

Biological Diversity and the Urban Environment

prepared by
UNESCO in cooperation with FAO

as a contribution to the Ecosystem Conservation Group:
FAO, IUCN, UNDP, UNEP, UNESCO, WORLD BANK, WRI, WWF



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Background

1. At its eighteenth session, held on 9 July 1998 at the headquarters of the Food and Agriculture Organization of the United Nations (FAO), in Rome, the Ecosystem Conservation Group (ECG) decided that the issue of biological diversity and the urban environment was a priority topic for the Group's members and that an issue paper should be prepared on the topic by FAO and the United Nations Educational, Scientific and Cultural Organization (UNESCO). In particular, the paper should identify key issues in the interface of biological diversity and the urban environment and assist ECG members to promote interlinkages, complementarity and compatibility of their relevant work programmes. Following substantive discussions within ECG of the subject matter, and based on comments by ECG members on an earlier version of the paper, the present paper has been prepared by UNESCO, working in collaboration with FAO.

Introduction

2. Ongoing urbanization trends indicate that more than 50 per cent of the Earth's population was already living in urban areas in the year 2000 – and the trend continues. The impacts of urbanization on biological diversity are complex and challenging. Among the negative impacts of cities and the urbanization process on biological diversity, the following are often singled out:

(a) Conversion of natural landscapes and ecosystems into cities through urban expansion, with attendant consequences for hydrology, soil quality, air quality, etc.;

(b) Level of resource use, pollution and waste generation usually much higher in cities than in surrounding areas, which may have negative impacts on biological diversity not only within, but also far away from the city (in other words, urban areas can leave substantial "ecological footprints");

(c) Accelerated changes in land use, demography, social and economic characteristics and consumption patterns, both in urban and related rural areas, with an unstable and unpredictable demand-and-supply dynamic between rural and urban areas.

3. At the same time, by concentrating a larger number of people per square kilometre than any other form of human settlements, cities can – at least in theory – reduce the pressure on rural areas and therefore have relatively positive impacts on biological diversity. Furthermore, the urban environment can provide a safe haven for certain species and, in some cases, even unique habitats.

4. Although the urban environment might be relatively poor in biological diversity (but often richer than expected), existing biological diversity and resources are often vital for the survival of the city and its inhabitants. Examples of benefits that urban people can derive from biological diversity and resources found in cities and urban hinterlands include: food, shelter, fuelwood, climate regulation, watershed protection, recreational opportunities, cultural and aesthetic values, environmental education and employment opportunities. City administrations and developers often fail to take these benefits fully into consideration, however, and their value is often eroded over time, thereby further aggravating the costs of unsustainable urban management and growth. Furthermore, some microbial biological diversity that can have negative impacts on human health and welfare may be particularly well adapted to the urban environment. There is therefore a range of negative and positive impacts, costs and benefits, linking urban environment and biological diversity.

5. Efforts committed to improving the relationships between urban environment and biological diversity will typically have to address a complex set of driving forces that promote urban sprawl and degradation of the urban environment (e.g., population migration, resource use and consumption patterns, trade, transport, infrastructure, pollution and waste). Cooperation, including among ECG members with their broad spectrum of competences and resources, is therefore important and should be promoted. This also holds true for initiatives targeting the underlying causes of urban environmental degradation and negative impacts on biological diversity (e.g., population growth, poverty, market and government failure).

6. In view of the particularly challenging nature of these issues, future success stories of biodiversity-friendly urban development and management can be expected to secure high international recognition, such as in the framework of the Convention on Biological Diversity and in the follow-up to the Habitat II conference (see annex I to the present paper).

I. Stating the problem

7. In order to assess available information and data (and the lack thereof), policy measures and their effectiveness vis-à-vis different aspects of the interface between biological diversity and the urban environment, as well as to identify appropriate actions, ECG members have found it useful to subdivide the problem into two main categories:

(a) Conservation and sustainable use of biological diversity within the urban and peri-urban environment;

(b) Mitigation of the negative impacts of urbanization on the surrounding and more distant biological diversity of urban and peri-urban areas.

8. In this context, ECG suggests that the notion of the “urban environment” should be interpreted to cover a broad range of different areas including megalopolises, mega-cities, cities, towns, villages, urban hinterlands, urban fringes, peri-urban areas and human settlements, including refugee settlements.

9. Furthermore, ECG members recommend that a distinction be made between natural, semi-natural and human-influenced biological diversity in the urban environment, as they all make important – but different – contributions to health, welfare, amenity, education, climate and the economy (through agriculture, horticulture, floriculture, the provision of habitats for wildlife, conservation, recreation, etc.).

10. At this point it would be apposite to remark on the major differences between cities in industrialized countries – the “North” – and in developing countries – the “South” – and, in particular, on the phenomenon of burgeoning urbanization that marked the second half of the twentieth century. Massive rural-to-urban migration, combined with natural growth in developing countries, has resulted in the fact that only a fifth of the world’s megalopolises are at present located in industrialized countries, with the rest in the third world – in particular, in Latin America and Asia.

11. The unequal distribution of environmental “ills” among industrialized and developing countries is also reflected in patterns of urban development. In the preparations for the United Nations Conference on Environment and Development – the Earth Summit – held in Rio de Janeiro in 1992, a number of priority environmental problems were identified for industrialized countries and other more specific problems for developing countries, at different levels of intensity (UNESCO, 1992). These can be summarized as follows: the environmental ills of the rich, industrialized countries included, among others, transboundary air pollution; soil toxification (as well as loss of soil productivity and fertility) caused by excessive use of agrochemicals (fertilizers, biocides), and the accumulation of animal wastes; surface and underground water pollution; acid rains and their impact on forest and aquatic (especially lacustrine) systems; inadequate or even delinquent management and disposal of wastes (including toxic, radioactive and industrial waste); and forest fires, very often not accidental, particularly in the Mediterranean areas.

12. As far as cities were concerned, it was recognized that in industrialized countries urban development is marked by faulty and strongly sectoral planning, management and policy-making, strongly based on linear short-term economic and political thinking and dominated by speculation, especially in coastal regions. Moreover, exclusion, marginalization and alienation are growing problems of industrialized countries, absurdly set in a scenario of abundance, wealth and economic power (on this point, see also annex III on the quest for the sustainable European city).

12. In developing countries and regions, problems identified included, among others, advancing desertification; land degradation and soil loss, principally through erosion and salinization; uncontrolled floods and droughts; rapidly progressing deforestation, particularly in tropical regions; loss of biological and genetic diversity; ecosystem and landscape deterioration and land degradation; rapid demographic growth; and massive migration due to different causes, including wars and famines. Where urbanization was

concerned, the pattern observed was for accelerated, disorderly urban growth with a dominance of urban giants, in which up to three quarters of the population lived in precarious and marginal conditions of poverty and need.

13. Of course, such environmental problems are not exclusive to the North and the South, respectively. Certain "cross-over" cases might be cited, such as developing countries on the way to industrialization, notably some in Asia and Latin America, that tend to emulate industrialized countries in their patterns of production and consumption. Furthermore, in developing countries there are areas of wealth and wasteful high consumption patterns, accentuating situations of discrimination and inequity. By contrast, in the rich North there are growing pockets of poverty with increasing numbers of jobless and shelterless, thus setting in place a vicious cycle of mounting social degradation.

14. It is against such a backdrop that the issue of biological and genetic diversity, its occurrence, distribution, functions, benefits and conservation in urban, peri-urban and industrial systems, and in fact, in human settlements of all sizes and in different regions of the world, should be considered in a properly objective manner.

15. The situation has been analysed as follows (Celecia, 1995): "Experience has shown that the perception that industrialized countries may have of problems of urbanization in the third world can be affected by ethnocentric and culturally relative biases. We may ask ourselves to what degree the most presumptuous of architects, urbanists, land use planners or policy makers may come out with socially relevant, economically valid, politically realistic and environmentally sound solutions to planning and management problems in cities that grow at the rate of tens or even over a hundred thousand souls per year. Still, the literature abounds with analytical studies of developing situations carried out by experts of industrialized countries in which, on the one hand, proposed solutions may appear presumptuous, often based on assumptions, limited in scope, out of proportion with their detailed assessment, and confined to discrete component problems in a limited scale, and which may not take into account weakened government systems, uncertainty, demographic factors and dynamics, cultural and social filters, internal conflicts including wars, dwindling natural resources, the discrepancy between urban and rural development policies and resulting exacerbation of rural to urban migration, among other variables."

16. A citizen of a major European or North American city, or that of any other industrialized region, may take pride in the green belt surrounding his or her city (provided that developers do not get their hands on it, and assuming that degraded open or built-in areas are conveniently isolated, dissimulated or relatively inaccessible), yet may not be properly aware of the possible impacts of the city on its immediate and more remote hinterlands. In fact, the impacts exerted by that particular city may not only be measured in its confines and the extensive hinterland, but extend also to other countries or regions, taking the form, among others, of air pollution, acid rain, the pressures of the demand for energy and for specific biological and mineral resources, massive agricultural and other subsidies, the fluctuations of the stock market, the spatial need for waste disposal, the exigencies of recreational space. This falls within the notion of "footprint" as described in chapter III below. Thus, while the city tries to tackle acute problems arising within its boundaries such as minorities, the shelterless, the jobless, delinquency, gangs, spontaneous outbursts of violence, drug trafficking and addiction, illegal immigration, clandestine labour, etc., all of which may be treated on a piecemeal basis, it may choose to minimize or even ignore their impacts on related rural and natural hinterland systems, while pretending to derive the maximum benefit from them. Of course, the notion of "the city" means people: individuals, neighbourhoods and communities, as well as planners, managers and policy makers.

17. In most third-world urban sprawls, the hinterland is under constant pressure, eroded by the inexorable expansion and displacement of the city as the urban-rural boundary is pushed ever further outward, with little if any time allowed for minimal planning and management adjustments. There is pressure for land, often taking the form of "spontaneous" or even planned colonization; pressure for energy, for drinking water, for food, for materials, as well as for business opportunity, for change, for equity and justice. Of course, under such circumstances, open, green spaces, semi-natural and natural areas and various categories of protected areas risk being inadequately protected and their integrity is under increasing threat.

18. It seems absurd to hope for good partnership for the conservation and protection of the natural environment within and around urban and peri-urban areas – where such natural environments still exist - from growing populations subsisting under conditions of great stress and need. These populations are responsible for what is variously called "demographic pressure", marginality or exclusion. The problem can only be addressed through alternative approaches to land use and natural resource planning and management, as well as through conservation policies and strategies which accord people their proper place in such processes, in attempting to harmonize and reconcile the conservation of biological and genetic diversity, as well as the diversity of biotopes, ecosystems and landscapes, with sustainable and equitable development, in which the participation of local populations constitutes an essential feature. In this context we refer to the example of Nairobi, set forth in box 1.

Box I

Conservation of biological diversity in the context of Nairobi's city planning and management

Introduction

Nairobi is surrounded by coffee farms, savanna grassland plains and the Karura forest and endowed with rich biological diversity resources. Its rapidly growing population has, however, placed severe pressure on the capital's biological diversity. In 1948, when the first "plan for a colonial city" was prepared, 118,894 people lived there. By 1979, close to five years after the formulation of the 1973 Metropolitan Growth Strategy, the city had a population of 827,775 people. Today (2000) there are over 2.5 million inhabitants. The population increase has presented varying social and economic demands for land. As a result there is drastic pressure not only on predominantly agricultural peri-urban land but also on conservation areas. Parallel to this has been the growth in poverty levels due the rising unemployment, poor national economic performance and the unabated urban pull on the rural population. Consequently, a considerable proportion of the city's population, estimated at close to 60%, has systematically been pushed towards the contiguous areas of conservation zones.

The city of Nairobi cannot grow sustainably without taking physio-biological diversity issues on board. This calls for tangible measures in steering the city's growth and development. The best way forward would include adopting an all-inclusive and comprehensive approach on planning matters. Various efforts are being undertaken by various groups, which have gone a long way towards strengthening planning and other legal measures for conserving the city's biological diversity, such as:

Nairobi's informal settlements strategy

The Nairobi Informal Settlements Coordinating Committee (NISCC) is an organization which draws membership from various stakeholders within Nairobi city, including the central Government, Nairobi City Council, non-governmental organizations and private institutions. NISCC has formulated a strategy which recognizes the role of informal settlements in the city's social and economic development. The strategy serves as a convenient entry point in biological diversity conservation measures through coordination of the growth and development of informal settlements. The river basin is one of the ecosystems which could benefit considerably from the efforts of NISCC.

The river basin ecological system is today one of the city's most threatened physio-biological diversity resources, especially from informal settlements. The city's informal settlements have shown a strong tendency to grow more and more along the riverbank reserves. Many poor and low-income households find the areas relatively secure. Thus, most of them have naturally squatted along riverbank reserves, which cannot be alienated for private use through public allocation. The problem is compounded by weak enforcement of conservation rules and regulations. As a result, those who cannot access urban land and housing at affordable rates, because of their limited economic and political power, find sanctuaries in the reserved areas. Most the affected households who squat in these areas have at one time or another been displaced by the formal systems. Their only alternative, so it would appear, is to look for mechanisms to solve their shelter problems. Unfortunately, the resultant scenario has constituted a major threat to the conservation of the river basin ecosystems.

Consequently, the Nairobi informal settlements development strategy tackles the improvement of the physical environment by bringing the existing settlements into compliance with the Physical Planning Act. Conservation measures are placed at the centre of the regularization process in the strategy and particularly within the river basins.

The strategy has introduced participatory, inclusive and informative processes in managing the settlements' transformation. Through this, the strategy has been able to mobilize the local communities to support initiatives of restoring and managing their neighbourhood river basin ecosystems. A number of projects have already been formulated within the strategy framework by various stakeholders, and all of these have an environmental component. This has helped promote the conservation of the area's biological diversity. The linkage between poverty and the conservation of the river basin ecosystem means, however, that implementation of the development strategy will take a long time to yield visible fruits. Urban poverty is still on the rise and this potentially places more pressure on the river bank ecosystem.

Source: Bio-Diversity: Paper presented by Mr. Tom P. Odongo (Assistant Director – Forward Planning), City Planning Department, Nairobi City Council, Kenya

II. Conservation and sustainable use of biological diversity within the urban environment

18. Although many cities have a fairly good idea of their resources in biological diversity, few can claim to have a complete picture of the distribution of biological diversity within the urban environment, how biological diversity is being used and how best it should be managed. This is often particularly true in the South. For example, there is a general lack of data regarding the nature and role of peri-urban biological diversity (in the broader sense, including villages) in the tropics, where the climatic conditions have favoured the establishment of rich and extensive communities comprising native, naturalized, cultivated and weedy species. The role of these communities in the local economy, and in the maintenance of biological diversity – although probably of considerable importance – is simply not known in any detail. This is therefore one area appropriate for cooperative research (in this context, see also box 2).

Box 2

Points on biological diversity, nature and cities

As part of an effort to debunk myths on biological diversity (UNESCO, 1994), we understand that:

- (a) We barely know what biological diversity exists. We are only just beginning to appreciate the potential value and uses of biological diversity to humans. Moreover, the role that different species have in the maintenance of natural and human-influenced systems remains largely unknown. Most species have yet to be identified and studied;
- (b) To be effective, conservation efforts should focus primarily at the biotope, ecosystem and landscape levels to preserve the integrity of the system and minimize loss, since conservation focused on individual species is often not viable or cost-effective;
- (c) Conservation of biological diversity should not target only tropical ecosystems. The effort should be global, and should lead to a general framework for conservation and sustainable use of biological diversity throughout the world;
- (d) Protected natural areas do not by themselves meet all conservation needs. Most biological diversity is found outside protected areas, in natural and semi-natural systems and in situations dominated to different degrees by human intervention, such as land under agriculture, cultivation or fallow, grazing lands, managed natural and plantation forests, and also urban, peri-urban and industrial systems. Moreover, protection should also include the diversity of cultivated and domesticated species, races and varieties and their wild relatives. It also requires the integration of conservation and regional development planning.

In our consideration of the relationship between cities (including their biological diversity) and their natural and rural hinterlands, it appears necessary to take into consideration the historical dimension of human occupation and land and resource use patterns through time. Landscape ecology becomes a useful tool for the integration of interacting systems. The history of human settlements goes along with the evolution of the landscape in which nature, culture and society constitute an inseparable blend.

Historically, the occurrence and distribution of biological diversity in cities has received mostly sporadic and dispersed attention. Even if some prominent biologists have inventoried and described living organisms in cities, most bioscientists have considered that these highly human-dominated systems did not merit much attention as compared, for example, with more natural, "pristine" environments, ranging from tropical rain forests to high-altitude mountain tundras. The same can be applied, for example, to soils: we may notice from soils maps dating from the beginning of this century that only relatively recently do soils in urban, peri-urban and industrial systems receive either pedological or edaphological attention.

The urban environment can thus harbour a biological diversity that is not only adapted to its complex, evolving mosaic offering multiple habitats to numerous species of animals and plants and other living groups, but owing to changes in land use and intensified agricultural production, risk disappearing from the countryside. With properly managed spaces, the city can thus become a haven for dwindling native flora and fauna and communities. In this way we are faced with new understanding of the patterns of biological diversity, in which it may become difficult to distinguish between "natural" and "human-impacted" or "human-influenced" systems (also referred to as "artificial systems"), both of which merit being studied, inventoried and mapped with greater attention.

The twentieth century has witnessed a growing interest in scientific work in the domain of nature in and around cities. Moreover, a number of factors have further contributed to the evolution of urban nature conservation, as reviewed by Heywood (1996):

- (a) The increasing amount of urban wasteland, including the products of industrial transition;
- (b) The development of environmentalism, plus the activism of urban groups in the "greening" of cities;
- (c) Recognition of the discipline of urban ecology;
- (d) The creation of urban wildlife organizations;
- (e) The reduction in some forms of pollution (e.g. smoke-free zones);

- (f) Growing recognition of the fact that the urban environment is a mosaic of ecological niches that house a variety of species ("The landscape does not end where cities begin" - Nicholson-Lord, 1987);
- (g) A responsive attitude on the part of local authorities.

To the above can be added (Celecia, 1999):

- (a) A greater presence of devoted amateur naturalists and highly informed gardeners in urban and peri-urban areas;
- (b) Increasing environmental education efforts, both formal and informal, in urban and peri-urban areas, reaching broad sections of the population, including frequent journalistic contributions (e.g. special sections in Sunday supplements);
- (c) Greater pressure on planning offices and policy makers from local populations and citizen activist groups.

Fast-increasing attention is being given to restoration, recovery, re-creation or rehabilitation of nature in cities. In fact, there is growing appreciation for the enhancement of natural (recalling the prudence that should be attached to this term) and semi-natural habitats, and the great number of possibilities which the resulting urban mosaic provides for the development of a rich and unique biological diversity.

19. Unlike the natural environment proper, urban and peri-urban biological diversity depends on the action of humans for its survival. This also holds true for agricultural biological diversity, where intra-specific variation is the target of conservation and the basis of production, as well as for some relatively wilder and semi-wild urban and peri-urban plant and animal species. Accordingly, the management of urban biological diversity can be expected to be as complex and knowledge-intensive as that of the biological diversity found in more pristine areas, including many national parks. Below are some examples where active urban biological diversity management is critical.

20. Many urban and peri-urban green areas – those employed for agriculture and agroforestry, allotments and home gardens, arboriculture and horticulture – fall under the category of urban farming, which in many cities in developing countries constitutes a fairly significant portion of the total urban area. Most cities contain a great number of home gardens, community and public gardens, peri-urban farms, commercial greenhouses, cropping and livestock-raising businesses, which provide habitats, water-cycling, species adaptation and other biodiversity-related benefits to their communities, as well as valuable income and job opportunities. Urban residents often practise agricultural activities and contribute to urban agroforestry systems, fruit tree plantations and home gardens that sustain considerable genetic diversity and provide important food production and tree cover.

21. Urban woodlots and forests have important ecological functions, such as the cleansing of contaminated air, cooling of the ambient temperature, regulating the microclimate, preventing landslides and providing a habitat for wildlife. Their benefits are also significant in terms of watershed protection and flood control. More detailed data on the extent of such amenities as urban and peri-urban forests (both natural and planted), community forests, sacred groves and village commons are limited, however. Our knowledge of their role and value in relation to the needs of the local communities (e.g., for fuelwood, fruit, medication, etc.) is generally also very scant, and this constitutes an important area for future research.¹

22. Urban horticulture, in addition to direct food and agricultural production, contributes significantly and at low cost to the in situ conservation of a great variety of traditional fruits, vegetables, roots and tubers as well as ornamental plants, some of which are no longer available in the commercial horticulture sector.

¹ Indeed, as the income opportunities from commercial and other investments (e.g. in highways, parking lots, shopping malls, etc.) targeting scarce, open, green city space may be substantial and easy to calculate, it appears important that the economic value of urban biological diversity should also be assessed. In addition, it is important to endeavour to develop mechanisms for capturing these values into funds for the conservation and continued sustainable use of urban biological diversity.

Considerable plant diversity is encountered in home and backyard gardens, where amateur but dedicated gardeners propagate and perpetuate traditional fruit and vegetable varieties. This is not only true in industrialized countries, where members of renowned gardening clubs compete for the best-quality fruit and vegetables. It is also the case in backyard gardens in developing countries, where a number of interesting land races and varieties of indigenous and exotic horticultural species can be found.

23. These plant collections definitely contribute to ensuring food supply and security, especially for the urban poor, and for specialist crops (herbs, condiments, etc.), and to maintaining biological diversity. They also help in conserving special features, of particular interest today, such as taste and aroma, and offer a source of resistance to pests and diseases. Other potential benefits include natural biological control organisms, maintenance of natural cycles, including for soil organisms and micro-organisms, pollination, symbiotic associations and new species of economic importance.

24. One example in this context is the avocado disease called Avocado root brown rot (*Phytophthora cinnamomi*), which is of considerable economic importance. Resistance to the disease was found recently in home gardens in Costa Rica, Guatemala and Mexico. This plant material is currently being used for breeding lines in the United States and Israel, in order to introduce this resistance into commercial varieties.

25. Parks, gardens and zoos also play an important role. City parks and gardens can range from tiny, completely artificial areas in the middle of the city to quite substantial (protected) areas at the interface of urban and rural areas, with significant components of the original flora and fauna (for an overview of issues related to protected areas in and around cities, see McNeely, 1995 and Celecia, 1995). Even the most artificial environments may provide living space for insects and other arthropods and birds, at least on a temporary basis, and larger areas may support quite large bird species, such as ducks, geese, owls and other raptors, and mammals such as rats, mice and foxes (in this context, see box 3).

26. City parks, public and private gardens, communal nurseries, zoos and eco-museums often perform important functions in terms of public education and awareness about biological diversity. Other uses of genetic diversity in the urban environment include botanical gardens, gene banks and research stations that are often of high value for scientific research and taxonomic training.

27. Wetlands and humid environments are similarly important: because of their perceived low commercial economic value and their capacity to host species causing human discomfort and diseases, wetlands have traditionally been the first casualties of urban development. Although wetlands are increasingly valued for the importance of the various ecosystem goods and services they render (e.g., cleansing and provision of water resources, food production, carbon sequestration and recreation), and for their rich biological diversity, they are still subject to conversion around the world, such as along coastal zones, where urbanization pressure is particularly heavy.

28. A look at certain figures will help justify the particular focus placed on coastal zones in this context: although coastal zones represent only about 15 per cent of the surface of the globe and less than 0.5 per cent of the volume of the world's oceans, it is estimated that, by the year 2100, 75 per cent of the world's population (i.e., some 11 billion) will be concentrated in coastal regions. Two thirds of the world's cities with a population of over 2.5 million are situated near estuaries, and 16 of the 26 largest cities are situated in coastal zones. Wetlands can indeed be managed in order to reduce any negative effects while conserving biological diversity and their positive effects. Examples of such wetlands incorporated within, or close to, urban areas include the Poitou marshes and the Somme Valley marsh – "hortillonnages" (market gardens) – in France and the raised planting platforms separated by water-filled canals (Chinampas) in Mexico.

Box 3

Wildlife and the urban environment

The existence and survival of wildlife in cities are influenced by a number of factors:

Size – very large wild animals are typically incompatible with cities and as a general rule the smaller the animal is, the more chance will it have to find a suitable niche in the urban environment;

Ecology – food and habitat requirements are critical determinants. Opportunistic omnivores, for example, stand a better chance to survive in the city than more vulnerable specialized herbivores;

Behaviour – animals that are timid and easily disturbed will be at a disadvantage in the urban environment. Species that do not threaten people or cause them too much economic damage or harm will have an advantage;

Mobility – species, like birds and insects, that can fly over and bypass barriers will be able to take advantage of favourable patches of habitat that are out of reach for other species.

III. Mitigation of the negative impacts on surrounding and more remote biological diversity of urban areas and urbanization

29. Urbanization and environmentally unfriendly city management are known to have numerous direct and indirect negative impacts on biological diversity. The main negative impacts include:

(a) Fragmentation, degradation and destruction of a wide variety of ecosystems, ranging from coral reefs, coastal wetlands and mangroves to patches of forest and grassland;²

(b) Urbanization can also have less drastic but still highly disruptive effects on virtually any kind of ecosystem through the loss or reduction of tree cover, the loss of indigenous species and an increase in exotic (alien) species;³

(c) Various forms of pollution from vehicles, factories and incinerators for waste disposal can result in air and water-borne pollution that can affect the fauna and flora in cities, as well as those far from urban conglomerations. For example, birds on remote oceanic islands thousands of kilometres from the nearest city have been found to be experiencing drastically decreased reproductive success because of airborne dioxins;

(d) High levels of consumption of energy and resources that can affect biological diversity inside, as well as far outside the city;

² Low-density, car-dependent urban development spread out over the landscape at the urban fringe and in rural areas may be particularly devastating to biological diversity. In addition to destroying agricultural land and wildlife habitat, it often also contributes to reduced investment in the urban city centres. Many people therefore tend to move to the city outskirts in search of a higher quality of life.

³ The introduction of alien species can be a significant problem. A prime example is non-native garden plants which spread, a problem which could become worse with climate change. There are also examples in which the introduction of alien bird species into cities has had disastrous consequences (e.g. starlings in the United States). Commensals of man can also become a real problem, particularly if non-native. In the United Kingdom examples include cats marauding local bird populations; in Australia foxes cause significant problems with the fauna, and sacred ibis have become a pest in Sydney, living on rubbish in bins and breeding at rapid rates.

(e) Degradation of watersheds and soils influences the capacity of forests to secure water production and macroclimatic conditions and to prevent flooding and landslides in the urban environment and in cultivated areas.

30. Often, these effects are particularly negative in regions with more vulnerable ecosystems, such as in arid and semi-arid zones. On the desert fringe, where the demand from cities has exhausted the resources of species traditionally used for fuelwood, the population has no alternative than to use other fuel materials, which often have other valuable uses. This is true, for example, of the use of cow dung for soil fertility improvement. This results in the degradation of tree-covered areas and causes the diversity of the gene pool to be eroded. In an environment where few species are adapted, traditionally known by the population, and valuable for combating desertification, the potential loss from the gene pool and of the tree cover may be irreversible.

31. As the pressure of urbanization is particularly heavy along the coastal zones, it is no surprise that, in direct consequence of the conversion of coastal and marine habitats and the effects of pollution and various economic activities, including tourism and overfishing, coastal biological diversity is often under serious threat (although exact data on this are generally lacking). The impact of urban expansion can be particularly devastating to biological diversity in and around small islands, which often contain small populations of endemic species confined to limited geographical areas (see box 4).

Box 4

Island biological diversity and urban areas

Cities such as Hong Kong and Singapore are on islands and lie within regions containing unique species gene pools (flora and fauna). Their forest ecosystems, which are within the city limits, are relatively small and their degradation leads directly to species extinction. Already in 1848, concern over the possible effects of deforestation on Singapore's climate led the governor to prohibit the further destruction of forests on the hills. Today, the direct effect of nature protection and forest reserves is evident in terms of increased mangrove productivity and water supply. The Singapore Botanical Garden (which includes a patch of the original native forest) also plays a key role in gene pool conservation, environmental education and greening of the city.

Source: Webb, R. (1997)

32. Consequently, urban areas and their ecological footprints are now a key issue. Cities across the world have traditionally drawn resources from forests, rangelands, farmlands, watersheds or aquatic ecosystems outside their boundaries. Unaware of the consequences of their actions, cities are drawing upon the carrying capacity of distant ecosystems, often causing irreparable environmental damage. The expanding ecological footprints of cities pose a special risk to biological diversity in that city inhabitants usually have no idea of the environmental damage they are responsible for in distant lands and, therefore, they lack the motivation and incentives to undertake actions to reduce this damage. There is, accordingly, a need for urban communities to be increasingly competent and ingenious and for urban managers to lead the change in their current consumption patterns, bringing them into step with the carrying capacity of the ecosystems they draw on. This problem also points up the important but difficult task faced by administrations and managers in the peri-urban and rural areas in endeavouring to ensure better control of unsustainable resources use under their authority.

IV. Urban environment and biological diversity: Existing frameworks, activities of ECG members and key action areas

33. Major United Nations initiatives, such as Agenda 21, Habitat II and the conventions on biological diversity, climate change and desertification, provide an important framework for activities related to urban environment and biological diversity. Attached to this paper is a brief summary of these initiatives in relation to biological diversity and the urban environment (see annex I).

34. Also attached to this paper are brief descriptions of biodiversity-related activities undertaken in urban environments by ECG organizations, as well as examples of meetings, colloquiums and symposia, demonstrating the growing interest in nature in and around cities in other forums as well (see annexes II and IV). Following discussions within ECG, and drawing on its members' wealth of experience in urban management and development, key areas have been identified for future activities in the interface between the urban environment and biological diversity, as described below.

A. Key action areas related to biological diversity in the urban environment

35. Although the advancement of urban management policies, as well as new, cleaner technologies and more environmentally conscious consumer behaviour, give rise to some limited optimism regarding the development of green, biodiversity-friendly cities, ECG emphasizes that the challenges ahead are still formidable, in particular in developing countries. The lack of financial resources and scientific data, inadequate public awareness and a shortage of suitable institutional structures, coupled with urban migration and urban population growth, are key obstacles to more sustainable urban management and development. Efforts aimed at addressing these obstacles will largely have to focus on the key areas outlined in the following sections.

1. Research and information

36. Awareness and appreciation of the existence and importance of urban biological diversity are still limited. Interdisciplinary research is needed to help urban planners and managers to determine the extent, distribution and importance of a city's biological diversity resources. Research concerning biodiversity-sensitive urban development should include a consideration of the loss of ecosystem goods and services, as well as the loss of biological diversity itself. For example, wetlands in urban areas soak up rainfall; draining them can lead to the flooding of houses, businesses, etc. It is therefore important to promote increased understanding of the goods and services that ecosystems provide, as well as the biological diversity they hold. Key research needs therefore include:

- (a) Collection and analysis of biological and ecological data, biological diversity inventories and monitoring in the urban environment;
- (b) Development of biological diversity indicators to measure change;
- (c) Economic assessment of costs and benefits associated with the conservation and sustainable use of biological diversity, as well as its loss (including the costs of inaction and a business-as-usual approach – in this context, see box 5);
- (d) Improved understanding of the connection between public health, urban environment and biological diversity;
- (e) Modalities for restoring and rehabilitating biological diversity in the urban environment.

Box 5

Economic assessment as a tool for planning the conservation of biological diversity

Economic information is a vital element in decision-making and urban planning. Information on the costs and benefits associated with biological diversity conservation is often lacking, however. Increased efforts have therefore been made to supply such information. Not without methodological and scientific difficulties, these efforts attempt to reveal individuals' preferences for changes in biological diversity as a basis for assigning economic values to such changes. Key challenges in this context are represented by the lack of markets for many biological diversity goods and services, and therefore of readily available information on people's preferences, as well as the lack of biological diversity data (e.g., information on existing biological diversity, its function and the goods and services it produces, whether directly or indirectly).

Nevertheless, a number of economic valuation studies have been published on issues related to the urban environment, including on the benefits of urban streams and rivers, clean air and water and the use of green city space for recreation. Additional work in this area is called for, as well as more comprehensive economic assessments of the total economic value of those activities, projects and processes that threaten to diminish or destroy urban biological diversity (i.e., the opportunity cost of biological diversity conservation).

Examples of case studies on economic assessments of various environmental goods and services can be found on:

<http://www.epa.gov/docs/oppe/eaed/eedhmpg.htm>

2. Urban institutions and management instruments

37. Efforts have been and are being made in many cities to integrate environmental considerations into urban planning. The greening of cities and the reduction of pollution hazards are now considered in many cities in the North as an integral part of quality of life sought by urban planners. The improvement of the urban environment has become a key element in electoral campaigns conducted by politicians seeking office, thus demonstrating the importance of the issue. It is also significant that, in some countries, Governments faced with unmanageable, unsustainable capital cities have decided to build new ones in the countryside, on occasion with mixed results.

38. City planners, architects and managers are, however, rarely well equipped to handle biological diversity issues. Coordination is lacking and the relation between the urban and the rural environment, including the dynamic change of the land use and cover at their interface, has to be integrated in a forward-looking manner. There is also scope for improving public participation in city management decisions. Legislation is often lacking or enforcement is weak. Land tenure arrangements and incentive structures tend to work against biological diversity objectives. Key action areas therefore include:

- (a) Modalities for ensuring effective public participation in urban decision-making (see box 6);
- (b) Development of coordination mechanisms among different urban institutions for improved consideration of biological diversity objectives;

- (c) Development of coordination mechanisms among neighbouring municipalities and relevant institutions, in order to plan and act in line with broader concepts (e.g., ecosystem, watershed and mountain, wildlife corridors, landscape, etc.);
- (d) Development and application of incentives for the conservation and sustainable use of urban biological diversity;
- (e) Promotion of financial instruments and private-sector investments for the urban environment;
- (f) Reform of public policies and subsidies that undermine the city environment;
- (g) Zoning of the urban environment and its hinterlands according to biological diversity objectives (i.e., core areas, buffer zones, transition zones and corridors);
- (h) Promotion of measures to set aside and protect continuous natural structures, and not only isolated green patches in cities;
- (i) Exploration of the possibility of densification of the existing urban fabric, instead of encroaching further into the peri-urban areas.

Box 6

Porto Alegre: Public participation in urban decision-making

Porto Alegre, the largest city in southern Brazil with some 1.5 million inhabitants, has developed an innovative budget process that allows people living there to participate in preparing the city's budget. The participatory budget process of Porto Alegre (*orçamento participativo*) is based on some 20 discussion forums and plenary meetings that are open to all people living in any of the city's 16 geographical sectors. These forums cover five major themes: traffic and transportation; economic development and tax issues; town planning and urban development; health and social security; education and cultural and recreation activities. Through the forums and plenary meetings, the city inhabitants are actively participating in deciding how the city should run its business.

3. Environmental training, education and awareness

39. ECG considers that there is considerable scope for promoting the sustainable use and conservation of urban biological diversity through increased public awareness, professional training and education on biological diversity. Key action areas include:

- (a) Provision of educational amenities in suitable urban spaces;
- (b) Development of public education and awareness campaigns and materials related to the urban environment and biological diversity;
- (c) Professional training and education for technicians, decision makers and policy makers to promote interdisciplinary activities and improve linkages between governmental and municipal institutions;
- (d) Special education projects targeted to reach youth and women.

4. Urban green space and urban food production

40. Given the vital importance of urban green space for public health, recreation and biological diversity, additional efforts must be made to achieve the further expansion and conservation of such space, including

through the establishment of city parks and protected areas. Although widely viewed as a marginal form of production, urban food production is gaining increased recognition worldwide as an important economic sector and source of biological diversity.⁴ For these reasons, ECG encourages additional activities in these areas, in particular activities aiming at:

- (a) Establishment and maintenance of city parks, green corridors, botanical gardens and protected areas (see boxes 7 and 8);
- (b) Promotion of urban and peri-urban agriculture and food security (see box 9);
- (c) Special efforts targeting the role of women in urban food production;
- (d) Promotion of tree cover in the urban and peri-urban environment (street plantations, home gardens, etc), including farming systems (agroforestry and arboriculture).

Box 7

Stockholm national city park

Through an innovative law, vast green areas in and around the Swedish capital, Stockholm, were set aside in 1994 by the Swedish Government as a national city park ("Ulriksdal-Haga-Brunnsviken-Djurgården Nationalstadspark").

The law provides that, within a national city park, new buildings, constructions or other measures are allowed only provided no infringements are made on the park landscape or the natural environment and provided that no natural or cultural values are lost within the cultural landscape.

Besides providing added protection to the city's biological diversity, the city park has also resulted in a lively debate concerning sustainable city development and spurred an increased interest in green city issues among the urban population and city planners. A number of other Swedish cities, including Gothenburg and Uppsala, are also considering establishing national city parks.

Box 8

Hanam biological diversity strategy: initiative of the Republic of Korea

In September 2000, Professor Kwi-Gon Kim, a staff-member of Seoul National University, submitted to UNEP and UNDP, both collaborating agencies in ECG, and to the United Nations Centre for Human Settlements (UNCHS) (Habitat), as well as to the environmental protection authority of the Republic of Korea and the Hanam city authorities, a document outlining a proposed strategy for Hanam city that would broadly respond to article 6 (a) of the Convention on Biological Diversity, which reads: "Each Contracting Party shall develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity...". In 1997 the Republic of Korea drafted its own national strategy on biological diversity and, on this basis, started to develop region-specific biological diversity strategies. Situated in the south-eastern hinterland of the Seoul metropolitan area, Hanam still offers a diversity of topographical, hydrological and biogeographical features with their corresponding biological and genetic diversity, which justify its being considered as one of the specific strategy sites. Together, its rivers, streams, valleys, terraced land, forests, mountainous areas and riverside wetlands offer a diversified regional landscape. Most of Hanam is designated as a green belt, which calls for a systematic management and conservation plan, as well as the development of a plan to strengthen the interrelation between the areas under consideration. Moreover, the area is rich in archeological and historical sites and cultural remains.

⁴ See <http://www.fao.org/urbanag/> for a virtual conference and information market related to urban and peri-urban agriculture and food production.

In the context of the general concern for greater knowledge of existing biological diversity in the different areas of the landscape, there is a need for an expert evaluation of species richness and abundance, as well as a need to enlist the voluntary participation of the public in conducting surveys of flora and fauna. Ecosystem restoration is also part of the plans for this area, as well as habitat conservation. Among other important components of the strategy are planning a network to maintain a green area axis and the biological diversity of built-up areas.

Projects for people and wildlife include the Han river ecology park, nature restoration projects and a firefly ecological park. The issue of the enhancement and protection of biological diversity has inspired the drafting of an ecotourism plan, and a determination to mitigate the overall constraints of rapid urbanization and industrialization. Rather than merely conducting a local survey as an ecological research exercise, the ultimate goal is to guide local residents to engage in sustainable development activities, giving attention to topical features and monitoring activities for the preservation and protection of identified species and, ultimately, to promote the protection of habitats in local microsystems and the increase of species diversity, and to make possible the harmonious coexistence of humans and other living organisms.

Box 9

City food: Lesson from UNICEF

In 1986, UNICEF prepared and disseminated a slide presentation under the title *City Food*. The 140 colour slides begin with a historical review to show that, throughout history, significant quantities of food have been produced in and around urban centres, and that nowadays urban food production is commonplace in all continents. This is followed by sections dealing with food and nutrition, women and children and community initiatives for food-growing, in which women play an essential role. Examples of home and community gardens are given in Panama City, San José, Managua, Manila, Kinshasa, Nairobi, Lusaka, Canton and other cities in China, Lae in Papua New Guinea (a UNESCO/MAB urban project), and Boston. Special cases include: Lusaka (use of public land by squatter settlements for food production); Bamako (availability of vacant city areas, including railway rights of way); Managua (government city farms); Addis Ababa and Maputo (government cooperative market gardens); Belize City (school gardens); Hong Kong (gardening in the face of accelerated urbanization, a UNESCO/MAB urban study). The accent is on people, their participation and initiatives.

B. Key action areas related to biological diversity outside the urban environment

41. ECG recalls that cities and urbanization are key elements in the development process whose environmental impacts go far beyond the urban environment and which, if left unmanaged, will make traditional biological diversity conservation models obsolete. Therefore, additional national, regional and international efforts are needed to address and mitigate the negative impacts of urban areas on surrounding and more distant biological diversity.

1. Industry, transport, energy, housing

42. Often infrastructure, whether roads, business parks or facilities for tourism, is inadequately assessed from an environmental standpoint for its long-term benefits to the local economy. In broad economic terms, development is not sustainable if it causes serious or irreversible damage to wildlife. Environmental assessment must ensure that damage to the environment is minimized and that opportunities to enhance it are found.

43. Experience has shown that housebuilding must be sensitively planned and minimize environmental impacts. Housebuilding, like any other form of building development, can have direct impacts on nature conservation through habitat loss. It can also have indirect effects through fragmentation of the countryside and wildlife habitats, increased air and water pollution, increased pressure on resources such as water and minerals, and increased recreational pressures, resulting in disturbance.
44. New housing should minimize the need for the development of greenfield sites and maximize the use of brownfield sites. A "sequential test" approach that focuses the search for housing sites on urban areas in the first instance has great merit. However, the brownfield vs. greenfield issue is more complex than it often seems. Brownfield land will not always be appropriate for new development, because of other important characteristics that it may have. For example, many sites that could be described as brownfield have established nature conservation importance or are valuable urban green spaces, which contribute significantly to the quality of urban life. It would be wholly inappropriate to develop such sites.
45. Governments should take an integrated approach to transport provision. Such an approach would lead to a transport policy that improves the quality of life by reducing environmental impacts through lower traffic and emissions levels and better public transport, while enabling people to live and work locally. Emphasis should be placed on upgrading existing transport links rather than building new ones, and on reducing dependence on road vehicles (especially the car). While there is often a need for quality transport provision every effort must be made to minimize environmental impacts. The direct effects of transport (such as habitat loss and fragmentation) can be significant but so, too, can the indirect effects, such as acid rain and climate change. Each transport link must be subject to economic and environmental assessment and transport policy as a whole needs to be subject to a strategic environmental assessment.
46. Although roads are naturally of importance for attracting incomers, easing access problems and boosting the economy, better or faster roads often simply allow goods, services and people to travel in and out of an area more quickly and thus have less time to contribute to the local economy. In addition, built infrastructure may not always be the most appropriate option. For example, the promotion of information technology to enable more people to work from home may be a better goal than improving access from the country to the town.
47. In spite of important technological progress, urban pollution and waste generation remain important impediments to sustainable urban development and management. This is particularly true in and around the majority of those cities that can ill afford investments in clean technologies and efficient waste management and recycling schemes. Without appropriate urban air and water pollution control and waste management installations, the urban environment, including in the city's more environment-friendly green areas, will prove unsuitable for a wide range of biological diversity. Air and water pollution also contributes to the urban areas' ecological footprints.
48. A key feature of the urban waste management sector may be its capacity to create "closed" rather than "linear" systems, where waste is recycled and resources reused. Linked to these challenges is the issue of sustainable consumption patterns that will be needed in order to help minimize the creation of urban pollution and waste.
49. In short, key activity areas identified by ECG which merit further attention include:
- (a) Application of strategic environmental assessments;
 - (b) Incorporation of biological diversity objectives in urban transport planning;
 - (c) Urban pollution reduction and waste management;
 - (d) Development of biodiversity-friendly energy generation, distribution and consumption;
 - (e) Modalities for managing urban expansion, including the possibility of establishing urban growth boundaries;
 - (f) Policies for reduction of the ecological footprints of urban areas.

50. While the above list is far from exhaustive, ECG believes that efforts in these areas could drastically improve the conservation and sustainable use of biodiversity within the urban environment while mitigating the negative impacts on biological diversity in urban hinterlands and beyond.

2. Networking for greener cities

51. Finally, many cities and large metropolises are already actively struggling, with varying degrees of success, to become more green and biodiversity-conscious. The lessons they have learned (positive and negative) could therefore be of large value to other city administrations (see boxes 10 and 11 for examples). ECG therefore welcomes the development of networking among different urban areas facing similar challenges, for the purpose of sharing experiences and best practices.

Box 10

Urban expansion management policies and coordination in England

Green belts

England has developed the green belt concept in order to plan and manage urban expansion more effectively. Green belts are designated to contain urban growth, preventing urban sprawl and coalescence. They offer a strong mechanism for town and country planners to prevent development in these areas. The green belt policy was revised in 1995 to give specific purposes to the designation, including to safeguard the countryside from encroachment. This policy also specified that green belt land could be used to secure nature conservation interests.

Biodiversity project officers

In London, a biodiversity project officer is being employed by a partnership of conservation organizations. A main objective of this post will be to produce a biological diversity action plan for the city and to contribute to public education and awareness campaigns, public participation in urban decision-making, and the restoration and rehabilitation of urban biological diversity.

Box 11**Metropolitan spatial development framework for Cape Town*****Urban edge***

Cape Town is world-renowned for the biological diversity and scenic splendour of its natural environment. This, however, has increasingly come under threat from urban sprawl. A metropolitan spatial development framework (MSDF), developed for Cape Town over the last eight years, identifies four key policies for achieving sustainable urban growth for the city. One of these policies, the determination of a detailed urban edge, was completed in 2000. The urban edge consists of two interrelated components: a cadastrally delineated urban edge line, and management guidelines for zones on either side of this line. The urban edge has already had a considerable impact in limiting urban expansion into sensitive and valuable natural environments. It is recognized, however, that the efficacy of this element is dependent upon a package of interrelated supportive actions, such as, for example, urban densification.

Metropolitan open space system (MOSS)

Another of the four key policies of the MSDF is the determination of a metropolitan open space system (MOSS). There has been a growing need for a rigorous framework to guide the planning, management, implementation and maintenance of MOSS in Cape Town as urbanization pressures increase and public sector resources are increasingly limited. A MOSS study covering the entire metropolitan area was therefore commissioned in 1999. This study aims to identify all open space that should constitute a MOSS, as well as appropriate management guidelines for this MOSS. This will ensure open space is rationalized, secured and managed in a holistic and sustainable manner.

(See www.cmc.gov.za/peh/msdf)

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Annex I

Urban environment and biological diversity in the context of Agenda 21, Habitat II and the conventions on biological diversity, climate change and desertification

A. Agenda 21

1. Agenda 21 adopted by the United Nations Conference on Environment and Development – the Earth Summit (Rio de Janeiro, 3-14 June 1992) – includes comprehensive coverage of urban issues (chapter 7: “Promoting sustainable human settlements development”) and biological diversity concerns (chapter 15: “Conservation of biological diversity”).
2. The Commission on Sustainable Development was created in December 1992 to ensure effective follow-up to the Rio Earth Summit and to monitor and report on implementation of the Earth Summit agreements at the local, national, regional and international levels. The special session of the General Assembly held in June 1997 for the purpose of an overall review and appraisal of the implementation of Agenda 21 adopted a document entitled “Programme for the Further Implementation of Agenda 21”, which had been prepared by the Commission on Sustainable Development. It also adopted the programme of work of the Commission for 1998-2002.
3. At the special session, Governments acknowledged that a number of positive results had been achieved, but recorded deep concern that the overall trends with respect to sustainable development were worse at the current time than they had been in 1992. They emphasized that the implementation of Agenda 21 in a comprehensive manner remained vitally important and was more urgent at the current time than ever.
4. In order to make progress, Governments underlined the importance of poverty reduction and of changes towards more sustainable production and consumption patterns, taking into account the linkages between urbanization and the environmental and developmental effects of consumption and production patterns in cities, with a view to promoting more sustainable patterns of urbanization. Governments also encouraged the further development and implementation of local Agenda 21 programmes (since 1992, over 2,000 local authorities in 65 countries have developed local Agenda 21 initiatives, which in many cases try to build bridges between urban development and environment conservation), and stressed that urgent action was needed to implement fully the commitments made at the United Nations Conference on Human Settlements (Habitat II, see below). Key issues in this respect included new and additional financial resources, transfer of expertise and technology, capacity-building and decentralization of authority through, inter alia, strengthening of local capacity and private-public partnerships (United Nations, 1997).
5. More detailed information about the Commission on Sustainable Development and the implementation of Agenda 21 is posted on the Web site <http://www.un.org/esa/sustdev/>

B. Habitat II

6. Participants at the United Nations Conference on Human Settlements (Habitat II) (Istanbul, Turkey, 3-14 June 1996), negotiated the Istanbul Declaration and the Habitat Agenda, which addresses the goals of adequate shelter for all and sustainable human settlements development.
7. The Habitat Agenda (United Nations 1996) includes explicit references to issues in the interface between the urban environment and biological diversity. In the section of the Agenda on sustainable human settlements, Governments commit themselves to the objectives of promoting changes in unsustainable production and consumption patterns, particularly in industrialized countries, and to population policies and settlement structures that are more sustainable, reduce environmental stress, promote the efficient and rational use of natural resources – including water, air, biological diversity, forests, energy sources and land – and meet basic needs, thereby providing a healthy living and working environment for all and reducing the ecological footprint of human settlements.

8. In the Habitat Agenda (para. 101), Governments recognize that many cities are witnessing harmful patterns of growth, of production and consumption, of land use, of mobility and of degradation of their physical structure and note that such problems are often synonymous with soil, air and water pollution, waste of resources and destruction of natural resources. They further observe that some human settlements are also subject to limited water supply, sanitation and drainage and to dependence upon toxic and non-renewable energy fuel sources and irreversible loss of biological diversity. Many of these trends are aggravated or accelerated by high population growth and the magnitude of rural-to-urban migration. Demographic factors, combined with poverty and lack of access to resources and unsustainable patterns of production and consumption, particularly in industrialized countries, can cause or exacerbate problems of environmental degradation and resource depletion and thus inhibit sustainable development. Therefore, a largely urbanized world implies that sustainable development will depend very largely on the capacity of urban and metropolitan areas to manage the production and consumption patterns and the transport and waste disposal systems needed to preserve the environment.

9. In terms of biodiversity-related actions, the Habitat Agenda suggests (para. 139) that, in order to promote a healthy environment that will continue to support adequate shelter for all and sustainable human settlements for current and future generations, Governments at the appropriate levels, in partnership with all relevant interested parties, should:

(a) Promote the conservation and sustainable use of urban and peri-urban biological diversity, including forests, local habitats and species biological diversity; the protection of biological diversity should be included within local sustainable development planning activities;

(b) Protect existing forest resources and promote, where possible, afforestation around and within human settlements in order to fulfil basic needs relating to energy, construction, recreation and food security;

(c) Encourage, where appropriate, the establishment of productive and recreational green belts around urban and rural agglomerations in order to protect their environment and contribute to the provision of food products;

(d) Reduce significantly the degradation of the marine environment emanating from land-based activities, including municipal, industrial and agricultural wastes and run-off, which have a pernicious impact on the productive areas of the marine environment and coastal areas;

(e) Ensure that children have access to the natural world on a daily basis through free play outdoors, and establish education programmes to help children investigate their community environments, including natural ecosystems;

(f) Ensure adequate opportunity for public participation by all interested parties at all levels of environmental decision-making.

10. The United Nations Centre for Human Settlements (UNCHS) (Habitat) has been designated by the General Assembly as focal point for the implementation of the Habitat Agenda. Its mission is to support efforts to implement the Habitat Agenda through policy advice, capacity-building and the establishment of partnerships at the international, regional, national and local levels. UNCHS (Habitat) has prepared a set of guidelines for different partners, including national Governments, local authorities, civil society, the private sector and United Nations resident coordinators.

11. UNCHS (Habitat) has developed a number of activities and programmes jointly with United Nations agencies and programmes, such as the Sustainable Cities Programme, which is a joint facility of UNCHS (Habitat) and the United Nations Environment Programme (UNEP), for the development of a sustainable urban environment, founded on broad-based public participation. Through the Localizing Agenda 21 Programme, UNCHS (Habitat) works with local authorities in cities with nearby fragile ecosystems to seek synergy between urban development and environmental conservation. The Centre is also sponsoring the identification of best practices and indicators for monitoring the implementation of the Habitat Agenda.

12. Extensive information about the Habitat Agenda and its implementation is available on the internet on the Web site <http://www.unhabitat.org/>

C. Convention on Biological Diversity

13. Although the Convention on Biological Diversity does not explicitly deal with the urban environment, several of its articles are highly relevant to this issue. These include, in particular, article 6, on general measures for conservation and sustainable use, article 7, on identification and monitoring, article 8, on *in situ* conservation, article 9, on *ex situ* conservation, article 10, on the sustainable use of components of biological diversity, article 11, on incentive measures, article 12, on research and training, article 13, on public education and awareness, and article 14, on impact assessment and minimizing adverse impacts.

14. In the framework of the Convention process, a number of issues have been identified (but not necessarily resolved) related to the urban environment-biological diversity interface, including suggestions for future research. Examples include: loss and fragmentation of agricultural land and natural habitats due to urban encroachment; the use of lichens as cheap and sensitive air pollution monitors in urban and industrial areas; occupation of forest areas by urban settlers with limited traditional ecological knowledge; impacts of urban areas on protected areas; degradation of rivers and lakes and other water bodies from urban development (UNEP, 1995; 1997).

15. Within its work programme, the Convention on Biological Diversity has adopted a thematic ecosystem focus under which different types of ecosystems are subject to consideration by the Conference of the Parties to the Convention. The urban environment is, thus far, not recognized in the framework of the Convention's ecosystem approach. In the Convention process, national implementation is paramount, and it is clear from a number of national reports submitted by Parties to the secretariat (pursuant to article 26 of the Convention) that they are conscious of the need to look closely at the urban environment-biological diversity interface. It is possible that ECG could find these reports of value in its deliberations.

16. The Convention's clearing-house mechanism may be found on the Web site <http://www.biodiv.org/>

D. United Nations Framework Convention on Climate Change

17. The United Nations Framework Convention on Climate Change does not explicitly address issues situated on the interface between the urban environment and biological diversity. Implicitly, however, the Framework Convention is, of course, a key convention in this context, as the release of greenhouse gases contributing to climate change are typically a function of economic activities, production and consumption patterns linked to the urban environment. As these activities and patterns can also have negative impacts on urban biological diversity, efforts to control emissions of greenhouse gases can therefore be expected to produce positive biological diversity impacts. Furthermore, as climate change is expected to have relatively important consequences for the distribution and composition of biological diversity, efforts to curb global warming will also, in the long run, prove beneficial for urban – and other – categories of biological diversity.

18. There is also a strong connection between the Framework Convention and the ECG focus on urban environment and biological diversity in relation to Convention-related efforts to enhance carbon sequestration in forests and on agricultural land. Reforestation and increased green areas in general can indeed help produce multiple benefits, such as carbon sequestration, increased biological diversity and an enhanced urban environment. There is also a risk, however, that such schemes might pose a threat to biological diversity in cases where only a limited number of faster-growing species are favoured.

19. Fuller information about the Framework Convention and its implementation is available at the Convention secretariat's Web site <http://www.unfccc.de/>

E. United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa

20. The United Nations Convention to Combat Desertification focuses on the physical, biological, social and economic aspects of desertification; the importance of demand-driven technology transfer; and the involvement of local populations. The development of national, subregional and regional action programmes

by national Governments in cooperation with donors, local populations and non-governmental organizations lies at the heart of the Convention.

21. Parties to the Convention commit themselves to address the underlying causes of desertification and pay special attention to the social and economic factors contributing to desertification processes. This may involve addressing issues of unsustainable consumption and production patterns in and around urban areas that contribute to desertification. In their national action programmes, Parties are encouraged to consider measures targeting conservation and the sustainable use of biological diversity in accordance with the provisions of the Convention on Biological Diversity.

22. Much effort has been spent on developing the Convention's Global Mechanism as a multi-source and multi-channel instrument for finance. It is quite possible that, through the Global Mechanism, partnership activities will be developed and financed with the aim of addressing the associated issues of combating desertification in relation to the urban environment and biological diversity.

23. Fuller information about the Convention to Combat Desertification may be found on the Web site <http://www.unccd.ch/>

Annex II

Summary of activities of ECG members related to the urban environment and biological diversity (information provided by the organizations concerned)

1. In order to promote linkages between and the complementarity and compatibility of work programmes, we provide below a brief summary of relevant projects, programmes and activities of members related to the urban environment and biological diversity. Over time, an ECG Web page devoted to the urban environment and biological diversity could provide a cost-effective tool to keep this information up to date and help promote an information exchange and dialogue on key issues among ECG members and interested urban planners, managers, scientists, educators and the general public at large.

A. Food and Agriculture Organization of the United Nations

2. The goal of the FAO programme on urban and peri-urban forestry is to document, synthesize and disseminate information about urban and peri-urban forestry, particularly in developing countries; to identify and clarify key issues; and to provide both technical and methodological guidance to assist member countries in the planning and implementation of urban forestry programmes. Activities to date concentrate on raising awareness of the issue and improving documentation on the subject. A 1993 issue of the FAO forestry journal, *Unasylva*, focused on urban forestry.

3. In addition, a number of separate publications have been prepared, including: *The Potential of Urban Forestry in Developing Countries: A Concept Paper*; *An Annotated Bibliography on Urban Forestry in Developing Countries*; and *Urban and Peri-Urban Forestry in Quito, Ecuador*. A number of case studies on urban and peri-urban forestry in various regions of the world were scheduled for publication in 1998. These include studies on Cairo, Quito, Rio de Janeiro, Tehran and the Sahelian countries, and a comparative study on Hong Kong, Kuala Lumpur and Singapore. FAO is currently providing technical assistance in urban and peri-urban forestry through its field programme in Yemen and Turkey, and continues to support project identification and formulation in several other countries. The programme plans to support the preparation of guidelines for use by cities and countries for the development of an urban forestry. The programme is working in collaboration with the Support Group on Urban Agriculture.

4. In addition, FAO has also addressed issues of urban and peri-urban agriculture through its programme on peri-urban production systems, animal production and health and veterinary public health, its programme on food supply and distribution to cities, its work on home gardens and nutrition, poverty alleviation projects in urban areas and evaluation of costs and benefits of urban agriculture and its programme on peri-urban horticulture.

B. United Nations Development Programme

5. The primary focus of the United Nations Development Programme (UNDP) is on poverty reduction. Since half the world's poor (at least 650 million people) already live in urban areas, this is obviously an important area of action. Furthermore, since it is the urban poor who suffer most from the lack of access to clean drinking water, the effects of polluted water, soil and air, and the use of inefficient and unhealthy energy technologies, efforts on behalf of the poor also contribute to the twin concerns of this paper, namely, the conservation and sustainable use of biological diversity in the urban environment, and the mitigation of negative impacts of urban areas on surrounding biological diversity.

6. Through its 132 country offices all over the developing world, and through its wide range of programmes, UNDP is directly and indirectly addressing these issues. For example, the UNDP Urban Development Cooperation programme comprises more than 300 urban-targeted cooperation projects valued at more than \$400 million. In addition to numerous country programmes around the world that have a direct relation to the interface between urban development and biological diversity, and the strategic initiatives in the areas of rural-urban linkages, urban agriculture, sustainable public transport and city-to-city cooperation, it is worth noting the following UNDP global programmes:

(a) Public-Private Partnerships for the Urban Environment (Web site <http://www.sdnhq.undp.org/ppp/>); this programme helps bring together Governments, private business and civil society to pool their resources and skills in addressing the urban environmental challenges of the twenty-first century. It supports the efforts of cities, municipalities and communities in the developing world to improve the lives of their citizens and reduce negative environmental impacts through private-sector participation in critical environmental services. The programme supports the development of small and medium-sized public-private partnership projects in three key sectors: water and sanitation, waste management and energy efficiency. The programme emphasizes activities with direct benefits to poor urban neighbourhoods, making poor people the principal beneficiaries of improved and extended services, productive and efficient urban management and improved employment opportunities;

(b) Urban Management Programme (Web site: <http://magnet.undp.org>); this is a technical cooperation programme designed to strengthen the contribution that cities in developing countries can make towards sustainable human development through efforts aimed at poverty reduction, sound environmental management and good governance. In the last 10 years, the programme has brought together – all over the world – local governments, the private sector, non-governmental organizations, community members and donors to collaborate as partners in identifying problems and seeking solutions to urban issues. As populations grow, the focus of efforts to develop sustainable human settlements will have to be in the urban areas, where half of the world population lives and works and natural resources are being consumed in a way that has impacts far beyond the limits of urban areas. In the current phase of the programme, UNCHS (Habitat) is the executing agency, while UNDP provides core funding and overall monitoring;

(c) Local Initiative Facility for Urban Environment (Web site: <http://magnet.undp.org>); this programme has been operational at the community, country, regional, interregional and global levels since its launch at the Earth Summit in 1992. The programme is a community-based initiative operating in more than 60 cities in 12 pilot countries – Bangladesh, Brazil, Colombia, Egypt, Jamaica, Kyrgyzstan, Lebanon, Pakistan, Senegal, South Africa, Thailand and the United Republic of Tanzania. It confirms the effectiveness of participatory local governance through local-local dialogue to address urban environmental problems affecting the poor. In collaboration with local urban authorities, non-governmental and community-based organizations and the private sector, the programme supports small projects that improve the local environment. These projects become the basis for policy dialogues and strategies for scaling up the assault on urban environmental problems that mar urban neighbourhoods, deter the economic advance of the poor and damage the natural environment beyond urban boundaries. The programme also funds and supports regional and interregional non-governmental organization networks and cities associations concerned with local urban environmental problems, guiding and propelling country-based initiatives from conception to implementation. It encourages the sharing and dissemination of best practices at all levels of the programme's reach: local, municipal, country, regional, interregional and global.

C. United Nations Environment Programme

7. Activities relating to biological diversity in the urban environment are interspersed throughout UNEP programmes. The world's cities make major contributions to the social and economic development of many human societies, and in the South, they absorb up to two thirds of human population growth.

8. In conjunction with UNCHS (Habitat), UNEP has a Sustainable Cities Programme which spearheads support to authorities so they may better understand and address environment-development interactions. This takes place through innovative mechanisms to strengthen environmental planning and management. Support is provided through demonstration city projects, where city management authorities and their partners implement a closely coordinated set of environmental planning and management activities.

9. Activities undertaken within the framework of environmental planning and management include preparing environmental profiles to clarify key environmental concerns (including biological diversity) and their relative importance. Consultations are also conducted to prioritize issues of civic concern, and thereby facilitate the mobilization of key interest groups in society whose involvement is necessary for sustained intervention and managed change.

10. Most UNEP activities in the urban environment relate to the polluting effects of industry and domestic waste disposal as well as public education. The development of environmental management systems for cities is a major activity, designed to promote the sustainable management of waste water and storm water. Combating the damaging effects of persistent organic pollutants (POPs) and ozone depletion, especially as a result of mainly urban activities, are major concerns for UNEP.

11. In conjunction with UNESCO, UNEP is involved in the development of a training package for managers of World Heritage sites in Asia and the Pacific. Other activities include the development of tourism in natural parks and protected areas, working with the World Tourism Organization and the World Conservation Union (IUCN). These activities overlap substantially with other urban and biodiversity-related issues.

12. In the newly reformed UNEP, the Division of Technology, Industry and Economics will work in collaboration with other divisions and external partners (other United Nations agencies, national and local authorities, non-governmental organizations, industry and business) to contribute to understanding and knowledge of environmental issues relating to, among others, industrial and urban development. In addition, it will provide input to policy development and implementation in key areas, including biological diversity.

D. United Nations Educational, Scientific and Cultural Organization

1. Background

13. The main UNESCO programme of relevance to the issue of the interface between urbanization and biological diversity is its Man and the Biosphere programme (MAB) (see box 1 below).

Box 1

UNESCO's intergovernmental Man and the Biosphere (MAB) programme

Improving scientific understanding of natural and social processes relating to interactions between people and their environment; providing information useful to decision-making on resource use; promoting the conservation of genetic diversity as an integral part of land management; combining the efforts of scientists, policy makers and local people in problem-solving ventures; mobilizing resources for field activities; strengthening regional cooperative frameworks – these are just some of the principal elements of the UNESCO Man and the Biosphere (MAB) programme.

UNESCO has a long history of concern with environmental matters, dating back to the fledgling days of the organization. From the 1950s to the present day, a number of international programmes dealing with integrated approaches to natural resources management have placed UNESCO on the cutting edge of basic and applied sciences. These have been followed by a number of other environmental programmes in such fields as hydrology, marine sciences, earth sciences and the natural heritage, all of which continue to provide a solid focus for the organization's concern with the human environment and its natural resources.

MAB was launched by UNESCO in the early 1970s. It is a nationally based international programme of research, training, demonstration and information dissemination. The overall aim is to help provide the scientific basis and trained personnel needed to deal with problems of the rational utilization and conservation of resources. MAB emphasizes research for solving problems: it is thus concerned with research by interdisciplinary teams into the interaction between ecological and social systems, with field training and with the application of a systemic approach to understanding the relationship between the natural and human components of development and environmental management.

MAB is a decentralized programme with field projects and training activities in all regions of the world. These are carried out by scientists and technicians from universities, academies of sciences, research laboratories and other research and development institutions, under the auspices of more than 100 MAB national committees. Activities are undertaken in cooperation with a wide range of international governmental and non-governmental organizations (UNESCO, 1997a).

[Web site: <http://www.unesco.org/mab/>].

14. Launched in the early 1970s, MAB was the first international venture to consider cities – the places where half of humanity lives and works – as environmental systems. By developing a progressive and evolving research agenda in cities and other human settlements, MAB has contributed both to laying the foundations for an ecological paradigm of urban systems and to testing interdisciplinary and integrative approaches – both conceptual and methodological – for problem-oriented research aimed at improving knowledge and understanding of these complex systems and their relationship with their hinterlands, immediate, remote and global.

15. Such research should contribute to improved planning, management and policy-making and, more specifically, to mitigating the impact of cities on the rural and natural hinterlands on which they depend for energy, materials, food, water, labour and land. Most importantly, MAB has consistently aimed at making cities more liveable and human, and at harmonizing development planning with conservation and the sustainable and equitable use of natural resources, seeking full involvement of local populations.

2. MAB field studies on urban, peri-urban and industrial systems and their application

16. As the urban scenario developed within MAB, it became obvious that new approaches to urbanization and to the urban-hinterland relationship were required – approaches that were technically feasible, ecologically sound, economically and socially viable, and practicable for the various government organizations required to apply them, in the face of the uncertainties of the modern world. These goals could be tested through the conduct of problem-oriented, focused research projects, with an emphasis on understanding the interactions and interdependences within, between and among the systems and on long-term perspectives rather than short-term expediency. In pursuit of these objectives, a great many countries and institutions and their scientists, planners and managers were mobilized, in most cases within the framework of their MAB national committees or their UNESCO national commissions.

17. From the launching of MAB in 1971 to the present, a great many MAB-sponsored expert and planning meetings, seminars, workshops and scientific consultations have been and continue to be organized. These activities have been of regional, interregional, subregional, binational, national or even local character in different parts of the world, covering a wide spectrum of ecological, biogeographical, bioclimatic, economic, social, cultural, political and development situations. Moreover, they have contributed to the development of conceptual and methodological approaches and their application for some 150 field studies in a great variety of sites, ranging from small settlements and regional units to mega-cities, thus consolidating an ad hoc but dynamic MAB urban network at the interregional and regional levels.

18. Numerous training, environmental education and awareness activities, and exchanges of information and personnel, have been held in conjunction with field research activities. MAB scientists, planners and managers have made significant contributions to national and international colloquiums, symposia and congresses in related fields. Many projects in the network have inspired similar work elsewhere, thus proving their demonstration capacity.

19. Over the period since the mid-1970s a number of cities have been studied as ecological systems in the framework of the MAB programme, incorporating work on urban biological diversity and vegetation. These cities include Berlin and Frankfurt in Germany; Vienna in Austria; Rome in Italy; Barcelona, Madrid and Valencia in Spain; several cities in the United Kingdom (under the United Kingdom MAB Urban Forum); Dayton in Ohio, United States of America; Tokyo and Chiba Bay in Japan; Hong Kong in China; Seoul in the Republic of Korea; Jakarta in Indonesia; Kuala Lumpur in Malaysia; Lae in Papua New Guinea; and Mexico City and Xalapa in Mexico, among many others.

20. The studies have thus been directed towards identifying ways of enhancing the efficiency, self-sufficiency and “people-friendliness” of cities, minimizing their impact on their near and distant hinterlands in an effort to make them both more sustainable and more liveable.

21. These studies have a range of different points of entry into their conceptual and methodological frameworks. These include: patterns of extra-somatic energy flow (Hong-Kong, Gotland); use of plants as indicators of chemical changes in the urban environment (Vienna, Rome); urban food production (Buenos Aires, Lae); urban forestry (Madrid, Xalapa); managing urban space for children (Toronto); use of sensitivity models for urban and regional planning (Lower Main-Frankfurt); vegetation and urban climate (Dayton, Seoul, Valencia). Particularly valuable experience has been gathered from such cities as Hong Kong, Rome, Barcelona, Lae, Bangkok and Seoul in mounting studies that encompass a spectrum of natural and social disciplines, as well as actors – assessments of sources and flows of energy and materials (e.g., water, foodstuffs, polluting substances), complemented by studies of urban plant and animal life (with particular concern for biological and genetic diversity in cities) and of the role of cultural and social organizations in making city living environmentally friendly. The latter studies have taken into consideration those intangible factors and processes – so difficult to qualify and even more difficult to quantify – which are characteristic of human society, and are so often neglected and ill understood in planning, management and policy-making.

22. The following example of the Rome MAB project (see box 2 below), which has been under way for some 25 years, represents one of the many such projects being implemented around the world.

Box 2

Rome: Pioneering MAB project.

Early efforts

Launched in the late 1970s and still in progress today, the study of Rome as an ecological system is both a pioneering effort and one of the most enduring contributions to the MAB urban network. Begun under the leadership of the late Professor Valerio Giacomini, a founding father of the UNESCO MAB programme, the study was designed to promote collaborative multidisciplinary and interdisciplinary research in urban ecology, as well as to contribute to broad-based community and municipal efforts oriented towards environmental and sustainable development issues. In its early years the project ranged in its coverage from the most quantifiable variables (energy, water, air and water pollution, waste, noise, traffic, mapping of the entire city environment, illegal settlements, vegetation, wild fauna and domestic animals, physical cultural heritage, the system of fortifications, etc.), to the most intangible, unquantifiable variables, relating to perceptions of the Roman population of their own environment.

In the years that followed, research continued in several of the component areas, with particular attention to psychosocial surveys, bio-ecological field studies and research on the changing urban fringe. Several key publications reviewed in the UNESCO journal *Nature and Resources* provide useful insights into this prolific project, and also contain valuable syntheses of related research in various fields, and the results, applications and policy implications of this research.

Perception of place in the urban environment

Under the long-term multidisciplinary MAB research project on the city of Rome as an ecological system, a study has also been made, in the area of environmental psychology, on the construct of place as a basis for studying the relationship between the city and its habitants, focusing on the kind of activities performed by these inhabitants in three urban contexts: the neighbourhood, the city centre and the periphery. Different activity patterns can be identified among persons living in the same neighbourhood and differing in age, gender and social and cultural characteristics, both inside and among the various urban places considered. According to the inhabitants' different characteristics, the city is viewed in various ways, either as a wide or a restricted urban place. Only to a minority will the city seem to be an integrated, multiplace system, composed of home, neighbourhood, city centre and periphery, and these tend to be highly educated and socially-oriented males

This analytical tool, known in the field as "multi-place analysis", can be used to compare the relationship of the inhabitants with their urban environment in other large or small cities, in the same country or region. Thus the method was applied in a comparison of data from Rome and the small Italian city of Lecce. The study revealed that inhabitants of a small city tend to undergo more integrated urban experiences involving a range of different places, and between home and neighbourhood. In a smaller city, with less isolation in urban conditions and activities than are likely in a large city, there is a greater opportunity for interpersonal social interaction.

One of the main implications of these comparative findings for urban planning is that a city can be modified only as a "multi-place" system, that is, taking into account the characteristics of inter-place urban pragmatics adopted by the residents in the various parts or places of the city itself. In the canons of environmental psychology, the concept of "place" appears to be of crucial importance in understanding the transactions and relationships between urban dwellers and their environment. Within this environmental perspective, the environment can be perceived as a composite of immediate and distant places, arranged hierarchically in the psychological framework of the persons, in such a manner that each place is part of a larger place and can in turn be subdivided into smaller places. The city thus becomes a "multi-place system".

The field of environmental psychology – and more particularly of perception of the environment – is the subject of a postgraduate course in the Department of Psychology of the University of Rome (La Sapienza), which has been collaborating in MAB research for nearly 20 years. One of the department's graduate students became a 1996 grantee within the MAB Young Scientists awards scheme. The research proposal is entitled: "Environmental perceptions and behaviours toward green areas among urban people", and represents a synthesis of the abundant body of work produced by this research team and the resulting publications.

(Bonaiuto and Bonnes, 1997. "Multi-place analysis of the urban environment: A comparison between a large and a small Italian city". *Environment and Behavior* – in press)

"Rome as a sustainable city" ("Roma città sostenibile")

Twenty years on...

Rome's local authorities (Comune di Roma) produced a volume with the above title as a contribution to an international conference held in November 1995 to launch the Mediterranean local Agenda 21. The book was prepared under the auspices of the Municipal Agency for Energy and Environment. The first part, with an introduction by Mayor Francesco Rutelli, focuses on the signs of change, with an overview of Rome as a discontinuous urban system, presenting a reflection on the environment as an opportunity, a model of sustainable Rome, and the result of two years' experience in five priority areas: urban green space, suburbs, transports, impacts and participation. The second part addresses efforts to bring Rome in line with Agenda 21, providing a description of such practical, problem-solving projects as the following:

- Creation of 10 new suburban parks;
- Reduction, as against previous estimates, of new building developments by 38 million m³, equivalent to a town of 400,000 inhabitants, i.e., some 20 km² of land;
- Integrating different means of public transport through a Metrobus project;
- Reducing the negative impacts of cars through a campaign named "Bollino Blu" (Blue Stamp), aimed, among other measures, at regulating the access of cars to the city's historical centre, control of exhaust emissions and introduction of oil and diesel fuels with low benzene and sulphur content;
- Separation in waste collection and disposal;
- Promotion of low-energy-consuming lamps;
- Organization of municipal district workshops to encourage dialogue and joint actions between citizens and the town council.

In 1993, the citizens of Rome, which has been on the World Heritage list since 1982, were called for the first time to elect their mayor and local government by direct suffrage. Manifesting their dissatisfaction with the uncontrolled growth and the expansion of low-quality suburban areas lacking essential services, voters entrusted the city administration to an environmentalist mayor. A political coalition was thus established whose programme includes priority attention to all the issues outlined in the previous paragraphs. This volume represents a continuation of the MAB project on Rome, started in the mid-1970s.

(Source: Comune di Roma, *Roma Città Sostenibile*. (Ecomed – Agencia per lo sviluppo sostenibile del Mediterraneo, Rome, 1995), 133 pp.)

3. A wealth of information on MAB research

23. Hundreds of publications, in the form of books, series reports, technical notes, journals, bulletins and newsletters, have resulted from UNESCO field research projects and related activities. Taken together, these constitute a valuable and widely consulted source of scientific and practical information. A description of some of these publications is provided below, in box 3, and a fuller listing may be found in the bibliography at the end of this annex.

Box 3

MAB in print, a library on its own

Working in collaboration with MAB national committees and UNESCO regional offices, over the past decade the MAB secretariat has undertaken the compilation, analysis and synthesis of a large volume of work (comprising several hundred bibliographical references), as well as booklets for different audiences resulting from over 20 years of MAB and related activities in urban systems. First published in English and Spanish in the late 1980s, the *MAB Urban and Human Ecology Digest* was the first compilation of its kind. Overview reports were included in widely distributed books and other publications, such as *Man Belongs to the Earth* (1988); the *MAB Programme Biennial Report* (1988-1989); and *Ecology Chronicle* (1989-1990), published by UNESCO. A special issue of the *UNESCO Courier* entirely devoted to MAB (April 1981) and published in 21 languages included an extensive review of the MAB approach to the study of cities as ecological systems. An entire special issue of *Ambiente* magazine (No. 38, 1983), devoted to the city, reviewed selected MAB research projects. Many other subsequent issues of the same publication have reported on MAB studies of urban ecology.

Specialized and general-interest journals, magazines, bulletins and newsletters have provided regular coverage of MAB urban activities (examples include *InfoMAB Bulletin*, the *Biosphere Reserves News Bulletin*, *Nature and Resources*, *UNESCO Features*, and *UNESCO Special*, all published by UNESCO, Paris; *Urban Nature* magazine, United Kingdom; *Ambiente* magazine, Argentina; and *Diálogo* magazine, Venezuela). The *All of Us* environmental education dossiers, produced and published in four languages by the UNESCO Centre in Barcelona, Spain in collaboration with UNESCO, has included an issue – No. 6, February 1994 – on cities, based almost entirely on MAB experience. More recently, a special issue of *Nature and Resources* – Vol. 32, No. 2, of 1996, released in April 1997 – was completely dedicated to the issue of the sustainable city as a contribution to Habitat II, providing an overall view of combined efforts by UNESCO in this field.

In the second half of the 1990s, synthesis studies and reviews were published by the Open University of the Environment in Curitiba, Brazil; in *Ambiente* magazine in La Plata, Argentina; and by long-standing MAB projects in urban ecology such as that in Rome, Italy, encompassing two decades of multidisciplinary and by interdisciplinary research ranging from biological diversity issues to psychosocial comparative research; and by the project on the ecology of the City of Seoul, Republic of Korea, which includes 12 component research studies in a wide range of topics conducted over a period of some 15 years. Special mention should be also made of the United Kingdom publication *Urban Wildlife News*, a bulletin of the organization English Nature (formerly the Nature Conservancy Council of the United Kingdom), which carries the MAB label, incorporating news from MAB and MAB-related activities in Europe and other regions of the world.

Box 4

Atlas of the Flora of Rome (*Atlante della Flora di Roma*)

At the current time, when the Convention on Biological Diversity is providing a major stimulus to the scientific and governmental communities, and there is a much clearer understanding of the extent and importance of biological diversity in a broad variety of environmental situations, including urban, peri-urban and industrial systems, the new Atlas of the Flora of Rome represents an important contribution in terms of both content and method to our knowledge about and inventorying of biological diversity in urban ecosystems.

The Atlas is the product of one of the components of the long-term MAB ecological study of Rome, which has focused on the occurrence, distribution and characteristics of the spontaneous flora of Rome (excluding plants which have accidentally escaped from cultivated areas). The list of indigenous and naturalized plants recorded over a 10-year period (1985-1994) comprises 1,285 species belonging to 591 genera and 131 families. Of these, 1,032 species (80.3%) are native plants, while the remaining 253 (19.7%) are introduced neophytes, mostly from the American continent. The distribution of biological forms highlights the varied physiognomy of the plant communities of the city. Highest species diversity occurs in large parks, along river banks, in archaeological sites and in woody areas west of the city. It has been ascertained in this study that green corridors play an important role in ensuring a high floristic diversity in the midst of an urban area.

The green and the historical go together in Rome, constituting an irreplaceable urban landscape in the manner of a mixed heritage. It is the marriage of these two qualities that makes Rome so unique.

L.C. Grapow, *Atlante della Flora di Roma: La Distribuzione delle Piante Spontanee come Indicatore Ambientale* (Rome, Argos Edizioni, 1995). In Italian, with English summary.

4. Cities and biosphere reserves

24. Through the World Network of Biosphere Reserves (see box 5), UNESCO, in the framework of MAB, has promoted the application of the biosphere reserve concept as green belts around cities. Such belts have been established around Sao Paulo and Rio de Janeiro in Brazil and San Francisco in the United States. Some member States are considering the application of the biosphere reserve concept also to urban, peri-urban and former industrial areas. The MAB Urban Group, which was launched in November 2000, has been mandated to explore the application of the biosphere reserve concept to urban areas and their hinterlands. Information about the Group may be found on the Web site www.unesco.org/mab/urban/maburban.htm

Box 5

Biosphere reserves

Biosphere reserves are areas of terrestrial and coastal marine ecosystems where, through appropriate zoning patterns and management mechanisms, the conservation of ecosystems and landscapes and their biological and genetic diversity is combined with the sustainable use of natural resources for the benefit of local communities, including relevant research, monitoring, training and education activities. Thus, biosphere reserves are chosen on the basis of their ability to reconcile the conservation of biological diversity and the sustainable use of biological resources. There are now 391 biosphere reserves in 91 countries in different regions of the world. A number of these reserves are found near cities of varying size – examples include: Montseny (Barcelona), Manzanares (Madrid), Doñana (Seville) and Sierra Nevada (Granada) in Spain; the Tatra Mountains in the densely populated Podhale region in southern Poland; Schorfheide-Chorin and Spreewald in Germany; Charlevoix in the region of Montréal in Canada; Mata Atlantica (São Paulo and Rio de Janeiro) in Brazil; Parque Costero del Sur (La Plata and Buenos Aires) in Argentina; and the Everglades (Florida), the southern Appalachians (south-eastern states) and the central California coast in the United States of America.

This list is of course far from exhaustive. In every case, the reserve's management plans must make provisions for the possible consequences of such proximity to cities. This is achieved through a system of zoning, which provides for a range of measures extending all the way from minimal intervention, i.e., a core zone containing samples of representative ecosystems for scientific observation and monitoring, to buffer and transition zones representing increasing levels of human intervention and experimentation in approaches to sustainable development for the benefit of local populations, including the enhancement of traditional systems of land and resource use, environmental education and training, sustainable tourism and other practices.

The difficulties in establishing integrated management plans which include both cities and nearby protected areas reside in excessive sectoral thinking and organization, overlapping jurisdictions and communication problems between competing adjacent local authorities. It may also be difficult to harmonize varying levels of public consultation and participation in the management of protected areas even within the same urban area.

As the world moves forward into the twenty-first century, urbanization and urban systems have become a dominant global environmental factor. The time is therefore ripe for a conservation strategy that fosters local participation in management plans seeking to reconcile conservation and local development in sustainable terms, thereby making possible the integration of cities into broad regional conservation units. In this way, urban planning and countryside management are integrated into what could be called an "urban biosphere reserve strategy", which would lead to awareness of the place that nature has in the city, and the key role that biological diversity plays in the lives of city people, together with environmental education and contact with other species. The "open" character of the city as an ecosystem, described in previous sections, should thus motivate urban, regional and land use planners to ensure a continuum between cities and their rural and natural hinterlands. This strategy would not only serve nature conservation but also enlarge the perceptive field of citizens in the realization that the city is blended into its territory.

The interdigitation and continuity of urban natural and semi-natural spaces, which through appropriate planning and management and community involvement will connect with natural and rural hinterlands, could very well include the network of linear wildlife and cultivated habitats, including canals and rivers, streams, hedgerows, ditches, railroads and road verges, parks, gardens and allotment gardens, which in themselves also constitute remarkable habitats, supporting a surprisingly diverse flora and fauna. The urban environment can thus harbour a biological diversity which is not only adapted to it, but is also under threat of disappearance from the countryside as a result of drastic changes in land use and intensification of agricultural production.

5. Other UNESCO activities involving cities and linked to the MAB programme

25. Through the World Heritage Convention, UNESCO is supporting the conservation of valuable city environments (natural and cultural) around the world. Information about the Convention may be found on the site <http://www.unesco.org/whc/>. In addition, over the period 1996-2001, UNESCO is implementing an intersectoral project on the management of social and environmental transformations in cities, which links together its Management of Social Transformations (MOST) and MAB programmes. One activity within this project includes providing young people in San Roque (São Paulo, Brazil) with training in environmental employment areas.

6. Selected bibliography of UNESCO/MAB and MAB-related work in urban systems and other types of human settlements

26. Over the following pages, we provide a selective bibliography of publications – books, journal articles, reports, brochures and others – relating to work carried out under the MAB programme.

- Ambiente**, 1983. La Ciudad (Roma, Bolonia, Venecia, Francfort, Hong Kong, México, Cono Sur). *Ambiente*, N°38, Número Aniversario dedicado al Programa El Hombre y la Biosfera (MAB) (Fundación CEPA, La Plata, Argentina), 1983
- AMBIO**, 1996. The Sustainable City (18 articles). *AMBIO, Journal of the Human Environment*, special issue, XXV(2), (Royal Swedish Academy of Sciences, Stockholm), 1996, 148 p.
- Barker, G. and A. Graf**, 1989. Principles of Nature Conservation in Towns and Cities. (Nature Conservancy Council-English Nature, United Kingdom), Peterborough, 1989
- Barker, G., M. Luniak, P. Trojan and H. Zimny (eds.)**, 1994. Proceedings of the II European Meeting of the International Network of Urban Ecology. *Memorabilia Zoologicae* (Polish Academy of Sciences, Warsaw), 1994
- Batisse, M.**, 1992. Nord et Sud: Confrontation ou Dialogue? *Annales des Mines* (Paris) Juillet-Août:27-31, 1992
- Bonaiuto, M. and M. Bonnes**, 1997. Multi-place analysis of the urban environment: a comparison between a large and a small Italian city. *Environment and Behavior* (in press)
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Annex III

A regional example: Europe and the quest for the sustainable city

A. The sustainable city

1. The notion of the "sustainable city" was first found in a UNESCO publication in 1988 and was further developed into that of the "resourceful city" in 1991. Sound planning and management must go hand in hand with environmental approaches and sustainability. Building upon the definition of "sustainable development" that has emerged over a long process of international discussion and analysis, a summary review is given below of selected international programmes and events of interest for Europe in which the concept is directly applied to cities. These programmes and events include:

- (a) The Sustainable Cities Programme (UNCHS (Habitat), 1990);
- (b) The Green Paper on the Urban Environment (European Commission, 1990);
- (c) The Sustainable City Project (European Commission Expert Group on the Urban Environment, 1993);
- (d) The European Sustainable Cities and Towns Campaign (first European conference on sustainable cities and towns, 1994);
- (e) The Healthy Cities Project (World Health Organization, 1991);
- (f) The Local Agenda 21 initiative, established in response to the Earth Summit in Rio in 1992 (International Council for Local Environmental Initiatives, in partnership with the International Union of Local Authorities, 1992);
- (g) The Ecological City Project (OECD Environmental Group on Urban Affairs, 1993);
- (h) The Programmes on Management of Social Transformations (MOST) and Man and the Biosphere (MAB), 1996-2001. This includes a programme on working towards socially sustainable cities and building a knowledge base for urban management in the twenty-first century;
- (i) A communication entitled "Towards an urban agenda in the European Union" (European Community, May 1997), contribution to the debate at the European Summit of Regions and Cities held in Amsterdam from 15 to 17 May 1997.

Many other initiatives could be added, showing Europe's concern for sustainability in the most urbanized continent in the world.

B. City and rural/natural environments in Europe

2. European activities in this area focus on the significance of biological diversity within the city and in its hinterland. The crucial role of biological diversity has been placed under the spotlight, revealing its validity for all situations, from the most natural to the most human-dominated. These activities have demonstrated the importance of including information on the role of biological diversity in awareness-building and environmental education among urban and peri-urban populations: in this way, people are taught to appreciate more fully the benefits of nature and to contribute to its conservation and enrichment in and around urban environments.

3. This thinking is illustrated by several case studies:

- (a) Parc de Collserola, in the vicinity of Barcelona;
- (b) European Federation of Natural and Rural Metropolitan Peri-urban Spaces (based in Barcelona), recently set up to facilitate the exchange of knowledge and experience among cities, with a view to conserving biological diversity within cities and in the proximity of their outskirts;

- (c) Copenhagen and its “fingers” (see box 1);
- (d) Rome and its flora (see annex II, box 3);
- (e) Valencia and its horticultural space: “la Huerta”.

4. For further information, see J. Celecia and D. Richard, “Redefining concepts, challenges and practices of urban sustainability”, European Foundation for the Improvement of Living and Working Conditions. Office for Official Publications of the European Communities (Luxembourg, 1997), 205pp.

Box 1

Copenhagen, the “Finger City”: Interdigitation of urban development and green areas in long-term urban and regional planning

For almost 50 years, development of the greater Copenhagen metropolitan area has been based on the “finger city” concept, designed to control urban growth. This concept promotes the use of public transport (originally the existing railway lines) and the protection of green space between the “fingers” of this railroad, encouraging the penetration of these green areas towards the city centre. The modifications and refinements of this theme through the years all show clear movement along one consistent line: the four respective regional plans of 1948, 1961, 1973 and 1989 all demonstrate the further development and elaboration of the same concept, with a longer and more comprehensive railway system (the fingers) with localized urban development along their route as part of an explicitly formulated relocation strategy, and the functional development and protection of green space between the “fingers”.

The Copenhagen planning system has been moderately successful in promoting public transport and reducing average travel time. Car traffic in the city of Copenhagen today is at a lower level than in 1970. The decentralization and development of secondary centres has also been successful, giving the population of the suburbs better access to jobs and services. As a result, traffic and related congestion and pollution in the centre of Copenhagen is under more efficient control. In addition, the green wedges between the fingers are protected. The plans have not been successful in all respects, however. A recent survey of office construction in the greater Copenhagen area reveals that only about half of the office floor space built between 1980 and 1990 was actually developed in the priority areas near the public transport stations.

The Copenhagen example of regional and municipal land use and transport planning shows that long-term consistency in planning is an important factor. Notwithstanding modifications and changing planning objectives, the main planning concept of the finger city has been maintained. It is because of this consistency that it has proved possible to integrate land use and public transport planning. Recent planning themes, such as the concentration of working areas around stations and the development of green and ecological zones, fit well within this main planning concept. The lesson is that environmental policy should be based on consistent and sustainable land use plans and principles.

Adapted from EURONET/ ICLEI, “Case studies”, In: *Local Sustainability. European Good Practice Information Services. Best Practices Database* (European Commission, Brussels), 1997

5. Some supranational initiatives designed to reconcile nature conservation and development – either on a statutory basis, as with the biosphere reserves of UNESCO, or in the framework of legal commitments from member States, as with the Natura 2000 network supported by EC-DGXI, or in the context of public awareness-raising measures, as with the campaign on “Nature Conservation outside Protected Areas”, run by the Council of Europe – may be seen as applicable in the urban environment context.

6. Special attention is paid to food production in urban areas. Leaving aside purely sentimental and aesthetic considerations, urban and peri-urban agricultural and horticultural spaces not only represent another pool of biological and genetic diversity in such areas (provided the domestic utilization of pesticides is limited), as promoted by the International Office of Allotment and Family Gardens (see box 2), but also provide, in a context of economic crisis and identity, a ground for social justice, as shown by movements such as the French League for the Home Garden and for the Family, created in the late nineteenth century to serve and consolidate the family, enhancing its natural base: the land and the home.

Box 2

The International Office of Allotment and Family Gardens goes to Parliament

On 19 March 1997, representatives of the International Office of Allotment and Family Gardens, which represents 3 million urban family gardeners in 14 affiliated countries, were invited to participate in a hearing at the European Parliament on the theme "Breathable cities: reinforcing community policies on the urban environment", in the presence of members of the European Commission and international experts. The aim of the hearing was to accord to the urban environment a European priority status. The value of gardens as vehicles for nature protection in cities and the need for solutions to numerous urban problems were strongly emphasized. Through European Deputy Ms. Viviane Redding, the International Office submitted to Parliament a petition on the following issues: recognition of family gardens in European policies; recognition of the volunteer work of European leagues in favour of nature and of the environment; concrete support for their action.

Source: Jardin Familial de France, No. 382, juillet/août 1997, p. 14

Growing interest in nature in and around cities: Selected meetings, colloquiums and symposia held at the national, regional and international levels

1. Any review of the activities of ECG and related organizations and programmes concerning biological diversity in urban and peri-urban areas must also take into consideration the many activities outside ECG that have been mounted in recent years and that continue to gain momentum. It is true that, as happens in many scientific domains, such activities remain sporadic, dispersed and often limited in scope, in most cases owing to limitations in financial and human resources. Moreover, their so-called "international" component is constituted, in many cases, by a few participants from countries other than those of the host country itself – often neighbouring countries – and by scientists already present in the host country, either as invited or visiting academics or advanced foreign graduate students presenting the results of their theses.
2. In any event, there is a genuine will to gain a better understanding of a subject in which there is a great need for further extensive and applied research. Fortunately, there is also heightened interest in an integrated and interdisciplinary approach to environmental research as a basis for planning, management and conservation. This is already leading to substantial contributions to our knowledge, understanding and inventories of flora, fauna, biotopes and ecosystems in urban, peri-urban and industrial systems, and to updating of that knowledge. International organizations and programmes, whether governmental or non-governmental, should keep close tabs on such activities in order to increase their data and information base on urban and peri-urban biological diversity and natural resources in cities in general, and, where possible and necessary, offer their support, sponsorship or patronage.
3. There are many such examples, the more notable of which include:
 - (a) Second European meeting of the International Network for Urban Ecology, Polish Academy of Sciences, Museum and Institute of Zoology, Warsaw, December, 1992. This meeting, the proceedings of which were published in 1994, was held within the framework of the MAB programme and INTECOL. The first meeting was held in Berlin in 1991;
 - (b) Second symposium on natural areas in conurbations and on city outskirts, held at the Science Museum, Barcelona, Spain, in October 1995. This international event was organized by the Metropolitan Park of Collserola, Barcelona, the Community of Municipal Governments of the Barcelona Metropolitan Area, and the Official College of Biologists, and its proceedings were published in 1995. The first symposium, on the theme of large parks in metropolitan areas, was held in 1983, also in Barcelona, and organized by the former Barcelona Metropolitan Corporation;
 - (c) Publications of the Muséum National d'Histoire Naturelle, Paris.
4. More recent events include:
 - (a) Fourth International Symposium on Urban Wildlife Conservation, held at the University of Tucson, Arizona, United States of America, in May 1999. The proceedings of this important symposium are forthcoming;
 - (b) Colloquium on the theme of "Peri-urban nature areas: an opportunity and a challenge for cities"; this event was held in Lyon, France, in December 1999, in the framework of the Jacques Cartier Centre symposia. Its proceedings were published in October 2000. This colloquium represented a follow-up to the second symposium on natural areas in conurbations and on city outskirts, held at the Science Museum, Barcelona, Spain, in October 1995. It also included a meeting of the European Network of Periurban Natural Parks (FEDENATUR);
 - (c) International conference on the conservation of nature in big cities, held under the slogan: "Praga-2000: Natura Megapolis", was convened by the Czech Union for the Conservation of Nature, in cooperation with the Municipality of Prague, the Ministry of the Environment and IUCN. The Conference

was held in Prague, Czech Republic, in August/September 2000, and its abstracts have been published. The proceedings are forthcoming;

(d) International conference of the Society for Ecological Restoration, on the theme: "Reflections on the past, directions for the future" (SER 2000), was held in Liverpool, United Kingdom, in September 2000. The conference's abstracts are available and its proceedings are forthcoming;

(e) International symposium on the urban ecology of birds and mammals in Europe, held in Nienover (near Göttingen), Germany, on 11 and 12 November, 2000. This event was organized by the German Society for Wildlife Ecology and Nature Conservation (GWN) and its proceedings are forthcoming.



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