



Generation
Climate
Europe

Cities as ecosystems : How wildlife survives and shapes our urban environment

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Introduction

As natural environments are increasingly transformed into human-dominated landscapes to accommodate growing urban populations, many animal species are being forced to adapt. This trend is expected to continue, with the proportion of people living in cities projected to rise from [55% to 68%](#) by 2050. As urban areas expand, so too does their impact on ecosystems.

[Urbanisation](#) has led to widespread habitat loss and declining biodiversity, displacing many species that once thrived in these environments. Yet some animals have successfully adapted to life alongside humans, finding new opportunities in cities and towns.

Where humans and wildlife live in close proximity, [conflicts](#) can arise. Common challenges include the transmission of zoonotic diseases from wildlife to people, wildlife–vehicle collisions, and property damage, as well as harm to people, pets or the wild animals themselves. However, coexistence can also bring important benefits. Urban wildlife plays a [significant role](#) in maintaining healthy ecosystems in and around our towns and cities, by pollinating plants, dispersing seeds, controlling pests and recycling nutrients. In addition, many people [value and enjoy](#) the presence of wildlife in their daily lives, giving it cultural significance. Beyond these benefits, many also believe that wildlife also has an [inherent value](#) and right to exist, including within human-dominated environments.

Recognising the many benefits of coexisting with nature, there are growing efforts to better integrate nature into cities, for example in China. Expanding green spaces such as parks, green corridors, and rooftop gardens helps [address challenges linked to climate change](#) by reducing urban heat, improving air quality, and lowering flood risk. These spaces also support human well-being, particularly [mental health](#). As a result, wildlife is likely to play an increasingly important role in urban environments. In this article, we introduce three key types of species found in cities: an ecosystem engineer, a bioindicator, and a non-native species.

Red fox: the shy engineer of urban environments?

Red fox (*Vulpes vulpes*)



- **Lifespan:** 3-5 years on average in the wild, with urban populations usually living until the end of this range thanks to abundant food
- **Size:** 45-90 cm
- **Weight:** 3-14 kg
- **Habitat:** Urban, desert, mountain, forest.
- **Role:** Ecosystem engineer
- **Why it matters:** Seed dispersal, denning, scavenging carcasses

Source: Mike Pennington / Geograph <https://www.geograph.org.uk/photo/2751042>

The red fox (*Vulpes vulpes*) is the **most widespread carnivore on the planet** and thanks to its great adaptability, it is able to live in diverse environments like deserts and mountains, but also forests and urban settings. They can be found on almost all continents, ranging across North America and Europe, but also Oceania, northern Africa and central Asia.

How has this resilient species been able to survive and thrive in cities such as Zurich, Berlin, [London](#), and [Warsaw](#)? One reason is its omnivorous diet. Since the red fox is a [generalist](#) and opportunistic predator, it is able to eat almost anything it finds, from carcasses to wasted food. An [example](#) of this is a British study which found that urban red foxes eat much higher amounts of anthropomorphic food compared to ones living in rural areas. On top of that, the red fox is most active at dusk, night and dawn (crepuscular and nocturnal), times when cities are generally quieter and safer. Finally, red foxes living in urban areas have adapted to be [bolder](#), with reduced [neophobia](#) (fear of the new), enabling them to dwell in this highly alien environment. However, these impressive adaptations can only take them so far, as foxes continue to depend on the presence of green spaces within our cities, such as parks, gardens or cemeteries.

This explains how red foxes have successfully integrated into some of Europe's largest cities, but it is also important to understand the important role that this [ecosystem engineer](#) plays in an urban environment. The clearest example of the red fox in its role as ecosystem engineer is its burrowing and denning activities. Fox dens, especially those found in places like parks and cemeteries, not only provide [shelter](#) for foxes, but also for hedgehogs, rodents, and [invertebrates](#). At the same time, [burrowing alters soil properties](#) and increases both nutrient availability and herbaceous species richness. In other words, the red fox actively reshapes the urban environment.

Foxes also influence their urban environment through [endozoochory](#) (seed dispersal) and [research](#) shows their scat (droppings) play an important role in distributing fruit seeds. Likewise, by feeding on [carrion](#), red foxes reduce waste management costs and help prevent the spread of disease.

As cities continue to expand, urban wildlife will become even more important as a field of study. The red fox serves as a good example of how an animal can alter, and also be altered by, harsh urban environments. In addition to its important role as ecosystem engineer, there are also some early indications that the red fox could serve as a useful [bioindicator](#) too, which indicates the need to research its impact further.

Bats in the city: indicators of urban ecosystem health

City-dwelling bats (*multiple species*)



- **Category:** Mammals
- **Size:** Varies by species (wingspan ~15–40 cm for many urban species)
- **Weight:** ~5–40 g (typical small urban bats)
- **Lifespan:** 5–20+ years depending on species
- **Habitat:** Urban areas, buildings, parks, woodlands, waterways
- **Role:** Bioindicator species / Ecosystem service providers
- **Why it matters:** Indicators of environmental change, pest control, pollination and biodiversity health

Source : Stankowich, Ted . "Order Chiroptera – the Mammal Lab." Themammallab.com, 2021, themammallab.com/2021/10/order-chiroptera/.

Bats are one of the most species-rich groups of mammals and play a crucial role in ecosystems worldwide. They provide major [ecosystem services](#) such as insect pest control, seed dispersal and pollination of economically important plants. Bats are also [highly sensitive](#) to environmental changes, and their populations respond quickly to environmental disturbances, making them [valuable bioindicators](#). This means that monitoring bat populations can provide valuable insights into environmental health, as changes in their populations, activity, or species diversity indicate broader biodiversity trends. The accumulation of [heavy metals](#) in bat tissues, for example, makes them useful for tracking pollution levels.

While bats overall are highly sensitive to environmental change, some resilient species have shown the ability to adapt to suit challenging urban environments. A [2022 study](#) showed how city-dwelling bat species have developed certain shared traits, including low-frequency, long-duration echolocation calls, small body size (allowing them to navigate limited urban spaces), and flexible roosting behaviour that enables them to

use both natural and artificial shelters. Together, these characteristics demonstrate how cities can act as [ecological filters](#), favouring species with specific adaptations while excluding others. As different bat species respond differently to urban pressures, studying which species persist or decline also allows scientists to understand the intensity and type of environmental disturbance.

Despite these adaptations, bats face multiple threats in urban environments. [Habitat loss and fragmentation](#) caused by urban expansion remove green spaces, water bodies and remove mature trees, which are [important](#) for roosting and feeding. [Artificial lighting](#) further disrupts bat movement, feeding behaviour and species distribution, while [anthropogenic noise](#) can interfere with echolocation and communication. Bats have a large body surface area that can lose a lot of water, therefore they are highly vulnerable to [dehydration](#), especially due to the loss of drinking sites in urban areas. As climate change increases air temperatures which further reduces the availability of water bodies, this is expected to place these sensitive species [under even greater pressure](#).

As explained, bats are highly sensitive species that are vulnerable to a number of pressures including urbanisation and climate change. However, this sensitivity also makes them a valuable bioindicator, and studying bats can provide important insights that can help us to design more sustainable and wildlife-friendly cities. [Research](#) shows that cities can provide important refuges for bat species, if we can just provide important infrastructure such as well-connected green spaces and tree corridors, and preserve [old trees](#) and natural roosting sites. Incorporating these features into urban planning would significantly improve conditions for bats and, in return, support overall biodiversity.

The grey squirrel: a non-native species shaping urban ecosystems

Grey squirrel (*Sciurus carolinensis*)



- **Category:** Mammals
- **Size:** 24-28.5cm
- **Weight:** 400-650g
- **Lifespan:** 2-5 years
- **Habitat:** Farmland, Woodland, Towns and Gardens
- **Role:** Invasive species
- **Why it matters:** Damaging to woodlands, threat to the native red squirrel

Source: The Wildlife Trusts. *Grey Squirrel*. © Amy Lewis.

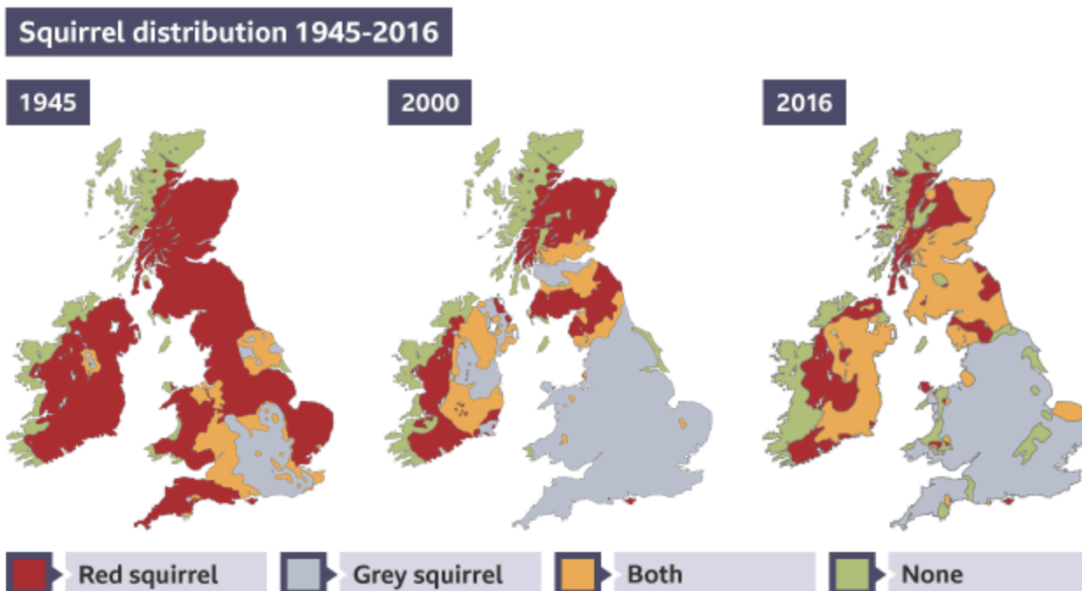
<https://www.wildlifetrusts.org/wildlife-explorer/mammals/grey-squirrel>

The [grey squirrel](#) is native to eastern North America. It thrives in parks, gardens, and peri-urban forests. It has silver-grey fur (although some individuals can appear slightly ginger) and a long, bushy tail that helps it to balance when climbing trees. Grey squirrels mainly feed on nuts, tree seeds and acorns. In autumn, they bury food to ensure a supply during winter, when resources are scarce. They also eat buds, flowers, shoots, pine cones, and occasionally young birds and eggs.

Although dominance hierarchies exist within grey squirrel populations, they are [not territorial](#) and often live close to one another. Their breeding seasons are in spring and summer. Depending on food availability, females may have up to [two litters per year](#), each with three to four young (known as 'kits' or 'kittens'). Grey squirrels build nests ('dreys') high in the trees, using twigs, leaves, and bark. These provide shelter in winter and a safe place to raise their young. Their natural predators include foxes, stoats, birds of prey, and pine martens.

Grey squirrels were introduced to Europe in the **late 19th century**, when they were brought from the United States to the United Kingdom as pets, or for release on country estates. Although today most grey squirrels in Europe are found in the UK ([~ 2.7 million](#)), populations have also spread in Italy following their introduction in [Turin in 1948](#). From Italy, they pose a **growing risk** to red squirrel populations across mainland Europe, particularly in countries such as Switzerland and France. Therefore, [limiting further spread](#) is crucial.

In Europe, grey squirrels are considered an invasive species because they pose a **serious threat** to native red squirrel (*Sciurus vulgaris*) populations and wider ecosystems. Their arrival has led to a [steady decline](#) in red squirrels, because grey squirrels are [more adaptable](#) to urban environments and human disturbance, can outcompete red squirrels for food and space, and also carry the deadly [squirrelpox virus](#). Grey squirrels also pose a threat to the wider ecosystems they inhabit, as they [damage trees by eating seeds and stripping bark](#) to access the phloem beneath. This behaviour can **reduce tree growth** and **regeneration** in both natural forests and commercial plantations in Europe.



Distribution of the Red and Grey Squirrel in the UK and Ireland.

Source: BBC Bitesize. (2018, February 26). Biotic factors - data - Adaptations, interdependence and competition - Edexcel - GCSE Combined Science Revision - Edexcel - BBC Bitesize. BBC Bitesize. <https://www.bbc.co.uk/bitesize/guides/z84mk2p/revision/5>

[Various management projects](#) in the UK and Italy have aimed to control grey squirrel populations while supporting red squirrel recovery. Methods have included **culling**, as well as **capturing, sterilising, and releasing** grey squirrels in isolated urban parks. These approaches have been effective on a local scale. However, controlling grey squirrels across larger regions is difficult, and complete eradication is often not feasible. Public opposition, especially from animal welfare groups, can also make control efforts challenging. For this reason, **public awareness** and **education** are essential and have played an important role in successful [projects](#).

The spread of the grey squirrel is a clear example of how introduced species can disrupt ecosystems, especially in urban and peri-urban environments. It highlights the importance of responsible **species management**, early **intervention**, and **public engagement**. Looking ahead, a combination of [monitoring, targeted control, habitat management and public education](#) will be necessary to protect native species such as the red squirrel.

Conclusion

Cities are usually imagined as the opposite to nature, full of buildings, roads, noise, and artificial light, but it is very important to remember that even these bustling places can be home to many different species.

For example, **urban bats** show how cities can act as ecological filters, favouring the species that can adapt to these harsh environments. These important bioindicators also help us to assess the health of urban environments and provide insights for building more biodiverse and sustainable cities. The **red fox** provides another important example of how wildlife adapts to survive and even thrive in Europe's largest cities, and can even shape these urban landscapes through different mechanisms like seed dispersal or burrowing. Finally, the **grey squirrel** exposes a different story - how urban environments can enable invasive non-native species to spread, with consequences for Europe's native species and ecosystems.

Taken all together, these species highlight how our cities can be 'natural' spaces themselves. Rather than being separate from nature, these urban environments are full of species and interactions which matter for conservation of our biodiversity as well as many of the important ecosystem services that we depend on.

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