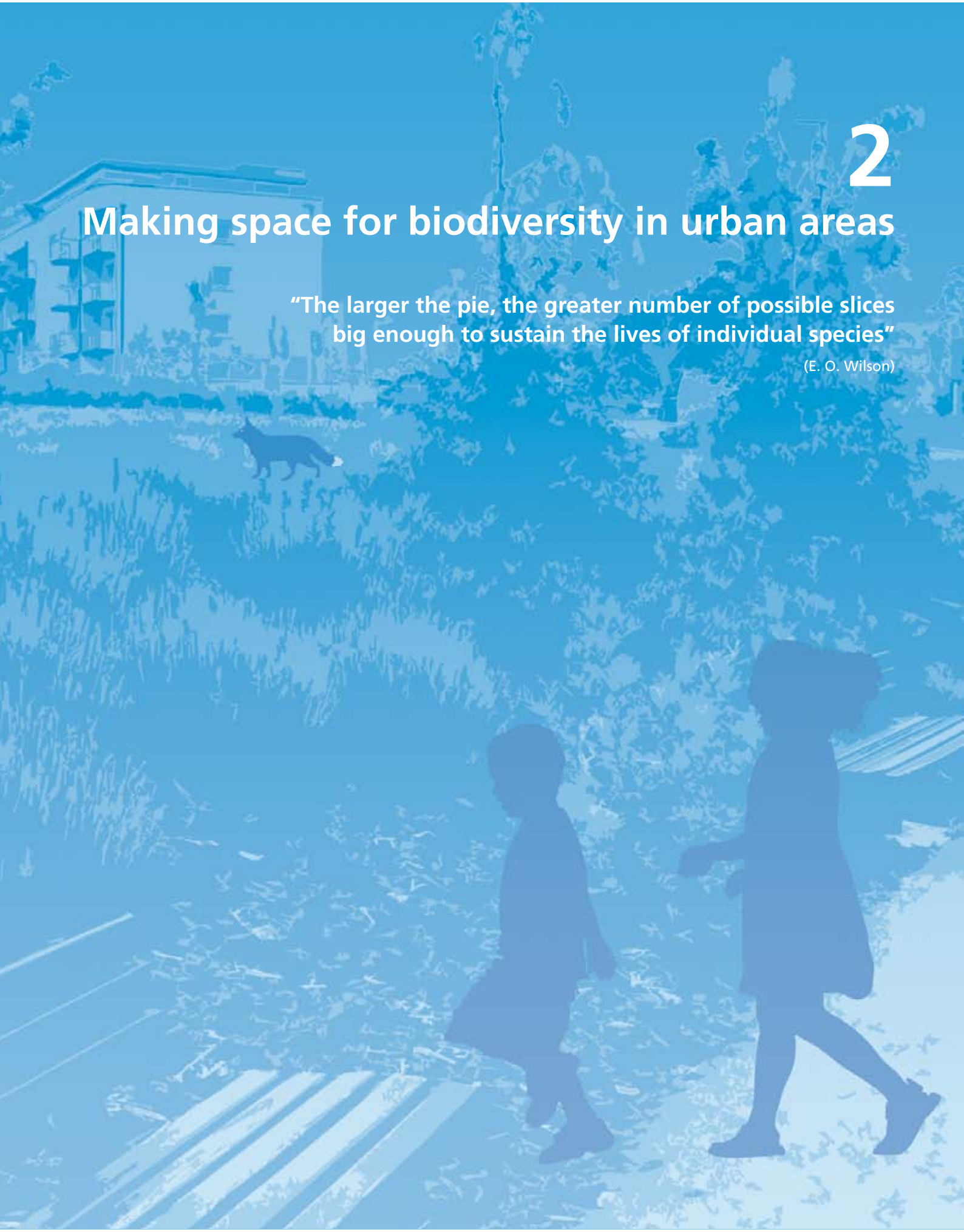

2
Making space for biodiversity in urban areas

"The larger the pie, the greater number of possible slices big enough to sustain the lives of individual species"

(E. O. Wilson)

2. Making space for biodiversity in urban areas

Urban habitats and species are sometimes considered to be less important than their rural counterparts. However, biodiversity can be higher in cities than surrounding rural areas providing rich and diverse ranges of plants and animals, which often occur as unusual or unique communities (Angold et al., 2006). Urban green space provides a unique landscape that supports a diversity of flora and fauna and provides an ever-expanding human population with direct access to nature. Maintaining our connection with nature is a fundamental need and has significant implications for the quality of life of city dwellers. The presence of high quality biodiversity in urban areas provides us with additional environmental and economic benefits including cleaner air and water, more attractive properties and recreational areas. By examining the planning and development process and promoting best practice, we can ensure that nature and natural processes are employed to help support a functioning city and that our biodiversity resources are safeguarded.

Urban environments are often sub-divided into green space, grey space, brownfield sites and private gardens and balconies. Each of these provide their own opportunities for biodiversity enhancement.

2.1 GREEN SPACE

Urban green space includes everything in cities that has vegetation. Collectively it is sometimes referred to as "Green infrastructure", encompassing the entire working landscape in cities that serve roles such as improving air quality, flood protection and pollution control (Girling and Kellett, 2005).

Common types of urban green spaces include;

- Doorstep and communal green space (including balconies and courtyards)
- Private gardens
- Institutional land
- Local parks
- District and regional parks
- River corridors and floodplains
- Coastal zones

2.2 GREY SPACE

Grey space is defined as the built environment, incorporating buildings, pavements and roads. These were traditionally seen as being of limited benefit to biodiversity and were rarely ever designed with biodiversity considerations in mind. Today, advances in design and best practice methods means that the potential for supporting biodiversity has improved. Incorporated features such as green roofs, green walls, modified bricks and roof tiles, have the potential to support wildlife and significantly add to the biodiversity value of a development. Although adding vegetation to the roofs, walls and around buildings

will not replace the habitats lost, it will help compensate and in some instances, create a diversity of new habitats for birds, bats, invertebrates and a diversity of plants. The quality and type of artificial surfaces used throughout a development play an important role in defining the biodiversity potential of a site. A high degree of sealed surfaces, such as concrete, or asphalt, provide no potential for plants or wildlife to live. In addition it creates rapid runoff of rainfall into the drainage system and can lead to flooding. By using partially sealed, permeable surfaces such as gravel with grass coverage, wood-block paving or honeycomb brick with grass and limiting the area of hard standing, natural infiltration is permitted into soils below and there is greater potential for small plants and invertebrates to exist.

Plate 7. A European green roof and living wall. Source: ecotourismblog.

Plate 8. A green roof atop a building in Beijing. Source: Treehugger.

2.3 BROWNFIELD SITES

Brownfield site refers to land that is or was occupied by a permanent structure, which has become vacant, underused or derelict and has the potential for redevelopment. Brownfield sites are part of the cycle of planning and development. By their nature they are transient communities. They are periodically lost through redevelopment while other brownfield areas develop as new sites become vacant. This natural dynamic creates a balance in the number of brownfield sites that persist at any one time. Several studies have focused on the biodiversity value of brownfield sites and found them to be diverse for flora, particularly in the younger pioneer and tall herb phases, which persist longer on nutrient poor substrate or under disturbance. These communities eventually develop into more stable grassland or scrub communities. The biodiversity of brownfield sites will benefit by not having any intermediate measures taken to "tidy up" these sites while they await redevelopment. Instead it is better if they are allowed to recolonise and undergo the natural processes of ecological succession.

2.4 PRIVATE GARDENS AND BALCONIES

A substantial proportion of urban green space comprises private gardens. While development design dictates the quantity of public space and private gardens, landscape design and post-development management dictates its quality. Once the development has been completed the biodiversity value of the private space is beyond the influence of the planning system. The same principles apply for design and management of private green space as for public green space. Wildlife-friendly gardening methods can be encouraged through local biodiversity initiatives. Balconies are a standard feature of high-density urban developments and provide occupants with private space for some planting and access to open

space. The value of this personal space is often not fully appreciated. Some studies suggest that residents in high-density developments are less susceptible to illness if they have a balcony or terrace garden and the psychological benefits of seeing and caring for plants are well known (Johnston & Newton, 2004). Larger balconies encourage people to sit out and use the area more. While these small areas may have limited biodiversity value, they contribute to the overall network of green space within a development.

2.5 THE EVOLUTION OF THE GREEN CITY

Almost since the beginning of urban planning, planners have sought means of incorporating nature into the city and preserving the surrounding landscape. The motivation for this has included aesthetics, health, recreation and amenity. However, motivations relating to nature conservation have also been considered for a surprisingly long time.

"The case for the conservation of nature and for the increase of our accesses to her must be stated more seriously and strongly than is customary. Not merely begged for on all grounds of amenity, of recreation, and repose, sound though they are, but insisted upon. On what grounds? In terms of the maintenance and development of life". *(Patrick Geddes, Cities in Evolution, 1915)*

Geddes offered a concept of regional planning, emphasising essential connections between the city and its region, which he described as any geographic area that expresses a certain unity of climate, soil, vegetation, industry and culture. His simple three-part component of the regional city incorporated place, folk and work, which equate to environment, society and economy (Hough, 2004), the three strands of modern sustainability.

As cities grew rapidly in the late 19th century there was increased emphasis on integrating nature into the city landscape. Many early landscape architects, most notably Fredrick Law Olmsted (1822- 1903), sought not only to improve the appearance of the city but to improve health and provide areas for rest and recreation for the crowded urban population (Hough, 2004). Olmsted, who was responsible for New York's Central Park and the 'Emerald Necklace' in Boston, viewed his parks and parkway systems as means of extending the rural character of the countryside into the city. His work is viewed as the precursor to the modern concept of greenways; the spatial planning concept where a string of green areas are connected into a system of protected lands, managed for multiple uses including nature conservation (Fabos, 1995; Ahern, 2000). The notion of bringing nature into the city expanded after Olmsted to include the idea of urban containment and buffering. Ebenezer Howard's (1850-1928) influential Garden Cities of Tomorrow (1902) outlined a model of a self-sustaining town. Howard promoted the idea of planned satellite communities surrounded by greenbelts, containing carefully balanced areas of residences, industry and agriculture. Green belts were designed to define the city limits and preserve the integrity of the countryside surrounding the London area.

The London Metropolitan Green Belt encircles the greater London area covering approximately 5,000 km^2. The concept first emerged in the mid-1930s to provide public open space and recreational areas, and was later developed as a means of preventing urban sprawl and preserving both urban and rural character. In addition to their primary planning functions they help preserve valuable landscapes and support nature conservation objectives on the urban fringes. There are currently 14 green belts in England covering

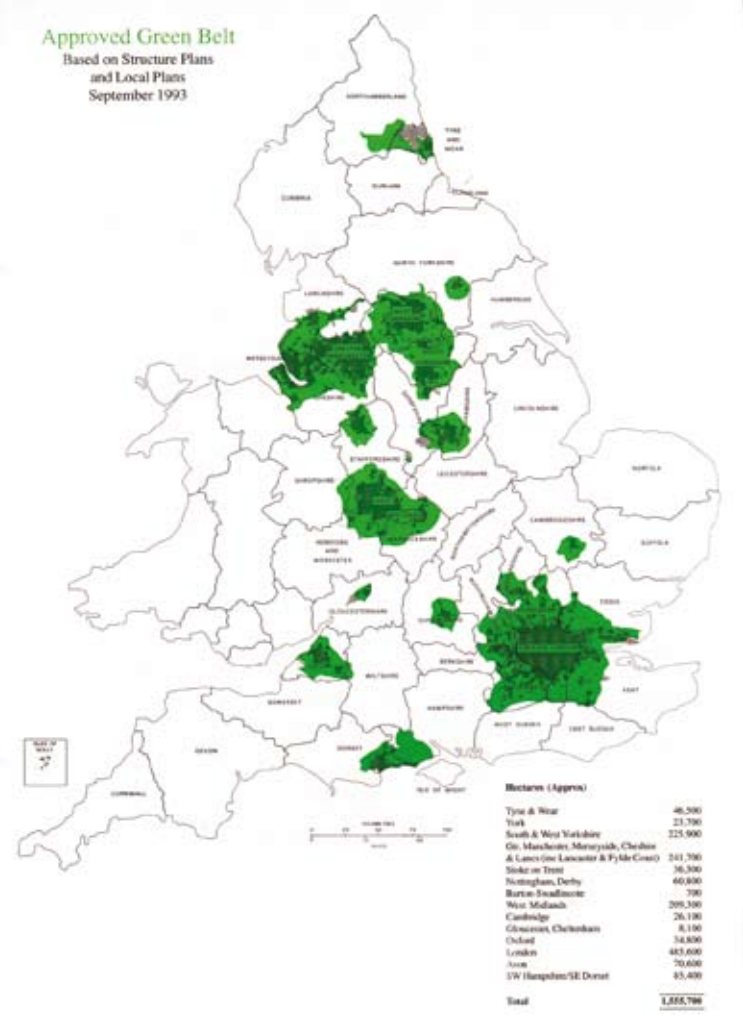

Figure 1. Fourteen Green belts in England cover approximately 13% of English land cover (DoE, 1995).

approximately 13% of the English land cover (DoE, 1995).

Strategic gap and green wedges polices provide axes of protected land that extend into the city. The main overlap between strategic gap and green wedge and Green Belt purposes is in the area of preventing the coalescence of settlements. Green wedges penetrate urban areas and can be used to preserve landscape and wildlife links between town and country, providing recreational facilities and promoting positive land management (DETR, 2001). Green Belts primarily buffer and separate areas while greenways are always linear and, in addition to buffering development, provide a corridor for human and wildlife movement (Searns, 1995). Greenways and green networks generally refer to connected patches and linear strips of habitat that have an inbuilt ecological use including hedgerows, woodlands, wetlands and artificial corridors such as roads, railway lines, road margins and streetscapes (Girling and Kellett, 2005).

Copenhagen provides an example of regional urban green space planning. The city has evolved from a compact core into the Greater Copenhagen area over the past 60 years. The master plan for the development of Greater Copenhagen, published in 1947, became known as the 'Finger Plan'. The five fingers were intended to contain and buffer new settlements and the necessary infrastructure in the form of roads and railways. The landscape between the fingers would remain open, supporting agriculture, recreation and amenity purposes. Since the publication of the plan, the city has expanded radially through a series of regional plans. Provincial towns and suburbs have been linked by transport corridors. Urban areas are confined to the linear corridors. Green wedges protected from urban development fill the spaces between the urban corridors. This provides efficient transport structures though the fingers and assessable landscape close to most people. However, many cities have not had the benefit of such foresightedness and are now faced with repairing and restoring degraded habitats and severed linkages.

Although green belts, green wedges, greenways and green fingers are largely planning designations, they can directly or indirectly support biodiversity objectives by providing and maintaining connected open space in areas of high density urban development. The spatial arrangement of these designations is important. Firstly, they should align with natural features of significance in order to adequately protect elements of greatest biodiversity value. These would generally

be large features such as river corridors, woodland and other substantial tracts of semi-natural habitat that are clearly identified at the landscape scale. Secondly, these designations should be connected to one another by preserving existing links or creating additional linkages in the landscape. Thirdly, they should provide additional linkages that radiate outwards into the wider landscape. Smaller features such as hedgerows, streams and treelines that are identified at the habitat-scale can form additional linkages.

In order to do this, landscape and ecological features should be taken into account within the regional framework of planning. In addition to protecting and maintaining existing features and habitats of value, Masterplans should seek to identify potential connecting corridors and to enhance the ecological value

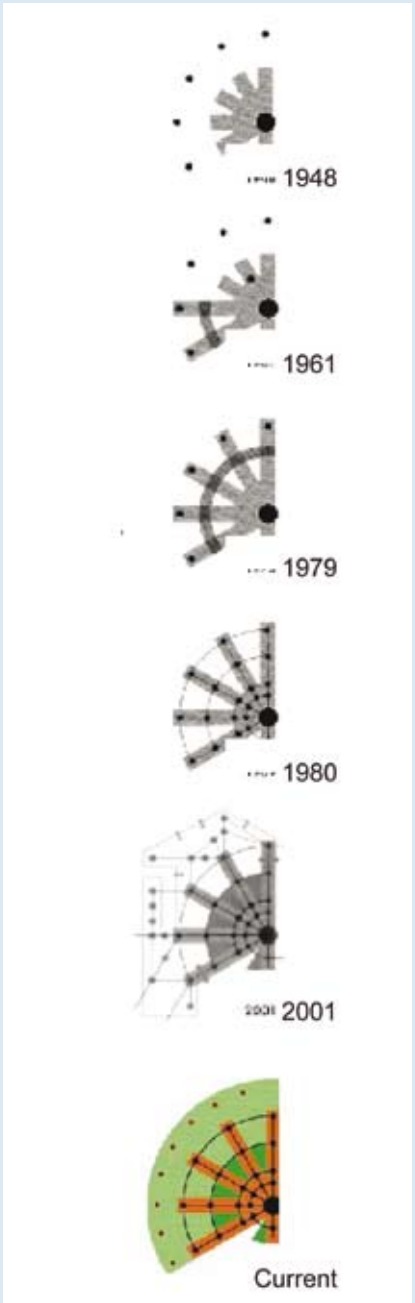

Figure 2. Schematic diagram of the radial development of Greater Copenhagen from 1948 to 2001.

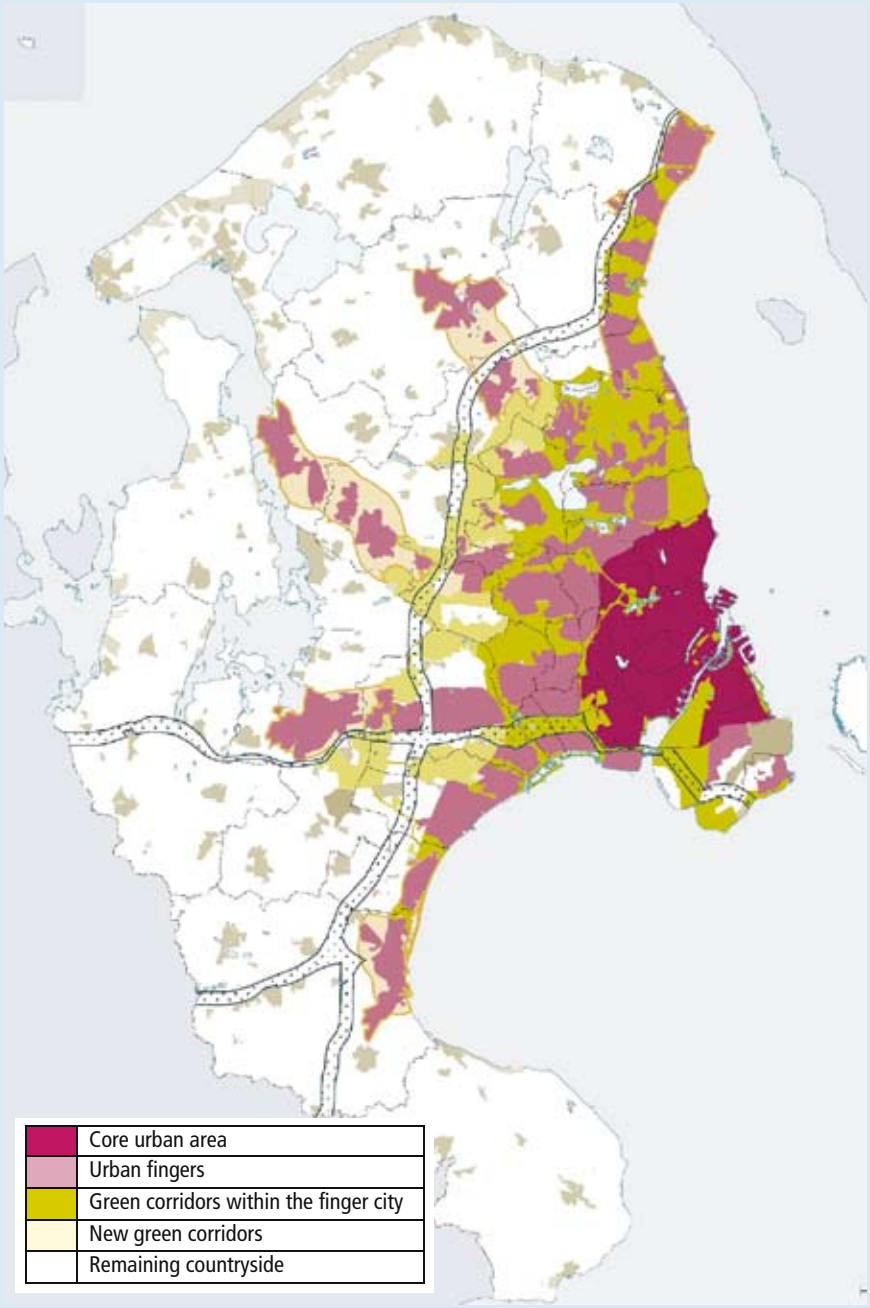

Figure 3.Greater Copenhagen showing the finger-like urban extensions and network of planned green space.

of these linkages over time. The ecological benefits may not be realised in the immediate future, but over time an ecologically coherent network of green space will evolve using natural features and the existing landscape as a framework for urban growth.

2.6 DESIGNING GREEN SPACE FOR BIODIVERSITY

Planning for biodiversity must take the spatial requirements of species into consideration by providing sufficient habitat for them in a connected arrangement. A spatial overview at the landscape-scale is required to overcome existing fragmentation and prevent further depletion of connected features.

Designing space for biodiversity requires the integration of knowledge from spatial planning and landscape ecology. Patterns in vegetation are the result of variation in physical conditions such as soil type, hydrological conditions and land use. For example, calcareous grasslands require lime-rich soils with a high pH and that are grazed or mown repeatedly to prevent scrubs and trees encroaching. Patterns in vegetation can be viewed at different spatial scales ranging from the wider landscape-scale to the regional-scale and smaller habitat-scale. Planning for biodiversity needs to be considered at all spatial scales.

2.6.1 Landscape-scale design

Viewed at the landscape-scale, land cover can appear as a mosaic of patches and linear strips embedded in the surrounding environment, or matrix. In the rural Irish landscape, the dominant matrix is generally agricultural grassland. Patches are formed by areas of woodland, wetland or other habitats that differ from the surrounding matrix. Patches can vary in size from extensive woodlands to a small pond. Hedgerows, treelines, rivers, streams and other linear habitats form networks of connecting features that criss-cross the landscape forming valuable habitat and acting as corridors for the movement of species.

In cities and towns, the surrounding environment is predominantly urban development. Habitat patches and corridors are frequently the remnants of the previous rural landscapes or new habitats that have been created or evolved within the urban matrix. Patches are formed by open spaces such as parks, institutional grounds and gardens. In addition to existing linear features such as streams and treelines, new potential corridors are created by road verges, railway lines and other artificial features where vegetated margins can facilitate movement.

Patch size is an important factor. Conditions within the centre of a patch are generally different to conditions along the edge, creating what is known as the edge effect. As the overall patch size decreases, the internal area (core area) of the patch also decreases and the edge habitat increases. Specialist species adapted to core conditions will be more greatly affected by this loss than generalist species that can happily survive on the edges of habitats. Specialist species tend to be more limited in their ability to adapt to new conditions and are therefore particularly vulnerable to change. They also tend to have a more limited distribution and are therefore relatively rare in the wider landscape. Generalist species on the other hand show greater flexibility in their requirements. They can survive in a variety of habitat types and can move more freely between areas. These species tend to be widespread and generally common within the landscape.

Connectivity

Connectivity within the landscape is about maintaining functional connections between patches of similar habitat and allowing free movement of species from one area to another. By definition, all patches exhibit some degree of isolation as they differ from the surrounding landscape type. The key to successful ecological planning is to ensure that ecologically valuable patches do not become too small or isolated to support species. The size, number and location of patches contribute to how they function as habitats within the landscape and the degree to which species can move between them.

Fragmentation

Habitat fragmentation is the opposite of connectivity and is the degree to which habitat patches in the landscape become physically and functionally isolated. It can occur when contiguous patches are sub-divided into smaller areas or when the surrounding matrix becomes too hostile to allow movement between neighbouring patches. The remaining patches are smaller and more isolated, which limits the resources available to plants and animals and restricts movement between areas.

Key factors defining habitat quality are size, diversity, naturalness, typicalness, rarity, fragility and history.

2.6.2 Habitat-scale design

Every organism has a few basic requirements for survival: food and water for nourishment, a place of rest and shelter from hostile conditions, and ultimately reproduction for genetic transfer and survival of the species. The manifestation of these requirements takes different forms depending on the species. The objective of ecological design is to optimise the conditions for species survival in order that their basic requirements are fulfilled. The quantity of urban space for plants and animals is an important factor determining biodiversity value of new developments. A number of key factors are used to define habitat quality and are aspired to in the ecological design. Among them are size, diversity, naturalness, typicality, rarity, fragility and recorded history (Ratcliffe, 1977). These are the key factors that need to be considered when managing or creating habitats.

Size

Large areas of habitat are considered to be of greater importance than small. An ecological rule of thumb is that the larger the area, the greater the number of species that it can support (all other things being equal). In addition to supporting greater numbers of species, many species such as otter require large, continuous territories where they can move freely.

Diversity

Genetic, species and habitat diversity are key measures of biodiversity. A greater diversity of habitats is more likely to support a greater number of species. This helps create complex food webs and robust, healthy ecosystems.

Naturalness

Natural and semi-natural habitats have the greatest value for biodiversity, as they are more likely to support a greater variety of native plants and animals. Semi-natural refers to habitats that, although altered by human influence, support native plant and animals.

Typicalness

Each local area supports habitats typical of that region. These habitats are often indicative of local physical conditions such as geology, soil type and climate. Establishing plant communities that are typical of the region helps to expand the range of these habitats within the locality. This in turn helps support local animal populations.

Rarity

Rare habitats, plants and animals are by their nature limited within the wider landscape. This may be because their required environmental conditions are scarce or their extent has been reduced through habitat loss. Their rarity makes them vulnerable to local extinction.

Fragility

Some habitats or species are especially vulnerable or sensitive to change. Those with restricted area or ranges are generally considered to be more vulnerable.

History

The recorded history of a site can relay important information about the past condition of the site or previous management. Most habitats have been altered in some way by human intervention. By using appropriate management, habitats can be maintained at their optimum condition for biodiversity value.

(Adapted from Ratcliffe, 1977)