

Urban Biodiversity: Rebuilding ties between wildlife and people

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Biophilia and paradigm shift

Humans are increasingly leaving the rural world to live in big cities. Half of the more than 7.5 billion people in the world already live in cities. According to United Nations data, in 2050, 70 % of the world's population — which will by that time have surpassed 9.5 billion people — will live in large cities. This percentage has already been reached in Europe, and specifically in Catalonia, where almost three quarters of the population is concentrated in the metropolitan area of Barcelona. Meanwhile, 90 % of our territory — rural, forest and agricultural land — is becoming increasingly depopulated and only 1.6 % of people live from working the land (Fundació del Món Rural, 2016).

This growing asymmetry is an obligatory starting point in the reflections I propose. It tells us that most people's daily lives are spent between walls, cement, asphalt and technology; with all the cultural richness that life brings us in big cities, yes, but also losing the subtle but strong ties with the rest of nature, losing ancestral knowledge of the habits of wildlife and of what our ecosystems and landscapes are like and how they work. Biodiversity is the word we use to denote all these elements, all the diversity of life on the planet, from genes to species, ecosystems and landscapes; we too, humans of the *Homo sapiens* species, are part of it, although we show a growing disassociation from other living organisms. We often relegate nature only to the sphere of our weekends and holidays; a sphere which we enter in search of calm and enjoyment, considering it from an often ignorant perspective in terms of the extent to which our wellbeing and our lives depend on it. Seeing it as a mere supplier of products and services, without taking into account, as Jaume Terradas (2017) says, that “we are not users of nature, we are part of it.” Perhaps it is because of this, because of the sense of belonging, that many people manifest a latent feeling of biophilia, which Edward Wilson (1984) defined as “the innately emotional affiliation of human beings to other living organisms.” And it is precisely biophilia and, in particu-

lar, the movement of biophilic cities (see Beatley, 2017; www.biophiliccities.org) that is driving a change in trend, which advocates cities that integrate nature within them, incorporating habitats where countless organisms find places to live. Cities that are greener, healthier and more biologically diverse.

The paradigm shift facing humanity is perhaps not unconnected to this process of increasing “naturalisation” of cities. In this era — which we call the Anthropocene era because human activity is the main driving force for change on the planet — global warming and the accelerated “loss of biodiversity and risk of collapse of ecosystems” (to borrow the words not of any environmental organisation, but of the World Economic Forum 2017) are some of the main risks that threaten the world or, rather, threaten the continuity of a dignified life for all people on the planet. The change is accelerated and, perhaps because of this, a sense of urgency is being awoken in many people and collectives who are taking a step towards changing concepts about the construction of cities. New ways of conceiving and managing urban space are emerging, with the idea that it should be above all a pleasant place that provides a healthy environment for all the people who live there. In this sense, the availability of urban green spaces, which allows us to reconnect with nature, has been shown to be a determining factor for people’s good physical and mental health (see the article by M. Triguero in this volume).

The concept of urban green spaces is now no longer limited to garden vegetation and tree-lined streets, but covers spaces conceived and managed from a much broader perspective, also to promote biodiversity. This is what the European Commission has defined as¹ urban “green infrastructure” (see C. Castell’s article in this volume) and “nature-based solutions” that include drainage, flood control basins, green roofs, walls and paving. We are learning how our buildings and infrastructures can — in addition to tarmac, stone, concrete, metal and glass — incorporate living coverings: mosaics of species of exotic, native, wild or cultivated vegetation which, together with other urban green elements, such as fountains and lakes, make up a large “green and blue grid” integrated into cities and connected to the surrounding ecosystems, rivers, forests and crops on the outskirts.

In this vision of the city, the boundaries between artificial and natural are blurred, and the new environments it offers are increasingly home to

1. “Green infrastructure” (in the singular, because in the plural it has another meaning) is defined, according to the European Commission communication COM (2013)249, as a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. (...) It is present in rural and urban settings.

diverse urban wildlife, as it is usually called, although it includes both species that spend their entire lives in the city and other species that, like many of us, move between the city and its surroundings, carrying out some activities in urban spaces and others in their surroundings. However, just as vegetation planning and management can be relatively well controlled, the presence of wild animals is often beyond our control, and poses significant challenges in order to achieve successful coexistence with people. We create environments that are colonised by animals which bring many benefits, but which are also invaded by unwelcome species and cause major concerns for urban space managers. Let us reflect, not with a view to carrying out an exhaustive review, but rather in order to outline some considerations that contribute to better orienting the design and maintenance of urban spaces.



Examples of green infrastructure: a green wall and a square in the centre of a large city that offers leisure opportunities in contact with nature, and that contributes to recovering varieties of local crops. Photo: Carme Rosell

Wildlife returns to the city

The community of wildlife that lives in cities is very diverse and depends, firstly, on the composition of species that inhabit the natural spaces in its surroundings, but also changes radically depending on how urban spaces are designed and maintained.

We can try to classify an urban wildlife community in many ways, depending on the animal groups to which the species belong, their degree of threat or the legislation that protects them, their degree of dependence on humans or their capacity to take advantage of the resources we offer them (anthropophilic and synanthropic species), or even, from a totally anthropocentric perspective, depending on whether they have effects that we consider positive (beneficial wildlife) or if they have pernicious effects (problem wildlife). We can label each species of urban wildlife, but the reality is complex and good management must move away from a Manichaeian vision. The presence and effects of each species are determined by what the urban spaces we offer them are like, and also, to a large extent, by people's behaviour towards animals.

Cities have always been home to wildlife. Some species make them their permanent habitat; for example, rats (*Rattus* sp.) and domestic mice (*Mus musculus*), some species of reptiles such as lizards (*Podarcis liolepis*) and geckos (*Tarentola mauritanica*, *Hemidactylus turcicus*), frogs (such as those of the *Hyla* genus that live in ponds) and countless species of birds (more than 80 species breed in Barcelona according to the recent Atlas drawn up by the ICO and the University of Barcelona) and even insects and other invertebrates. In recent years we have seen how species have been incorporated that are not always welcome, as they cause disturbance to people or damage to urban features such as roofs and trees in the streets, or to crops in the surrounding areas — examples of these are gulls (*Larus argentatus*, among others), and invasive parrots (*Myiopsitta monachus*, *Psittacula krameri*). Large wild animals have also been added that we did not think were capable of living in cities. In Barcelona, as in other cities throughout Europe, a good example is the wild boar (*Sus scrofa*), once a wild beast, and now increasingly accustomed to urban life. Notable examples from further afield are white-tailed deer (*Odocoileus virginianus*) found in many cities in the United States, coyotes (*Canis latrans*) living in Chicago and other North American cities, pumas (*Puma concolor*) living in Los Angeles, and langurs (monkeys of the *Semnopithecus* genus) colonising cities in India. David Attenborough, in the recent documentary Cities (BBC One, Planet Earth II) shows us many ex-

amples and revealing images of how wildlife lives alongside humans in large cities.

This growing phenomenon of large wild beasts living in cities is often associated with a sense of biophilia and, ultimately, with humans' behaviour towards wildlife. Some animals learn that cities are a new territory to colonise, a place where they find shelter and abundant food, and where people do not hunt or chase them away, but provide them with food and take care of them. Humans go from being predators to protectors, but paradoxically this does not always benefit the animals, because often, when they become accustomed to living with us, we cause them to lose an essential characteristic: their wildness. They lose the ability to lead a life that is totally independent of ours, to seek shelter or to find food on their own in the forests and other natural spaces to which they belong. By feeding them, we make them dependent on humans and turn them into animals that can become problematic, cause harm or spread diseases to people; as such, we make them unable to return to the wild and condemn them to captivity or death.



Large wildlife, such as deer, wild boar, pumas and coyotes, enter cities, where they are no longer hunted or driven away, but in fact protected and fed. These practices do not benefit these animals; they cause them to lose their wildness and can often prevent them from returning to the forests and natural habitats to which they belong. Photo: Jordi Ruiz Olmo

The management of people's interactions with wildlife is therefore an essential element in the management of urban wildlife. Re-learning the habits and behaviour of the wildlife that returns to the city, and what we

should or should not do to avoid conflicts, are indispensable steps to re-establish ties with animals and be able to live together, leaving them to remain wild.

However, most of the wildlife that inhabits cities only brings us benefits, including aesthetic enjoyment, the pleasure of looking at beautiful animals (dragonflies, butterflies, birds, etc.) and listening to birds singing in a park, street or courtyard of the city, none of which are insignificant. Other species are allies in the gardening and cultivation of urban allotments; a good example are pollinating insects, which provide us with a valuable service, essential for some plants to bear fruit, and which are currently in alarming decline worldwide due to the toxicity of many of the pesticides applied in agriculture and in the maintenance of green spaces. Cities that manage their urban green spaces without using toxic products promote the conservation of pollinators, and Barcelona is a pioneer in this sense, as in 2015 it approved the eradication of the use of glyphosate and other toxic herbicides for the maintenance of green spaces and public thoroughfares. This measure, together with the supply of nutritious plants and hollows that offer shelter and a place to breed for certain species, may contribute to increasing numbers of butterflies, beetles and pollinating bees, many of which are threatened species. We can also support the honey bee (*Apis mellifera*), although in this case, the regulations governing this activity should be complied with and the installation of hives should not harm other endangered pollinator species, as these bees quickly grow in number and can compete for food. This example illustrates the need for the design of measures aiming to recover biodiversity in green spaces to set clear objectives and be based on good knowledge of the ecology of the species we intend to promote and the regulations that may affect them.

Other examples of urban wildlife species that provide us with benefits are insectivorous birds, which contribute to the control of pests and bothersome mosquitoes. This is the case of swallows and swifts (*Delichon urbica*, *Hirundo rupestris* or *Apus apus*) that also help us with their migrations to connect with the rhythms of nature, highlighting the change of the seasons, arriving with the good weather and leaving before winter returns. Bats, of which there are many species, all of which are protected and some of which are threatened or endangered, are also natural allies for the control of mosquitoes and we can promote them with many different actions. These include the adequate design of buildings which offers places to shelter, with the installation of artificial hollows, and good lighting management (type of lights, light spectrum, intensity and period of illumination). Some European cities are already defining a “black area”

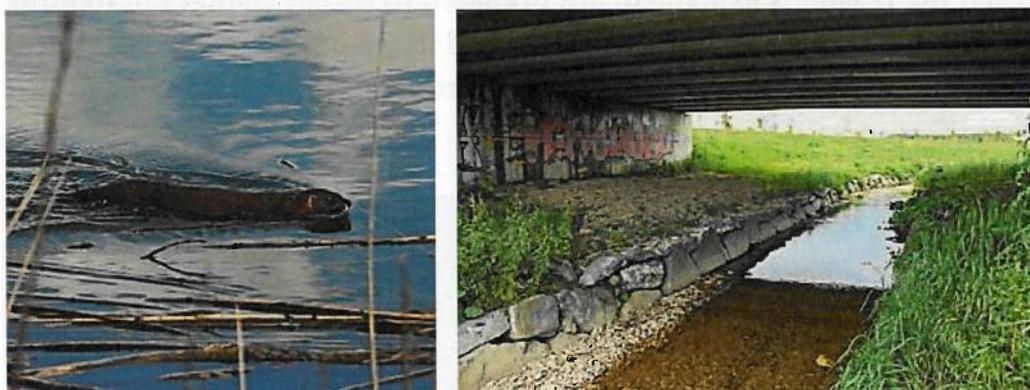
(which is added to the “green and blue” of terrestrial and aquatic green spaces). These are urban and peri-urban corridors where lighting management is adapted to benefit bats. Despite reluctance on the part of some managers, in a recent survey carried out in Lille, France, 93 % of citizens, when the reason is explained, are prepared to accept changes in lighting management to benefit bats (unpublished data from the “Chirolum” project integrated into the ITTECOP programme - *Infrastructures de Transports Terrestres, Ecosystèmes et Paysages*).



Many of the bird species that we can find in our gardens are small winged wonders that also contribute to the control of insects that cause infestations. Photo: Óscar Aldama

Therefore, many cities not only develop measures to integrate wild flora and fauna, but take measures to promote the recovery of threatened species, clearly showing that cities can, if they so wish, provide key spaces to contribute to the conservation of biodiversity. Ecological connectivity can also be enhanced through green spaces that are connectors or stepping stones, a system of interconnected habitat hubs that are essential for the maintenance of biological flows and the long-term conservation of the populations of many wild animals. We mention only as examples the programme for the management of ponds and fountains in parks and gardens that the Barcelona City Council began in 2008 and which has provided numerous points for the reproduction of a number of species of frogs and toads that are declining rapidly throughout Europe. Moreover, there is the emblematic commitment of the city of Vitoria which contributes to

the conservation of an endangered species, the European mink (*Mustela vison*), a small mustilid that can travel freely through the streams that enter the city owing to the adaptation of viaducts and drainage devices that run under urban roads.



Cities can contribute to biodiversity conservation. In Vitoria, the structures through which streams cross urban roads have been adapted to prevent collisions and encourage the movement of the European mink, a small endangered mustilid. Photo: Vachlav Lavac and Carme Rosell.

Management of the habitats that cities offer wildlife

The key to cities contributing to the conservation of biodiversity, as well as preventing them from being colonised by problem wildlife that causes damage or nuisance, lies in the design and management of the urban environment. In particular, it should be pointed out that it is in the planning and projection of urbanised spaces that we can initiate processes that will promote the conservation of threatened species and wildlife that benefit people or, on the contrary, we can create complicated management dynamics that will subsequently force many resources to be allocated to applying techniques for the control or prevention of damage.

The management of habitats that are home to urban biodiversity has characteristics that differentiate it considerably from that of habitats in natural spaces. Adam and Lindsey (2009), in their reference book *Urban Wildlife Management*, summarise some specific features that should be kept very much in mind in the management of urban green spaces, and which have also been highlighted in other documents that are essential reading when talking about urban ecology (Forman, 2008; Niemelä, 2011). Some of these features are discussed below, along with other relevant aspects that require particular attention when managing green spaces and urban wildlife.

- **Attitudes and expectations of residents and users of urban space**

If, as has been said, the attitudes and behaviour of people towards animals are decisive in shaping the community of wildlife that will finally colonise a space and its effects, it is clear that for the design and management of each place it is necessary to consider the expectations and attitudes of the people who will use it, and also to ensure that we give them the necessary information so that they can understand why we are doing things the way we are doing them and why we need their help to interact with wildlife in an appropriate way. Those who feed the wildlife in cities often do so out of curiosity, a desire to get closer or a desire to protect (due to a sense of biophilia). They must understand that giving food to wildlife can cause irreparable damage and deadly changes to their behaviour. People must also be informed of how a pond that we fill with vegetation becomes a habitat that is home to a great diversity of species, even though it loses the immaculate appearance of ponds where the water is treated to avoid the growth of any type of organism. They should also be informed of the reason for installing small wooden structures full of holes through which small and harmless bees constantly come and go. This lost knowledge must be transmitted in order to rebuild the ties between people and the organisms that make up urban nature. People will enjoy the benefits of living with wildlife to the extent that we are able to give them information about the new neighbours with whom they will share the space and offer guidance on good practices in how to interact with them.
- **“Potemkin Gardens” or habitats that contribute to the conservation of biodiversity?**

Many urban habitats are very small-scale (although not all, since within some cities we also find large gardens, rivers and even forests). We often face the challenge of giving “ecological meaning” to the management of small green areas, tree-lined streets, green walls and roofs, and small gardens in interior courtyards and balconies. This small scale does not disqualify the space as a habitat for urban wildlife, but requires restrictions and a good design that considers what conditions it should have, depending on the species we want it to be home to and its location in relation to other reduced habitat areas. Proper design optimises the full potential of every urban space, no matter how small, to be harnessed and given meaning within the framework of the urban green infrastructure as a whole. If we don’t do this, small urban green habitats run the risk of being what Martin F. Quigley (2011) calls “Potemkin Gardens”, refer-

ring to a beautiful setting without substance. He gave them this name because of the ploy of Marshal Potemkin, who in 1787, after conquering the Crimea, and wishing to alleviate the desolate appearance of the landscape devastated by war in preparation for the triumphal journey of Empress Catherine II, installed a series of façades that recreated idyllic imaginary villas along the roads. Pretty and pleasant to look at, but fake. Similarly, in the urban environment, if we do not design spaces properly, we can build green areas that are beautiful but which do not have ecological functionality. This is permissible, as long as we do not consider that greenery has the function of promoting the conservation of biodiversity.

- **Exotic yes, as long as it is not invasive or harmful**

Promoting biodiversity in cities does not imply dispensing with exotic species; on the contrary, many of the foreign species that populate gardens and streets have characteristics that make them particularly suitable for urban space and that, in addition, offer play, shelter and food resources to wildlife. Exotic and native species can coexist perfectly in the re-vegetation of urban spaces to support biodiversity, but what must always be avoided is the introduction or proliferation of invasive species: those that can survive and reproduce in natural spaces and cause damage to other species or ecosystems — including crops —, affect people's health or cause damage to elements of the urban space or infrastructure. Some invasive species with very harmful effects are precisely species that



The *Carpobrotus edulis* is a beautiful exotic plant as well as an invasive species with harmful effects on biodiversity. It spreads from the gardens in which it is planted and takes over large surface areas in which it causes the death of the local plant life.

are planted and escape from urban gardens or ponds. Here are just two examples: the beautiful but fatal balsam (*Carpobrotus edulis*) that has covered extensive areas of places such as Cap de Creus, to the detriment of vulnerable native communities, and which requires significant effort to curb its expansion; or the proliferation of the water fern (*Azolla filiculoides*), an aquatic species escaped from aquariums and urban ponds that is spreading through the natural environment and quickly covers the surface of the ponds it colonises, affecting other aquatic organisms that it displaces or plunges into darkness. We will not go into detail on this controversial and complex aspect of the control of invasive species, which is also regulated by law, but it should be taken into account that although many exotic species in urban areas are compatible with the conservation of biodiversity, species classed as invasive should never be integrated or supported.

- **Crops and “temporary nature” also contribute to the conservation of biodiversity**

Biodiversity also includes cultivated species and domestic livestock. Some crops, particularly rainfed crops, are valuable habitats for many rare or threatened species. In urban land development there are often opportunities to conserve croplands that, together with small forest stands and the banks of rivers or streams, create mosaics of habitats which contribute to conserving species that are in decline. The conservation of cultivated species, both herbaceous plants and shrubs and fruit trees, can be a relevant contribution to the conservation of local varieties. In this sense, urban allotments can also play a role in the recovery of urban biodiversity. Similarly, a concept that is emerging strongly is *Temporary Nature*, in reference to natural ecosystems that are conserved in spaces of urban land that, until the time comes for their development, can conserve the original plant communities or others managed specifically to promote biodiversity; this can also help prevent them from becoming marginal wastelands that attract undesirable activities, such as illegal dumping. In these spaces it may be viable to conserve meadows that are mowed or grazed in favour of plants and small fauna associated with open environments. An example of this is the development of the space where the ALBA synchrotron is located, in Cerdanyola del Vallès, where urbanisation coexists in some sectors with the conservation of a biological corridor that integrates dry crops maintained owing to agreements with farmers, the conservation of vegetation cover in non-urbanised plots, and measures to support biodiversity in gardening and green spaces,

both in the public space and in the buildings of the business park. All within the framework of a strategy to promote green infrastructure.



Before construction begins, dry crops and natural grasslands are maintained on developable land in the ALBA Park area, which contribute to the conservation of a rich diversity of plants and animals associated with open environments. Photo: Carme Rosell

- **Ecological traps: avoiding mortality of urban wildlife**

Finally, we must not forget that humanised environments are not without risks for wildlife. Therefore, one of the challenges in the re-naturalisation of cities is to avoid the creation of what are known as “ecological traps”, places that attract animals (be they insects, birds or other groups of wildlife) and that pose high risks of mortality or injury to them. Some examples are the mortality of birds by collisions with the windows of buildings, which are invisible to them or create dangerous mirages of non-existent greenery due to the reflection of the trees growing next to the buildings. Other organisms, in this case aquatic, may die during the maintenance of fountains and ponds, trapped in drains or affected by biocide treatments. Pollinating insects can also be victims of collision with vehicles if we create a garden for pollinating insects in the middle of a roundabout. These are all real examples that we have seen in recent times, perhaps unexpected complications, that should not stop us from re-naturalising cities; they only force us to take this aspect into consideration in order to correctly define the places where we operate and to apply good design and maintenance practices in each space. However, in the emerging discipline of wildlife conflict management, there is sufficient knowledge and innovation to prevent damage, including devices to prevent wildlife from accessing spaces where they can suffer or cause damage. Let us also remember that there are various regulations that justify the need to apply good practices to prevent the death of fauna, in particular that of species of special conservation interest. We highlight only the European directive known as the Habitats Directive (Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna), which sets out the obligation to avoid the “incidental capture or killing” of the animal species listed in Annex IV. The message that emerges is that, when designing spaces to recover urban biodiversity, it should

be taken into account that it may be necessary to adapt maintenance practices — for example, adapting the system, machinery and mowing period in lawn maintenance, or adapting the system of periodic cleaning of urban fountains and ponds by choosing the most appropriate times of the year and foreseeing, if necessary, prior rescue of wildlife.

Cooperative knowledge

The construction of cities that integrate more urban nature must be based on the integration and development of new cooperative knowledge. To the collectives that traditionally contribute to the construction of buildings and public space (architects, urban planners and engineers, and also sociologists and doctors, among others) we now need to add the professionals who enable the ecological dimension to be integrated. All this must be done without overlooking, of course, the involvement of the people who inhabit or are users of the spaces. This is the only way to integrate nature in the city with the maximum benefits for people's health and wellbeing.

Interdisciplinary dialogue and work — so often spoken about and so rarely carried out — are indispensable for building the new biophilic city. Likewise, to give “ecological meaning” to the design and management of spaces, is vital to apply an integrating and ecosystemic approach — a “Margalefian vision”, as it is called by some of us who were lucky enough to benefit from the expertise of the distinguished ecologist Ramon Margalef. He, like no one else, knew how to transmit this way of looking transversely into space and time in order to understand how the species that inhabit a space interact with each other and with the environment, and how this system can evolve over time. This is the way in which we need to look at things in order to understand that when we carry out cleaning and planting in an urban green space we are also initiating ecological processes that, in part, we will no longer control: they will depend on the complex network of relationships that this piece of habitat will establish with other areas of the city. And that is why, for good design and maintenance of these spaces, it is essential to integrate as much knowledge as possible from different perspectives.

We will end with the reflections of another ecologist, the Frenchman Gilles Boeuf (2014), who concluded his speech in the inaugural lecture of the Collège de France, in December 2013, with this question: “Throughout this 21st century, will we be able to fully justify, and finally deserve, the description of *sapiens* that we have given ourselves?” Certainly, it will be es-

essential for us to add wisdom to overcome the challenges we face, among which is the design of the urban habitats of the future, where nature must have a place.

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