EXECUTIVE SUMMARY

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

Citation: Secretariat of the Convention on Biological Diversity (2012) *Cities and Biodiversity Outlook—Executive Summary.* Montreal, 16 pages.

For further information, please contact:
Secretariat of the Convention on Biological Diversity
World Trade Centre
413 St. Jacques Street, Suite 800
Montreal, Quebec, Canada H2Y 1N9
Phone: 1 (514) 288 2220
Fax: 1 (514) 288 6588
E-mail: secretariat@cbd.int
Website: www.cbd.int

Graphic Design: Em Dash Design

Preface by the Executive Secretary of the CBD

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. 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.

The CBO volume from which this summary was produced complements the more detailed scientific assessment titled *Global Urbanization, Biodiversity, and Ecosystems – Challenges and Opportunities.* 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.

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. The complete CBO includes information about more than 50 of them—please refer to the web-based version for full details.

For a complete list of editors, authors, contributors, and credits, please consult www.cbd.int/en/subnational/partners-and-initiatives/cbo.

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

Cities and Biodiversity Outlook was supported by the Government of Japan through the Japan Biodiversity Fund, by the European Union and several national research councils in Europe through BiodivERsA, and by SIDA through The Resilience and Development Program—SwedBio.

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

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 (see Figure 1). More than 60 percent of the area projected to be urban in 2030 has yet to be built. Most of this growth is expected to happen in small and medium-sized cities, not in megacities.

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.
- 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.
- Urban expansion is occurring fast in areas adjacent to biodiversity hotspot areas and faster in low-elevation, biodiversity-rich coastal zones than in other areas.
- 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.

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.

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. 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 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.

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).

India

India's population is currently about 30 percent urban and is expected to become 50 percent urban by about 2044. 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.

China

China, with around 50 percent of its population now living in cities, 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.

LATIN AMERICA AND THE CARIBBEAN

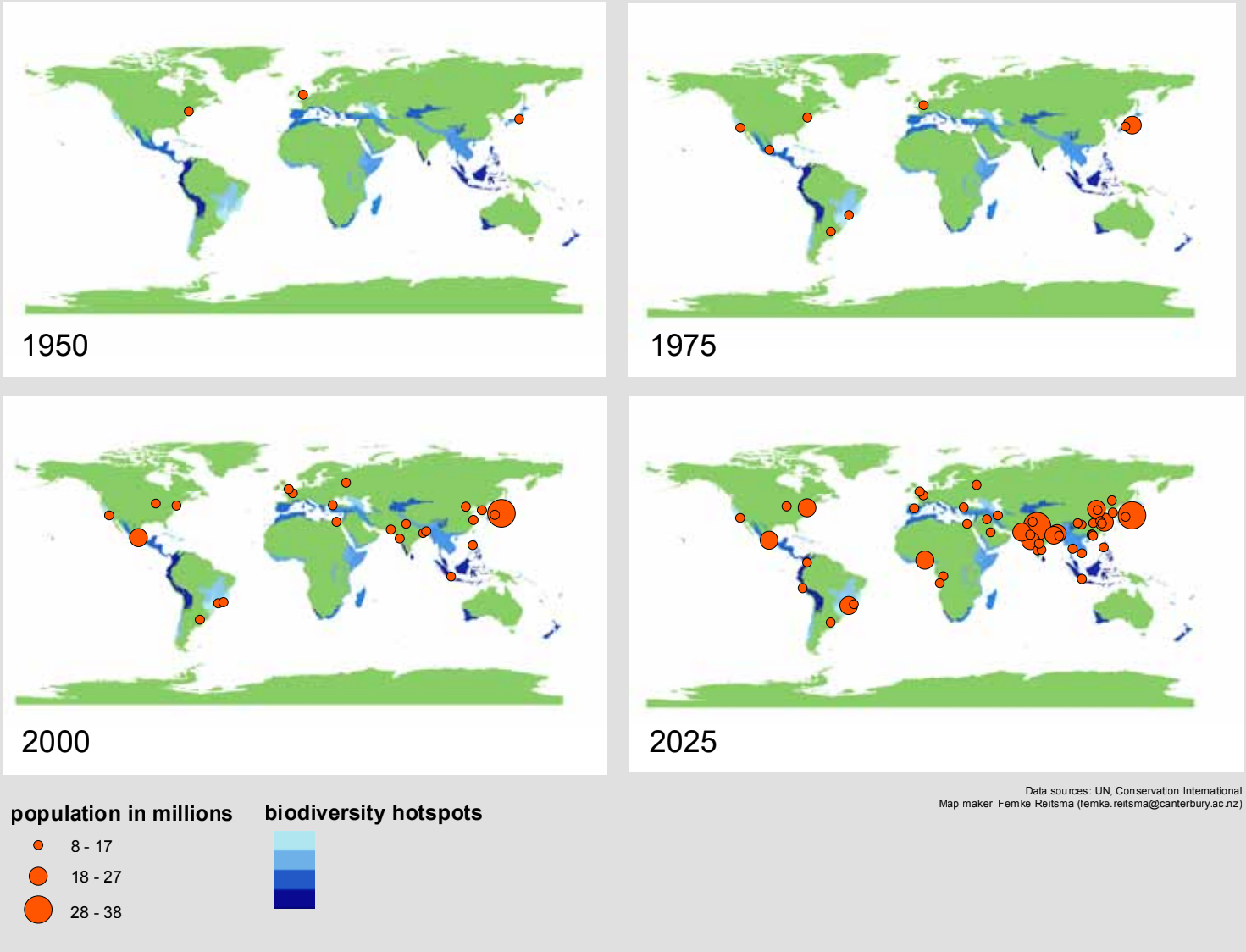
More than 80 percent of the population in Latin America lives in cities, and by 2050 it is expected to reach 90 percent, thus making it the most urbanized of all world regions. The region includes megalopolises such as Mexico City, São Paulo, and Buenos Aires, whose populations exhibit significant social 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, into the Amazon basin from the Southeast in Brazil, and along major roads and rivers.

In the Caribbean, urbanization 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.

EUROPE AND NORTH AMERICA

Europe and North America share a similar urban development pattern. 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

Figure 1. Global urbanization and biodiversity hotspots, 1950–2025.



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. 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.

OCEANIA

Oceania is defined by the United Nations as the islands within Polynesia, Micronesia and Melanesia, and Australia and New Zealand. Urbanization came late to 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. On the other hand, 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.

Key messages

The 10 key messages in this section highlight how urban planners, engineers, architects, policy-makers, politicians, scientists, and citizens alike can take on the challenges of reducing the loss of biodiversity.

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.

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.

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 are biodiversity rich 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.

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.

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

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.

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.

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.

are the creation of biosphere reserves 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 can help cities conserve and manage their biodiversity.

CITY BIODIVERSITY INDEX

The City Biodiversity Index, or CBI, 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.

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.

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

TEEB—THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY

TEEB 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'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.

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.

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.

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.

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

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

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 4.2. 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.

and diets. Urbanization is also generally accompanied by increased air pollution, which causes significant mortality as a result of cardiovascular and respiratory disease.

Understanding the complex interactions between urban populations and infectious disease is also paramount, particularly since approximately 1 billion people currently live in squalid, slum-like 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). 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.

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.

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.

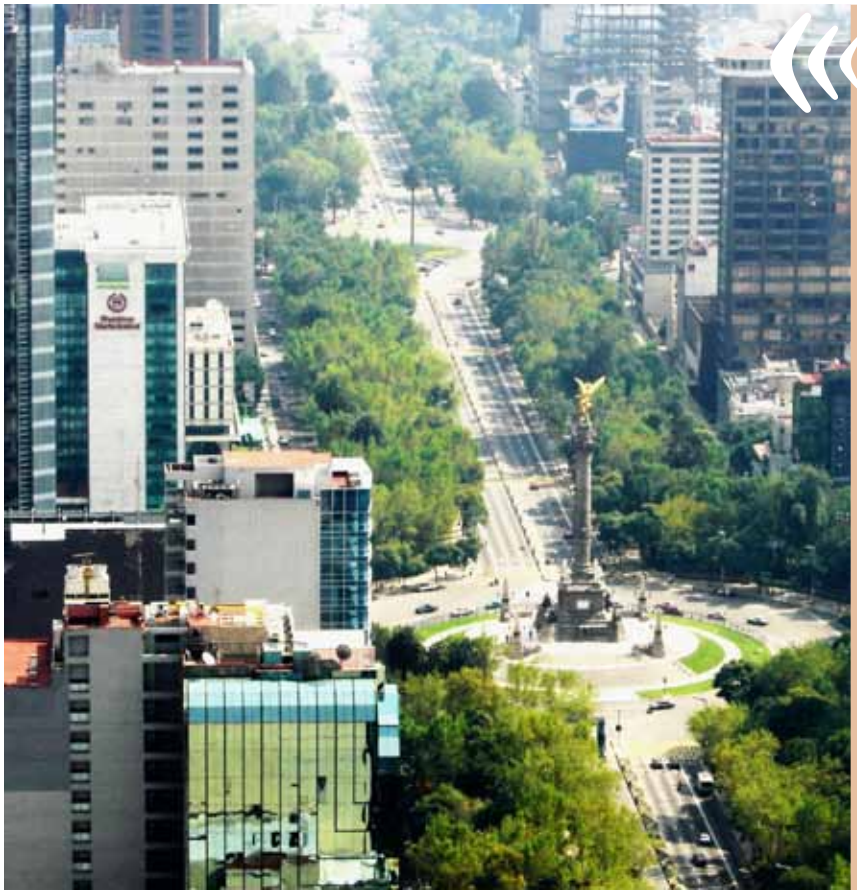
Green spaces offer numerous ecosystem services

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. Forests can contribute indirectly to climate-change mitigation by providing more shade and cooling, thereby reducing overall energy consumption. Finally, 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 strategies for using urban green space to mitigate the UHI include green roofs, 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.

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.**

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.



Action on Climate Change in Mexico City

Mexico City was the first Latin American 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.

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.

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.

To integrate urban biodiversity and ecosystem services into local governance, the key elements of a Local Biodiversity Strategy and Action Plan can be incorporated into overarching city-wide plans. 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 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.

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

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.

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. The efficiency of 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" (i.e., across divisions such as environment, planning, transportation, education, finance and nutrition).

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.

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.

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 for Sustainable Development (ESD) 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.

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.).

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.

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.

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.

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 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.

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.

CHALLENGES & OPPORTUNITIES

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