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URBAN ECOSYSTEMS

Introduction

Contrary to popular belief, urban environments are not devoid of wildlife; in fact many towns and cities contain a greater variety of species per unit area than equivalent areas in the countryside. The reasons for this are:

- Urban areas contain lots of small-scale, human-made habitats, and animals and plants have learnt to adapt to these environments: birds for example treat vertical walls as cliffs and feed on discarded human food.
- Species have been introduced both intentionally and accidentally. Canals, railways and roads act as corridors for seed dispersal, and people also transport seed on the soles of their shoes. Seed may also escape from warehouses, or be brought in within topsoil.
- Unlike rural areas, urban environments are unaffected by agricultural sprays, and consequently provide a refuge for flora and fauna.

Factors influencing urban ecosystems

Plants and animals living in urban areas are influenced by a range of factors:

- Soils tend to be shallow, low in organic matter and sometimes polluted, although those in allotments and gardens are deeper and more fertile.
- Large cities produce a 'heat island effect' which reduces the incidence of frost and therefore benefits sensitive plant species.
- Air pollution in cities adversely affects species such as lichen.
- Green spaces may be too small to support viable plant and animal populations.
- Proximity to seed sources and the length and degree of human disturbance also influence the nature of plant and animal compositions.

Types of urban habitats

Urban areas contain a variety of different habitats, ranging from relatively undisturbed patches of woodland which have been enclosed by development, to highly artificial environments such as pavements and walls (Figure 1).

Figure 1: Urban habitats

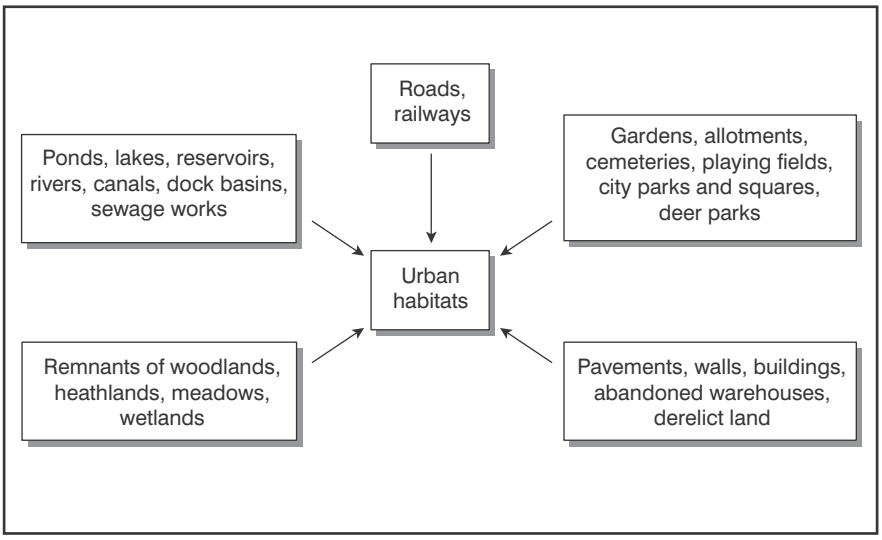


Figure 2: The butterfly bush

The characteristics of some of the more common types of urban habitat are outlined below.

1. Derelict land

In summer, waste ground is often covered with colourful, fast-growing, highly productive plants such as the butterfly bush and rosebay willowherb. The butterfly bush (*Buddleia davidii*), is a woody, deciduous, perennial shrub which produces lots of winged seed, easily dispersed by the wind (Figure 2). Its nectar attracts a variety of insects and butterflies, including the red admiral and small tortoiseshell. Its leaves are eaten by caterpillars which in turn are consumed by spiders and ladybirds. The butterfly bush is common in southern Britain, while wetter wasteland sites in the west of the country support giant hogweed and Japanese knotweed. Rosebay willowherb favours burnt sites, which explains why it was widely seen growing on London bomb sites after World War II.

Figure 3: Succession on derelict land

Years	Community	characteristics
0-3	**Oxford ragwort community**: some willowherb, butterfly bush, colt's-foot, annual meadow-grass, creeping bent, rye grass, knotgrass, groundsel	Many annuals; plants produce lots of wind-dispersed pollen and can withstand drought, one or two dominant species.
3-6	**Tall herb community**: rosebay willowherb, Michaelmas-daisy, golden-rod, creeping thistle, lupin, mallow, yarrow, goat willow, butterfly-bush	More perennials; arrives by seed but many spread by underground rhizomes. Organic matter increasing.
6-10	**Grassland community**: Yorkshire fog, false-oat grass, cock's foot, red fescue, couch grass, plantain, some brambles, thickets of Japanese knotweed, willow and birch	Small grasses replaced by taller grasses.
10+	**Scrub woodland community**: ash, sycamore, rowan, hawthorn, elder, rowan, willow, birch, butterfly bush	Trees begin to shade out understorey; closed canopy established within 40 years.

Early plant colonisers on derelict sites have low nutrient requirements and provide shelter and organic matter for secondary communities. As organic matter increases, a plant succession develops (Figure 3). Earthworms and woodlice decompose organic matter, while field voles live within the tall herb community. Scrub woodland supports woodmice and bank voles, and birds, such as wren and linnet, live within bramble thickets.

2. Pavements

Plants growing on pavements must endure de-icing salt, vehicle exhaust fumes, human trampling and wide variations in diurnal and annual temperatures. Gaps between the slabs trap moisture and decaying leaf litter which support plants such as dandelion and plantain. These species have a tough rosette of basal leaves which protect the growing parts from trampling. Other resistant species have a creeping, tuft, or mat-like habit. Many are hemicryptophytes, ie they bud at ground level, eg plantain, or are therophytes, ie they survive the unfavourable, cold season as seeds, eg pineapple weed.

Pollination is difficult for plants which are widely dispersed on paving stones, and consequently many species produce lots of wind-blown seed, or are self-pollinating. Pineapple-weed is frequently found on pavements because its sticky seeds adhere to shoes and vehicle tyres. Sow-thistle and garden escapees such as snapdragon and wallflower commonly grow at the base of walls where there is more shelter and nutrients. The lichen *Lecanora muralis*, often mistaken in urban areas for discarded chewing gum, is tolerant of air pollution and is common on paving stones.

Slugs, earthworms and centipedes shelter from the heat of the day under slabs. At night the slugs emerge to browse on plants growing in the cracks, while earthworms search for dead leaves. Silvery thread-moss provides a home for springtails, which in turn feed on rove and ground beetles. Ants nest under the slabs and feed on the honeydew produced by aphids which live on lime, plane and flowering cherry trees. Algae growing on the paving stones provide food for white-tipped and garden snails.

3. Walls

Limestone walls and mortar between bricks favour calcium-loving plants, including wall-pepper. Plants are adapted to the dry conditions by storing water in fleshy leaves (eg white stonecrop and wall pennywort), or having thin, in-rolled leaves to reduce transpiration. Ivy-leaved toadflax uses its leaf and flower stalk to track the sunlight, but once pollinated its flowers seek the dark and deposit seeds in deep crevices. Moss supports insects which are eaten by moth larvae. Dead organic matter is consumed by woodlice, which in turn are eaten by centipedes and spiders.

North-facing walls in the northern hemisphere are moister than those which face south and consequently support a greater plant cover, including species such as maidenhair and spleenwort. Wall rock type influences species composition. Species also vary from the top to the base of the wall. Over time, as the wall weathers and plants decay to produce organic matter, a plant succession develops. Typically, algae and lichen are replaced by moss, followed by flowering plants such as red valerian, and eventually woody species such as yew, elder and holly.

4. Buildings

Black-headed gulls and feral pigeons have learnt to treat vertical faces of buildings as cliffs and roost on roofs and ledges. Over time these birds have attracted predators such peregrine falcons, whose numbers are increasing in urban areas. House martins nest under the eaves, while grey squirrels and bats occupy roofs within buildings.

5. Allotments/gardens

Gardens and allotments provide shelter and food for animals such as woodmice, hedgehogs and grey squirrels, and birds such as robin, blackbird and blue tit. Blackbirds eat earthworms, while grey squirrels consume nuts and bark and hedgehogs eat insects, slugs and berries. Compost heaps support decomposers such as earthworms, while disturbed, nitrogen-rich soils are favoured by nettles.

Badgers and foxes have learnt to scavenge for food from human refuse, and their numbers are increasing within suburban areas.

6. Parks, woodland, street trees
Trees in urban areas are valuable because they filter out pollutants and dust, screen buildings and roads and provide shade in summer and colour in the autumn. They also provide nesting and roosting sites and food for birds, many of which are insectivorous.

Tall, mature chestnut and plane trees, interspersed with grassland are common features of city parks. Decaying wood and branches are removed for public safety, which otherwise would support saprophytes (creatures that live on decaying matter), while dead autumn leaves are swept away, creating a rather sterile environment.

Playing fields are common habitats for magpies, common and black-headed gulls. Regular grass-cutting prevents ephemerals such as groundsel and shepherd's-purse from flowering and seeding, while perennials and rosette forms such as dandelion and daisy are undamaged by the mower.

Scrub woodland develops on abandoned land such as old railway sidings. Typical species include silver birch, willow, elder and sycamore, sometimes with an understorey of bramble.

Ageing horse chestnut, lime and London plane trees sometimes line city streets. Some of these trees, however, have become very large and consequently have been extensively pruned. The London plane tolerates air pollution by shedding its soot and dust-covered bark. Ornamental cherry trees, together with native species such as hornbeam, maple and whitebeam, are also found along residential streets. Trees, however, create problems because canopies reduce light levels, roots intrude into underground cables and pipes, and dropped fruits can make pavements hazardous for pedestrians.

7. Roads and railways
High air pollution from vehicle exhausts, together with de-icing salt, discourages plants from colonising roadside verges. A busy road also acts as a barrier for species such as beetles and hedgehogs. Verges unaffected by agricultural sprays can, however, provide a refuge for plants and animals such as voles. Kestrels sometimes hover overhead to prey on voles and to scavenge roadkill.

Cinder tracks along railways are often colonised by Oxford ragwort, a plant which originally grew on volcanic soils on the slopes of Mount Etna in Sicily. It was introduced to the Oxford Botanic Garden in 1690, and subsequently escaped and spread along railway tracks throughout southern Britain in the 1800s. Abandoned railway lines, many dating from the 1960s, have since been colonised by scrub and woodland.

8. Canals and other aquatic habitats
Canals have been responsible for introducing species such as Canadian waterweed and the zebra mussel. River and canal banks are often covered with invasive species such as Japanese knotweed, Indian balsam and giant hogweed. Sometimes fig, apple and pear trees grow along river banks, from seeds originally contained in sewage effluent discharged into rivers. Other urban aquatic habitats include reservoirs, ponds, lakes and sewage works. City ponds and lakes provide habitats for a variety of wildfowl, including Canada geese. Rising Canada goose populations are causing overgrazing and trampling around lakeside margins, and polluting water.

Threats to urban ecosystems

Urban ecosystems are threatened by a number of human activities, including:

- Redevelopment of derelict land, wetland drainage and canal infilling.
- Pollution – heavy metals such as cadmium and zinc emitted from smelters accumulate in food chains and can reach toxic levels. Many types of lichen are sensitive to sulphur dioxide pollution. Chemical pesticide draining from allotments and gardens is also harmful to wildlife. High surface runoff during storms can transport oil and other industrial effluent into rivers, adversely affecting sensitive invertebrates such as stonefly and mayfly, and fish including roach and smelt. Industrial and domestic sewage effluent causes eutrophication, leading to a proliferation of algae which shades out waterweed. Acidic water discharged from chemical industries and toxic spoil heaps also damages plants and animals.
- Illegal tipping – wetlands and derelict land are often perceived as repositories for illegal waste disposal which damages ecosystems.
- Invasive and noxious species. Invasive shrubs such as Japanese knotweed, Indian balsam and rhododendron produce dense canopies which shade out native plants and reduce species diversity. Giant hogweed contains toxic substances within its sap, which on contact with skin causes blistering. Sycamore, which produces lots of wind-dispersed seed, displaces native trees in woodland and shades out herbs and shrubs. Rats carry disease, while house mice and cockroaches damage foodstuffs. Rising numbers of ring-necked parakeet in south west London threaten to displace native birds.
- Recreational pressure – heavy trampling on playing fields and footpaths on popular urban commons, such as Richmond Park in south west London, reduces plant cover and compacts soil.

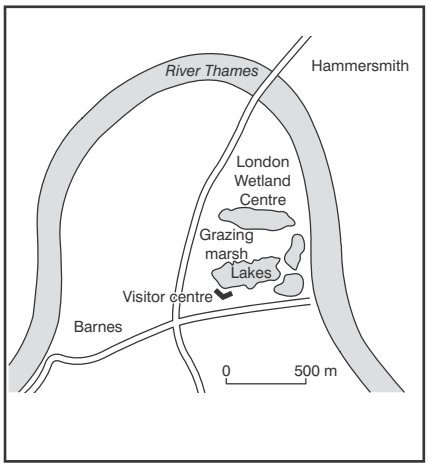
Conservation

Urban habitats are often transient. Left alone, canals infill and derelict land reverts to scrub woodland. Management is therefore necessary to maintain species diversity. The problem is, however, that waste ground is frequently perceived as untidy and neglected space and a location for illegal disposal of waste, which encourages rats. To conserve plant communities on derelict land these sites therefore need to have tidy edges, well-maintained paths, interpretation boards and ways of discouraging vehicle access to prevent illegal fly-tipping.

Other ways of promoting urban ecology include:

- incorporating wild spaces in urban designs and planting with native species
- reclaiming toxic sites by adding organic matter to encourage plant colonisation, or growing species which tolerate toxic conditions such as creeping bent, red fescue and ribwort plantain

Figure 4: The London Wetland Centre



- encouraging gardeners to grow organically to reduce the harmful effects of pesticides and insecticides
- mowing grass less frequently and during periods when plants are not in flower
- leaving wide roadside verges for plants to colonise
- adding 'green roofs' to buildings by sowing *sedum* cuttings in a growing medium
- cutting, uprooting or treating invasive species with herbicides. The Wildlife and Countryside Act 1981 also prohibits the growth in the wild of Japanese knotweed and giant hogweed
- designating an area a Site of Special Scientific Interest (SSSI) or creating a local nature reserve (LNR), thereby protecting rare species and creating recreational and educational opportunities (see case study).

Case Study – London Wetlands Centre

Four disused, concrete-lined reservoirs have been landscaped into an area of shallow lakes, ponds, reed beds and grazing marsh to create a wetland habitat in Barnes in south west London (Figure 4). The London Wetland Centre was opened in 2000 and occupies an area of 43 ha. It currently attracts about 180,000 visitors annually.

The site was designated an SSSI in 2002 and is managed by the Wildlife and Wetlands Trust. Grazing marsh and shallow lakes attract nationally important numbers of shoveler and gadwall ducks, while the reed beds support bitterns and warblers. Wading birds such as redshank and lapwing nest on islands in the lakes in the summer. The site has a visitor centre, restaurant, shop and viewing hides and offers guided walks and educational courses. Wooden boardwalks link different parts of the site and protect the wetland habitat from trampling pressure.

Other examples of conservation projects and protected urban habitats in London include:

- Camley Street Park – a local nature reserve developed on a former coal depot on the banks of the Regent's Canal.
- Lavender Pond – a wetland habitat developed in former Surrey Docks.
- Richmond Park – a historic royal deer park in south west London. A lowland acid grassland and ancient oak woodland with rare fungi and stag beetles designated an SSSI and Special Area of Conservation (SAC).
- Highgate Woods – an ancient hornbeam woodland with some oak and birch and introduced Norway spruce, beech and rhododendron, in north London.
- Mill Hill Old Railway – disused railway track now overgrown with oak, sycamore, maple, birch and alder near Barnet.

Conclusion

This unit shows just how much variation and complexity exists in urban ecosystems, despite some serious threats to their continued existence. Examples here are based in London, but similar ecosystems exist in all UK cities and beyond.

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Focus Questions

1. Describe and explain plant colonisation on derelict land.

2. Pavements, roads, railways and canals produce distinctive ecologies – explain.

3. How might the deliberate or accidental introduction of new species into urban areas change ecosystems?

4. With reference to examples, describe and explain how urban areas can be managed to conserve and promote ecological conservation.