity and ecosystem services must be based on multi-scale, multi-sectoral, and multi-stakeholder involvement.

9

Cities offer unique opportunities for learning and education about a resilient and sustainable future.

10

Cities have a large potential to generate innovations and governance tools and therefore can—and must—take the lead in sustainable development.

CHALLENGES & OPPORTUNITIES

MORE THAN **60%** OF THE AREA PROJECTED TO BE **URBAN** IN **2030**
HAS YET TO BE **BUILT**