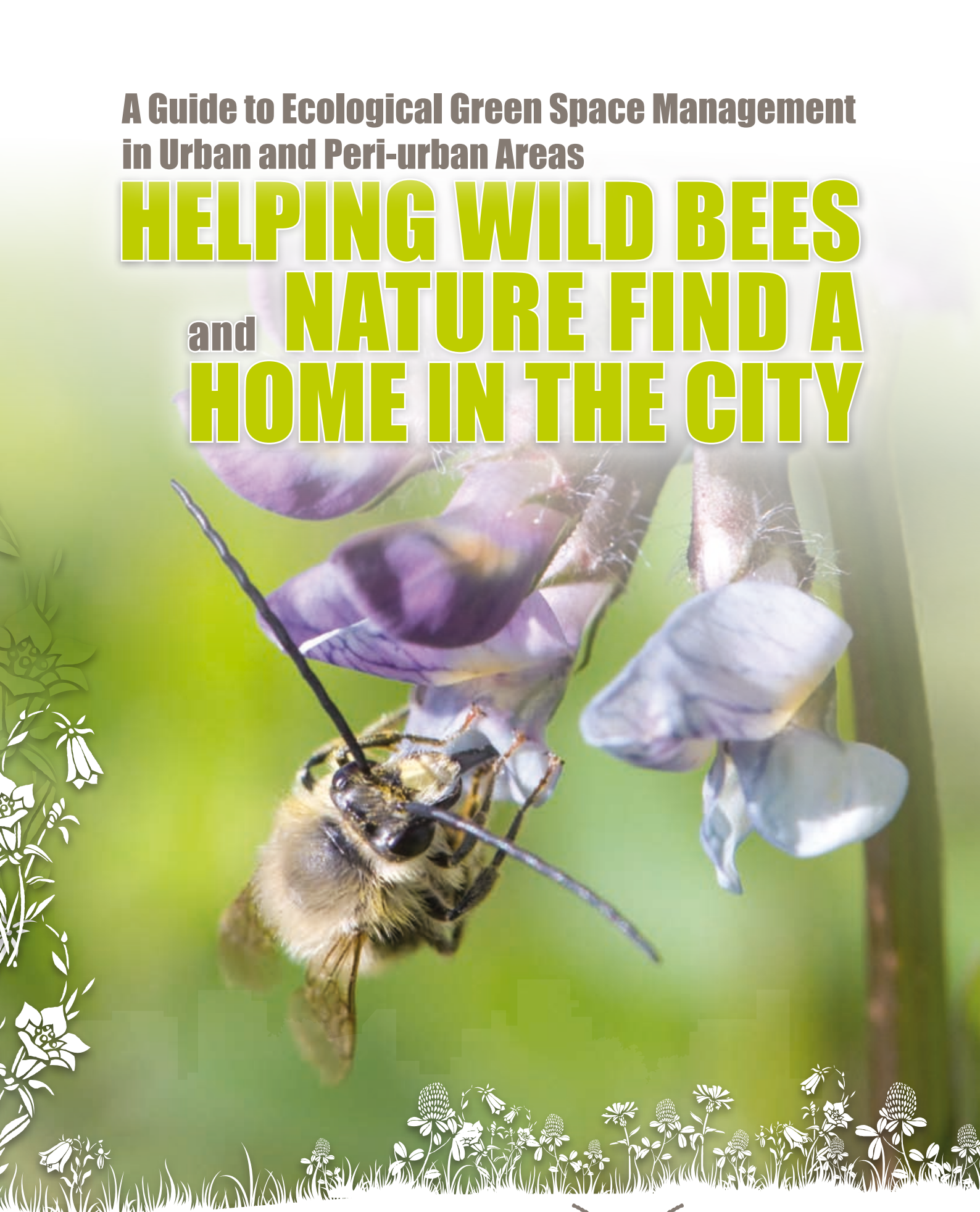
A Guide to Ecological Green Space Management in Urban and Peri-urban Areas

HELPING WILD BEES and NATURE FIND A HOME IN THE CITY

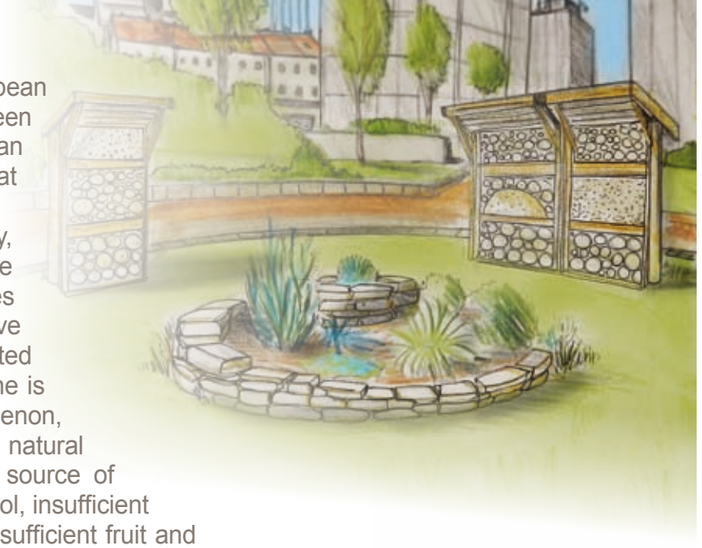


URBANbees
La ville et ses abeilles

Life

ARTHROPOLOGIA

INRA
SCIENCE & IMPACT



With around 80% of the European population now living in cities, green spaces in urban and peri-urban areas have become vital to ensure that people can enjoy a healthy quality of life. Simultaneously, and even paradoxically, the city today is also proving to be a refuge for some wild plant and animal species that can no longer thrive or even survive in farming areas amidst intensively treated crops. The fact is that biodiversity decline is now a scientifically recognized phenomenon, and its impact on the functioning of natural ecosystems and agroecosystems is a source of extreme concern (e.g., lack of pest control, insufficient pollinating services and subsequently insufficient fruit and seed yields, and a drop in soil fertility and the amount of organic matter being recycled).

As a result, green space management, in both city and countryside, must expand from its role of providing mere decoration, and be made as a mean for reviving the age-old concept of sharing space with other forms of life, in short as a mean for sharing with Nature. This is why it seems so imperative to introduce differential green space management systems in urban spaces as well as in peri-urban agricultural areas, to make room for habitats where biodiversity can thrive by offering food and lodging to wild species, but also to protect the green lungs in the heart and on the edge of cities.

All of these actions taken together serve to naturally reinforce the coherence and impact of ecological corridors (green and blue infrastructures), which are instrumental in maintaining the natural balance of flora and fauna and enabling them to move about. Therefore, preserving the environment in urban and peri-urban areas could play a major role in protecting Nature as a whole, while also responding to a growing expectation in society today.

This is the reason why citizens, companies and local authorities alike can and must all play their part, by any possible means, to reduce this loss of biodiversity, and even make active steps towards helping to maintain it. To start the ball rolling, simple initiatives can be put in place to raise awareness, set up installations and adopt new management practices so as to bring about this critical and necessary change in the portrayal and uses of Nature, as well as public attitudes towards it.

The aim of the LIFE+ **URBANBEES** programme is to target urban areas across Europe to disseminate the key elements needed to introduce ecological green space management, using an approach especially focused on wild bees. The Rhône-Alpes region is fully aware of the global issues at stake in biodiversity decline, and especially the alarming matter of bee decline as well as the need to maintain high-quality farming and recreational areas, and therefore it has offered continued support to this pro-Nature project since 2008. Having initially concentrated on Greater Lyon and the Rhône-Alpes region at large, the **URBANBEES** programme is now turning its attention much farther and spreading out towards the rest of Europe.

Nature knows no bounds, but neither does pollution. Therefore, from now on we should be tackling this very issue of biodiversity conservation on a European-wide scale, to pull together and take action to safeguard our natural capital, for future generations to lean and thrive on.

Jean-Jack QUEYRANNE
President of the Rhône-Alpes Region
Former Minister

>> A practical guide to be read without moderation...

In 2010, as part of the **URBANBEES** Programme, we took up the challenge of merging together biodiversity and the city. While everyone else was talking about honey bees and honey production, we set out to put our emphasis on wild bees, and to speak about diversity and ecosystem services. And it worked!

Wild bees are a fantastic tool for addressing a wider issue, namely the relationship between man and nature. Habitat destruction and standardization, climate change and agricultural, industrial and domestic pollution – all of these threats which bear down heavily on the state of biodiversity are rooted in a common cause: the excessive interventionism of mankind.

Driven by a desire to dominate as well as a need to justify his actions, man has come to believe himself to be indispensable. And yet the simple truth, often hard to swallow, is that while nature has no need for us, we have a fundamental need for nature.

It was in this vein that Robert Hainard, the Swiss naturalist, artist and philosopher, wrote in 1967: "*The day will come, and sooner than we think, when the level of development of a civilization will no longer be measured in terms of how much sway it holds over nature, but rather the extent to which it has let nature survive, in terms of quantity, and quality, scope and wildness*."

Almost 50 years on, the time is more than ripe to start learning how to live again in harmony with nature, and to bring human activity into balance with preserving biodiversity for the benefit of each and every one of us. Yet, in order to reach that goal, every action counts, and every major stakeholder must come on board and commit to the cause: this is an issue to be dealt with by society as a whole.

After four years of undertaking research and setting up initiatives in France to help wild bees thrive in Greater Lyon, we have been able to build up experience and draw some valuable insights and lessons, which we would like to share with you here. Thanks to this guide, you will soon have the keys to success for transforming your city into a haven for biodiversity.

We hope that you enjoy reading this guide, and we wish you great success and joy in your efforts and projects towards conserving and enhancing wild bee abundance and diversity.

Bernard VAISSIERE, INRA PACA
Hugues MOURET, ARTHROPOLOGIA
Jean-Paul BRET, Mayor of Villeurbanne
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Table of contents

>> Introduction

Providing a home for bees in the city… what kind of a crazy idea is that? And yet that is precisely the challenge set up by the European Life+ Biodiversity URBANBEES programme, and the very same challenge that we are inviting you to take up here with this guide.

Due to the destruction of natural environments, the overuse of resources, and agricultural, industrial and household pollution, human activity has managed to kill off numerous animal and plant species and place them under greater threat than ever...
The state of BIODIVERSITY has steadily declined since the 1950s, as revealed in the findings of monitoring reports released by the International Union for the Conservation of Nature (IUCN)[1]. Moreover, recent scientific research on the decline of honey bee colonies as well as wild bees has raised the alarm on the significant threats facing the pollinator populations and the potential dire consequences of their decline.
The great paradox is that some wild pollinators, faced with the spread of artificial environments, the destruction of natural habitats due to intensive farming, and the widespread use of pesticides in agricultural areas, are now turning towards urban and peri-urban areas to find refuge. These spaces offer clear advantages, since they are warmer, they provide flowers over an extended period of the year, and are generally less polluted by pesticides than intensive agricultural areas. Yet there is still considerable room for improvement in providing a welcoming environment for these distinguished guests - wild bees.
The Life + Biodiversity **URBANBEES** Programme (2010-2015) aims to gain and promote a greater understanding of wild bees, to boost their abundance and diversity in urban and peri-urban habitats, and to disseminate throughout Europe a validated action plan providing land management guidelines for making green space more pollinator-friendly. We encourage you to join us and set out on a discovery trail to learn more about wild bees, and explore how urban environments can play a role in preserving this vital backbone of our natural heritage.

URBANBEES site with the nesting devices - City of Saint-Priest

A. Goals and target groups

The task of protecting wild bees, and on a broader front, protecting biodiversity, requires us first and foremost to stop the use of chemical pesticides and fertilizers, and introduce systems of green space management that work in harmony with different ecosystems. Therefore, the goal of this guide is to provide practical advice and support to decision-makers, planners, managers and caretakers of green spaces, from both private companies and public authorities, and help them in every step of the way towards implementing a system of urban space management and planning that is wild pollinator-friendly.

B. Methodology

This guide is the culmination of a five-year of the implementing the **URBANBEES** programme coordinated by the Bees & Environment unit of INRA PACA (the regional centre of the French National Institute for Agricultural Research in Avignon) with expertise of the naturalist association ARHROPOLOGIA amongst other partners. It summarizes all the recommendations that have emerged from the scientific research findings of the PhD work of Laura Fortel as well as the feedback on communication and awareness raising initiatives, and training programmes. We also included at the end a reference list of the major tools available to local authorities in France and Europe to set up an ecological action plan for green space management.

To broaden the scope of this guide even further, working groups were set up and individual interviews were conducted with 30 participants, all responsible for designing and managing the green spaces in the Greater Lyon, and working at local authorities or in associations, landscaping companies, or environmental engineering consulting firms. Thanks to their input in explaining the practical nature of their work, these folks were able to help us base our recommendations on a concrete, realistic approach, taking into account all of the pitfalls that can arise when working in the field. In addition, by explaining their expectations and needs, they also helped us to make strategic choices for the content and develop this management guide.

C. How do I use this guide?

- The opening Background section provides an introduction to wild bees, explains the issues at stake in protecting them in urban and peri-urban areas, and presents the **URBANBEES** project;
- The “Methodology section” outlines the key stages involved in setting up an ecological management plan tailored to each type of habitat. Recommendations are given, illustrated by French and European case studies;
- The “Tools section” gives the methodological and technical keys that you will need to apply the recommendations outlined in the “Methodology section”, step by step;
- The “Bibliography” gives a further list of tools in France and beyond to enable you to explore in greater details the various aspects presented in the guide. You can easily refer to it at any time;
- Definitions of the technical and scientific terms found in this guide are given in the “Glossary”;
- Finally to summarize all the information, but also to help with communication within your own department or towards the general public, a poster is provided enclosed, explaining the issues at stake in protecting wild bees in the city.

Discovering wild bees

Apis mellifera, the honey bee, is well known by the general public, and the subject of much scientific research. Yet what we generally do not know is that it is only one of 2,000 bee species identified in Europe (and over 20,000 in the world). Today it is these so-called “wild” bees that are attracting increasing attention from researchers and naturalists.

A. What is a bee?

Bees are insects, and as such they have 6 legs, 2 antennae and a body made up of 3 ‘sections’: the head, thorax and abdomen. Bees also have two pairs of wings. They belong to the order Hymenoptera, which includes insects with a “wasp waist” – a constricted, narrow part between the thorax and abdomen, resulting in a pinched waist – called Apocrita (bees, ants, wasps) - and insects belonging to the suborder Symphyta (also called sawflies) which do not have a wasp waist.

Halictid wild bee (*Halictus* sp.)

Brief introduction to taxonomy

Taxonomy is the science of describing and classifying living beings into a hierarchy based on their natural relationships to each other:

Kingdom → Phylum or Division → Class → Order → Family → Genus → Species.

For example, *Osmia bicolour*, a very common solitary bee, belongs to the animal kingdom, to the phylum Arthropoda, to the class Insecta, to the order Hymenoptera, to the Megachilidae family, to the genus *Osmia*, and to the *Osmia bicolour* species.

Unlike wasps, which take the “meat” off carcasses, or hunt to feed their larvae, bees have evolved to become herbivores: they feed themselves and their offspring only on pollen and nectar. All females are equipped with apparatus (SCOPA) designed especially for gathering and carrying pollen, except for CUCKOO BEES, which are parasites that lay their eggs in the nests of other bee species, and therefore do not collect any pollen. Also, bees belonging to the genus *Hylaeus (Colletidae)* carry the pollen and nectar mixed together in their CROP.

Male halictid bee

Certain flies (syrphid flies; Syrphidae) MIMIC bees and wasps. Yet it is still quite easy to differentiate them: flies have 2 wings, very short antennae and large eyes. In addition, syrphid flies, also known as hoverflies, have the distinguishing feature of being able to hover in a completely stationary position.

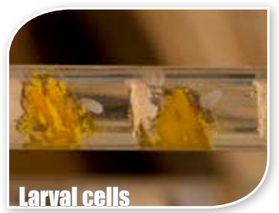
Hoverfly

Given the vast diversity of bees, it is difficult to identify most species as it requires the detailed and meticulous observation of precise features. This guide does not attempt to provide keys to identify different bee species, but rather it describes some interesting features and behavioural traits that are easy to spot.

B. Wild bees versus the honey bee

In direct contrast to *Apis mellifera*, the honey bee, and a few other bee species such as some bumble bees (e.g., *Bombus terrestris*), mason bees (e.g., *Osmia cornuta*), and the leafcutter bee *Megachile rotundata*, all other bee species are wild.

Most wild bees are solitary: each female builds its own nest where it lays several eggs. Each egg is enclosed inside a larval cell that contains enough food reserves for it to reach full adult growth (bee bread made up of nectar and pollen). The nest is built using an array of different materials, depending on the species. Seventy percent of bees build their nest in the ground and these are called GROUND-NESTING bees. The remaining bees (CAVITY NESTERS) build their nests in any hole that will deem fit, such as inside hollow or pithy plant stems. Other bees build their nests in branches or logs of wood pierced with holes, and even in empty snail shells!



Larval cells

The life cycle of a wild bee lasts for an average of one year, covering 4 different stages of development, with each phase varying in length, depending on the species. The egg hatches a few days after it was laid. The larva takes 6 to 8 weeks to eat up its food reserves before metamorphosing into a pupa, whereupon it stays enclosed inside its chamber, without eating for several months. Therefore it is vital for nesting materials to be protected from moisture. The adult bee finally emerges between the start of spring and the end of summer the following year, depending on the period of activity of each species. Adult females live for a few weeks weeks, whereas males have a much shorter lifespan, covering only the period of reproduction. With the exception of a few species, an adult bee does not survive the winter. Thus wild bees do not produce honey, which is typically used by other species such as the honey bee as food reserves during the winter months.

C. Species diversity and their varied lifestyles

European bees are classified into 6 families, spread across 2 groups based on the size of their **TONGUES**.

- **Short-tongued bees**
  Melittidae, Andrenidae, Halictidae and Colletidae.
- **Long-tongued bees**
  Megachilidae and Apidae.

Short-tongued bees generally forage flowers with an open corolla, where the nectar is easily accessible, whereas long-tongued bees can also visit plants with a deep corolla. Other criteria can be used to distinguish different groups, such as the pattern of the **WING VENATION** (network on the wing membrane), the shape of the appendices, and whether there have a structure for gathering nectar and pollen, and its shape. Considering the vast diversity of forms and different lifestyles within a single bee family, here we will only describe a few types of genera or species, whose particular features are easily recognizable.

1. Short-tongued bees

MELITTIDAE [36 species] [2]
Main genera: *Macropis, Melitta, Dasypoda*

These are mostly summer bees, which dig their nests in the ground. They are usually specialist pollinators, visiting only one plant species, or a few closely-related species.

Melitta nigricans

Macropis europaea bees are small with black and white pollen brushes, and they can be found congregating around the yellow flowering plants of *Lysimachia* spp. [3] near ponds and lakes.

Macropis europaea

Pantaloon bees, *Dasypoda* spp. [3], are solitary, and owe their name to their long pollen-collecting scopal hairs on the hind legs of the females. They nest in sandy soils.

ANDRENIDAE [466 species]
Main genera: *Andrena, Panurgus, Panurginus...*

Andrenids, also called sand bees or mining bees, are ground-nesters. Some are **SPECIALIST BEES**, whereas others visit a wider variety of flowers. They collect pollen with the help of **FLOCCULI**, which are arched hairs at the base of their hind legs.

Andrena haemorrhoa

Panurgus is a genus of small black bees that stand out for their unusual behaviour: when foraging yellow Asteraceae (such dandelion - *Taraxacum* spp., hawkweed - *Hieracium* spp., hawksbeard - *Crepis* spp., and oxtongue - *Picris* spp....), they look as if they were swimming on the capitulum.

Panurgus sp.


Nest of a mining bee
Andrena sp.

HALICTIDAE [316 species]
Main genera: *Halictus, Lasioglossum, Sphecodes…*

These widespread and diverse bees, often called “sweat bees” are known for nesting in the ground, particularly along paths in firmly packed soil. Although mostly solitary bees, certain species display varying degrees of sociality: a dominant female, the queen, lays the eggs, while the other females do the work of gathering nectar, feeding, and protecting the nest ... The females of the *Halictus* spp. and the *Lasioglossum* spp. stand out for the hairless groove at the end of their abdomen. The males are thinner with long antennae.

Halictus sp.

Lasioglossum sp.

COLLETIDAE [147 species]
Main genera: *Colletes, Hylaeus*

Colletid bees have a bifid tongue (forked).

Colletes spp. bees have scopae on their hind legs, and usually gather pollen from one or a few plant species. For instance, *Colletes hederae* bees only gather pollen from the ivy *Hedera helix*, (hence their common name the Ivy bee) meaning that they can only be seen in autumn, when ivy plants bloom. They are ground-nesters, and cover the cell walls of their nest with a transparent type of membrane that looks like to cellophane - hence their name "plasterer bees".

Colletes hederae

Hylaeus spp., or “masked bees,” is a family of tiny, nearly glabrous (hairless) bees, with a smooth and glossy in appearance and distinctive triangular-shaped markings on their faces, or large yellow patches, making them easy to recognize. They do not have an organ to collect pollen, so it is stored with the nest in the female’s crop.

Hylaeus sp.

2. Long-tongued bees

APIDAE [553 species]
Main genera: *Nomada, Eucera, Anthophora, Epeolus, Melecta, Xylocopa, Apis, Bombus...*

The *Anthophora* spp. are large, solitary bees that can sometimes look like bumble bees. In particular, the male species of *Anthophora plumipes* (also known as the “hairy-footed flower-bee”) can be distinguished by the long hairs on their midlegs.

Anthophora plumipes

Xylocopa spp. include some of the largest bee species. Their bodies are completely black with a blue-toned sheen, and iridescent dark-coloured wings. These solitary bees hollow out nest cavities in dead wood, hence their name “carpenter bees”.

Xylocopa sp.

Beekeepers raise colonies of honey bees or *Apis mellifera* to harvest honey and other hive products. Less hairy than bumble bees, honey bees are easy to spot thanks to their pollen baskets, which they use to aggregate the pollen into a little balls on their hind legs.

Apis mellifera

Bumble bees or *Bombus* spp. have large bodies, with thick, colourful hair. They live in relatively large colonies inside ground cavities, often choosing to adopt an abandoned rodent’s nest, or above ground (in a tree trunk or nest box). The workers aggregate the pollen in their pollen baskets on their hind legs, just like honey bees. One species of bumble bees, *Bombus terrestris*, is raised on a large commercial scale for its use in the POLLINATION of greenhouse crops, such as tomatoes (*Lycopersicon esculentum*).

Bombus sp. of the terrestris group

Beehives – not the ‘bee’ all and end all of biodiversity....

A host of new projects have sprung up in recent years to install urban beehives across Europe. Yet the honeybee is only one of 2,000 bee species in Europe, and 20,000 known species across the world. If the goal is to maintain biodiversity, then this is the full spectrum that we need to be dealing with!

↘ MEGACHILIDAE [441 species]

Main genera: *Anthidium, Stelis, Megachile, Coelioxys, Osmia, Chelostoma, Heriades…*

The females of this family have a brush of pollen-collecting hairs on the ventral side of the abdomen, which is usually of a different colour from the rest of their body.

Anthidium spp., “wool carder bees”, “cotton bees,” “resin bees,” or “mason bees” covers species that are generally stocky, with few hairs, and yellow (or orange) and black bands on the abdomen. They build their nest cells out of plant hairs and resin from conifers.

***Anthidium* sp.**

Megachile spp. is a group also known as the “leafcutter bees.” Their abdomens are slightly flattened, with short stubby hairs, and sticks out when the bees collects pollen. Most megachilid build their nests with fragments of leaves rolled up like little cigars. Other, more southern species (*Chalicodoma* spp.) are known as “mason bees” because they build sturdy nests made out of dirt, usually in rock surfaces, cliffs, or building facades.

***Megachile* sp.**

The *Osmia* spp. bees, also called “mason bees”, are usually hairy, and occasionally with a metallic green or blue sheen. They build their nests in any cavity with the right diameter (tubes, wood bored with holes or air vents) and plug the entrance with an array of natural materials (e.g., mud, clay, stones, and leaves). *Osmia bicornis* and *O. cornuta* are both very common species, and are amongst the first bees of the year to emerge, appearing in early February as soon as the temperatures become mild enough.

Osmia bicornis

The *Anthidiellum* spp. are tiny black and yellow bees that make their nests out of resin, hence their name “resin bees”. Bees belonging to the *Heriades* and *Chelostoma* genera are smaller, more slender, and generally less hairy.

***Heriades* sp.**

1 - Anthidium bee collecting plant hairs
2 - Leaf-cutter bee bringing back a piece of leaf to make her nest
3 - Mason bee flying back with a ball of mud to close her nest
4 - *Heriades* bee carrying a load of resin to build her nest

A. So they do not make honey? Then what are they useful for?

These were the kind of questions that we constantly heard cropping up during the awareness days, activity days and training courses that were organized as part of the **URBANBEES** programme. Yet bees, and more broadly speaking wild pollinators, are crucial to maintaining the natural balance of ecosystems because of their very foraging activity that enables pollination to take place. These winged insects fly about in search of food, and as they go from flower to flower, they transport pollen grains from the stamen (the male reproductive organ of the flower) to the stigma (the receptive surface of the pistil, which is the female reproductive organ of the flower). This process plays a vital role in plant reproduction and survival, and it leads to genetic recombination, and therefore the capacity of plants to evolve and adapt.

The *Millennium Ecosystem Assessment* recognized animal pollination as being one of the key ecosystem services provided by nature to man, totally free of charge. Over 80% of wildflower species and of cultivated plants grown in Europe depend on insect pollinators, and mainly bees [4]. This service is also extended to agricultural production (particularly in fruit and vegetable, oilseed crops and seed production). In 2009, scientists calculated that this pollination service represented over 153 billion euros in 2005 throughout the world, and over 14.2 billion euros in Europe [5].

Certain crop systems, such as the California almond orchards, use honey bee colonies to offset the wild pollinator decline, itself caused by the extensive use of pesticides and the destruction of habitat mosaics. Yet scientific research carried out in 2013 [6] found that increasing the number of beehives has no effect on the productivity of fruit orchards. Conversely, the abundance and diversity of wild pollinators has a significant positive impact.

Insect pollinators play an immensely beneficial role in agriculture, but it does not just end there. Fruit and seeds from wild plants also play a key part in feeding many wild animal species, either directly or indirectly, and thereby in enhancing the diversity of habitats. Insect pollinators therefore help maintain the natural balance of ecosystems and preserve countless different plant and animal species.


Carpenter bee

Pollinators and wild bees

Many different orders of insect take part in the pollination of flowers: Hymenoptera (especially bees, and to a lesser extent wasps), Diptera (flies), Coleoptera (beetles), Lepidoptera (moths and butterflies)... In some areas of the world, some birds or mammals (such as bats) are also important pollinators of certain plant species. There are even a few plants that flower underground, and their pollen is transported by earthworms.

Yet thanks to a wide array of characteristics, bees are the undisputed champions of pollination. All species have branched hairs that trap pollen grains, and they visit flowers to gather nectar and pollen to feed themselves and their brood. Furthermore, unlike most other insects, bees are consistent pollinators: when they go out on a foraging trip, they only visit flowers from one given plant species, which significantly boosts the chances of effective pollination occurring.

To put it plainly, when talking about farming practices or the natural environment, we have no other choice but to be acutely aware of the current decline of insect pollinators, and remain alert of its dire potential consequences.

B. Bee decline and the main threats for bees

A wide body of scientific research carried out on bees and other wild pollinators shows that we are, indeed, facing an overall population decline. In 2006, a landmark study revealed a distressing 52% loss of bee diversity in areas studied in the U.K., and 67% in the Netherlands, when comparing figures after and before 1980[7]. In some areas of Europe, over 65% of the wild bee populations were reported to be in decline[8]. And this figure is all the more disturbing if you consider the central role they play in maintaining the natural balance of ecosystems, as well as numerous plant and animal species. But there are also many reasons that explain this decline:

1. Destruction and fragmentation of habitats

Intensive farming, urbanization and building road infrastructures all lead to the destruction and fragmentation of natural habitats, which in turn then lead to isolated populations and genetic erosion. Furthermore, destroying hedgerows, bocage and natural meadows, draining WETLANDS, mowing roadside embankments too often, and impoverishing soil quality due to the increasingly artificial state of the landscape - all of these elements conspire to create a deficit in food and nesting resources for bees. In Europe between 1990 and 2000, the attraction for private housing estates plus the spread of suburban business parks and commercial areas meant that urbanization encroached on 8,000 km^2 of new land space - three times the size of Luxembourg[9].

2. Pesticides

The widespread use of pesticides in conventional farming can lead to death or, more insidiously, behavioural changes and disruption to the immune system of bees, thereby making them more vulnerable to parasites and diseases. Although the impact of pesticides on honey bees is relatively well researched, and often indicated on packaging, there is still a severe lack of research focusing on the consequences of pesticide applications for wild bees. And those consequences are only amplified if a bee goes to forage in areas that have been treated with different pesticides: the effect of the combined molecules on the bee can be tantamount to a chemical bomb.

And now with the arrival of a new generation of pesticides on the market – neonicotinoids - there is particular cause for concern[10]. The different molecules grouped within this category are 5,000 to 10,000 times more toxic than DDT, which has been prohibited in the European Union since 1986[11]. In 2013, three of the molecules were banned by the European Commission for a period of two years, and this may prove to be not enough considering the dangerous nature of these products.

3. Homogenization of the landscape: depletion of floral diversity and nesting sites

Today we are seeing our crops becoming increasingly uniform, and our natural meadows being replaced by vast fields of cereals. Yet these areas are of no use for wild bees or the wild fauna. Belgium is one such example: it has seen its area planted in corn (*Zea mays*) increase 80-fold in 50 years, at the expense of its legume forage fields (such as alfala *Medicago sativa*, clovers *Trifolium* spp., and sainfoin *Onobrychis* spp....), which are extremely attractive to bees.

Cities take a tough line on SELF-SEEDING PLANTS, preferring EXOTIC and horticultural plant varieties that have been highly modified (flowers with multiple whirls of petals, lack of anthers or reduced nectaries...) and are often poor sources of pollen and nectar. Yet these choices inevitably end up interfering with the feeding of pollinators.

Some wild bee species gather all their pollen on the flowers of a single plant species, genus or family. For example, it is the case for *Melitta tricincta* on the red bartsia *Odontite vernus* plant, for *Andrena hattorfiana* on the Dipsacaceae family, and again for *Colletes anchusae* and *Colletes wolfi* on false alkanet *Cynoglottis barrelieri*. The decline is most striking amongst these SPECIALIST POLLINATORS.

4. Competing with honey bees

Many local authorities and private gardeners are now aware of the serious issue of bee decline, and have therefore decided to install beehives in their parks and gardens. Yet the impact might have an opposite effect to the desired one. When there are too many honey bees, they can start competing for food with other wild pollinators, especially in cities where food supplies are limited. Scientific research[12] carried out in 2000 revealed that in order to ensure a natural balance, no more than 5 honey bee colonies should be installed per km^2. So, if such projects are designed to have an interesting educational impact, then care should be taken not to take things too far and their number should be kept in check.

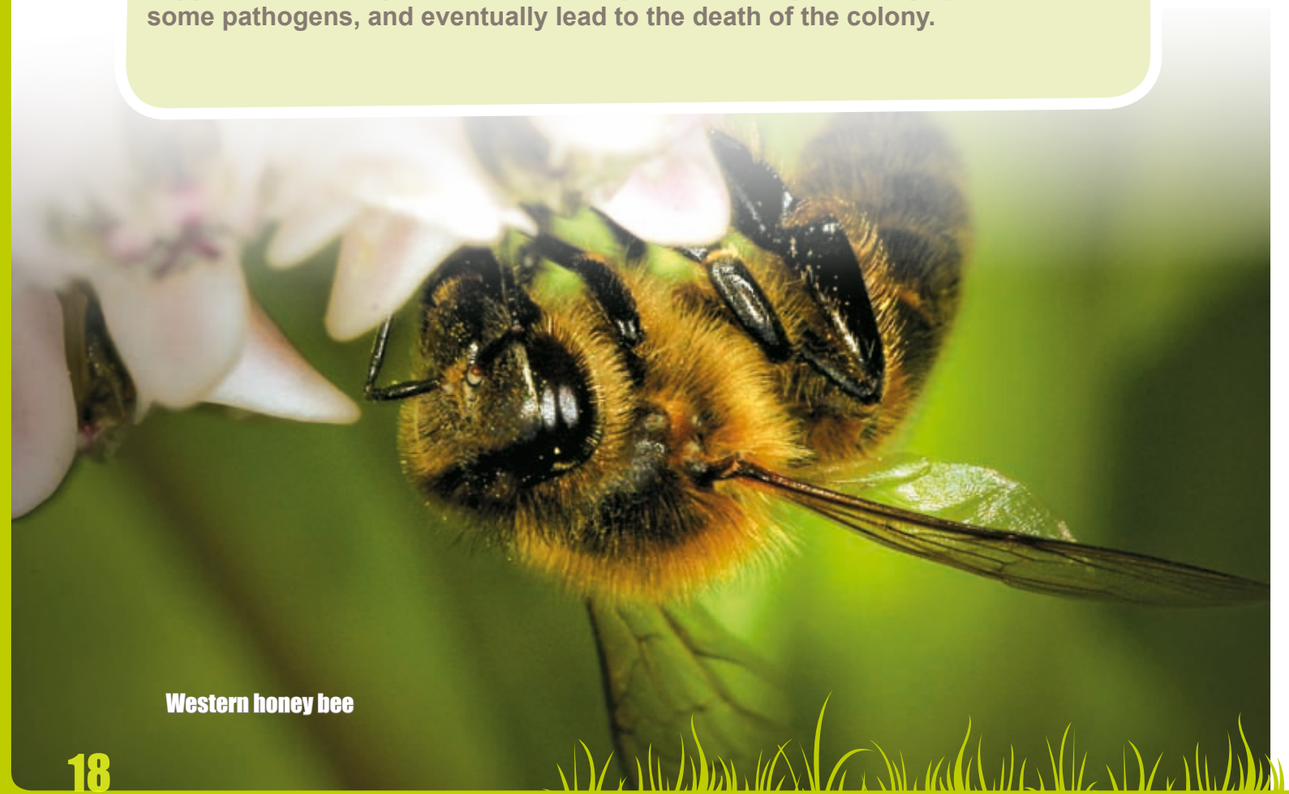
Colony collapse disorder: the multiple reasons behind the decline *Apis mellifera*[13] colonies

Apis mellifera **is the most closely observed and researched bee species. Thanks to monitoring programmes carried out by beekeepers, which attract keen interest from scientists, we are now equipped with a wide body of information on the evolution of colonies and the causes of their decline. For example, we know that in Central Europe between 1985 and 2008 there was a 25% decline in the stock of honey bee colonies and a decline of 59% in the United States between 1947 and 2005. In parallel, we are witnessing the near disappearance of wild colonies.**

Most research findings point the finger at a wide group at several factors:

- **Environmental factors such as pesticide exposures or malnutrition (lack of food resources).**
- **The worldwide-scale spread of predators (e.g., *Vespa velutina*, the Asian phornet), and parasites such as *Varroa destructor* (an Asian species of parasitic mite that targets adult bees, larvae and pupae), and pathogens such as *Nosema* spp. (a fungus that includes certain parasitic species that can infect adult bees). Buying and introducing queen honey bees or swarms from abroad only serves to accelerate the spread of these parasites.**
- **Genetic erosion of populations.**

In fact, it is now recognized that it is the interplay of all these factors combined that is the most likely cause of the sharp decline. Thus, low doses of pesticides, which alone may have no direct visible effect on bees, can still nevertheless trigger a weakening of their immune system, making them highly vulnerable to some pathogens, and eventually lead to the death of the colony.



Western honey bee

An horticultural flower bed in an urban setting - Lyon

Wild bees taking up home in the city

A. Bees finding refuge in cities

Recent findings from scientific research show that, given the destruction of habitats in agricultural and semi-natural areas and the level of pesticide contamination of our environments, urban and residential areas can provide a welcome refuge for numerous species. And this applies especially to wild bees, thus 262 different bee species have been recorded in Berlin[14], 110 species in the residential gardens in New York[15], 56 species in Vancouver (Canada)[16], 104 in Poznan (Poland)[17], and a further 95 species in the Botanical Gardens in Geneva.

As part of the **URBANBEES** programme, an extensive survey was carried out on 24 study sites in and around Lyon in 2011 and 2012, during which we identified a total of 309 bee species. This number is certainly set to rise once we receive the full set of results listing additional bees that were identified in 2010, 2013 and 2014.

Indeed, urban and peri-urban areas offer several advantageous features to wild bees:

- There are fewer pesticide applications than in conventional intensive farming areas;
- Cities are 2 to 3 degrees warmer than the surrounding countryside, and bees are generally thermophilic insects that are attracted to warm environments for building their nests;
- An abundance of flowers is usually present in parks and gardens throughout most of the year (NATIVE, exotic and horticultural plants);
- Our cities also provide surprising nesting opportunities: cracks in uneven walls, piles of wood or sand, patches of exposed dirt and trampled ground...

B. Key measures for tailoring green space management to wild bees

Yet these advantages should be further reinforced by appropriate measures designed to meet the basic needs of wild bees to increase their abundance and diversity. Indeed, green spaces are not all automatically pro-biodiversity environments by their very nature alone. Their positive impact depends heavily on the specific choices made in terms of management and urban greening.

1. Implementing an ecological green space management plan

- Stopping the use of pesticides and introducing alternative methods of pest control;
- Introducing differentiated green space management, adapted to the various types of land use;
- Spacing out cutting work to leave green surfaces to grow taller, using centrifugal patterns and cutting the stems higher up;
- Maintaining natural environments and introducing specialized pro-biodiversity devices such as ponds, hedges, fallows, and insect hotels...

2. Providing high-quality food resources

Adult bees mainly feeds on nectar and pollen, and they feed their larvae a mixture of nectar and pollen. Therefore one of the fundamental elements of protecting wild bees involves encouraging the growth of suitable flora:

- Choose mostly native plants, adapted to the needs of native bee species and to the pedoclimatic conditions of the surrounding environment; keep exotic plants to a strict minimum and shy away from horticultural plants with highly-modified flowers;
- In plantings and flowerbeds, seek to gain a variety of plant species and flowering periods;
- Encourage the growth of self-seeding plants in numerous areas spread out across the entire territory.

3. Providing nesting sites

Given that swathes of natural habitats are being destroyed in agricultural areas, such as hedges and thickets, certain wild bee species are homing in our cities to find refuge in our walls and along our pathways. We therefore need to increase favourable natural habitats for bees:

- Replace neatly clipped mowing techniques by cutting higher up the stems;
- Let the plants grow taller by cutting or mowing less frequently;
- Leave in place any dead wood and debris from tree pruning;
- Conserve unmanaged areas by letting fallow to grow over naturally, or plant wild hedgerows;
- Maintain areas of exposed dirt (paths and trampled zones) and roadside embankments;
- Limit waterproof surfaces as much as possible.

Grass cutting

Bee or insect hotels can also be installed, knowing that they are designed first and foremost for educational and observational purposes.

To boost rich diversity, bees must have adequate food supplies and nesting sites. Therefore, it is essential to maintain **ECOLOGICAL CONTINUITY** across the different types of environments, and especially between the green spaces in urban and peri-urban areas.

Obviously, the measures we are recommending here are not for the exclusive benefit of wild pollinators. Bees qualify as **UMBRELLA SPECIES**: that is, any measure to protect them has a much broader impact in that it will help to conserve and enhance biodiversity as a whole. Furthermore, bees have a strong and wide-reaching symbolic value, and they are key elements in raising the awareness of the general public and professionals. It is for these very reasons that all the partners involved in the **URBANBEES** programme decided to focus on wild bees.

C. Presentation of the URBANBEES programme

The Life + Biodiversity **URBANBEES** Programme (2010-2015) aims to gain and promote a greater understanding of wild bees, to boost their abundance and diversity in urban and peri-urban habitats, and to disseminate throughout Europe an action plan providing a land management model for making green spaces more pollinator-friendly.

This programme is coordinated by INRA PACA (French National Institute for Agricultural Research - the regional centre for Provence-Alpes-Côte-d'Azur), and ARTHROPOLOGIA (a naturalist association). It is built upon a close working relationship with the cities of Lyon and Villeurbanne, the Social Sciences Department of the University of Lyon and the Natural History Museum of London.

The programme is funded by the European Union, the French Ministry of Ecology, Sustainable Development and Energy, the Rhône-Alpes region, the Greater Lyon, the retail chain Botanic®, and the Compagnie Nationale du Rhône.

Furthermore, 10 local districts and institutions have also been key partners in the **URBANBEES** programme, responsible for settting up the specialized nesting installations for wild bees: Collonges au Mont d'Or, le Grand Moulin de l'Yzeron, Grigny, Limonest, Meyzieu, Saint-Priest, Sainte Foy-lès-Lyon, the Syndicat Mixte des Monts d'Or, the Syndicat Mixte du Rhône des îles et des Lônes and the VetAgro Sup campus.

Completed URBANBEES site with nesting devices and information panels – city of Villeurbanne

The **URBANBEES** programme was organized around four main building blocks:

- Concrete actions with the installation of specialized nesting devices – bee hotels, rammed earth walls, soil squares, insect spirals – on 16 sites across Greater Lyon to help wild bees nest. These structures were installed by the park & recreation services of the different districts working in partnership with the project, and with the support of the association ARTHROPOLOGIA. Regular monitoring on these study sites enabled us to observe and study the behaviour of the bee populations, and also to measure the degree to which these installations actively helped wild bees with nesting;

- Scientific research led by INRA PACA aimed at (i) comparing the abundance, species composition and structure of the wild bee community along an urbanization gradient in and around the Greater Lyon, (ii) assessing the interplay between the bees and the flora present on the sites, and (iii) monitoring the occupation dynamics of the various nesting devices that were tested out using different materials and plant species elements. The results from this research brought a deeper understanding of wild bees, but have also helped to shape a series of recommendations that suggest concrete initiatives designed to aid wild bee survival, spanning plantings, landscaping and installations;

- Training courses that were an integral part of the programme and which were organized by the association ARTHROPOLOGIA, and targeted at professionals (farmers and park and recreation personnel) and students to help promote an alternative ecological land management system in natural, agricultural and urban habitats;

- Communication campaigns, coordinated by the association ARTHROPOLOGIA, that also were a major part of the programme. With over 75% of the European population living in urban areas (EEA, 2006), these are key areas for raising public awareness, and bees provide an excellent entry point for addressing the wider issues connected to protecting biodiversity. Therefore numerous communication initiatives (special activities, outings, conferences, workshops, training courses, exhibitions) were organized throughout the programme to raise awareness amongst the various stakeholder groups concerned (children, the general public, elected officials and professionals), but also to secure their involvement in protecting wild bees.

This guide *Helping Wild Bees and Nature Find a Home in the City* is a key result of the URBANBEES programme. It summarizes the findings gathered from the various initiatives and the scientific research carried out along these four main building blocks.

Main scientific findings from the programme

The programme findings are included in the different sections throughout this guide, and are due to be further completed in subsequent editions. However, here we can already provide a summary of some of the more striking results that have emerged from the field research led by INRA PACA and conducted with the association ARTHROPOLOGIA:

- 309 bee species have been recorded on the 24 **URBANBEES** study sites, that is a third of the total number of bee species currently known in France;

- Urbanization affects bee species in a selective way. Whereas short-tongued species and ground-nesting species are adversely affected by urbanization, mostly due to the loss of soil from artificialization, in direct contrast cavity users and long-tongued bees thrive in urbanized areas;

- Peri-urban environments play an important role, as these areas are where one finds the most diverse bee community. The reason is probably that these habitats offer the characteristics of an **ECOTONE**: lying at the interface zone between the city and the countryside, these spaces offer a wide variety of different habitats, and are therefore good for biodiversity. Moreover, the abundance of cuckoo bees, which are dependent on host species, is regarded as being the sign of a certain stability in peri-urban environments, indicating healthy ecosystems.

Mating of mason bees
Osmia cornuta

Section 2 >> Methodology for implementing an ecological green area management strategy in urban environments

Programmes for protecting biodiversity have long focused on maintaining valuable spaces and species modelled upon the Natura 2000 network. Yet this strategy is not enough. By focusing on these areas alone, we are simply turning a blind eye on the consequences of human activity outside these areas, on the agricultural and industrial pollution, or again on the **URBAN SPRAWL** and the increasing drive towards artificial habitats.

With over 75% of the European population living in cities[18], the fight against urban sprawl is one of the major issues in European politics today. The challenge in the upcoming years will be to increase the density of urban dwellers in cities, while also improving their wellbeing and actively working towards protecting biodiversity. It is a whole change of mindset to redesign our model of the ideal city, whereby urban spaces are brought back into the ecological network and biodiversity is placed at the heart of our parks, gardens and buildings. Therefore human activities must be developped in line with biodiversity.

From this perspective, every bit of space counts. And this is why we are providing you here with a step-by-step methodology, broken down into different categories of space, so as to help you implement an ecological action plan for green area management in your city, all illustrated by French and European case studies:

- Derelict wasteland and abandoned urban areas
- Parks and recreation areas
- Urban and peri-urban agricultural areas
- Private and collective gardens
- Cemeteries
- Sports areas
- Wetlands and embankments
- Roadsides
- Buildings and their surrounding grounds

A few general recommendations

Every ecological land management plan must start off by phasing out the use of pesticides and artificial fertilizers, which are only symptomatic of our interventionism, and the cause of major and persistent pollution as well as the imbalance of natural ecosystems. There is no magic formula to compensate for stopping the use of herbicides, insecticides, and other fungicides. The key to success lies in implementing a combination of alternative methods adapted to each particular case.
For this purpose, it is essential to train green space workers in the different elements that make up biodiversity, as well as in ecological land management practices. Furthermore, you must get them involved in the process of making management choices so as to make full use of their field experience and provide recognition to their work.

Raising awareness amongst the general population, elected officials and decision-makers is another key step, because ecological land management involves a complete transformation of the framework of the urban living environment. If a new set of practices is to be accepted, then first it needs to be understood.

Each planning project must be assessed and adapted in terms of biodiversity by changing practices, but also by taking into account the reactions and feedback from local residents. The project should evolve naturally and sustainably after its implementation.

Remember that this guide is far from exhaustive. Do not hesitate to contact local agents at all levels and of various trade (town planners, landscapers, ecologists and nature protection associations...) to find out about the full range of tools available in your area or region. And above all, experiment and be inventive!

Public contracts becoming more environmentally friendly

Since the European directive 2004/18/EC was introduced, France has changed its criteria for awarding public contracts such that they now include performance measures for environmental protection (*art. 53 of the French public procurement code, introduced in 2006***). If a local authority hires a company to manage green spaces, then it now has the right to stipulate a ban on the use of pesticides in its selection criteria. Moreover, it can also gear its public procurement policy towards a more ecological approach by including environmental criteria in its calls to tender for products and supplies (organic meals in school canteens, street furniture made out of locally sourced wood, locally sourced plants…).**
Local authorities can therefore set themselves up as ecological role models by favouring companies that take concrete steps to help preserve the environment and biodiversity. However, if there is to be any real impact, it is essential that these environmental criteria weigh heavily in the balance during the final decision-making process for awarding public contracts - a process which all too often uses price as the sole decision criteria.

Derelict wasteland and disused urban areas

Urban wasteland and derelict areas left temporarily abandoned - these fallow areas scattered across our cities are often used as dumping sites, and generally have a negative local image. Yet these wild stretches of nature can have a permanent as well as temporary effect, acting as valuable green lungs for both biodiversity and local residents. It is therefore crucial to locate all these areas, include them into the ecological network, and help the local population to reclaim public wasteland and save it from being eaten away by urban erosion.

Step 1: Pinpoint these areas

- by identifying and mapping the natural residual spaces on your territory;
- by incorporating these spaces into the ecological network and management plans of your city;
- by assessing the current state of biodiversity in these areas. This phase is optional, as it can be costly and demand a lot of hard work. *Nature does not always need man's expertise in order to survive*. To achieve a healthy balance, nature sometimes simply needs to be left alone. In this light, some residual spaces will only require minimal management to supply enough key habitats and ensure the maintenance and transfer of fauna and flora.

Step 2: Conserve these natural areas

- by using adequate land management tools to prevent these sites from being eaten away by urban erosion;
- by acquiring areas of natural land with considerable biodiversity potential so as to ensure their sustainability;
- by monitoring soil quality and introducing cleanup operations for pollution control by applying suitable soil remediation measures such as phytoremediation when necessary;
- by reducing interference with the land to the strict minimum so as to let nature run wild.

Step 3: Enhance urban wasteland

- by regular waste collection to keep the site clean;
- by making the site accessible to visitors: marking out paths, connecting these spaces to soft transport pathways such as cycling paths and developing educational discovery trails... ;
- by getting local stakeholders involved (green space managers and operators, citizens, associations, elected officials ...) in setting up projects to enhance these wastelands, adapted to the particular characteristics of the site (municipal vegetable gardens and fruit orchards, pop-up community gardens...).

Naturpark Schöneberg Südgelande - Berlin

Montpellier identifying and enhancing its urban wasteland

As part of its scheme to create a green corridor network across the city, Montpellier City Council launched a project in 2009 to identify and enhance its derelict wasteland and disused urban areas. The goal of this project was to promote and enhance nature within the city by densifying its green habitat network, and simultaneously boosting the typically negative image of these areas.

A survey of these abandoned areas was conducted to develop a typology incorporating spaces of all sizes, ranging from brownfield sites to micro-spaces blooming with self-seeding plants. Based on this typology, a set of objectives was defined and measures were applied to maintain and enhance these spaces: gaining protection through the local Urban Planning Code, introducing ecological land management practices, building refuge zones for biodiversity, integrating a **green and blue infrastructure** (green corridors and greenways such as Montpellier's 'Marathonienne' walking and cycling path) and introducing scientific monitoring and communication campaigns...

Budget for the green corridor network scheme: research €210,000 / work €5,500,000

The Schöneberg Südgelände Nature Park

Berlin is pursuing an active policy to regenerate and enhance many of its brownfield sites. In the Schöneberg area of the city, a former rail-marshaling yard that had been abandoned since 1952 was turned into a public park in 2000, opening 18 ha of natural land to visitors. The rehabilitation work was scaled down to a minimum so as to keep the spirit of the place alive: cutting down trees only along the footpath, maintaining the former railway, planting no new vegetation... Today, the only maintenance work carried out in the park simply boils down to keeping the paths cleared.

Nestled between two railway lines, and formerly totally inaccessible to the public for around 50 years, this site offers an exceptional display of biodiversity: the centre of the park is a Natura 2000 site. Visitors can amble through the area along a network of raised duckboards so as to prevent the ground from being trampled

"And why not..."

... Learn how to make seed bombs out of clay, compost or loam, mixed with perennial and local plant seeds as a way of sowing flowers into the most inaccessible areas. How? Follow the model pioneered by Liz Christy in the 1970s, or more recently, the French seed sowing collective 'Semeurs de Biodiversité' and the Green Guerillas... But make sure you do not plant only old seeds!

Parks and recreation areas

Local green spaces scattered throughout neighbourhoods are essential spots for city dwellers to relax and discover nature. Parks and recreation areas are also key components in urban ecological networks, as they constitute **NATURE RESERVES** for wild fauna and flora, or **GREEN CORRIDORS** depending on their surface area.

Adopting green management practices in these areas is a means of boosting biodiversity, as well as protecting the health of all operators working on the sites and contributing to the wellbeing and environmental awareness of visitors.

Wildflower meadow – Parc de la Tête d'Or in Lyon

Step 1: Reduce environmental pollution and health damage

- by imperatively stopping the use of pesticides and artificial fertilizers;
- by replacing high-polluting machines by manual methods, and failing that, electric machines;
- by choosing ecological materials to make street furniture: local varieties of wood, recycled plastic... ;
- by promoting green waste management schemes and sorting and recycling other waste materials (plastic sheeting, public litter...), and trying to produce as little of it as possible.

Sept 2: Favour pro-biodiversity land management schemes

- by connecting parks to the urban ecological network;
- by introducing different green space management practices to the various areas of the park, depending on their different uses;
- by mowing and cutting less frequently;
- by reducing waterproof surfaces to make room for vegetated paths, dirt tracks or paths made with stabilized permeable soil;
- by getting green space operators involved and training them up in new green space management practices;
- by gaining an eco-label accreditation to validate your ecological land management scheme (in France for example: Ecojardin and EVE...).

Step 3: Offer room and board to a variety of species

- by providing varied habitats: ponds, woodpiles, wild hedgerows and forbs that are left to grow tall and cut high only once a year... ;
- by choosing native and **NECTARIFEROUS** flora;
- by installing specialized nesting structures to offer shelter to wild bees and other animals: nest boxes, hotels, houses and spirals...

Step 4: Raise public awareness and get the population on board

- by putting up information panels to explain ecological land management and biodiversity;
- by organizing events to raise awareness: eco-volunteer days, nature walks, and workshops for building nests and growing vegetable gardens and orchards;
- by encouraging the general public to get involved in park maintenance: community gardens and herb gardens... ;
- by training green space operators to be able to inform visitors appropriately;
- by setting up a communal compost heap.

Parc de Champvert in Lyon

This green habitat network project was launched in 2012, running from the 5th borough of Lyon across to the 9th borough, and since its beginnings it has shaken up the city's whole approach towards land development and the management of some green spaces. Previously, the Parc de Champvert had been a very ordinary city park, with typical flowerbeds full of exotic plants, tarmac pathways and neatly clipped lawns. However, in 2012 and 2013, the park was reorganized to make more room for biodiversity and anchor itself firmly within the ecological network. All the horticultural plants were replaced by native plants, including small fruit plants (blackberry bushes *Rubus* gr. *rubus* spp., raspberry bushes *Rubus idaeus*, and strawberry plants *Fragaria* spp.…). The tarmac gave way to a pathway surfaced with wood chips as well as a "reinforced lawn" which was planted around the villa that lies inside the park. In addition, a section of the recreational lawn was turned into a wildflower meadow to provide a favourable habitat for pollinators. Here the forbs is left to grow high, as it is only cut once per year and with the blades at their highest position. A bee hotel and an insect spiral were installed, as well as a pond on the edge of the park. The project was carried out with the help of local naturalist associations. The park operators were given training in new management practices, and the project team set up the installations with the help of local volunteers together with gardeners from the Lyon city who took part in order to train themselves up in ecological management practices.

Budget: €212,000 for the renaturalization of the park; €51,000 in running costs (buying supplies, plants and nest boxes and investing in communication tools…); €24,000 awarded as grant funding to nature protection associations (carrying out inventories and setting up eco-volunteer days and training days…).

The square in Fontaine Ecu in Besançon

Formerly a private estate stretching over 4,200 m², this park fell into the hands of the Besançon City Council in 2008. It was awarded an EcoJardin label in 2012 as proof of its overall commitment to ecological land management practices.

Pesticides have been banned in green spaces throughout Besançon since 2000. Any weeding is done manually or using alternative techniques following a specific weed control plan. A cutting plan specifies the areas to be covered, as well as the cutting heights (never less than 8 cm), and half of the total surface is made up of forby areas where cutting work is strategically delayed. When choosing new plants for the square, preference was given to local, native species, which are better from an ecological point of view as their flowering periods are staggered throughout the year.

"And why not..."

… Take inspiration from the Atelier des Friches association based in Lyon, and install multicoloured totem poles as original nesting structures to house wild bees, and send out an eye-catching signal to both the young and old city dwellers alike.

Urbantotem with bee nests installed by the Atelier des Friches association in Lyon

Bushes and trees are pruned only when strictly necessary, and in pace with the different cycles for flowering and fruit bearing, as well as nest building for bats and birds. All the gardeners have been trained in ecological green space management and in local biodiversity. Awareness raising events and initiatives have been set up for the general public: outreach planting projects with schoolchildren, information panels, guided visits... A bee house for solitary bees was installed by one of the local schools.

Urban and peri-urban agricultural areas

As we are faced with the current need to re-localize our economies, developing local agriculture has emerged as a key avenue to be explored. Yet the use of pesticides still remains a major problem. Therefore any shift towards sustainable farming methods should place the protection of biodiversity at its centre.

A few key ideas for local authorities::

Step 1: Review the state of agriculture on your territory.

- by making an inventory of the different farms, specifying the type of crop and livestock in each case, as well as the farming methods used: noting whether pesticides are used, or any methods that promote biodiversity...;
- by listing all the areas of fallow land.

Step 2: Promote urban and peri-urban agriculture

- by conserving agricultural areas thanks to existing regulatory tools;
- by setting up partnerships with existing farmers: freeing up land for use, lending tools and equipment, giving advice and setting up agreements;
- by developing short distribution channels: collective sales outlets, mass catering, AMAP (associations supporting small-scale community farming), farm-gate sales and pick-your-own farms and local markets...;
- by planting or encouraging urban and peri-urban vegetable gardens and fruit orchards.

Step 3: Enlist farmers as partners in protecting the environment

- by encouraging organic farming: providing financial aid and training...;
- by putting farmers in touch with environmental protection associations;
- by incorporating organic agricultural areas into the ecological network.

Farmers' market

A few examples of good practice for farmers:

Step 1: Stop the use of pesticides

- by adapting your choice of crops to suit the surrounding environment;
- by introducing varied production, through crop rotation and crop combinations;
- by taking the plant extract of wild plants growing in the surrounding area and using them as natural insecticides, insect repellents, activators and fertilizers... ;
- by providing a favourable habitat for beneficial insects that help with crop growth.

Step 2: Foster biodiversity

Insect hotel

- by providing varied habitats on your farmland: ponds, wild hedgerows and fallow land... ;
- by maintaining areas of wild flora and growing nectariferous flora;
- by installing specialized nesting structures to provide a home for wild fauna in the area: nest boxes, houses, perches, insect spirals...;

Step 3: Adopt a global approach

- by using professional training or meetings with local naturalist associations to strengthen your knowledge of biodiversity and to become familiar with the tools designed to enhance it;
- by networking with other farmers committed to the same ecological approach to pool ideas and information on farming practices, as well as to encourage and help conventional farmers to convert to organic methods;
- by raising the awareness of visitors who come to your farm, or, as an alternative, by setting up a pick-your-own initiative.

Grass strip inside a greenhouse

A. Nantes Métropole on a quest to reclaim its fallow land

Since the 1990s, the urban community of Nantes (Nantes Métropole – NM) has been pursuing an active policy to revitalize its peri-urban farmland. In 2009, a total of 3,700 ha of fallow land was surveyed. The different local districts in the area, the Nantes Chamber of Agriculture, and Nantes Métropole worked in partnership to bring landowners and farmers together in an attempt to reclaim 500 ha of land for agriculture by 2014. In addition to the farmland protection measures already in place in the Urban Planning Code, Nantes Métropole can also acquire agricultural areas and buildings. Plus there is a drive to reinforce short distribution circuits as well as to strengthen ties between farmers and consumers (setting up farm shops and organizing yearly farm open-days). Most of the new farmers who set their operation on this land are organic farmers.

B. Vegetable gardens and fruit orchards in the city

You can see urban vegetable gardens flourishing in cities throughout Europe, along streets and even on rooftops. These initiatives have multiple advantages: encouraging local food production, increasing biodiversity, improving rainwater management, plus raising awareness amongst local residents…

However, particular attention must be paid to the quality of the soil, which may have been previously polluted by harmful chemicals. One solution is to grow a vegetable garden above ground, in other words in special containers filled with healthy soil. This technique is used at the Prinzessinnengarten vegetable garden in Berlin, where vegetables and aromatic herbs are grown in bags, on pallets and in crates.

Prinzessinnengarten vegetable garden in Berlin

Moreover, if you want to protect your vegetables from exhaust fumes, urban vegetable gardens should be designed in the proper way. Namely, shield your garden from the street using a planted barrier (bushy hedge) 3 metre thick, and then cultivate lines of plants arranged in the following order, moving away from the street: fruit trees, followed by tuberous crops, then peas (*Pisum* spp.), and finally salads. To water your garden, install a rainwater catchment and purification system using aquatic plants that are particularly effective in filtering out heavy metals.

Another way to escape pollution is to grow your vegetable garden high above ground level, such as on the roof, as demonstrated on top of the AgroParisTech Institute in Paris. Tomatoes (*Lycopersicon esculentum*) and lettuces (*Lactuca sativa*) thrive there planted in soil that has been built up using a 'lasagna gardening' layering system: chopped-up wood material collected from tree pruning work in the city, mixed with compost, and enriched with earthworms and fungi to reproduce a natural ecosystem. It yields high-quality products, that are already used as ingredients in some of the most reputed restaurants in Paris.

"And why not..."

… Try out sheep and goat grazing as a way of maintaining wild areas that are under extensive management, such as undergrowth and the banks of waterways.

Collective and private gardens

The current upsurge in community gardens flourishing across our cities is only a reflection of city dwellers' thirst for nature, and their desire to muck in and «get their hands dirty» all the while growing healthy food products.

For amateur gardeners, these are places to come and socialize and reclaim public spaces. They are also ideal spots for raising public awareness.

As for biodiversity, these gardens can also provide useful food resources and nesting opportunities. But to reach that point, gardeners must first adhere to the idea of stopping the use of pesticides and chemical fertilizers at all costs.

Step 1: Encourage ecological collective gardens

- by making communal land available to the public (derelict wasteland, plots in parks and local gardens and disused urban areas);
- by designing spaces with the help of naturalist associations and keen local residents who would like to get involved;
- by drawing up a community garden charter: no use of synthetic chemical products, no invasive plant species, and giving priority to native plants...

Step 2: Foster biodiversity in collective gardens

- by providing a variety of plant species;
- by encouraging wild areas to grow (grasslands with forbs and areas which are left uncut to let self-seeding plants come to the fore...);
- by installing bee and insect hotels, bird nest boxes, and bat shelters.

Step 3: Raise community awareness about ecological gardening methods

- by launching awareness campaigns to promote self-seeding plants and encourage people to stop using pesticides and artificial fertilizers (information panels, conferences and discovery trails to explore edible wild plants ...);
- by providing information about the role of beneficial insects and other beneficial animals (information panels, pamphlets, conferences and guided nature tours ...);
- by organizing participatory workshops (focused on getting involved in green space management, nest building, and sharing gardening techniques ...).

A. ECObox – a portable garden that is above ground and ecological!

The first ECObox garden was set up in 2001 by the Atelier d'Architecture Autogéré in the 18th borough of Paris. Assembled out of pallets, the above ground plots have been planted with flowers and vegetables by local residents. The garden acts as a place for socializing, solidarity and experimentation.

This type of garden adapts to the changing face of the city, and is a good example of how to occupy derelict urban areas. It first moved places in 2004 to make room for a public facility project, and then moved again in 2008...

ECObox garden - Paris

Since 2009, the ECObox 3.0 project is set in a plot of railway land stretching 200 m^2 along the side of the railway line at the Gare du Nord. Built using the same above ground system, it has been expanded with other containers that showcase the creative minds of the gardeners involved: wooden crates, wicker baskets, teapots, shoes, pipes pierced with holes... even a pond and beehive have been installed.

B. Incredible Edible, self-sufficiency and sharing

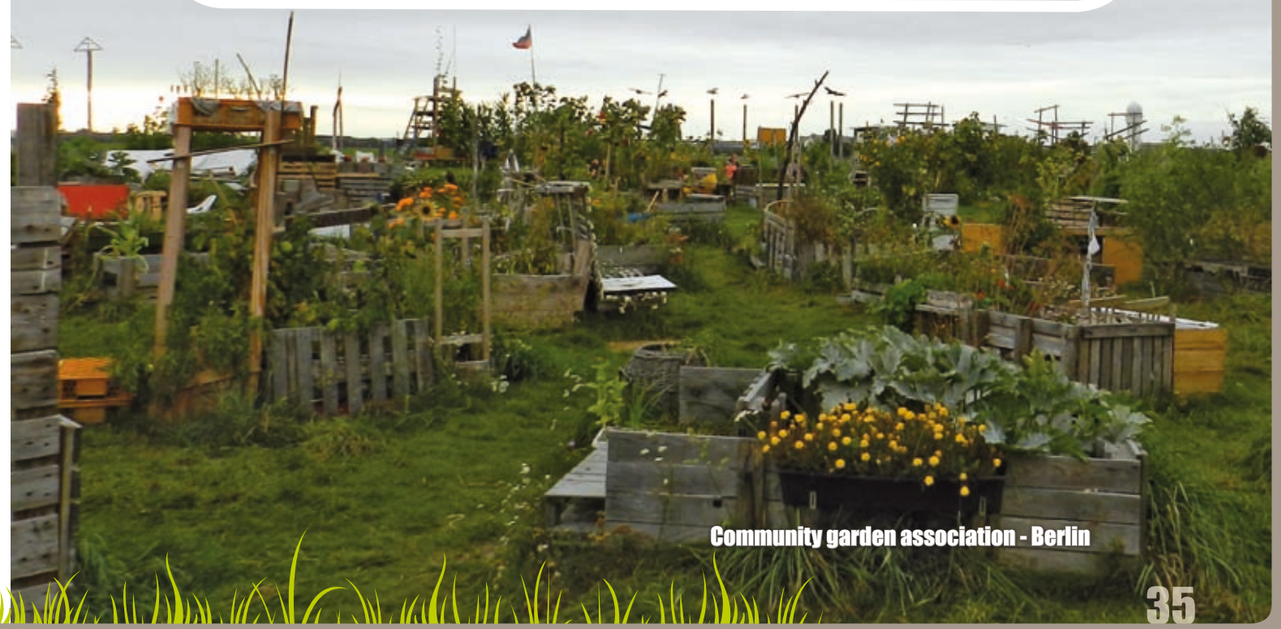
Founded in 2008 in Todmorden in England, the Incredible Edible project (called 'Les Incroyables Comestibles' in France) has the ambitious goal of trying to achieve food self-sufficiency in only a few months. Even though this objective is hard to reach, the projects are nonetheless an excellent vehicle for raising public awareness and building strong social ties within local communities.

Keen citizens who want to get involved are invited to set up a local network and start planting patches on local land as well as along the unfenced borders of public areas. The result has seen vegetable gardens, herb gardens and fruit trees cropping up all over towns and cities, accompanied by the sign «Food To Share». This slogan embodies the project's simple principle: each of us can get involved, each of us can help.

As a practical action plan, this movement is a model example of how to make the shift towards local and high-quality food production solutions, all born in a spirit of inventiveness and conviviality. It has already spread across the entire planet: from Germany to New Caledonia, via Mexico, Ghana, and Saudi Arabia on the way, more and more local authorities and local citizen groups are committing to taking part in the drive towards food self-sufficiency and sharing.

"And why not..."

... Join forces with local associations to organize an open plant-swapping event in both collective and private gardens, and gear the theme towards sharing native flora and locally produced seeds and cuttings.



Community garden association - Berlin

Cemeteries

Cemeteries are particularly sensitive areas. Usually «to keep things neat and tidy», out of respect for religion and also out of pure habit, spontaneous vegetation is usually kept strictly under control, and usually often destroyed. Moreover, it is always harder to gain support for phasing out the use of pesticides, and therefore the process takes longer. Yet cemeteries often take up a sizeable share of land of cities, and could prove highly attractive sites for enhancing biodiversity.

That said, most cemeteries have this goal in mind and are showing a gradual shift towards ecological land management systems. Numerous projects are rethinking the design of landscaped cemeteries by approaching them as places for meditation, reflection and walking, but also as true biodiversity reservoirs.

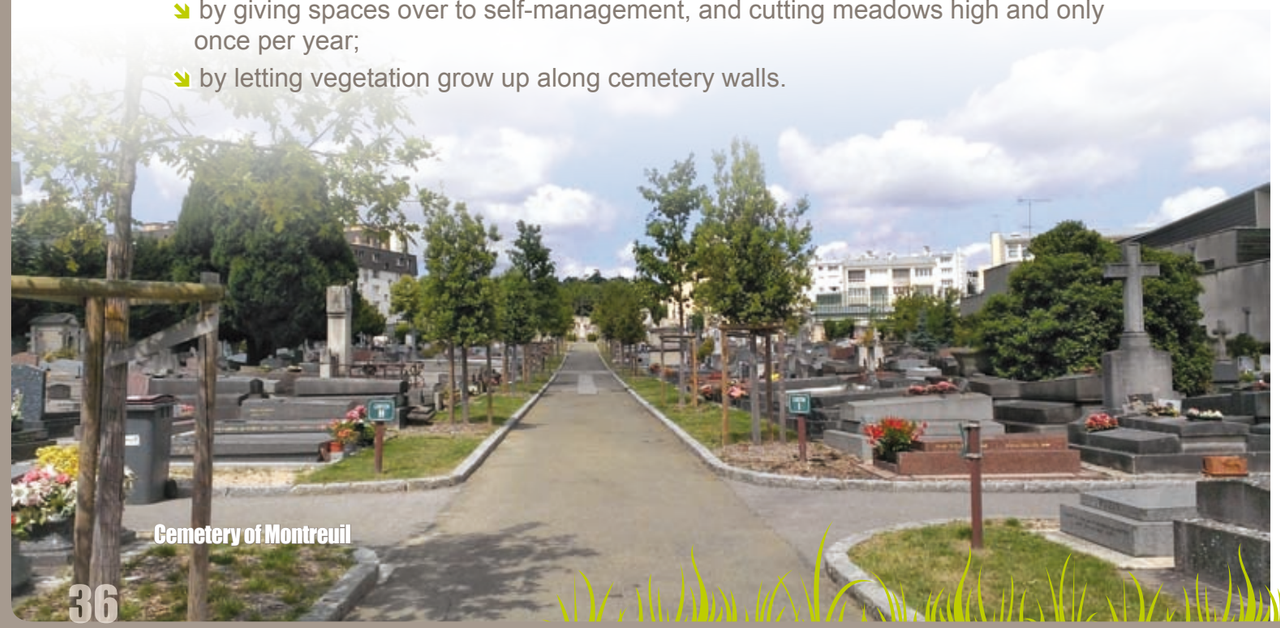
However, to make these projects sustainable, ecological management plans must be set up in parallel with information campaigns that are targeted at visitors coming to use the cemeteries. Therefore training cemetery keepers and maintenance staff is paramount to ensuring that families receive clear and reasoned answers to their questions.

Step 1: Reduce environmental pollution in cemeteries

- by incorporating cemeteries into the local differential management action plan;
- by removing all pesticides and introducing alternatives to chemical weedkiller, and this only if necessary: reducing the surface area in need of weeding (maintaining permanent green cover and reducing pathways in the area between graves), planting ground cover, and allowing self-seeding plants to grow between graves...;
- by reducing waterproof surfaces: planting green cover, adding mulch to secondary paths and using stabilized permeable soil...;
- by informing users about new practices (putting up information panels at the entrance of the cemetery and in areas under transformation, and organizing visits...).

Step 2: Foster biodiversity

- by mowing less frequently, and doing so exclusively in spaces that people walk through;
- by developing hedgerows and patches of woodland;
- by giving spaces over to self-management, and cutting meadows high and only once per year;
- by letting vegetation grow up along cemetery walls.



Cemetery of Montreuil

Step 3: Design ecological cemeteries

- by incorporating new cemeteries into schemes for ecological continuity;
- by cooperating with elected officials, users, landscapers, green space operators, funeral parlours, and naturalist associations;
- by creating a mosaic of different spaces adapted to the various uses of the site: meditation areas, soft transport pathways, flowering meadows, and wooded areas...

A. Versailles: prestige and ecological land management combined

Since 2009, Versailles City Council has stretched its zero-pesticide policy to cover four of its cemeteries, in a bid to protect the health of its green space operators as well as the water table. The scheme has so far secured an Ecojardin label for two of the cemeteries.

Several strategies have been developed to reduce weeding: adding green cover wherever possible, mineralizing and greening areas between graves, laying geotextile beneath the paving of alleys, adding ground cover, and mulching flowerbeds... if weeding is really necessary, then it is mostly performed with a heat weeder, though this is set to die out in the coming years.

Versailles cemetery

To add plant variety, climbing roses (*Rosa* spp.) and clematis (*Clematis* spp.) were planted along the walls of the cemetery, and bulbs were planted in the lawns. Around 90% of the new plants introduced by the city are perennials. In the cemetery in Gonards, a wildflower meadow and three beehives have been added.

The success of this zero-pesticide approach in the various cemeteries across Versailles has hinged on the support of elected officials, the importance of training gardeners and recognizing the importance of their work, as well as initiatives to raise the general awareness of users

B. The Mariebjerg cemetery, a model example of an ecological cemetery

Laid out between 1926 and 1936 by the landscaper Gudmund Nyeland Brandt, the Mariejberg cemetery in Denmark is considered to be a reference for landscaped cemeteries. The land area spans 26 ha and is divided up into 40 outdoor ‘rooms’, which are used as areas for meditation or strolling. A network of alleys which are planted with green cover all lead towards undergrowth, meadows, or a mosaic of clipped hedges. The cemetery is looked after with the aim of safeguarding the diversity of these different surroundings and tableaux of vegetated backdrops. Families must respect the specific rules laid out for each outdoor room: the size of gravestones and types of flowering plants...

"And why not..."

... Install bird nest boxes in the branches of trees and bee hotels to make up for the lack of nesting sites in cemeteries.

Completed URBANBEES site with a nesting devices – sports park in Limonest nearby Lyon.

Sports areas

Cities with zero-pesticide policies already in place have often found that sports areas are the final hurdle in the pesticide debate, and these zones often remain in a deadlock for the longest. The very mention of stopping the use of pesticides on football pitches or golf greens can unleash an outcry of protests, even from managers who are the most heavily committed to the drive towards zero pesticides. Yet it is quite feasible to set up a more ecological management plan for these areas too. Furthermore, it is vital for protecting the health of green space operators and users, especially children. In these areas, which span up to several hectares, there is quite enough room for sports players and biodiversity to cohabit side by side. Yet, to reach this point we must try to reverse the unhealthy trend for super trimmed, highly maintained sport grounds, where only a few manicured grass species are allowed to grow all over.

Step 1: Develop an ecological land management plan in sports areas

- by mapping the sports areas and categorizing the various parts based on their different uses (playing fields, thoroughfares, unused borders and adjoining areas ...);
- by gradually phasing out pesticides through more regular mowing cycles, by tending to lawns through mechanical means (core aeration of soil and soil scarification...) and by using manual weeding. This way your lawns will see a few other wild plant species growing;
- by optimizing water consumption: reducing irrigated areas, collecting and re-using rainwater and watering at night..

Step 2: Encourage biodiversity

- by tailoring your landscaping and management schemes to the different land uses: stop mowing the areas off the sports fields, reduce waterproof surfaces and conserve and enhance the natural habitats in adjoining areas... ;
- by tolerating self-seeding plants growing outside sports fields and greens;
- by providing varied habitats: planting a wild hedgerow and a stretch of grassland that is cut high and only once per year...

Step 3: Raise user awareness

- by putting up information panels about the new management practices being used on the site, and the urgent need to rethink our habits;
- by installing a wild bee hotel, an insect hotel and other bird nest boxes along the edges of sports areas. However, be careful to keep a clear distance from terraces and floodlights - and obviously the sports ground itself;
- by getting the people who use the sports ground involved in monitoring the biodiversity of the fauna and flora along the edges of playing fields, for example by giving them helpful clues to identify different species, but also by organizing a photographic monitoring project to track the gradual changes on the site.

Moving towards sustainable development on golf courses

The job of maintaining golfing greens usually entails a prolific amount of water and pesticides. Yet a number of golf clubs have tested out a more ecological management approach, and as of now this trend should be made to become the norm. Indeed, we can no longer treat golf courses as separate areas with a law unto themselves: their adjoining environments (wetlands, water tables) and the entire community (both in terms of biodiversity and humans) all suffer if we do. It is therefore a matter of societal need for change.

1. Granville golf course committed to protecting groundwater

The Granville golf course is located in the immediate vicinity of a protected area for water extraction, and so it set up an ecological management plan for its golfing greens and adjoining land following a prefectural order released in 2007. Pesticides were completely withdrawn from the 9-hole course that lies on top of the main well. And pesticide use was also drastically cut back on the 18-hole course that hosts national tournaments (only 4 pesticide treatments over 6 years). Now, only 1 ha of the total 90 ha of greens is chemically treated. An ecological diagnostic survey was carried out on the site, and a project was set up to encourage native plants to grow on the dunes. Moreover, the water consumption on the golf course was reduced by an average of five times its previous level in the course of only a few years.

2. The zero-pesticide experiment at the Esery golf club

In the autumn of 2009, the Esery golf club in the Haute Savoie region of France embarked on a new challenge: turning its 9-hole course into a zero-pesticide zone. The strategy for the golfing greens was to plant local, hardier flora, and to mow more frequently and higher up the grass blades. In terms of cost, the financial results turned out neutral, since the saving made on buying pesticides was offset by an increase in mechanical maintenance work. Four years later, the green space managers have drawn up an assessment of the experiment. The results are mixed, and highly dependent on the season. Therefore their recommendations include using a small amount of pesticide treatment, but only in cases of extreme need, and using fertilizers on the greens to help boost plant growth after the winter months. As for the areas of adjoining land, extensive management systems are seen to be the most ideally suited. The managers also insist on the importance of training up green space operators as well as keeping golf players informed about the new changes and the reasoning behind them.

"And why not..."

... Set up "sport and biodiversity" workshops, such as orientation courses and treasure hunts…

Wetlands and embankments

Over half of Europe's wetlands disappeared between 1960 and 1990. Water removal, drainage and pollution were to blame - yet these threats have continued to persist despite the strict regulations put in place.

What we must not ignore is that these ecosystems are among the richest in biodiversity in temperate areas, and they play a vital role for the fauna, the flora and the ecological network. Therefore it is crucial to maintain and restore the blue network, especially in cities, where the banks of waterways also double as ideal areas for walking.

Step 1: Locate the wetlands on your territory

- by identifying and mapping the wetlands and waterways;
- by making an inventory of the existing biodiversity already in place;
- by singling out any barrier that breaks up the continuity of wetlands, and the potential threats that may arise from using such areas and from development projects.

Step 2: Link up wetlands

- by including the conservation and rehabilitation of existing wetlands in all urban development projects;
- by reviving existing wetlands;
- by providing channels to let surface rainwater flow;
- by building networks of ponds and rain gardens.

Augustenborg Eco-borough - Malmö

Step 3: Implement wetland management practices that enhance water quality and biodiversity

- by imposing a total ban on the use of pesticides near waterways and reservoirs;
- by managing wetlands and the areas along waterways with tools that are adapted to the specific characteristics and uses of each site;
- by putting emphasis on invasive species control;
- by fostering biodiversity (optimizing derelict sites, keeping dead wood and introducing specialized installations...).

A. Munich – water quality and organic farming

When the people of Munich turn on their taps, the water flowing out is exceptionally pure. It comes directly from the Mangfall valley, and as such needs no drinking water purification treatment whatsoever.

At the end of the last century, the Munich City Council acquired a section of land in the valley, and set about reforesting some 1600 ha. By 1991, the water quality had begun to deteriorate due to agricultural pollution. So the city launched an incentive programme to get the farmers in the valley to adopt organic methods. Technical and financial aid was offered (€281 per year and per ha that was converted to organic practices) and farmers and local nature protection associations were encouraged to join forces in the fight to preserve the natural environment. Since 1999, 92 of the 107 farms have converted.

This programme costs the city €830,000 per year, or €0.01 per m^3 of water. By way of comparison, denitrification operations in France cost €0.3 per m^3.

Moreover, between 2000 and 2011, a renaturalization project was launched along an 8 km stretch of the Isar river that runs through Munich, and its results led to a greater abundance of fauna and flora.

B. Malmö, an example of open rainwater management

The Augustenborg Eco-City in Malmö (Sweden) is an area faced with frequent flooding and an insufficient sewage system. So when it was time to come up with a rainwater management system, the solution could be nothing short of innovative. From its very beginnings, the project adopted an open system for rainwater catchment and treatment. The area is now veined with rivulets, canals, ponds and flood retention basins, creating a true network of urban wetland. Moreover green roofs have since been planted on numerous buildings, which also help to ensure that the city's water is purified and evaporated before being rejected into the sea. And in 2007, the system was put to the test during a significant flooding – and it proved well its worth.

"And why not..."

... Organize special events and activities designed for schoolchildren and the general public which focus on the extraordinary diversity of these wetlands, and highlight their aquatic fauna and flora. To help you, make contact with naturalist associations in your area, as well as environmental education organizations.

Green spaces along public roadways

The areas of green space running along the sides of public roads are too often subjected to systematic and intensive management practices, without taking the needs of the environment into account. Yet roads and streets can act as ecological corridors that play an essential part in the connectivity of different environments. An ecological land management approach tailored to the specific, local constraints of each site can help guarantee this role of ecological corridor, as well as make the job of maintenance much easier - and all this with careful regard for driver safety and the visibility of road signs.

Community garden
Jardin du Ruisseau
in Paris

Step 1: Use ecological land management practices on public roadways

- by incorporating these spaces into all local differential management action plans;
- by stopping the use of pesticides;
- by tailoring management practices to suit the different strata of vegetation: no pruning, or if necessary, minimal pruning of trees and shrubs, and cutting forbs high instead of mowing it short... ;
- by limiting soil sealing and helping water infiltration.

Step 2: Add greenery to pavements and the base of trees

- by encouraging self-seeding plants, phasing out potted plants, and favouring native and nectariferous flowering plants;
- by inciting local residents to reclaim these spaces: by planting ground cover, or even mini vegetable gardens at the bases of trees, and seeding the gaps between paving stones;
- by informing local residents and raising awareness of new practices and self-seeding plants: information panels, discovery trails to explore biodiversity along the edges of pavements… ;

Step 3: Foster biodiversity

- by building wildlife crossings (tunnels, such as amphibian tunnels, and squirrel canopy bridges ...);
- by paying particular attention to migration and breeding periods: set up awareness raising initiatives, put up information panels for drivers and pedestrians, encourage people to drive slower, temporarily block entry to certain roads, or add detours through zones which are particularly sensitive during these periods... ;
- by making public lighting less intrusive and better adapted to bats, nocturnal birds, and insects: switch off streetlights in the middle of the night and ban the lighting of shops and office buildings, dim streetlights along roads, or use a more appropriate light wavelength (orange glow) and install timers and movement sensors.

A. Green toes on our pavements...

Since 2002, the streets of Lyon have been paved with flowers. It was Bernard Maret, a technical agent working for the town of Lyon, who originally came up with the idea of creating micro-floral plantations, which help build strong social ties as well as raise local awareness about biodiversity.
To set up one of these micro-floral plantations, groups of motivated local residents can contact the department for Parks, Gardens and the Environment of Lyon, which will then cut a hole in the concrete pavement 12 to 20 cm wide by 60 cm long.

Information panels are put up, and local residents are encouraged to roll up their sleeves and take part in the plantations. When choosing plants, there is a preference for perennials that are easy to tend. The group of local residents behind the project is then responsible for watering and looking after the plants.

Cost: €40 to €60 for one micro-floral plantation to be installed, €0 to €15 per year in maintenance (depending on the choice of plants and the degree of commitment by the local residents).

B. Bringing speed and biodiversity in tune with each other

In 2002, work began on the new East European High Speed railway line, which is set to link up Paris to Strasbourg by the end of 2015 with 406 km of track. Unfortunately, such large-scale construction projects bring the inevitable destruction and fragmentation of habitats. The French Rail Network (RFF) has made efforts to limit such damage or interference by including the protection of biodiversity as an objective in every step of the project:

- making inventories of fauna and flora to identify the key species and habitats in need of protection;
- wherever possible, avoiding the most environmentally rich areas when mapping out the railway route;
- digging ponds and planting forests to compensate for the destruction of natural habitats, and to offer a new home to the natural inhabitants that have been uprooted;
- relocating protected plant and animal species with the agreement of the French National Council for the Protection of Nature (Conservatoire National de la Protection de la Nature);
- building wildlife crossings to restore ecological continuity across the areas broken up by the rail line: so far, a total of 70 wildlife crossings have been installed for large animals (two of which are 40 to 45 m wide, and link up two Natura 2000 areas), plus 113 wildlife crossings for smaller animals and 50 amphibian tunnels. The size, location and management of the surrounding environment were assessed in a way that took into consideration the target animal groups that had been identified during the preliminary research phase.

A monitoring program was launched to assess the devices of the first part of the track when it was put in service in 2007. It showed that the measures used and devices installed were effective and it also enabled to focus on the most effective devices when the second part of the track was built.

"And why not... "

... Create an educational discovery trail through the streets of your city so visitors can explore the wealth of fauna and flora living along the pavements. Take inspiration from the Parks and Tree Department of Greater Lyon, which laid a nature trail through every neighbourhood of Lyon to highlight the different tree species.

Micro-floral plantations
- Lyon

Buildings and their surrounding grounds

If we want to match energy efficiency with the aim of protecting biodiversity and ensuring the wellbeing of citizens, then the planning projects of the future need to densify the urban tissue while increasing the areas of urban green space. These objectives may appear contradictory at first, which is why every bit of space counts: whether in residential areas, suburban business parks or commercial and industrial zones... each building and its surrounding ground must play its part, and be renovated or designed to accommodate greater biodiversity.

Step 1: Improve management systems for the areas surrounding buildings

- by choosing permeable surfacing materials for paths and car parks (greening, stabilized permeable soil and natural boundaries along paths ...);
- by stopping the use of pesticides and cutting grass high instead of mowing it short;
- by enhancing the surrounding grounds and providing varied habitats: removing single-species lawns and potted plants, and introducing wild forbs, wild hedgerows, water features, woodpiles and mounds of stones.

Step 2: Provide a home for biodiversity in our buildings

- by encouraging self-seeding plants to grow around the base of buildings, along the edges of paths, and in between walls;
- by installing green walls or green roofs;
- by fitting built-in nest boxes for bees, insects, birds, and bats;
- by planting forbs on terraces, balconies and window ledges.

Step 3: Adopt an ecological approach in new building design

- by assessing the impact of new building projects on biodiversity, and by taking the approach of «avoid, reduce and compensate»;
- by reducing the footprint of new buildings;
- by injecting biodiversity as a key dimension in all new projects;
- by drawing up building plans that, from the outset, provide for the appropriate materials and structures needed to build green roofs and walls, as well as nest boxes and shelters for housing wildlife. All planners would agree that these structures are much easier and cheaper to install if they have been taken into account at the design phase, and built during the construction work.

A. Berlin: the biotope area factor

Berlin city centre is particularly dense. Made up of a thick cluster of five-storey buildings giving on to small courtyards, it is severely lacking in green space. And yet green space is vital for biodiversity to thrive, for the wellbeing of inhabitants, and for replenishing the water table.

The city council has therefore drawn up a map of the city centre to show each individual building plot, and has used the biotope area factor (BAF) to fix a set of goals for greening and reducing soil sealing. This factor is calculated as the ratio of ecologically effective areas in relation to the total land area. An area's positive impact on the ecosystem is measured with a rating system: 0 for sealed, waterproof surfaces, 0.5 for green walls, 1 for open ground green spaces…

For example, the district of Firedrichshain-Kreuzberg started out with a 0.06 rating, and has a current goal of 0.3 for each of its plots. These objectives are imposed on architects and owners, yet free rein is given on the choice of method: green wall or green roof or a small green patch…. Furthermore, residents from the same block of flats can obtain a grant of €1,500 for greening their building courtyard.

B. Lyon Technology Park – a showcase for ecological management in business parks

Opened in 1995, the Technology Park is a business hub on the east of Lyon, covering 30 ha of green space, 30 ha of forests and 4 ha of lakes. Since 2005, ecological management practices have been in use in the green areas of the park, and these are constantly evolving in a bid to enhance biodiversity and accommodate an ever-growing number of businesses, workers, and visitors.

There has been no watering or use of pesticides for the past 9 years. The herbaceous stratum is managed in a way that is adapted to the various uses and to biodiversity: mowing grass regularly in passage areas, while cutting grassland once per year or less. Dead trees and branches are not cleared away but left in place as much as possible, particularly for **saproxylophagous** insects. Three reservoirs have been installed to collect and filter rainwater using aquatic plants, and temporary ponds have also been dug out. Two local naturalist associations carry out regular biodiversity monitoring surveys on the site (birds, amphibians, and dragonflies...).
All management decisions are made jointly between Greater Lyon and the maintenance company looking after the site. Each year, the site managers and the associations monitoring the state of biodiversity meet together to analyse the findings and feedback from the previous year concerning particular species identified and the use of the spaces, and then management adapt their practices are accordingly.

This shift towards a more ecological management model meant that maintenance costs were cut by over 25% between 2008 and 2012.

"And why not..."

… Invite staff and local residents to get involved in green space management by setting up a collective vegetable garden or fruit orchard.

Berlin City

Section 3 >> Tools for implementing ecological green space management in urban environments

You will now have a much broader overview of your ecological green space management project, tailored to the needs of wild bees and biodiversity. Yet, if you want to stop using pesticides, nurture varied habitats, or raise awareness, you will need to have the adequate tools. This section of the guide gives you key advice on: **(A)** maintaining or restoring ecological continuity, **(B)** implementing an ecological green space management plan, **(C)** stopping the use of pesticides, **(D)** choosing plants that are favourable to wild bees, **(E)** fostering biodiversity, and **(F)** training up your green space operators and gardeners, and raising local awareness.

A - Maintaining or restoring ecological continuity

The growth of modern intensive farming, transport infrastructure, urbanization and the gradual spread of industrial and commercial areas has led to the destruction and fragmentation of our ecosystems, which are the main causes of biodiversity erosion. In light of this, it is essential to curb urban sprawl, as well as the destruction of our natural environments, and rebuild the ecological network so as to enable animals and plants to move freely between the different natural habitats.

A.1 - Legal tools for protecting natural environments

Local authorities are equipped with numerous tools to protect natural environments on their territory, whether they have been introduced by the European Union or they are specific to each state. Given this diversity, the following list focuses mainly on French regulations, and we suggest that you contact your local planning or environment authority to gain more information on the tools available in your particular country.

1. Conserving natural environments

International and European texts	***Biosphere Reserves,** which are recognized by UNESCO, based on a proposal by individual states.*
	*Wetlands protected by the **Ramsar Convention** in recognition of their ecological, botanical and hydraulic interest.*
	*The **European Directive 2009/147/EC** or **Birds Directive** protects wild bird species, and in particular sets up **Special Protection Areas (SPA)**.*
Knowledge of natural heritage	*The French **ZNIEFF** inventory of natural areas of particular wildlife or ecological interest helps to deepen knowledge of natural heritage, and to increase the likelihood of natural environments being taken into consideration in development projects.*
	*The scientific **ZICO** inventory of Important Bird Areas has compiled a list of key conservation areas for wild bird populations, which is used as a basis for determining SPAs.*
French legislative protection	*The **Coastal Law** (N° 86-2) limits urbanization along coastal zones to preserve areas of outstanding importance in maintaining the natural balance of coastal ecosystems.*
	*The **Water Act** (N° 92-3) establishes a balanced approach to water management, especially through the conservation of wetlands.*
Regulatory protection	*A **Prefectural Order for the protection of biotopes** ensures the conservation of habitats needed for the feeding, breeding and nesting of protected species, and helps to prevent all practices that are harmful to ecosystems (e.g., destroying hedges or roadside embankments, use of pesticides....).*
	***Declared wooded areas**, part of the Urban Planning Code.*
	*A **Regional Nature Reserve** covers all or part of the territory of one or several local districts, and in particular helps to protect ZNIEFF areas.*
Protection under convention	*A **Land Charter** enables a territory with geographical, economic or social cohesion to agree on a collective project for sustainable development.*
	***Natura 2000 sites** are protected areas providing natural habitats for endangered animal or plant species, or species of special conservation interest, and form an ecological network stretching across Europe. The sites are designated by the European Commission or by ministerial order.*
	***Regional Nature Parks** are territories with natural and cultural heritage recognized as being rich or endangered, and are part of a development project to preserve and enhance these heritage sites.*
	***Sensitive Natural Areas** are sites of special interest that are under particular threat, and therefore protected by the departmental council via land acquisition or by signing agreements with the owners (public or private) of the site.*
Land control	***Pre-emption rights for land acquisition** give departments, local districts, public institutions and water supply agencies, etc…, the right to buy full ownership of any area of ecological or landscape interest that is in need of protection.*

2. Incorporating the green and blue infrastructure on your territory

On a European scale	*The **Pan-European Ecological Network** was created in 1995 by the Pan-European Biological and Landscape Diversity Strategy.*
On a French national scale	*The **national green and blue infrastructure** aims to identify and restore the continuity between natural environments. This initiative is incorporated into France's Environment, Building and Urban Land Use Codes.*
On a French regional scale	*The **Regional Ecological Coherence Scheme (SRCE)** fixes regional objectives in terms of land planning and the protection of natural environments. Since 2012, it has stretched to include the regional green and blue infrastructure. This document cannot be used legally against local planning documents, but rather it acts to support of it.*
On a French local scale	*An initiative launched by local districts or inter-municipal associations, the **Territorial Coherence Scheme (ScoT)** is an integrated development plan that fixes general objectives in terms of developing spaces and maintaining a balance between urban areas and natural and agricultural areas.*
	*The **Urban Planning Code (PLU)** makes a diagnostic survey of the territory, and sets up a planning project and a sustainable development project for the whole local district. It fixes objectives for the land use of each individual plot (urbanized areas, or areas set to be urbanized and agricultural or natural areas), enabling environmental corridors to be defined and protected. The Urban Planning Code can also give recommendations on plant choices, and installing wildlife crossings...*
	Other tools include zero-pesticide initiatives, charters, financial incentives...

3. Conserving peri-urban agricultural areas

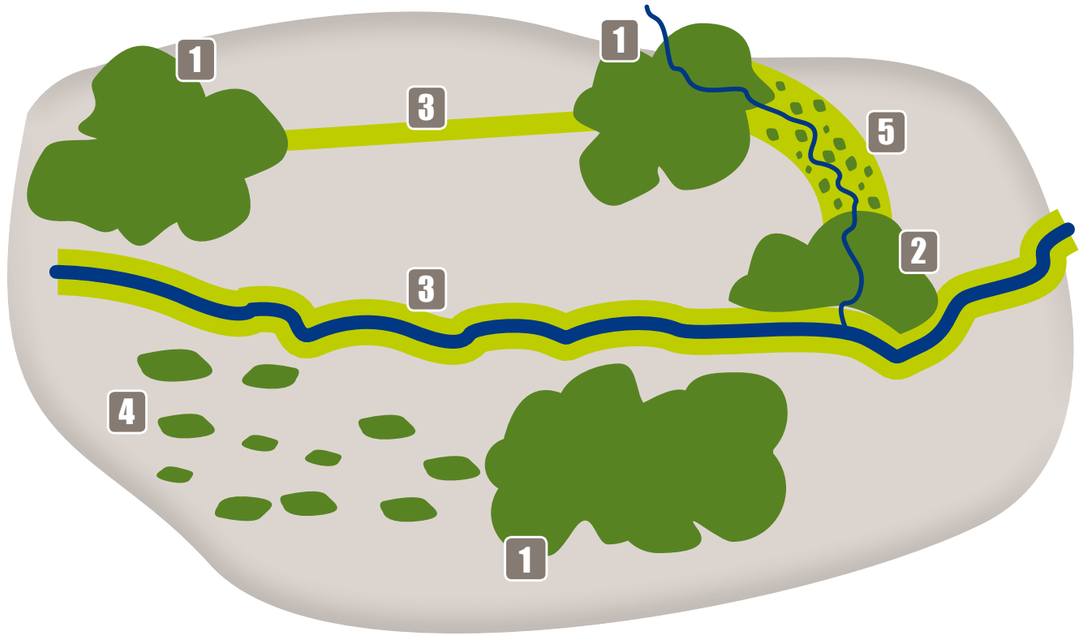
Land management tools	***Territorial Coherence Schemes** and **Urban Planning Codes** define the general outline of future land use.*
Tools for protecting agricultural areas	*A **Protected Agricultural Zone (ZAP)** can protect agricultural areas of particular interest from the perspective of their production or geographic location. These are defined by prefectural order.*
	*The **Perimeters for the protection and enhancement of peri-urban agricultural and natural spaces (PAEN)** can protect agricultural areas that are threatened by urbanization, and make steps towards enhancing them by adopting appropriate action plans, in consultation with all the parties involved. Local authorities can use this framework to purchase land by amiable agreement, expropriation or pre-emption.*

This list is non-exhaustive and can be supplemented by documents listed in the bibliography.

A.2 - Setting up a green and blue infrastructure

Fragmentation of the habitats is one of the main causes of biodiversity erosion. Isolating wildlife populations can render certain species incapable of feeding themselves or reproducing, and also leads to genetic erosion and eventually extinction. Therefore, to guarantee the healthy functioning of ecosystems, it is essential to reconnect our natural environments, and above all, to stop destroying the existing habitats.

In France, the Grenelle 2 Environment Law (July 2010) added a new dimension to the Environment and Urban Development codes - the commitment to developing a Green and Blue Network. The aim is «to (re)constitute a coherent ecological network across the territory on a national scale.» Elsewhere in Europe, people are equally talking in terms of 'networks', but also ecological continuity and biological corridors...



1 *Biodiversity reservoir*

2 *Secundary biodiversity reservoir*

3 *Linear corridor*

4 *Corridor with Japanese steps*

5 *Landscaped corridor*

This network is made up of:

- **Biodiversity reservoirs** (parks, forests, wetlands and derelict wastelands...) with enough food resources and nesting areas for a wide diversity of species to thrive;
- **ecological corridors** that link up the different biodiversity reservoirs to bring functional connectivity, but which also help animal and plant species to migrate and circulate. These corridors can take on various forms: linear corridors (along roadsides and embankments...), stepping stones (small gardens, balconies or ponds...), or landscaped areas (a mosaic of different spaces).

Depending on the specific needs and characteristics of each species, the space can be used to various ends. A corridor can constitute a biological reserve for certain plants and small animals, and yet act as a barrier for others. Therefore we need to set up a complex system of ecological connections in order to accommodate this diversity.

Setting up a green and blue infrastructure in cities

Urban areas should not be left out of the green and blue infrastructure. The large areas of green space must be reconnected within cities, but also connected up with natural peri-urban areas on the outskirts. This type of initiative involves opening up new green space, or pedestrian and cycling greenways, and can go a long way towards enhancing biodiversity, while simultaneously improving the urban living environment for city dwellers.

The methodology outlined below is modelled on a project that was set up in Lyon to restore the green habitat network in the 5th and 9th boroughs:

Short-term strategy – making a diagnostic survey of the territory

- Map the natural environments in your territory, specifying in each case the different land management practices in use;
- Make a biodiversity inventory of your territory so as to devise a tailor-made green habitat network strategy. To achieve this, consider getting in contact with local naturalist associations. Also, you can train your green area operators, and get the local population involved in carrying out inventories (designed mainly as an educational initiative);
- Identify the existing barriers, as well as the potential connections to be developed (disused railway lines, riverbanks and small areas of wasteland...);

Mid-term strategy – reconnect the existing natural environments

- Remove and avoid all artificial physical barriers wherever possible such as walls and wire fencing...;
- Introduce specialized installations to enhance biodiversity and give species freedom to move about: wildlife crossings, water features, insect hotels and spirals, and HIBERNACULA;
- Tailor the management practices for each area to suit its specific role in the ecological network;
- Embrace strong ecological values in your management plans by laying out formal, concrete steps: stopping the use of pesticides and chemical fertilizers, and keeping interference with the land to a strict minimum;
- Place the green and blue infrastructure at the heart of all local urban planning documents, making sure that it is featured across the spectrum, from small-scale to large-scale projects, to guarantee a coherent development strategy;

Long-term strategy – ensure the green habitat network takes root as a sustainable solution

- Regenerate the areas needed to bridge the gaps in the green habitat network: by greening urban wasteland, roadsides and embankments and digging ponds…;
- Regularly assess and adapt the project in pace with the changing shifts in biodiversity.

Throughout the project – encourage all parties concerned to get involved:

- Work in partnership with the different local authority departments including management: town planning, technical services, parks and recreation areas, public roadways and transportation...;
- Train green space operators to be familiar with the green habitat network project, with new management practices, and techniques for monitoring biodiversity…;
- Increase the awareness of private partners (company gardens and private gardens) to ensure a cohesive management plan across private and public land: management charters and official agreements…;
- Inform the local population and get people involved by organizing stands and conferences to promote the project, as well as guided nature tours and group workshop days, inviting the public to take part in setting up the installations.

Building an insect spiral with the help of the Brigades Vertes funded by the Rhône General Council. City of Collonges au Mont d'Or

B - Implementing an ecological green space management plan

Widespread interference with the urban landscape is inherited from centuries of intensive green space management, modelled on strict 'neat as a pin' aesthetic criteria. And this interference has in turn led to the standardization and ecological erosion of our cities as we know them today. Therefore, any work carried out on green spaces should first be assessed in terms of the land use and biodiversity of each site.

B.1 - Setting up a differential management action plan

In reaction to the highly criticized horticultural model on the one hand, and the rapid greening of cities on the other, a flurry of new ecological management models have developed across Europe at the end of the 1970s. In France, the first differential green space management plan was initiated in 1981 in Rennes, before spreading to numerous other cities of different sizes and in varying contexts.

Differential management involves giving up the systematic horticultural approach to maintenance, and replacing it with a sustainable management model that is designed to adapt to each specific landscape, land use, and ecosystem. This targeted approach works towards creating a network of diverse environments that fits nicely in the overall urban landscape, yet are also all useful for biodiversity.

1. Differential management meets multiple objectives:

- Reducing and ultimately stopping altogether the use of pesticides, thus enabling the conservation of natural environments;
- Creating a varied patchwork of urban surroundings by adapting management practices to the land use of each particular green space;
- Improving the living environment for city dwellers;
- Conserving and enhancing biodiversity that is both standard and of exceptional value.

left uncut - Strasbourg

In certain cases, differential management can also be used to cope with an increase in green space area, and optimize maintenance costs.

2. Introducing a differential management approach

Diagnostic survey of the territory: areas and land use

Each differential management action plan starts off with an inventory and mapping phase, to plot out the different green areas and integrate them in the local action plan: parks, recreation areas, grounds surrounding public and private buildings, roadsides and riverbanks, cemeteries, municipal campsites, and sports grounds...

The diagnosis of each site groups together a body of information to create an overview of the natural heritage (types of environment, biodiversity, and sensitive areas for protection), of the initial maintenance methods and the different uses of the sites by local residents.

For ordinary sites, without any outstanding or sensitive types of fauna or flora, you can get good results by simply applying the general recommendations (landscape mosaics and connecting up environments). You can apply these measures even if the biodiversity diagnostic phase has not yet been conducted.

Defining goals and establishing a management framework

The diagnostic and mapping phases both serve as a basis for setting management goals for the communal green space, and these are divided up into separate categories for each type of area. The number and denomination of the different categories vary from one city to the next. Usually, there are 4 or 5 categories. Here are some examples: areas of prestige, garden areas, recreational areas, and natural areas.

site in Parc de la Tête d'Or

A maintenance framework or charter is then drawn up for each area category, geared towards the different goals that have been defined. It lists the specific management practices to be applied to each plant and mineral stratum: choice of seeds and plants, watering, mowing or cutting, pruning, weeding methods and green waste management...

Tailoring management practices to suit areas and land use

Two areas from the same category can be managed in different ways, and likewise, a site can be cut up into several areas that are managed along the lines of different categories.

For example, a park could have a scenario whereby certain areas (the entrance and around a historic building…) are classed as being areas of prestige, and yet other parts (undergrowth, meadows and the banks of lakes...) are managed as natural areas. These spaces can be landscaped to simplify management as much as possible and still meet ecological objectives: by reducing the surface of pathways and flowerbeds that need weeding, replacing trimmed hedges by bush hedges, and planting ground cover at the foot of trees...

Moreover, the management framework must be applied using a flexible approach. First and foremost, management must be adapted to suit each individual situation, and the goal should not be to implement the whole set of recommendations in a systematic way everywhere, as not all them necessarily apply to a given area..

Training green space operators and getting them involved

The initial training usually given to green space operators and managers still focuses too much on conventional, systematic, chemical and mechanical management practices. Yet the land operators who maintain green spaces are not only there to apply the practices recommended in the maintenance charter, but they also act as the main contact point with visitors. They therefore need training (in ecological management techniques and biodiversity…) to be equipped to apply the management framework in a sensible way, and also to give information about these new management practices. These operators are in a prime position to observe biodiversity, and the different uses of space, but equally they should play a crucial role in the thought process both before and during the project, helping to adapt management choices to suit the particular characteristics of each site.

space operators

Strengthening communication and providing answers to city dwellers


Inauguration of the Cressonnière URBANBEES site - Lyon

Do not be surprised if a certain degree of public criticism emerges once your differential action plan has been put in place. Typically, this is due to a lack of understanding of new practices: mowing grass and pruning flowerbeds less frequently, removing waterproof surfaces, tolerating the growth of self-seeding plants, and even a degree of "messy", tangled foliage… all might be interpreted as lack of proper management. Therefore, operators need to prepare themselves to answer questions, and give explanations for the management choices on each different site (through meetings or organized visits) with the help of information panels. Some local districts have provided local residents with information pamphlets explaining the basic principles of differential management. You could also consider using local newsletters and the local press as a means of communication, but you could equally organize special activities to mark local or national events, focusing the theme around biodiversity or gardening.

It is also worth getting local residents and companies involved, and encouraging them to take part in this shift towards a new management model, thereby boosting the ecological potential of private areas, and helping to absorb them into the ecological network.

Following developments in each space and adapting management accordingly

A management action plan is not set in stone. It must adapt and develop in pace with the changing uses of each area, with biodiversity, and also take on board the feedback from operators about management choices. For example, it is possible for one area to change category, and also evolve towards a more extensive management system, so as to be integrated into an ecological corridor.

URBANBEES recommendations

- **Stop the use of pesticides across the whole spectrum of management categories;**
- **Confine the areas of prestige to essential spaces, as this category is usually both incoherent and destructive from an ecological perspective;**
- **Keep all areas clean (pick up rubbish regularly) and keep invasive plants at bay across all the different categories.**

B.2 - Applying ecological management techniques to the different plant strata

This section gives you the general outline of an ecological management plan designed for different plant strata, and tailored to help wild bees and also biodiversity as a whole. These recommendations must be adapted to the specific nature of each site, but can also be used as the framework for implementing a differentiated management action plan.

1. General recommendations

Stop the use of synthetic chemical products (pesticides – insecticides, herbicides, fungicides, and the likes – and chemical fertilizers)

These products interfere with the self-regulating mechanisms of ecosystems and cause long-term damage to the environment (water table pollution), as well as to the health of green space operators and visitors.

Reduce human interference

If you adapt the flora and layout of the areas appropriately, then you will save time and money, achieve a better aesthetic result, and in addition you will be making a large contribution to enhancing biodiversity.

2. Managing the plant stratum – grassy areas, flowerbeds and vegetable gardens...

For recreational areas that people use for playing games

Relaxing or simply walking through, select a rustic type of grass, rather than a single-species lawn – for example, clovers and dandelions are a valuable food source for many insects. Plant patches of bulbs across the lawns that will flower every year. Space out grass cutting work (we recommend this as a better alternative to mowing) and raise cutting heights (10 cm minimum), which will help prevent yellowing in the summer. Choose a centrifugal cutting technique, which starts off in the centre of the area, and then gradually moves out in a circular motion towards the edges. This will give insects and other small animals a means to escape. Keep strips of uncut meadow along the outside edges of the area;.

For areas that receive few visitors

Let a meadow grow high and cut it only once or twice a year, taking care not to cut all of the areas at the same time. This way you can keep enough different spaces to provide food and refuge for small animals. To help guide visitors through the area, clearly mark out the edges of paths using a mower or strimmer. This kind of minimum upkeep will also help to improve the public image of derelict wasteland.

Once you have finished cutting all areas of meadow

You can leave the residual clippings in place to act as natural soil fertilizer, or alternatively you can transfer the clippings to poorer grassland areas, with richer flower variety.

As for areas under extensive management (undergrowth and embankments)

Leave them to grow maintenance-free. As for strips of urban grassland or areas that are difficult to reach, try out grazing, and alternate the different species of animals to gain more effective results and minimize the negative impact: horses, donkeys, goats and sheep...


Banks of the Saône river when entering - Lyon

Choose forbs with pollinator-friendly flowers…
especially by selecting native plants with flowers that have not been highly modified.

Set up an alternative weeding plan…
by reducing the total surface in need of weeding: by planting ground cover, adding mulch, tolerating self-seeding plants, and pulling up weeds manually...

Streamline your use of soil-enriching agents…
and use organic products instead by recycling green waste: keeping grass clippings on site, composting, and using temporary mulch...

3. Managing the shrub stratum – hedges, thickets...

Keep pruning to a minimum
When choosing a new shrub to plant, consider its natural size at full adult growth (volume and height...)

If pruning is unavoidable…
then opt preferably for minimal pruning, and do it outside flowering and fructification periods. Leave pruning debris and dead branches in place, or recycle them to make ramial chipped wood (RCW) or mulch.

Shun exotic single-species hedges…
... and instead choose hedgerows or thickets composed of native shrubs that enable fauna to thrive (providing flowers for insects and fruit for birds...).

4. Managing the tree stratum

Stop systematic pruning and let trees grow freely
Tree pruning across the city only serves to weaken the trees and make them more vulnerable to diseases. The more a tree is pruned, the more it needs regular pruning. Conversely, a tree that is never or rarely pruned produces much less dead wood that runs the risk of falling to the ground. Therefore, when planting new trees, make sure that you take into account the size of the tree at its full adult stage.

Only prune trees if really necessary: if a branch poses a risk or creates a disturbance (if close to a building or a street light, etc.).
If pruning cannot be avoided, then opt preferably for minimal pruning, and use professionals who are trained in these new techniques. Schedule the work between September and February so as to avoid the nesting period for birds. If you have trees with cavities providing shelter and nesting opportunities for bats (Chiroptera), then begin work only as of October.

Leave dead wood and dead trees (standing, lying or piled up) on site, unless this constitutes a danger.
The dead wood can provide food and shelter to a wide range of animals.


Dead wood

Plant flowers and shrubs at the base of trees, or let vegetation grow spontaneously: self-seeding plants, ground cover and mini vegetable patches…
However, look out for the possible competition between some plants and young trees that may have negative effects on the trees.

As a general rule, break the habit of *'extreme interventionism',* and at times let things happen naturally on their own rather than always trying to do it yourself.

C - Stopping the use of pesticides

Whatever category of area or management approach you are dealing with, it is imperative to stop the use of pesticides and artificial fertilizers at all costs. They create a massive disturbance to ecosystems, cause soil exhaustion and poison environments and people. The idea that we cannot live without weedkillers herbicides or chemical fertilizers is still deeply ingrained in most people's minds. Yet a strategy that combines alternative methods with a transformation in aesthetic standards can lead to a green space management system that is more ecological, and also healthier for nature as well as humans.

MOVING TOWARDS A BAN ON PESTICIDES?

On 23rd January 2014, the French parliament passed a new law, that will come into effect as of the 1st January 2020, and which sets a ban on the use of pesticides [19] by the state, local authorities and public institutions, in public green spacesareas. As of January 2022, this ban will also be extended to private use.

We can only hope that this new measure will pave the way for a general ban on the use of pesticides across Europe. Yet it is important to remember that 90% of all pesticides consumed in France are confined to agriculture. So we cannot ignore the fact that our own choices in food production and consumption are also to blame.

C.1 - Weed control without using herbicides

Weed control is the most sensitive sticking point in the shift towards ecological management models:

- Gardening as a profession needs to be radically transformed. This may lead some green space operators to feel a sense of misunderstanding and worthlessness, or they may even put up resistance. It is therefore crucial to help them through this transformation period, and get them involved as much as possible by providing suitable training, and also by highlighting the positive impacts on their health and the environment. All new projects must be designed in consultation with members of technical staff, who are in the best position to assess the constraints posed by the management of the different sites. Moreover, these very same land operators are the frontline communicators to the general public. Therefore, if staff members are suitably informed and trained, and also convinced of the merits of their new management approach, they will definitely be in a better position to explain and defend the new practices to discontented local residents;

- Using similar amounts of resources, it is clear that alternative methods will not achieve results as clean as chemical herbicides. You therefore need to include supplementary methods, be case specific in approach, and identify the most appropriate practices needed for each different area. Furthermore, your stringency levels in terms of weed control will also need to be revised. A zero-pesticide policy can only work if it is elaborated in the context of an overall drive towards differential green space management, which, amongst other things, helps to free up the time needed for weeding while also reducing the surface that needs weeding;
- To offset the consequences of abandoning herbicides, introduce a management plan for self-seeding plants that is phased in over three stages: preventing their growth, tolerating their presence, and, as a last resort, weeding.

1. Prevent the growth of self-propagating weeds

Do not leave any ground exposed in flowerbeds or at the base of trees:


Mulch

- Cover the base of plants with organic mulch to help cut down on weeding and watering, to protect the soil and act as a soil-enriching agent, as well as to provide a home for invertebrates including insects. Different materials can be used such as grass clippings from mowing and cutting, dead leaves, and chopped wood (RCW). Consider making your own mulch. Mulching is carried out in the summer – to reduce watering – or in the fall – to protect the plants from frost in the winter. Spread a layer of around 3 to 7 cm, depending on the type of plants growing. Organic mulch breaks down into humus and nourishes the soil. Do not forget to regularly add fresh layers. In dry areas where xerophilous plants grow, you can apply mineral cover (such as small rounded stones and gravel);
- Lay out flowerbeds in an appropriate fashion by planting plants that cover the ground or with an extensive root system to prevent weeds, and especially invasive plants, from taking root;
- Use competition among plant species to your advantage: for example, if you plant a tree that absorbs large quantities of water, you will be helping to curb the growth of horsetail (*Equisetum* spp.), which thrives in damp soil.

Along pathways:

- Choose an appropriate stabilized permeable surface – pavement, but not cemented surfaces, or crushed gravel and natural gravel...;
- Apply a layer of geotextile underneath the stabilized surface to prevent self-propagating weeds from taking root;
- Reduce pathways in number and size: if wild grass begins to spread along the edges of a path, this is an indication that the path is not being used enough, and it is ultimately unnecessary. Plant grass or ground-covering plants over any superfluous pathways;


Ground cover

- Why not simply let the visitors do the work? Mark out the contours of a passageway using strips mown into the meadow. The path will be cleared and maintained of its own natural accord thanks to trampling by people as they walk through.

2. Allow self-seeding plants to grow


Hedge bindweed:
Convolvulus sepium
indicates soil that is too rich in nitrogen

To space out weeding, the best solution is to simply develop a more tolerant attitude towards self-seeding plants. These plants offer many benefits: they are a food source for animals and insects, especially for bees, they are useful indicators of soil quality, they are usually attractive to look at, and many are edible as well as have medicinal properties…

The association Plante & Cité conducted the 'Acceptaflore' survey, which served to gauge public perceptions of self-seeding plants in cities. Thanks to the findings, local authorities have been able to develop appropriate support tools to make self-seeding plants more widely accepted.
As a way of boosting its public image, try to organize awareness raising initiatives targeted at the general public, but also at gardeners, who are often adverse to the idea of leaving this unwanted flora - or weeds as they are usally called – go untouched, and therefore running the risk of being accused of not doing their job properly. Social influences, and worries about what others might think of us and what we do – or do not do – are still deep-rooted and affects our behavior.

Put up information panels about the spontaneous vegetation, and lay a botanical trail on the theme of the city's wild plants. Bring on board the help of green space gardeners to take part in this drive towards developing local natural heritage. The incentive for them is the opportunity to promote their work and gain greater recognition for their profession. You can also organize cookery workshops using wild plants, or organized tours of the wild flora lining the streets.

Self-seeding plants growing in the city

3. Weed control without chemical herbicide

The first two steps serve to cut back the area in need of weed control. As for the areas where weeding is unavoidable, you can find many alternative methods to herbicides:

- Manual weeding with a garden hand-hoe, an electric hoe, or a brush (for waterproof surfaces), and harrowing with a weeding frame (for sandy surfaces)... These are only a few examples of the wide range of tools and methods that can be used for working topsoil. Ideally, these techniques should be applied during short periods of dry weather;
- Thermal weed control using a flame, hot water, steam or hot foam. However, these techniques entail expensive and often cumbersome machinery, that often emit greenhouse gases and require large quantities of water. These methods should not be viewed as lasting solutions, but rather as transitional techniques for moving on to more natural methods that have a less harmful impact on the environment.

Therefore, each local authority must assess its own particular constraints, and tailor its technical choices towards the precise nature of each target site, while also taking into account valuable feedback from gardeners.

4. Managing invasive species

It is essential to keep pace with the spread of invasive species on your territory, and introduce appropriate techniques to remove them: limit their growth by using physicochemical or organic treatment, cutting aquatic weeds and grasses, grazing, manual removal techniques, covering the plants with a tight cover (to smother them without scattering debris), and encouraging competition using taller plants (trees and shrubs which pump water and block out the light).

C.2 - Recycle green waste

Green space management, especially its most conventional forms, produces a large quantity of green waste: grass, branches, wood and annual plants... Typically, this waste is disposed of elsewhere - a process that involves a lot of nuisance and energy, and which moreover calls for the need to fertilize the soil that has lost this natural organic matter. Waste is a precious commodity in ecological management, and should be returned to the soil from where it came from, depending on the type of natural cycle.

Once again, there is a whole range of supplementary methods that can be used. Indeed, be aware that composting cannot be a standalone solution, as the quantities of waste produced on a single green space area are often too large to be treated on site. Therefore, as a first step you must reduce the quantity of green waste produced, and then recycle it on site as much as possible.

1. Leave it where it is


Pruning debris left at the bottom of a hedge

Most green waste can be reapplied directly to the site where it came from. Clippings from grass cutting (or mowing) can be left where they are if the soil is not already too rich. They will provide useful inputs of organic matter, and limit the need to bring in extra fertilizer. In the same way, dead leaves cleared from pathways can be easily deposited in nearby flowerbeds, at the base of trees or on lawns. However, avoid reusing leaves from plane trees (*Platanus* spp.) and needles from conifers, but rather leave them in a specially designated compost heap.

Green waste produced from pruning – green or dead wood and branches – can also be laid down in flowerbeds to provide shelter for small animals and insects.

2. Mulching


Mulch

Grass clippings from mowing, dead leaves and chopped-up branches (Ramial Chipped Wood - RCW) all make excellent mulch for flowerbeds and the base of trees, but also help to reduce weeding and watering, to protect the soil from freezing and trampling, and provide a home for insects. Make sure that you adapt the quantity to the real need: mulch applied in the fall should have totally decomposed by springtime to make it easier to plant flowerbeds and let the ground breathe.

When green wood is pulped into wood chippings and immediately tilled into topsoil, it can be a precious mineral source, but RCW (Ramial Chipped Wood) must be used within 15 days of pruning.

You can therefore appreciate the importance of providing gardeners with high-performance chippers to be able to recycle pruning waste on site, and therefore cut down on the journeys and cost typically associated with green waste disposal.

3. Making compost

Composting is the natural breakdown of organic matter into humus - a process that is carried out thanks to microorganisms (bacteria and fungi) and small animals (earthworms, woodlice, mites and insects). Installing municipal compost heaps is a way of recycling waste that cannot be directly reused, such as wilted flowers, waste from vegetable gardens and weeding, fruit and vegetable peelings, and even animal dung from herbivores... The compost that is finally produced can then be used as a soil-enriching agent to nourish and enrich flowerbeds, rose bushes (*Rosa* spp.), orchards, and vegetable gardens.

THERE ARE MANY DIFFERENT TYPES OF COMPOST THAT CAN BE APPLIED, DEPENDING ON THEIR USE:

- Compost heaps do not need any particular structure. The waste is left in a designated area and regularly mixed without being piled up too high;
- In parks or collective gardens, you can set up a composter laid directly on the ground to make the composting process easier and more discreet. You can also install municipal compost heaps which are accessible to residents, and encourage the public to leave their organic household waste there;
- Earthworm composting in large containers produces compost all year round faster and without any smell. This is an ideal solution for schools, where composting sites can be set up to recycle some food waste from the canteen. However, they can also be installed in the courtyard of apartment blocks, or even inside apartments using an indoor earthworm composter. Worm composting helps to cut down on household waste, and can also be used to nourish houseplants.


Compost heap


Composting with earthworms

A FEW TIPS:

- **Regularly mix up your compost to avoid any bad smells emerging from the production of methane which occurs if the compost material lacks oxygen (this is not the case with worm composting);**
- **Make sure you maintain a balanced mix of waste elements in your compost (nitrogen, carbon and moisture). Mix the moist and nitrogen-rich organic waste (such as grass clippings and green leaves) together with elements that are rich in carbon (dried leaves and dry wood) to keep a healthy ratio. If there is too much carbon-rich waste, you simply need to add nitrogen-rich substances such as animal dung. Feel free to water compost if the waste is not moist enough, and to cover it during drought periods;**
- **Set up an organic waste collection system in your local district to cater for restaurants, schools, and even private residents, or alternatively offer an on-site reprocessing solution;**
- **When designing planting strategies for green spaces, shy away from plants that produce a lot of green waste, or waste that is not easily compostable, such as conifers.**

4. Exporting waste

If you apply the solutions listed above, then you should successfully manage to recycle your organic waste. However, if you find that you have a surplus of organic waste, consider offering it to the neighbouring local authorities. Farmers are often very keen to use waste material from grass cuttings or compost. Moreover, using a grazing strategy in certain areas could also help to reduce waste products, while simultaneously bringing in essential fertilizers (but be careful to avoid over- grazing). Finally, summer and fall clippings collected from areas of mature grassland meadows (rich in native wild flowers) can be used to "sow" new grasslands, especially as part of a regeneration plan.

5. Other waste

Green areas also produce other forms of waste that are generated by gardening, and general litter from visitors coming to use the area. All green space policies should seek to cut down on the amount of waste generated by maintenance work. Plastic plant pots, for example, can be easily reused or, indeed, replaced by biodegradable pots. Choose vegetable oils, or at least biodegradable synthetic oils, as fuel and lubricant to run the machines. This way, you will avoid the risk of pollution from leakage, and also improve the general working conditions for the green space operators.

As for general public litter, provide recycling bins in sufficient numbers for the number of visitors. Even though the waste will most probably need to be sorted again, these bins are nonetheless powerful symbols, sending out signals about the importance of recycling, and therefore raising public awareness by their very presence alone.

Finally, approach ice cream and snack vendors in public parks, and reinforce the message about the importance of keeping packaging to a minimum, and offering recyclable or compostable wrappers.

C.3 - Understanding and maintaining your soil

Soil is the interface between the mineral environment, which comes from the source rock below, and organic matter making up humus. It is a living environment, and its balance depends on the activity of a multitude of microorganisms and small animals. The widespread use of chemical fertilizers, a sign that we have forgotten these natural mechanisms, has led to the gross disruption and depletion of soils. Stopping the use of synthetic chemical products is a vital necessity, but it also requires a better understanding of soil, and an approach that works in harmony with its ecosystem.

1. Interfere less, observe more

A large proportion of human interference with the soil – ploughing, fertilizing, weeding – is useless, and often damaging to the soil. This chronic interventionism must be stopped so as to make way for more natural mechanisms such as nitrogen fixation produced from bacteria living in symbiosis with the plants, or by means of soil aeration with earthworms and other small animals.

All work carried out must be adapted to the particular characteristics of the soil, and therefore a solid understanding of the soil is a vital prerequisite. A lot of useful information can be gathered from simply observing self-seeding plants. For example, Japanese knotweed (*Reynoutria japonica*) grows in soil polluted by heavy metals and poorly drained, whereas couch grass (*Elytrigia* spp.) is symptomatic of ground that has been turned over too often and too deeply. Common daisies (*Bellis perennis*) indicate soil that is being eroded and has lost most of its calcium carbonate. By collecting these observations, you will be better equipped to adapt the nature of your soil intervention, and your planting choices.

Nature of the soil	Means of identification	
	Self-seeding plants	Other methods
Clay, heavy *Soil that retains moisture and minerals easily, but is hard to tend. It warms up slowly.*	Buttercup (*Ranunculus acris*), dandelion (*Taraxacum* spp.), field bindweed (*Convolvulus arvensis*), grasses (Poaceae)	The sausage test: Take a handful of moist. - If you manage to roll it into a sausage shape that holds together, then this indicates high clay content; - If the sausage crumbles easily in your hand, then it is loamy soil; - If it is impossible to make a sausage shape, then the soil is sandy. The vinegar test: Pour a drop of vinegar onto a patch of soil. If it fizzes or bubbles, then it is limy soil. If not, it is acidic.
Loamy, rich *Highly fertile soil that is easy to tend.*	Nettle *(Urtica urens),* couch grass *(Elytrigia* spp.*), mountain spinach (Atriplex hortensis),* white deadnettle and purple deadnettle *(Lamium album, Lamium purpureum),* black elder *(Sambucus nigra),* chickweed *(Stellaria media)*	
Rich in humus *Fertile soil rich in humus, that retains water well. It has a tendency to acidify.*	Heather (*Erica* spp.), ferns, foxglove (*Digitalis purpurea*), gorse (*Ulex* spp.), mosses…	
Sandy *Highly water permeable, it warms up easily, but holds little water and nutrients.*	Field pansy (*Viola arvensis*), couch grass (*Elytrigia repens*), Scots heather (*Calluna vulgaris*), field camomile (*Anthemis arvensis*)	
Calcareous (limy) *Highly water permeable, it warms up easily, but can block out the effects of some fertilizers.*	Poppy (*Papaver rhoeas*), white clover (*Trifolium repens*), common chicory (*Cichorium intybus*), hellebore (*Helleborus* spp.), field mustard (*Sinapis arvensis*), sainfoin (*Onobrychis* spp.), meadow sage (*Salvia pratensis*), cornflower (*Cyanus segetum*), thistle (*Caardus* spp.)	

2. Stop the use of synthetic products

Every green space ecological management plan must stop the use of synthetic chemical products at all costs. There are many natural substitutes that work in harmony with the soil.

By using a system of crop rotation and association, or by applying green manure, you can improve the nutritional value of your soil, as well as ensure soil aeration. Moreover, you will provide an ideal habitat for mycorrhizae. People are growing less and less legumes – Fabaceae – even though these plants produce a naturally high quantity of soil nitrogen. Sainfoin (*Onobrychis* spp.) and clover (*Trifolium* spp.) are two examples of legumes traditionally used as green manure and their flowers are an excellent source of pollen and nectar for bees.

Male *Eucera* sp. bee on a clover flower

Yet if you have a real need to boost soil fertility, then before even considering adding anything to it, the first key step is to do a soil analysis to get a clear picture of what is missing. Then, if you decide to add something, your choice of product and dosage should be in line with the needs of the plants you are planning to grow. Over-fertilizing, even with natural products, can be counterproductive. You can use a diverse range of natural soil-enriching agents that are both animal-based (manure, ground horn, dried blood and bone meal...) or plant-based (compost, green manure plough-down and RCW...) that serve to nourish the soil and balance out its pH. However, be careful to resist the temptation of offsetting the drop of chemical fertilizers by increasing the dose of natural products. Often the compost that is produced from green waste from maintenance work is quite enough to meet your needs.

If you apply mulch to areas of exposed ground, it can act as soil amendment, but it also provides an ideal habitat for beneficial species, especially decomposers, scavenging microorganisms which will then take on the task of enriching your soil by transforming organic matter.

3. Imported soil control

In the city, it is sometimes necessary to bring in soil from outside, even when building projects have already been carefully streamlined to shift as little soil as possible. When soil is introduced, you need to have good tracking means to monitor its origin and quality so as to avoid bringing in soil that is either poor quality, infested with seeds of invasive species, or even polluted from prior human activity (heavy metals and traces of pesticides…).

4. Provide a home for ground-nesting bees

On average, 7 bees out of 10 nest in the ground, in compact, clay or sandy soil. Several examples include the colletid bees, which prefer to nest in warm, sunny banks of ground, the andrenid bees, which prefer sandy soils, and the halictid bees which prefer to hollow out spaces in tightly packed ground, such as natural trails traced by wildlife or joggers. Therefore it is important to maintain a patchwork of different areas of exposed ground, something that is so badly lacking in cities today due to the waterproofing of surfaces, and ground work that is too frequent.
For example, you can recreate these stretches of bare ground by copying the soil squares installed on the **URBANBEES** sites. To make your own, you simply need to lay out a square patch of soil of whichever size you like, ensuring that it is 50 cm deep and that it is separated from the surrounding ground area by a wooden frame. Then lay down a drainage layer made up of rounded stones or gravel at the base of the hole that is a minimum of 10 cm high, before replacing the soil on top, having first sifted it finely to remove any roots, stones or debris.

Nest of a ground-nesting sweat bee (*Lasioglossum* sp.)

It is useful to cover the top of the square with wire mesh, such as chicken wire, to prevent small mammals from burrowing their holes inside or defecating there. The square must be hand weeded on a monthly basis to keep the soil bare.
These types of installations are ideally suited to particularly dense urban environments, which are lacking in areas of exposed ground.

C.4 - Pest control and attracting beneficial species

Sometimes a gardener can feel helpless in the face of the army of small creatures crawling around the garden. If you consider that pesticides lead to the decline of numerous species, then it now becomes crucial for us to re-familiarize ourselves with these small creatures, whether they help or hinder plant growth.

1. Attract beneficial species

Across the spectrum of different insects, birds, amphibians or mammals, there are certain species that are indispensable allies in the ecological management of green space: these are the “beneficials”. These creatures give man a precious helping hand in many ways:

- Predators and parasitoids take care of pest and parasite control;
- Decomposers are scavenging microorganisms that help to make humus and transform organic matter (dead plants and animals, and excrement) into mineral salts that can be assimilated by plants;
- Pollinators, such as bees, play a key role in plant reproduction by pollinating flowers, and therefore boosting both the yield and quality of fruits and seeds.

Aphid parasitoid (micro-hymenopterous insect)

Decomposer (rolly polly)

Some key beneficials:

- **The larvae of green lacewing (Chrysopidae), sometimes called “aphid-lion”, are fierce predators that prey on various types of aphids, scale insects, mites and caterpillars.**
- **A colony of 15 bats eats over 15 kg of insects each summer, and a family of owl preys on around 4,000 different animals per year, mainly rodents.**
- **Bacteria and fungi are essential scavenging microorganisms for decomposing all sorts of organic matter.**
- **Every night, an earthworm ingests, aerates and fertilizes its own weight in soil. The ground contains 1 to 4 tonnes of earthworms per hectare.**

To complete their life cycle, beneficial species need a rich variety of food sources, but also materials and areas for building shelters. In order to benefit from their help, we need to stop the use of pesticides and create varied habitats (self-seeding plants, greater vegetation diversity and natural flowering meadows...).


Wildflower meadow and bee walls - Meyzieu

To help them set up home, certain specialized structures can also be installed (insect spirals, insect hotels, ponds, piles of wood and stones...) as well as nest boxes especially designed for some beneficials.

Organizing release operations of beneficial species is a good way of raising awareness, but it also helps to boost population numbers of a particular species in a given area. However, make sure that you choose native species, and that you avoid generalizing these releases. Finally, planting or maintaining natural structures (hedges and fallow areas….) remains the most effective and lasting method.


Nesting material housing wild bees

2. Pest control

There are two key principles that govern ecological pest control:

Do not act too fast

In a balanced ecosystem, it is natural for beneficials to appear on the scene once pests arrive. Therefore it is out of the question to systematically wipe out pests as soon as they appear.

Moreover, it is important to gauge the real impact of each pest, and develop a more tolerant attitude towards species that do not pose any threat to either plants or health. For example, the horse-chestnut leaf miner (*Cameraria ohridella*) is a caterpillar that feeds on the parenchyma (ground tissue) of leaves, but which has no impact on the growth ring. When the leaves turn yellow and as a result fall early around mid-June, this does not impair the health of the tree, as its main phenological phases are already over. However, this may weaken horse-chestnut trees and make them more vulnerable to diseases, such as bacterial diseases. Collect up the leaves and compost them at a temperature of at least 70°C to kill off the eggs and caterpillars. Failing that, burn the leaves. This method can be extended to all bio-agents growing on the leaves.


Damage caused by the horse-chestnut leaf miner

Rely on complementary methods

Let us take the example of coloies of pine processionary caterpillar, which are known for ravaging conifer trees in the southern half of Europe in the spring. Beyond their impact on the trees, these caterpillars have urticating hair which cause stinging and irritation, and can cause serious harm to humans. There is no miracle solution to tackle this species, but there is a wide array of complementary methods: making appropriate planting choices and banning black pines (*Pinus nigra*) which the caterpillars target the most, and replacing any existing black pines with other trees; installing nest boxes for the crested tit bird (*Lophophanes cristatus*), which is a natural predator of pine processionary caterpillars; clearing caterpillars and deploying pheromone traps.


Pine tent caterpillar *Thaumetopoea pityocampa*

These measures must be accompanied by awareness raising campaigns, and municipal by-laws that force local residents to mobilize themselves and clear the caterpillars from their pine trees. Locals should also monitor their own gardens on a regular schedule, as these are typical sites for re-infestation outbreaks.


Ladybird larva eating an aphid

D - Choosing plants that are favourable to wild bees

If you want to build a pollinator-friendly environment, then choosing appropriate flora adapted to their needs is obviously a key factor. The following five principles will help guide you towards the right choice of vegetation to benefit wild bees.

1. Create greater vegetation diversity


Sainfoin
Onobrychis sp.

Each bee species has its own food preferences. Long-tongued bees prefer flowering plants with a fused corolla of petals creating a deep well, such as Fabaceae (clover and sainfoin), Lamiaceae and Orobanchaceae... whereas short-tongued bees gather nectar from flowers that have easily accessible pollen, such as Asteraceae (dandelion and ox-eye daisy *Leucanthemum* spp.), Apiaceae, and Rosaceae... Furthermore, certain specialist wild bee species only visit one particular plant species or a group of related species, and not all actively forage during the same period of the year. For example, *Andrena vaga* forages willow trees (*Salix* spp.) in the spring while *Colletes hederae* forages ivy plants in the fall. Therefore it is essential to encourage greater vegetation diversity on your plot of land to be able to stagger the different flowering periods.

2. Favour native plants


Common lime tree
Tilia × europaea

Bees and plants have been evolving together for millions of years. Native plants are therefore the most closely adapted to the local bee fauna. For instance, the common lime tree (*Tilia x europaea*) is a highly valuable food source for bees, whereas its Hungarian cousin, the white lime tree (*Tilia tomentosa*) produces nectar that is poisonous to some bees, such as bumble bees.

There are many wildflower seed mixes sold commercially, but they are generally made up of exotic horticultural species with often modified flowers.

It is therefore better to make up your own mixes. Get in touch with your local botanical association that will be able to give you information about the indigenous plants in your area. Also, take the opportunity to study the natural zones in your neighbouring vicinity, and to leave bare a patch of loose soil, and observe the different plant species that spontaneously grow there. It is also simple to go out to gather seeds from nearby grassland and then sow them on a small patch of land. On a larger scale, you can recycle the clippings collected from cutting work on areas of natural meadow, and use them to sow new areas where flowers can grow. These sowing initiatives using “hay meadow seeds”, or seeds “from the barn floor” will give you a mix that is adapted to your local environment.

3. Choose pollinator-friendly nectariferous plants


Wild cornflower
Centaurea cyanus

Wild bees are not generally attracted to flowerbeds full of horticultural annual plants that have highly modified flowers. Indeed, double-flowered or triple-flowered varieties produce very little pollen or nectar, and sometimes none at all. The best way of finding out whether a plant attracts pollinators is to simply count the number of pollinators that visit its flowers, and then use your observations to adapt your flowering plan. In addition, get in touch with your local naturalist associations that will be able to help you draw up a list of nectariferous plants that are adapted to the specific pedoclimatic conditions of your city (based on the list of nectariferous plants provided in the Appendix).

Moreover, we recommend that you choose perennials, which require much less maintenance than annuals. Shy away from invasive plant species such as the American goldenrods (*Solidago canadensis* & *S. gigantea*) or the black locust tree (*Robinia pseudoacacia*), that some bee species visit heavily, yet due to its invasive nature we discourage you from planting it.

4. Get your supplies from local producers

If you are looking to find seeds that are adapted to the site, reduce carbon emissions, and ensure that your plants are closely monitored, then you must turn to local producers to get your supplies. Horticulturalists and local nurseries should be strongly encouraged to produce native species and keep fully abreast of new changes in green space management practices, so as to make the most suitable choices for plants to grow in the years to come. Another solution is to produce your own seeds and plants in community nurseries. To cite one such example, the department of park and recreation areas of Lyon produces some of its own seeds and plants to use them in the green areas of the city. This is perfect for tracking purposes in the production chain, but it also opens up greater flexibility in the choice of plants.

5. Let nature take its course


Self-seeding plants

Numerous patches of urban environments can be taken over by ‘spontaneous’ vegetation: roadsides, the base of trees, pavements and space between walls... These self-seeding plants provide a rich food source, that is both of high quality and ideally suited to wild bees, while also contributing to the green network within the city. **Indeed, instead of always wanting to *do it ourself*, we need to learn how to stop meddling and *let nature take its course***.

E - Fostering biodiversity

Implementing an ecological and differential management action plan for green areas helps to create diversified habitats. You can install specific structures to complement this system, either to help compensate for a specific lack in a given space, or for educational purposes.

E.1 - Dig a pond

Water is a vital source of life, and is sought after by every living being on earth. As you get closer to wetlands, the environmental conditions gradually change, and you find a form of vegetation that is adapted to areas with a high level of soil moisture: wet grasslands, flood-prone areas and the banks of rivers and lakes. Therefore wetlands are considered to be some of the richest biotopes in France, as well as in temperate environments in general: 100% of amphibians, 50% of birds and 30% of rare and endangered flower species rely on wetlands to survive.

Wetlands are therefore essential to biodiversity. Yet half of the wetland surface in Europe disappeared in the course of the last century[20]. A pond is a habitat in itself, a source of food and water, and a breeding ground for numerous species. If you dig a pond in your garden or park, you will be allowing a whole thriving ecosystem to flourish, and soon you will be able to hear the sound of frogs croaking and see dragonflies busying about.


Damselflies

1. Materials and equipment

☑ EPDM rubber plastic sheeting, 1 mm thick (around €10 per m²)
Dimension calculations:
- *sheeting width = maximum width of the pond + twice the maximum depth;*
- *sheeting length = maximum length of the pond + twice the maximum depth.*

☑ **Or** heavy rubber plastic sheeting geotextile fabric and sand

☑ Plants

☑ Tools for digging up the soil (spades, shovels and pickaxes...). It is wiser to rent a mechanical shovel for digging a large pond. In this instance, pay attention to the soil stability

☑ A level and a long bricklayer's ruler, buckets and a wheelbarrow

2. Working time needed to install a 30 m² pond

6 man-days to dig the pond using a mechanical shovel, and to lay the sheeting.
1 man-day to set the pond (sourcing the plants, planting them and landscaping the banks).

3. Choosing the site

A NUMBER OF FACTORS MUST BE TAKEN INTO ACCOUNT:

- Choose a site that is sufficiently large. The minimum surface is 3 m² and can stretch up to several hundreds of square metres. However, sheeting cannot be installed in very large ponds. Therefore you can only dig this type of very large of ponds out in clay soil;
- Make provisions for a water supply. Ideally, a pond should be dug in the lowest area spot of landthe site, to help gather the runoff of rainwater. Failing that, install a rain catchment system nearby so as to fill up the pond (rain harvesting collecting through a roof catchment system for example). In this case, plants with a filtering and de-polluting effect should be placed at the entrance to the pond;
- Make use of natural dips and marshlands if available on the site;
- Do not dig along the edges of a hillock: the edges of the pond must all be at the same level;
- Find a sunny clearing, at some distance from trees, and especially from resinous trees, to prevent the pond from being covered by fallen leaves and excessive shade. However, partial shade in the summer months can help limit the degree to which the water heats up (reducing the level of dissolved oxygen) as well as slowing down the spread of algae (green water);
- For greater safety, ensure you keep clear of any roads or pathways when choosing your pond site. Assess the risk of drowning, and introduce appropriate security measures (protective barrier and sign information panels...);
- To make the site even more pro-biodiversity, dig the pond nearby a hedge, rockery or other wild spaces in your garden or park;
- Incorporate the pond into the ecological continuity (green and blue networks).

4. Digging the pond

It is best to dig the pond between March and September (or before the first frosts) to ensure that the ground is workable and not yet hardened. The advantage of digging it at the end of the summer is that you can then fill it up with the autumn rain.

When designing your pond, include different water depths so as to be able to accommodate a wide variety of different plant species. The recommended maximum depth should be of at least than 80 to 120 cm to help the aquatic fauna when overwintering. The banks of the pond should be slightly sloped to prevent them from collapsing, and also to make it easier for animals to get out if they happen to fall in by accident. Place the gentlest slope on the northern end of the pond so that it is well exposed to the south. The edges of the pond must be curved.

Follow the design plans, though you will need to dig a further 5 to 10 cm of depth to accommodate the thickness of the sheeting and substratum that will be fitted at a later stage. Make sure that you do not burst a hole in the underground pipes by accident.

As for the dirt that is dug out, you can either remove it, or reuse it to raise the northern bank of the pond to protect it from bad weather.

5. Waterproofing

There are a number of ways to waterproof a surface: sheeting, clay and water-repellent concrete... We recommend that you use PVC EPDM sheeting. A layer of pure clay needs to be at least 40 cm thick in order to be fully waterproof. Moreover, the clay is usually extracted from wetlands that are already in a poor state. Unless you want to "take advantage" of a worksite in such areas, we discourage you from using this type of clay. The ideal and most obvious solution is to dig watering holes in naturally clayishey areas that hold water easily.

Before laying the sheeting, remove any protruding elements (roots and stones...). If you are dealing with very stony ground, you are advised to spread a 5 cm layer of sand under the sheeting. Geotextile can also be installed to prevent roots from growing back up, although this is not necessary if a layer of PVC EPDM is being used. We sometimes recommend that you install wire mesh to prevent micro-mammals from piercing through the sheeting. Then lay out the sheeting, making sure that you smooth out any creases, and that you only tread on it barefoot to protect it from damage.

Before filling up the pond with water, add a further layer of earth to the bottom, a few centimetres thick, so as to provide a substrate for plants to grow.

6. Filling the pond

You are then ready to fill up the pond with water. It is best to use rainwater, either by waiting for rainfall, or by using water from a well, or a rainwater tank.

Cut the sheeting to size, ensuring that there is a 40 cm strip lying around the edge of the bank. This strip will be solidly attached to the sides, and hidden under grass or flat stones, or even concealed under the excess dirt that was dug out from the original hole.

Allow for a water outlet, taking care to position it where it will not be affected by flooding.

7. Laying out the plants

There are many sorts of plants that thrive at different depths of the pond:

- Riverbank plants (outside the water)
  Water forget-me-not (*Myosotis scorpioides*), water mint (*Mentha aquatica*), wild angelica (*Angelica sylvestris*), rushes (*Juncus* spp.), sedges (*Carex* spp.), water flag (*Iris pseudacorus*), creeping jenny (*Lysimachia nummularia)*, yellow loosestrife (*Lysimachia vulgaris*[21]), European bugle-weed (*Lycopus europaeus*), purple loosestrife (*Lythrum salicaria*), lily, water-hemp (*Eupatorium cannabinum*), lesser celandine (*Ranunculus ficaria*), marsh-marigold (*Caltha palustris*), great willow-herb (*Epilobium hirsutum*) and marsh willow-herb (*Epilobium palustre*)...

- Semiaquatic plants growing as far as 50 cm deep
  Reeds (*Phalaris* spp.), bulrush (*Typha* spp.), water plantain (*Alisma plantago-aquatiqua*), arrowhead (*Sagittaria sagittifolia*), flowering rush (*Butomus umbellatus*), four-leaf clover (*Marsillea quadrifolia*), watercress (*Nasturtium officinale*) and common reed (*Phragmites australis*)...

- Floating plants
  Water-lily (*Nymphea* spp.), duckweed (*Lemna* spp.), water soldier (*Stratiotes aloides*), frogbit (*Hydrocharis morsus-ranae*), water-crowfoot (*Ranunculus aquatilis*) and marsh pennywort (*Hydrocotyle vulgaris*)...

- Submerged plants, so-called oxygenating plants
  Bladderwort (*Utricularia* spp.) (carnivorous plants), mare's tail (*Hippuris vulgaris*), curly–leaf pondweed (*Potamogeton crispus*) and broad-leaved pondweed (*Potamot natans*)...

Be careful not to plant either Brazilian water milfoil (*Myriophyllum aquaticum*) or Canadian pondweed (*Elodea Canadensis*), as these are both highly invasive species.

Obviously, the species listed here should be adapted to the specific countries and areas where the pond is to be dug.

There are a number of solutions for growing pond vegetation:

- Wait for plants to spontaneously take root. This is a slow process that may become demotivating;
- We discourage you from buying plants at a garden centre. Yet if you end up doing so, make sure that you choose local plants adapted to your pond area, and that you avoid exotic species at all costs, especially invasive plants;
- The best solution is to collect plants and seeds from existing ponds. However, be careful not to remove too many plants, and above all, not to take protected species.

The next stage is to arrange the plants around the banks and inside the pond, either in pots pierced with holes, or directly in the substratum, depending on their root system. You can also use a stone to weigh down the bases during the time it takes for the plants to put down roots.

A few tips

- Do not try to fit in too many plants, because the vegetation will spread naturally of its own in the pond. For smaller ponds, you can start off with two different plants at each level, and then gradually add other species if necessary;
- Respect the specific requirements of each plant (root depth and amount of sunshine...) and the recommended transplantation methods.

Be careful! You should never put any fish into a pond. Beyond the fact that the fish you can buy in shops are usually exotic species, these predators have a particularly detrimental effect on the balance of small ecosystems such as ponds.

8. Landscaping the banks of the pond

You can landscape the banks to offer room and board to a wide variety of animals, while reinforcing the role of the pond as an ecotone. A good option would be to put up a multi-layered hedge, or set up hibernating zones (scree and woodpiles...) or hibernacula around near the edge of the pond.

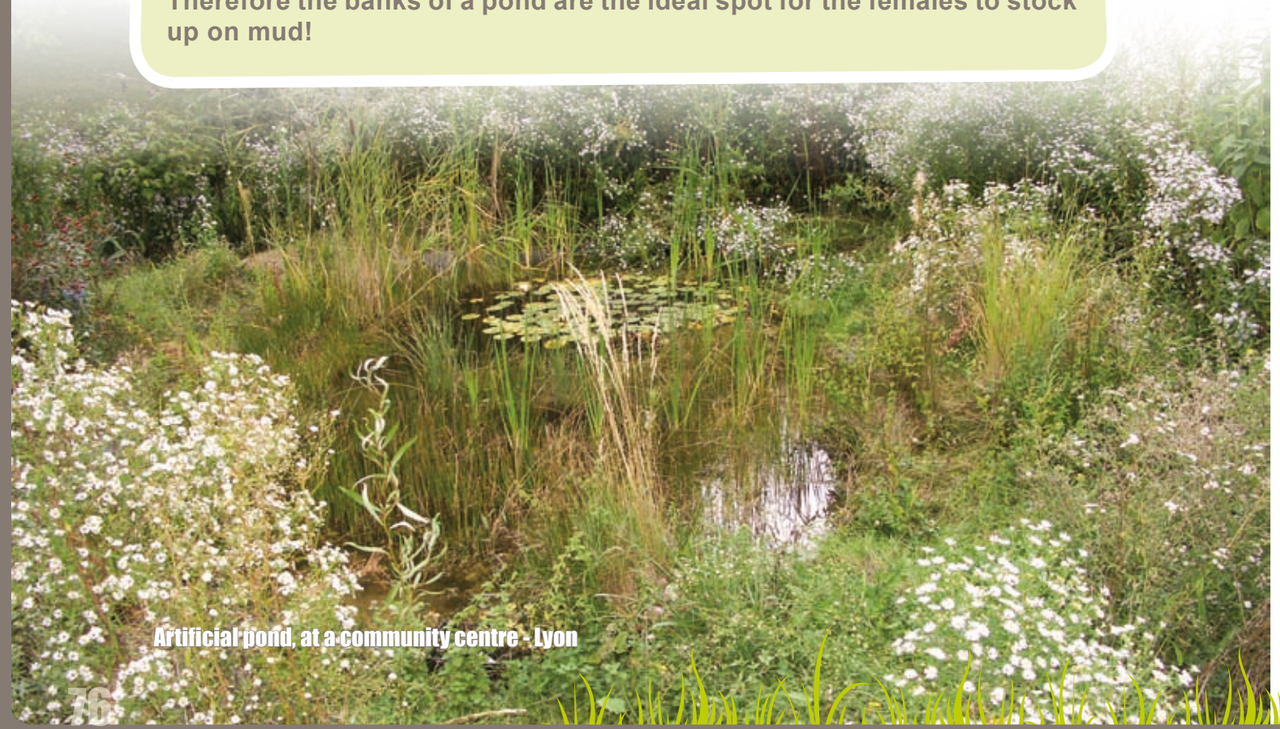
9. Looking after your pond

Once a pond has been installed, it requires very little care. It gradually finds its own balance, and develops clean, translucent water, which is a sign of good health. This process is a natural mechanism that can take a number of months. Furthermore, you may see some plants proliferate (duckweed - *Lemna* spp., algae,...): this is a normal phase that continues until the pond has stabilized its physico-chemical conditions. If any vegetation starts to get overgrown, you can remove some plants. However, take care to first shake them over the pond to avoid carrying away small animals, and potentially leading them to their death. You may also need to clean out the pond after a few years to stop it from silting up. This "cleansing" is carried out in the autumn, once the breeding period is over.
During cleaning operations, once you have removed the silt and plants, make sure you lay them out for a few days on a gentle slope on the banks of the pond so that small creatures have a chance to get back to the water.

To avoid water eutrophication, cut down on mowing in the vicinity, and pick out large leaves that fall into the water in autumn. By keeping a strip of tall grass around the edge of the pond that is only cut once a year, you will be enhancing biodiversity, stopping grass clippings from falling into the water, and making it harder to access the pond.

Did you know?

Certain bee species that build their nests in hollow plant stems and in logs pierced with holes use moist dirt to build their larval cell walls. Therefore the banks of a pond are the ideal spot for the females to stock up on mud!



Artificial pond, at a community centre - Lyon

E.2 - Planting a country-style hedgerow

Wild hedge
City of Die

A vegetative living hedge, beyond its aesthetic appeal, also acts as a highly effective windbreak, and is a welcome source of shade for city dwellers in the summer. It regulates rainwater, traps pollution and dust, and, when planted along the edge of a road, it can block out the noise from cars to some degree. Hedges can create a pen for livestock, and provide fruit and firewood, although these uses are less common today. In addition, it can be a rich food source, a breeding ground, and offer shelter for a wide variety of animals.

Hedges are buzzing transit corridors that successfully help to reinforce ecological continuity.

1. Choosing the site

Choosing the exact site and composition of a hedge depends on your objectives: will it be a windbreak, will it divide up the land, or act as a thicket in a park...? Whatever the case, contact your local municipality to find out about current regulations for planting distances and heights, especially when planting a hedge between two properties, on the side of a road or near power lines.

2. Composing the different layers of the hedge

A wild hedge is a linear form of woodland that is typically 1 to 5 m wide, arranged in a number of rows, and made up of 4 strata:

- a tree stratum measuring 10 m high or more;
- an arborescent stratum measuring 2 to 4 m high;
- a herbaceous stratum measuring up to 1.5 or 2 m high;
- a moss stratum just above the surface of the ground, made up of moss, fungus, scree and muddy ponds...

These different levels of vegetation work in synergy, complementing each other and providing animals with the variety of resources that they need. Take care to choose a wide range of plant species, and stagger the flowering and fruiting periods to ensure a rich food supply all year round.

Preferably choose native plant species that are adapted to the local environmental conditions as well as to the needs of the local fauna, and avoid invasive plants altogether. To cut down on excessive maintenance work, choose plants that fit the given space, taking into account their size at full adult growth.

When laying out the hedge, make sure you place small bushes on the southern side of trees to guarantee them maximum sunlight.

1 - Black haw (*Viburnum* spp.)
A bushy shrub that can grow 2 to 4 m high, flowering from March to July, depending on the species. Its flowers attract many pollinators.

2 - Willow (*Salix* spp.)
A tree that can grow up to 20 m high, and flowers blooms from February to March. Beehive Honey bee colonies gather the propolis from its buds and bark.

3 - Maple tree (*Acer* spp.)
A tall tree that can grow 10 to 40 m high. It is an excellent source of firewood and its branches can be used to make RCW.

4 - Box wood (*Buxus* spp.)
A bush that has leaf cover all year round. It provides an ideal shelter for overwintering or hibernation to some small mammals, including hedgehogs.

5 - Apple tree (*Malus* spp.)
A tree that blossoms in the spring. Its flowers attract many pollinators, and its fruit is popular with birds, mammals and park visitors! Make sure you choose a hardy rootstock.

6 - Privet (*Ligustrum* spp.)
A bush that can grow up to around 3 m high, flowering at the end of the spring.

7 - Dog rose hip (*Rosa* spp.)
A bush whose flowers attract pollinators, and whose fruit is popular with birds.

8 - Bramble (*Rubus* spp.)
A thorny shrub. Its flowers and fruit make it very popular with pollinators, birds and many people too.

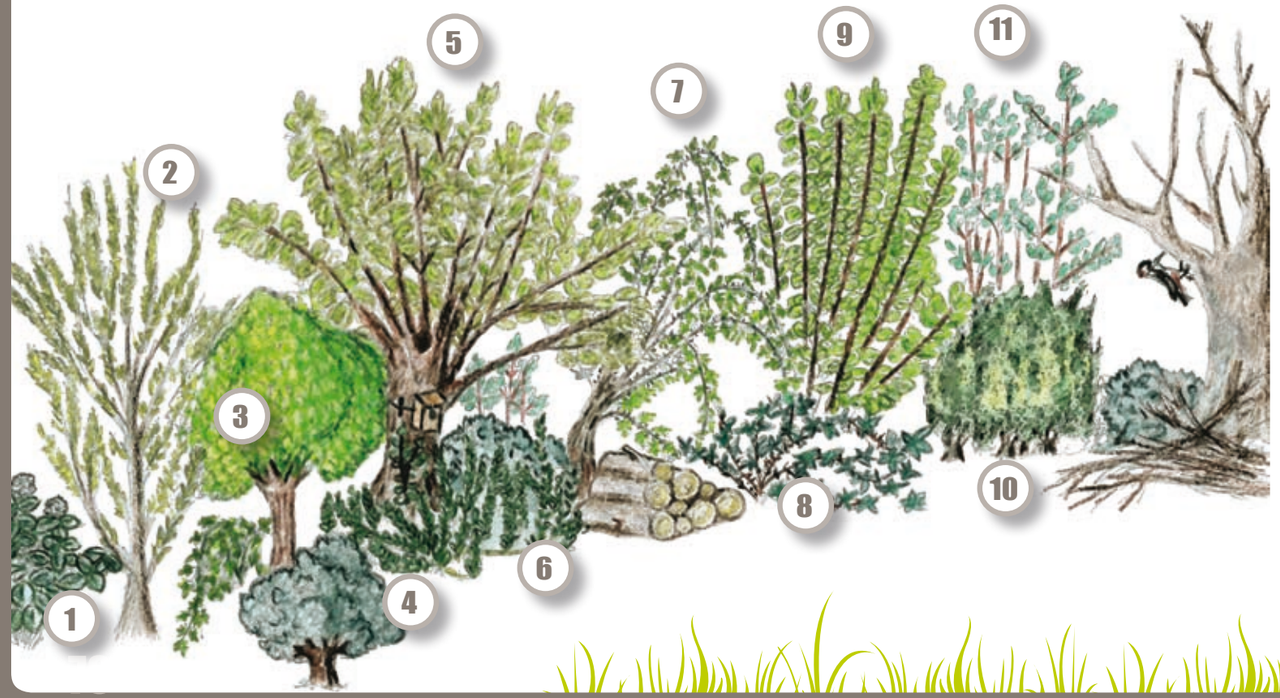
9 - Hazelnut tree (*Corylus* spp.)
A tree growing 3 to 8 m high, and flowering between January and March. Its seeds are much sought after by small mammals.

10 - Blackthorn (*Prunus spinosa*)
A bush that flowers in spring. Its flowers attract many pollinators, and its fruit is very popular with birds.

11 - Dogwood (*Cornus* spp.)
A tree or bush that grows 2 and 12 m high, depending on the species. Its flowers appear at the start of spring, and are highly coveted by pollinators.

Here are a few more planting suggestions: oak (*Quercus* spp.), ash (*Fraxinus* spp.), honeysuckle (*Lonicera* spp.), holly (*Ilex* spp.), ivy (*Hedera* spp.), elderberry (*Sambucus* spp.), birch (*Betula* spp.), wild cherry (*Prunus* spp.), poplar (*Populus* spp.), spindle (*Euonymus* spp.), and chestnut (*Castanea sativa*)...
You can also plant fruit trees and bushes: not only will this delight all those who like a good nibble, but if you plant them near low bushes, or trees that have been clipped low, then they will thrive all the more thanks to all the beneficial insects busying about in and around the hedge.

Avoid invasive plant species at all costs (such as maple ash - *Acer negundo*, black locust - *Robinia pseudoacacia*, hall's honeysuckle - *Lonicera japonica*, tree of heaven - *Ailanthus altissima* and summer lilae or butterfly bush -*Buddleja davidii*...) [22] or species that are poisonous to bees (silver lime - *Tilia tomentosa*).



3. Sourcing the plants

The best way to find plants that are adapted to the local land conditions is to go out gathering in the natural areas surrounding the spot where you plan to plant your hedge. We recommend this method for private gardeners. However, you must gain permission from the landowner before helping yourselves to any plants, and you should only take a reasonable quantity.

If you have decided to buy your plants from a nursery, obviously choose native plant species and ask for bare root plants, which guarantee that the plants are fresh, and therefore resistant.

4. Preparing the soil

Tamper with the soil as little as possible so as to maintain its natural biological balance. Start work at the end of the summer or the start of autumn, and simply spread out a layer of mulch made up of straw or chopped-up wood, 15 to 20 cm thick, across the surface you wish to plant.

5. Planting the hedge

Planting takes place in the winter, between November and March. The ideal period is the start of winter, before the first frosts, to make sure the roots have enough time to anchor themselves firmly in the soil during the cold season.


Planting a hedge

- Never prune the roots! Contrary to popular belief, cutting back the ends of damaged roots does not help the tree to recover its root system more quickly, but rather forces it to start the whole process of compartmentalisation all over again, which involves walling off the dead matter;
- Coat the roots by dipping them into a mix of clayish soil, cow dung and water, in three equal measures. Ensure that you use rainwater, and cow dung that has not been treated with dewormer;
- Dig a hole in the mulch and in the ground;
- Plant the bush or the small tree;
- Seal the hole by filling it up with a large amount of water;
- Put the dirt back in place. The collar of the tree (the swollen base) must be placed at ground level;
- Using your feet, pack the soil tightly around the foot collar of the plant and put the mulch back on top.

You can plant 2 or 3 rows of bushes and trees, but make sure you space them out sufficiently (the plant distance between adjacent plants should be at least 70 cm to 1 m). It is even better to have a double or even triple-layered hedge: the thicker it is, the more effective it is as a windbreak, and the better ecotone it creates.

6. Maintaining the hedge

If a hedge is properly designed, then it keeps maintenance to a minimum. Regularly add mulch during the first few years, and cut away any grass growing at the foot of the hedge to avoid competition with the bushes.

To guarantee plant regrowth, you can water the hedge for the first two or three years if necessary. It is better to water each bush or tree one by one, in copious quantities and spaced out over time. Water needs are highest in the spring when the first green shoots start popping up, whereas in the summer it is more a case of ‘survival’ watering.

Avoid pruning as much as possible. However, if it is really necessary, then shy away from mechanical clippers that crack the wood fibre into splinters, and opt instead for sharp, properly maintained cutting tools to get a clean cut: use secateurs clippers and a pruning saw-knife for small-scale pruning and a disc hedge trimmer for large-scale pruning.

7. Tailoring out your hedge to become a haven for biodiversity


Nest boxes

You can tailor your hedge to enhance biodiversity even further by installing nest boxes for birds, small mammals and insects. When you have finished pruning the trees, remember to leave the wood cuttings in place as they will provide useful refuges and wintering sites for numerous animals. Dead trees, whether standing or lying on the ground, can offer a home to a wide variety of saproxylophagous species that feed off dead wood, but also to many other occupants such as birds, bats, and various other insects that use the cavities for nesting or finding shelter in winter. To keep on the safe side, a dead tree that is still standing can be pruned down to the trunk.

Bonus idea

A hedge is the ideal place to set up a compost heap, as it will be kept out of the heat and rain, and stay hidden from view.


Hedge in autumn

E.3-Installing a large-scale bee hotel, a nesting wall

Urban flower beds push the quest for 'neat and tidy' to extremes: debris from pruning and dead wood are removed, lawns are clipped short, and dead plants are pulled out… And now we have a housing crisis for cavity-nesting bees! Remember that the 30 % of bee species that nest in hollow plant stems and wood are suffering from a severe shortage of nesting sites.

Why not make room for them in your parks by building a bee hotel? These foraging insects may not pay rent, but they will certainly make up for it with their trusty pollinating services offered to surrounding plants, plus a wonderful show in store for visitors.

Download the instructions on how to build a nesting wall – a single-column bee hotel – by visiting our website at this address:

http://www.urbanbees.eu/sites/default/files/ressources/Notice_Hotel-Urbanbees_Collectivite&Entreprise.pdf

1. Cost of wooden structure

Count around €1,200, including delivery and installation. This estimate is based on **URBANBEES** installations in France, in 2012. Consider getting in touch with your local structure for social integration, to see if they would be interested in getting involved.

2. Working time needed

X 2 to 3 man-days.

This includes the research phase, plus sourcing and preparing the filling materials (cutting logs to the right length, boringdrilling the holes, tree pruning and cutting the hollow plant stems), and finally filling the hotel.

3. Total cost

An estimated €2,600 (based on the average hourly wage in France in 2012), for a single-column nesting wall. This covers preparing the ground, building the wooden structure, preparing the filling materials, the time needed for filling the hotel compartments, boring the holes in the logs, installing the chicken wire netting and adding the finishing touches. Once the nesting wall has been built, unless it is vandalized, there will be no need for any maintenance for a number of years.

4. What materials should I use as filling?

Each of the three compartment in an **URBANBEES** single-column nesting wall has a volume of 0.5 m^3. When filling with stems, make sure that you have at least 3 times the amount of material, as they need to be packed tightly into the spaces provided in the nesting wall. Cut the stems and logs to the same length as the depth of your nesting wall (here: 50 cm).

5. Hollow or pithy plant stems

Hollow stems

- phragmites (reeds), hogweed (*Heracleum* spp.), wild carrot (*Daucus carota*), fennel (*Foeniculum vulgare*), giant reed (*Arundo donax*); or recycle certain exotic species: Bamboo (Bambusoideae), Catalpa, bamboo, Paulownia and Japanese knotweed (*Reynoutria japonica*)…

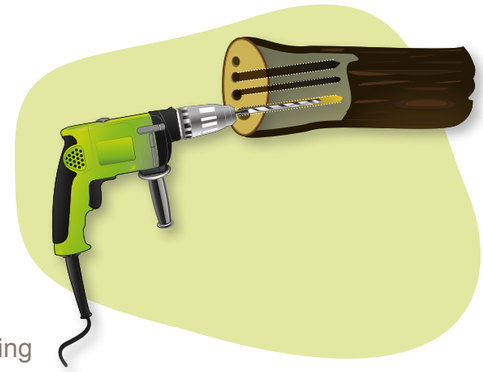

Wild carrot

Pithy stems

- raspberry bushes (*Rubus idaeus*), brambles (*Rubus* spp.), rose bushes (*Rosa* spp.); or certain exotic species: tree of heaven (*Ailanthus* spp.), deutzia (*Crenate deutzia)*, perennial sunflowers (*Helianthus* spp.), and hydrangea (*Hydrangea* spp.)…

Cut the stems to the required length at the node, or seal one of the ends; it is important that at least one of the two ends is left open, or that the node is positioned in the centre (that way there is an entrance on both sides).

6. Wood



Certain bees often lay their eggs in cavities dug out of wood by beetles. You can help speed up the process by drilling your own holes in the logs. To accommodate a wide diversity of species, drill holes that range from 3 to 120 mm in diameter, and which are 10 to 20 cm deep. Drill at a slight angle to make the holes slant upwards to stop rainwater from getting in. Make holes on all the faces of the log, being careful not to join up the cavities as one.

Ensure you use wood that has not been treated.

It is also best to choose a diverse selection of wood species to cater for the maximum number of different bee species. Avoid using wood that is too fibrous (as this will tend to leave bits of wood fibre sticking out inside the passage ways that have been dug out, rendering them useless to bees) or too dense (which will make it particularly hard to drill holes in the logs). Freshly cut resinous wood is also to be avoided, because it can repel certain some bees.

URBANBEES RECOMMENDATIONS

The field research carried out on the various bee species nesting in URBANBEES bee hotels helped to uncover their preferences for certain species variety. In view of these findings, we recommend that you use a diverse assortment of wood and stems, and in particular:

- **for the logs: poplar, sophora, plane trees (*Platanus* spp.) and elderberry;**
- **for the stems: bamboo, tree of heaven (*Ailanthus* spp.), giant reed and summer lilac (*Buddleia* spp.).**

7. Where should I put my bee hotel?

You should set your bee hotel somewhere sheltered from the wind, with one of the open sides facing southeast. There should be access from both sides, because certain some bee species prefer sunny cavities, whereas others prefer the shade for nesting.

The bee hotel must also be near a source of food. A good tip is to build an insect spiral nearby for growing aromatic plants.

8. A few tips to make life easier!

As filler, why not reuse debris collected up from tree or bush pruning work that has been carried out by the city or local gardeners?


Eco-volunteer day

Be encouraged to set up eco-volunteer days, which are open to the public, and aimed at preparing the materials needed to fill the bee hotels, while simultaneously raising public awareness on the importance of protecting wild bees as a means of enhancing biodiversity.

The model that we have given you here is only an example. Unleash your creativity: give a second life to used items and materials (crates and pallets...), take over street furniture, build bee hotels in all shapes and sizes... If you fit out the different compartments with the appropriate materials (straw, stones, perforated bricks...), then you can also provide lodging for an even wider diversity of small animals.

9. My bee hotel is buzzing with life!

Throughout spring, summer and all the way till autumn, you will be able to get a close view of at the different bee species busying away building their nests in your bee hotel.

Each female builds her own nest to lay several eggs. Each egg is enclosed inside a larval cell that contains enough food reserves for it to reach full adult growth. These reserves are called bee bread, which is made up of a mixture of nectar and pollen. Once the eggs have hatched, the female closes up the hole with different materials, depending on the species: mud, a mixture of dirt and stones, plant hairs, leaves, petals and resin… By studying the different types of opercula, you will be able to assess the presence and abundance of the various creatures staying in your bee hotel.


Red mason bee (*Osmia bicornis*) bringing back mud to close the entrance to its nest

10. Bee hotels - excellent communication devices

In a park, a big wooden structure such as a nesting wall is guaranteed to attract attention from visitors. Take advantage of this exposure to make both the youngs and adults aware of the importance of protecting bees and conserving biodiversity.

Special panels have been designed to be displayed next to all **URBANBEES** installations, and also to give information about the diversity of wild bees and their nesting habits. Feel free to contact us for free posters that you can then adapt to your own needs by either translating the text, or adding the logo of your local authority.

Example of an information panel put up on the URBANBEES sites

Also consider approaching naturalist associations in your region to set up activities and events near the bee hotels, as well as naturalist walks or nest-building workshops.


Nest-building workshop

E.4 - Installing an insect spiral

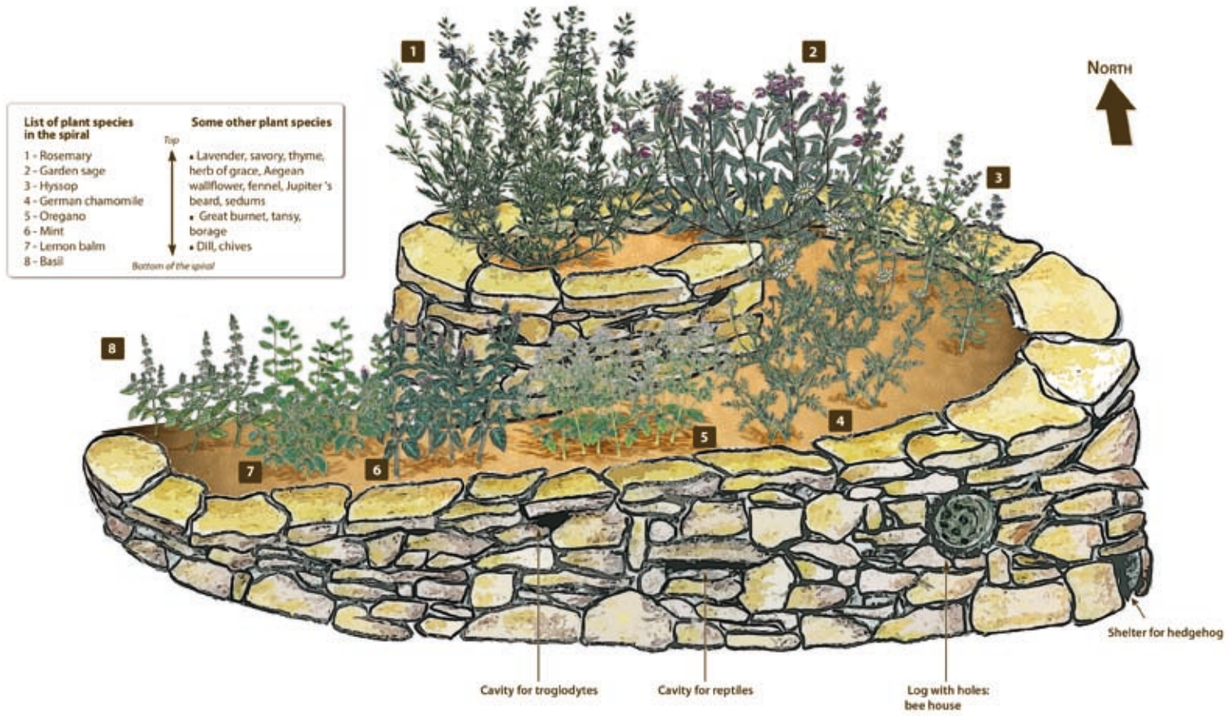
Behind this intriguing name lies simply a low stone wall, that is built up in a spiral shape, and topped with lean soil and stones. The basic principle is simple: warm up and dry a layer of light soil to encourage the growth of aromatic and nectariferous plants that pollinators love. And it does not end there! A multitude of small animals (bees, ladybird beetles, spiders, lizards...) can find room to nest at the base of the spiral, if it is weeded, or between the stones. By carefully shaping niches and nesting sites, you can transform your spiral into a haven of peace for numerous hedgehogs, reptiles or cavity-dwelling animals.

1. Materials

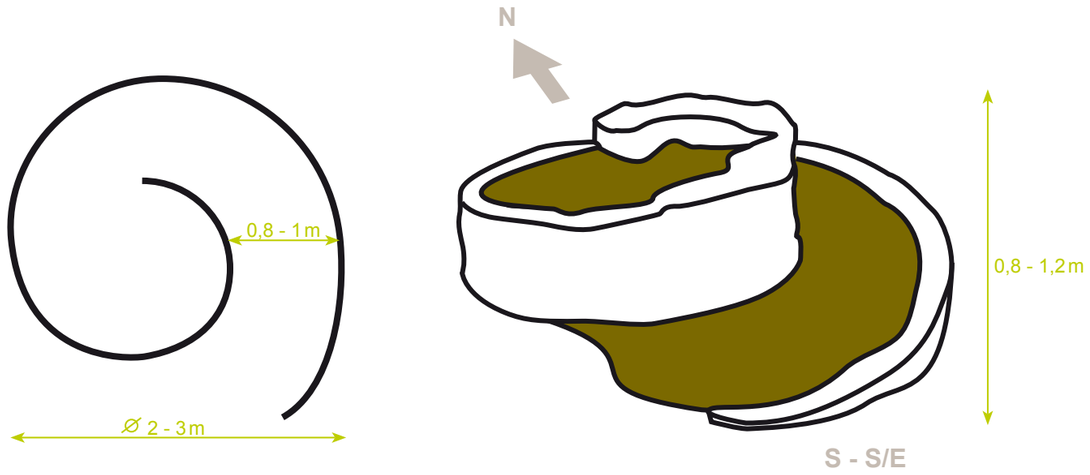
- ☑ around 3 m^3 of large flat stones
- ☑ 150 to 200 kg of sand
- ☑ 75 to 100 kg of NHL 3.5 natural hydraulic lime (EN459-1)
- ☑ around 0.7 m^3 of rounded stones measuring 2 to 3 cm in diameter
- ☑ 1 to 2 m^3 of mineral soil (poor soil)
- ☑ 1 m^3 of lean topsoil; this can be recycled from excavated soil
- ☑ aromatic plants

2. Equipment

Mortar box, wheelbarrow, cording, shovel, pickaxe, stakes, bucket, trowel.



3. Dimensions and orientation



4. Working time needed

Construction, filling and planting:

x 4 man-days for a spiral built using mortar
x 18 man-days for a spiral built out of dry stones

5. Maintenance

1 hour per month to keep the areas of exposed dirt cleared of weeds.

6. Cost

€2,000 for building the spiral, buying the materials, filling it and covering it with plants.

Some advice before getting started

- **Use locally sourced or salvaged stones to cut down on costs and transport.**
- **Make sure you pick a sunny spot.**

7. Building the Structure

Step 1: The base outline

- Trace the outline of the spiral using stakes spaced one metre apart. Keep a sufficiently wide strip of area (0.8 to 1 m) between the stakes to define the centre and the exterior of the structure. This will later make it easier to tend the aromatic plants.


Base outline of the spiral

Step 2: Excavation

- Dig a hole 20 cm deep inside the stakes, and slightly wider than the low wall structure (add 5 cm on both sides of the low wall). The size of this hole will vary between 30 and 40 cm, depending on the size of the stones you use for building, and will help ensure a more stable structure.
- Finally, fill the hole with a drainage layer made up of sand and rounded stones.


Excavation

Step 3: Building

- Start by placing the stones next to each other, one by one, following the outline of the spiral to create the base layer.
- Prepare the mortar by mixing up one shovel of lime for every two shovels of sand, and then add water. The mixture should not be too liquid, but rather have a jam-like consistency. A good way of checking is to stir the mixture with your trowel: a milky trail should appear.
- Wet each stone thoroughly and then bind them with joints of lime. It is best to bind in the inner part of the spiral so as to hide any unattractive parts, but also to keep the animal refuges on the outside of the structure.
- To get a visual idea of the slope in the structure, thread up the stakes with the cording. The stones should then be piled up in staggered rows on top of the base layer, starting in the centre. Bind the stones with joints of lime mortar, and then continue laying out and binding the structure in successive rows until you reach up to the cord.


Gravel bed


Base layer


Building

Step 4: Filling

- Fill up the spiral; first with rounded stones, then sand, and finally with mineral soil, making sure you follow the line of the slope.
- Then add a thin layer of lean topsoil.


Building

Step 5: Planting

- The temperature and humidity at the top of the spiral are not the same as at the bottom, so you need to take this difference into account when choosing what to plant where:
  - at the top, where the soil is driest: lavender (*Lavandula* spp.), hyssop (*Hyssopus officinalis*), wild basil (*Clinopodium* spp.), thyme (*Thymus* spp.), rosemary (*Rosmarinus officinalis*), herb of grace (*Ruta* spp.), wallflower (*Cheiranthus cheiri*), fennel (*Foeniculum vulgare*), Jupiter's beard (*Centranthus ruber*) and sedums (*Sedum* spp.)...
  - down the sides: great burnet (*Poterium* spp.), tansy (*Tanacetum* spp.) and borage (*Borago* spp.)...
  - at the base of the structure: dill (*Anethum graveolens*), oregano (*Origanum vulgare*), basil (*Ocimum basilicum*), chives (*Allium schoenoprasum*), mint (*Mentha* spp.) and lemon balm (*Melissa officinalis*)...
- You can stagger your planting throughout the year, except during periods of frost or drought, or during a heat wave. If you choose annuals like basil, then you should plant them in the spring, after the last frosts. In the autumn, plant only the aromatic plants, as their root system is hardy enough to brave the winter.
- Make sure you space out the plants around 40 cm apart. As each year passes, they will fill out and will soon cover the whole spiral.
- Finally, by keeping the ground exposed, you will not only stop grass from growing but also provide the dry, warm microclimate that is so vital for encouraging aromatic and nectariferous plants to grow. Moreover, you will enable burrowing insects to take up residence, especially hymenopterans such as Sphecidae, some wild bees and ants. And this means hand weeding!


Insect spiral with aromatic plants – Ecocentre du Lyonnais – La Tour de Salvagny city

E.5 - Building a wild bee house – model for gardens and balconies

Cavity nesters are always on the lookout for hollow plant stems and all sorts of other cavities to build their nests. Why not provide a home for them in your garden, on your balcony or window ledge by installing a wild bee house? That way you can get a closer look at these fascinating little creatures. The basic principle is simple: fill up any structure of your choice (either made or reused) with nesting materials (hollow or pithy plant stems and logs pierced with holes).

1. Equipment

- ☑ structure of the bee house
- ☑ hollow or pithy plant stems
- ☑ a few logs cut to the right length, adapted to the size of the structure
- ☑ a branch cutter or secateurs
- ☑ a drill with a bit measuring 3 to 12 mm

2. Working time needed

X 30 minutes to 2 hours depending on the structure chosen

To build the structure you can download the instructions available on the URBANBEES website (*http://urbanbees.eu/pageressources/outils-program*) or simply give free rein to your imagination. For instance, you can recycle all sorts of objects such as a wooden vegetable crate, terracotta flowerpot, an old letterbox or some PVC pipe...

Wild bee hotel installed in the city

3. Filling

The filling materials (logs pierced with holes, and hollow and pithy plant stems) are similar to those used to fill the nesting walls. Therefore, for the full details you can refer back to part E-3 page 83.

4. Installation

It is important to choose a sunny spot (facing south, southeast or southwest) sheltered from the wind. The bee house can be placed between 30 cm and 2 m high to prevent certain predators from disturbing our friendly foragers, and also to prevent moisture from being absorbed up from the soil.

5. Do I have guests in my bee house?

Throughout the spring and summer, you will be able to get a close view of the different bee species busying away building their nests in your hotel.

Each female builds her own nest to lay several eggs. Each egg is enclosed inside a larval cell that contains enough food reserves for it to reach full adult growth. These reserves are called bee bread, which is made up of a mixture of nectar and pollen. Once the eggs have hatched, the female closes up the hole with different materials: dirt, a mixture of dirt and stones, plant hairs, leaf pieces and resin… By studying the different types of opercula, you will be able to assess the presence and abundance of the various creatures staying in your bee house.

Leaf fragment used to close up the nest of a leaf-cutter bee

Carpenter bee larvae inside a wood tunnel

URBANBEES Idea

Organizing a nest-building workshop is an excellent way of teaching people more about protecting wild bees. Geared towards adults as much as children, these events can help people take concrete steps towards conserving and enhancing biodiversity.

Use a spacious room, or an outside area, and equip the participants with all the nesting structures they need, plus filling materials, branch cutters and drills. Help them to build a bee hotel, guiding them through each step, and meanwhile using the time to pass on useful information about wild bees. You can also approach an environmental education association to see if they would be interested in setting up these workshops.

E.6 - Installing nest boxes for beneficial insects

Whether you are dealing with predators, scavengers or pollinators, beneficial insects count amongst the gardener's most precious allies. Why not landscape a little space for them in the corner of your garden or park?

Nest box, hotel, house or shelter?

A nest box offers a nesting site for insects (in this case, they are widely known as 'hotels') or birds that are cavity nesters, or only partially so.

A house is used by mammals, mainly as a shelter against the winter cold, or by female species giving birth.

A shelter is used by animals that are seeking protection from the rain and cold.

This is the general rule. However, as you will see from the examples below, there are other names commonly in used for these types of structure.

An earwig hotel


Earwig *Forficula* sp

Earwigs (Dermaptera) are utterly harmless insects that owe their misleading name to the pair of cerci at the tip of their abdomen. These pincher-like appendices are meant to scare off predators, but they mainly appear to be used for mating and looking after eggs.
Earwigs start to busy about at sunset when they go out in search of food. On the menu: plant debris, ripe fruit, aphids and other small animals that hinder plant growth. During daylight hours. they take refuge in dark, damp areas: under leaves or tree bark, and in between the petals of flowers...

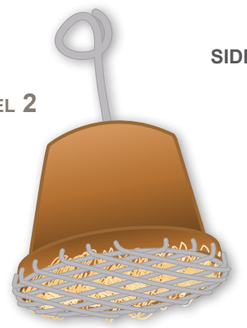
The earwig shelter is tiny. This shelter is simple and easy to make yourself, with very little equipment: an ideal way of becoming acquainted with the nuts and bolts of Do It Yourself.

1. Equipment

- ☑ an average-sized terracotta plant pot
- ☑ iron wire
- ☑ straw
- ☑ cutting pliers
- ☑ wire mesh or 2 sticks depending on which model you have chosen

SIDE VIEW

MODEL 2



MODEL 2

TOP VIEW

2. Working time needed

X 15 to 20 minutes

3. How to make it

MODEL 1

- Lay straw inside the flowerpot;
- Cut the wire mesh to size, so that it stretches wider than the mouth of the flowerpot;
- Place the mesh over the mouth of the pot, and fold the edges over the sides to keep the straw firmly held in;
- Roll the wire around a small stick and then thread the other end through the mesh and tie a loop to hold it fast, by blocking the stick across the hole at the base of the flowerpot.

MODEL 2

- Lay straw inside the flowerpot;
- Attach the two sticks in a cross shape by tying them together in the middle with wire;
- Thread the wire through the hole at the base of the pot;
- Roll the wire around a small stick and tie a loop to hold it fast on the inside of the base of the flowerpot.

4. Installation tips


Earwig hotel

Hang the earwig hotel on a tree, or stand it on the ground. Leave it in place for a few days, and then move it close to an aphid colony. Only move the nest box during the day while the earwigs are hidden inside. At sunset; they will come out of their hiding-hole and most probably head towards this aphid colony as a source of food.

Set up your shelter in springtime. Earwigs have a sweet tooth and they certainly would not say no to some ripe fruit once the aphid supply has dwindled. Therefore make sure you move your nest box once the aphids have disappeared.

Did you know?

At sunrise and throughout the day, you can find earwigs hiding in between the leaves of salad plants, and under bits of bark…. This can be met with suspicion on the part of gardeners, especially when it coincides with finding damaged plants elsewhere in the vegetable garden. These earwigs are often wrongly accused of being pests, when the opposite is the case: during the daytime, earwigs like to take shelter from the sunlight, and they usually hide in the same place as where they were busy working the previous night, hunting and eating aphids and other insects which damage plant growth in vegetable gardens.

A ladybird shelter

There are not many creepy crawlies that arouse heartfelt sympathy: ladybirds are therefore an exception to the rule, as adults as much as children are always delighted when they see one. This gleaming reputation may, indeed, have something to do with their rampant appetite for aphids. These insatiable carnivores devour enormous quantities of aphids throughout their life, both as larvae and fully-grown adults. And so they have on a truly precious role in the garden. In return, the least we could do is give them a helping hand by building them a small shelter for the winter. As winter approaches, any natural crevice will do to act as refuge, as long as it is wide enough.


Seven-spotted ladybird
Coccinella septempunctata

Did you know?

A ladybird larva consumes tens of aphids per day, and several hundreds during its larval development. The adult ladybird beetle also eats many aphids per day. It would be sad not to use such useful habits.

1. Equipment supplies

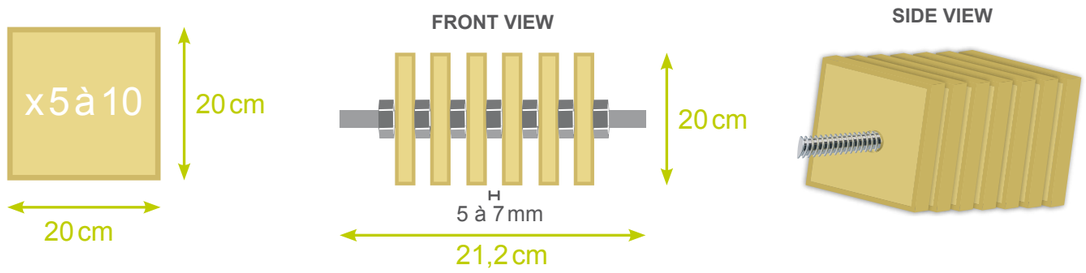
- ☑ 5 to 10 square-shaped boards of wood with a hole pierced through the middle (20 cm X 20 cm - thickness: around 2 cm)
- ☑ 1 threaded rod
- ☑ 6 to 12 nuts

2. Working time needed

X1h

3. Dimensions

H : 20 cm - D : 20 cm - L : 21,2 cm



4. How to make it

- Screw the 1st nut on to the threaded rod, until it is around 2 cm from the top.
- Slide the 1st wooden board on to the threaded rod until it is touching the nut.
- Screw another nut on to the rod.
- Continue piling up in this fashion, alternating between boards and nuts.
- Screw on the last nut.

5. Installation

Preferably in a sunny area, sheltered from the rain and wind.
Orientation: south / southeast

6. Advices

1 To take full advantage of the help that ladybirds provide, it is imperative to allow a certain number of aphids to set up home in the area. If there is not enough food supply, then the ladybirds will turn their backs on your vegetable garden. Therefore you need to be prepared to see a few plants colonized by aphids.

2 Whatever model you have chosen to build your shelter, you must keep a gap of 5 to 7 mm maximum between each board: any wider than that, and you may be opening the way to predators.

Did you know?

So-called harlequin ladybirds or *Harmonia axyridis* were originally introduced to control pests. More voracious than their native equivalents, at the time they appeared to be a great (and marketable) asset. However, experience and observations have proven that they have a negative impact on native ladybird populations, in particular due to the competition for food. Furthermore, certain harlequin ladybird larvae have been seen to eat up other ladybird larvae when food supplies have run dry. It would also appear that its introduction from Asia sparked off competition with native species.


Invasive harlequin ladybird *Harmonia axyridis*

A green lacewing shelter

This slender insect is easily recognizable, thanks to its transparent and heavily ribbed wings. Known for its discreet nature, it has a thin, delicate appearance, and is mostly active at night. Whereas the adult green lacewing loves to gorge on pollen, its larva is a formidable predator of aphids (Aphididae), scale insects (Coccoidea) and whiteflies (Aleurodidae) with the powerful mandibles that stretching out from its head. Therefore because of their feeding habits, lacewings are considered to be amongst the most beneficial appetites in the garden. Just like ladybirds, adult green lacewings use small spaces in which to hibernate and find refuge, so as to prevent any predators from getting in.


Adult green lacewing
Chrysoperla sp.

Did you know?

A lacewing larva consumes tens of aphids per day, and several hundreds during its larval development (while the adult visits flowers to feed).

The use of different types of nesting devices together enables one to host an array of small creatures that can combine their action against the spread of insects that are considered as pests.

1. Equipment materials

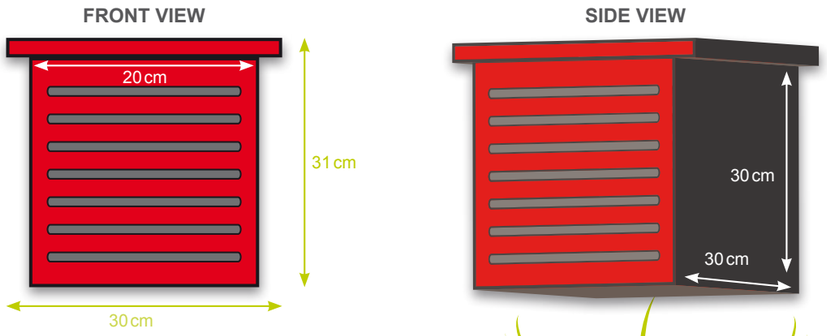
☑ 1 plank of untreated wood, 1.80 m long and 30 cm wide (choose a plank no less than 1 cm thick)
☑ woodscrews
☑ straw or corrugated cardboard (untreated and without ink printing)
☑ 2 hinges

2. Working time needed

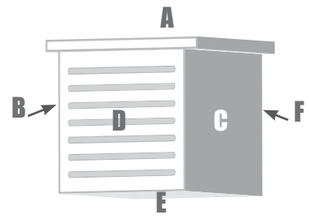
X ½ a day (including filling)

3. Dimensions

H : 32 cm - D : 30 cm - L : 30 cm



4. How to make it



- Cut up the plank into boards following the plan below;
- Pierce openings in the board that will serve as the facade by making horizontal slits (each slit measuring 0.2 cm to 0.8 cm wide);
- Assemble together the five boards that are 'full' (without slits) to form a sort of box shape;
- Lay straw or corrugated cardboard inside, and press down lightly;
- Close up the front of the box using the board slit with holes. If possible, slit the holes at an angle to prevent water from getting in;
- Paint the whole structure red (make sure you use natural paint, or mix up your own paint from red ocre).

5. Installation

Preferably choose areas sheltered from intensive sun exposure to stop the insects from emerging from hibernation too early.
Install it at a height, sheltered from the rain and wind.

6. Advices

1 The slits in the door must ideally be cut so that water does not go into the shed. To do that, it is necessary to use a miter saw.

2 If you do not have access to a miter saw, you can drill lines of holes that are at a ca 30° angle in place of the slits.

Did you know?

The adult females lay their eggs on the underside of leaves where they stay held in place thanks to a very thin peduncle (stalk), which makes it look as if the eggs were floating in midair.


Green lacewing larva

7. Natural shelters...

You don't have to be a DIY genius to get involved, as everyone is capable of offering shelters to garden animals. For instance, a simple pile of wood, stones or branches can make a perfectly good refuge to a wide range of species: such as insects, birds, amphibians, reptiles or small mammals.

E.7 - Boost the ecological potential of buildings


Green wall - Avignon city

Buildings are often seen as being an obstacle to urban biodiversity. Yet with the help of numerous tools, a building can be woven into the fabric of ecological continuity and turned into a contributing factor, not a barrier. Green roofs and green walls, nest boxes or flowering borders are all elements that can be incorporated into a building as early as at the design phase or during subsequent work. By landscaping buildings used for public administration, as well as schools and even historical monuments, local authorities will become role models, and provide inspiration to launch private initiatives.

Do not hesitate to refer to the excellent guide published by the LPO (French National League for the Protection of Birds) and the CAUE Isère (Council of Architecture, Urban Planning and the Environment for the Isère region of France) on biodiversity and the built environment (see the section *To explore even further*...).

1. Enhance the built environment

By their very nature alone, houses and block of flats can offer tremendous advantages to biodiversity. Self-seeding plants and small creatures can find a home in the cracks in walls, while bats and nocturnal raptors can take up residence in the roof areas...

And you can go a step further by installing nest boxes to house birds, insects, and mammals. These installations can be attached to walls or under roofs, or directly built into the structure of the building.

Be sure to choose the right nest box:

- Each species has its own nesting requirements (materials, height and colour...). Make sure you respect these requirements when selecting your nest box.
- A nest box must be fixed at the right height. Insect hotels should be between 30 cm and 2 m above the ground, nest boxes for cave-dwelling birds (tits...) should be a few metres high, under the treetops, swallows and swifts are best underneath the eaves, and nest boxes for peregrine falcons should be placed on top of buildings with more than 10 floors...
- It can be very easy to make these nest boxes yourself by following a model to be sure to meet all the needs of the species in question. Consider reusing old materials whenever possible.


Nest-building workshop

If you decide to buy your nest box in a shop, then make sure you choose one made out of untreated, locally sourced wood (or, failing that, following FSC label).

The skyline of today's modern city is filling up with an increasing number of projects to install honeybee hives on rooftops. However, one should bear in mind that for a honey bee colony to stay healthy, it needs a considerable quantity of pollen and nectar (ca 30-50 kg and 80-120 kg, respectively). Therefore honey bees living in areas with limited flower growth may end up severely competing for food with other wild pollinators.

2. Installing a green roof

A green roof offers a host lot of advantages: greening the city, helping rainwater regulation and adding thermal insulation to the building... You can even grow a vegetable patch up there, like on the roofs of the AgroParisTech institute in Paris. As for the impact on biodiversity, green roofs help to bolster the ecological network. A number of research studies have already demonstrated their high value for bees [23].

Yet not all green roofs are the same. If the conditions are favourable, it is better to install "intensive" roof cover, using a substratum of natural soil measuring at least 30 cm thick. This is to accommodate a wider diversity of plants, including bushes and small trees. However this technique can have a high impact in terms of cost and excess weight (600 to 2,000 kg per m^2) and can only be applied to flat roofs (5 % slope maximum).

The most ecological and economical way to green a roof is to let plants sprout naturally of their own accord. This way you can guarantee that species are adapted to the local environmental conditions, and that maintenance will therefore amount to almost zero.

To encourage greater biodiversity on a roof, it is important to have rich plant variety, as well as varied contours (creating microrelief) and sunlight levels, and to apply ecological land management measures. You can even envision adding a pond onto your roof that is filled by natural rainwater. Do not hesitate to get in touch with an ecologist who will be able to guide you towards the most appropriate choices.

If the idea of installing a green roof is too complicated or costly, then you could equally landscape a small terrace and fit it out with potted plants and nest boxes.

It is also possible to green one or several walls on the side of a building. There is a whole myriad of different techniques that exist, but the simplest is the age-old art of growing creepers (ivy, Virginia creeper [*Parthenocissus quinquefolia*], old man's beard [*Clematis* spp.], wisteria [*Wisteria* spp.] and climbing rose bushes-trees...).

3. Enhance the areas alongside buildings

The areas lying alongside city buildings today often just boil down to simple, neatly clipped lawns, or even just a pavement. Why not reduce mowing along these thoroughfares and let wildflower grassland sprout up outside your windows? You can also pull up some of the paving stones to plant a few flowers (or let them take root naturally) or ivy. And there you have it, biodiversity amidst the pavements! Do not forget that you can also fill your window ledges, balconies and terraces with flowers too. These 'micro flower patches' can be a considerable source of food for bees.

4. Other tips

Glass surfaces can be fatal for birds. When designing a new building, opt for reflective glass windows or lattice windows. On existing buildings, you can add markings to the windowpanes to reduce the risk of birds colliding into them sides (by sticking vertical white strips on the outside of windows, spaced a hand's width apart or by putting up net curtains...).

Apart from being an unnecessary waste of energy, the habit of lighting up buildings at night can cause serious disturbance to nocturnal animals and plants. Inside buildings, turn off any lights that are not needed, and block out interior glare by drawing the curtains or pulling down the blinds. Outside buildings, reduce lighting and opt for lights that point downwards. Decorative lighting should be kept to a strict minimum, and a total ban should be imposed on lighting up shops and offices at night. It is also worth adding that certain tones of light colors have much less impact on most nocturnal fauna (this is especially so for light wavelengths close to the colour orange).

F - Training and raising awareness

Amongst the key findings that emerged from our discussions with green space operators and managers when introducing ecological green space management methods, is the fact that the most common obstacles were the reluctance on the part of gardeners on the one hand, and complaints from the local population on the other. Yet if you step in early with well-targeted training courses and awareness raising initiatives, then you will be on the fastest route to breaking down these barriers, and turning gardeners and local residents into true allies. That said, green space operators still need support from elected officials as well as other municipal departments to help them to inform the population.

F.1 - Train up green space operators and managers

The success of an ecological land management strategy is rooted in the skills and involvement of the people responsible for maintaining the green spaces. You must therefore set up adequate training programmes that are adapted to the specific needs of these operators, and which enable them to understand the management choices made, familiarize themselves with new practices, and deepen their knowledge of biodiversity.

1. Who should be trained?

- Steering a shift in land management policy can only work if the decision-makers, elected officials and company managers are all fully motivated to bring about change, and open to new practices in favour of biodiversity;
- Green space managers, heads of green space departments or general services managers within companies are the people who will rewrite general policy by drawing up an overall action plan for green space management, taking into account the specific constraints of each area;

Training green space operators in Lyon

- The reluctance of gardeners could put the brakes on ecological management projects taking root. They should receive the right training too with courses adapted to their needs, so that they become well versed in the alternatives to pesticides and involved in making changes to management practices, but also to gain recognition for their work and be readily equipped to answer questions from visitors;
- Local authorities appeal to outside experts to accompany them in their urban planning choices, and therefore these professionals – engineering consultants, landscape architects, associations... – also need training in theise new mass of knowledge and techniques... These structures and individuals should be encouraged to share feedback and advice, so as to shed new light on their ideas by bringing a cross-disciplinary dimension to the urban environmental debate.

2. Make changes to initial training

When you introduce an ecological management plan, it triggers changes not only in the needs of local authorities and landscaping companies, buty also in the recruitment criteria for hiring new gardeners. Horticultural and landscape gardening training programmes must therefore attune themselves to these new shifts and include modules that cover fields such as native biodiversity, ecological management, alternative practices to pesticides, soil properties or and even the role of beneficial insects and other beneficial animals. Indeed, a large number of schools are already pointing in this direction and calling on the expertise of naturalist associations and land agents committed to an ecological management model.
Urban planners also need to be informed about the issues involved in maintaining urban biodiversity. The key lies in multidisciplinarity, which encourages a transversal approach and encourages professionals in the field to join forces and collaborate. This way, every individual and structure involved is urged to consider the issues at stake.

3. A few examples of tailor-made continuous training

Continuous training must adapt to the specific constraints of each structure, and tailor its programme to suit the real needs of the land operators.

Recognize and promote the expertise of gardeners

Since 2006, Lyon City Council has adopted cross-training as part of its shift towards ecological green space management. If a land operator has a particular skill or passion - for example wide knowledge of native flora, birds or building nest boxes - then he or she is invited to transfer that knowledge to other land operators who are interested. This strategy encourages gardeners to meet up and share ideas about the new techniques emerging today. It also stimulates recognition for their knowledge and work, as well as teaching them how to explain the new practices, and pass them on to others.

Face up to time constraints

Most companies find that their main constraint is the fact that gardeners do not have enough time to be trained. To tackle this issue head on, certain landscaping companies have set aside specific time slots that are officially scheduled in as group meetings for exchanging ideas about biodiversity. These mini small training sessions are conducted on green space sites, depending on the opportunities available and on the precise nature of the project. They offer a twin double perspective, as they are led by the company's biodiversity manager in parallel with local associations, with each party bringing their own input. These on-the-job training programmes promote a growing awareness of the issues at stake, as well as helping gardeners to bring about changes in their methods.

Involve green space operators in making an inventory of local biodiversity

Gardeners play a key role in monitoring biodiversity. This is why suitable tools have been created to help them identify local plant and insect species. One such example is the Protocole Papillons Gestionnaires (PROPAGE), which is developed by the French Natural History Museum (Muséum National d'Histoire Naturelle) and targeted at green space managers, with the aim of providing them with the appropriate tools to identify and monitor butterflies. Managers are then invited to enter the data they have collected on a special website (*http://propage.mnhn.fr/*). The time investment required amounts to only around 30 minutes per year.
Researchers from the French Natural History Museum use this tool to collect a wide range of data, which they then use to build up a large-scale picture of butterfly diversity, as well as information about management practices. A similar tool has been developed to observe urban flora: Florilèges.

ARTHROPOLOGIA is currently working on publishing a set of guidelines, to give an overview of certain European bee species that are easy to recognize, with tips on how to identify them.

Getting your projects endorsed

If your green space is accredited with a label, this acts as a stamp of approval that will formally certify and promote your ecological management policy. Charters and labels are also excellent devices for motivating teams, and sending out a direct message to local residents. Take steps to find out more about existing ecological labels in your country.

France has a number of labels for ecological green space management (the *Ecojardin* label, developed by the association Plante & Cité, and the *EVE* label awarded by Ecocert...) as well as other more specialized labels (the *Pelouses sportives écologiques* label awarded by Qualité France for ecological lawns used on sports grounds, and *Golf Ecodurable* awarded by Ecocert for ecologically sustainable golf courses...) and a series of charters (a tree charter - *Charte de l'Arbre*, a zero-pesticides charter for cities, towns and villages - *Charte objectif zéro pesticides dans nos villes et villages* and a charter for animal and bird shelters set up by the LPO - *Charte des refuges LPO*...).

Other labels should also include the protection of ecosystems as part of their criteria, such as the *Villes et Villages Fleuris* label in France, awarded to cities and villages that display a profusion of flowers all year long and for high standards in sustainable urban greening.

F.2 - Informing visitors – active and passive communication devices

The concept of stopping the use of pesticides or installing specialized nesting structures may give rise to a lot of questions, fears and even complaints from local residents. Yet, by knowing and understanding the project, they can make it their own, and thereby learn to respect it. Here is a list of just a sample of the useful tools available for raising awareness, and advising and reassuring local residents. Feel free to use your imagination to adapt the communication methods and channels to the precise needs of your own project, as well as to local expectations.

If I get too close will I get stung?

This is a worry that frequently came up during URBANBEES events: *do wild bees sting*?

Solitary bees are perfectly placid and harmless insects, and of all the different species that exist, only a few can actually physically manage (mechanically speaking) to sting humans. Moreover, the bee venom that stings human skin generally bears no health risk at all, nor sustained reaction: the pain quickly dies away and within an hour you can barely feel any effects at all. Allergists based in Lyon claim that only one case has been identified to date of a wild bee species triggering an allergic reaction in humans: the case involved a child who was stung by the large Xylocopa bee (carpenter bee).

Yet we certainly cannot say the same about social bee species, such as the honey bee (*Apis mellifera*) and bumble bees (*Bombus* spp.). Their venom contains potent allergenic properties, and whereas someone with a small reaction may feel pain for only a few hours, someone with an allergy may develop strong reactions, which in certain rare cases may prove fatal. *Apis mellifera* is the prime culprit as its sting and venom poses a serious risk to public health: local or generalized reactions, allergies and anaphylactic shock...

Therefore do not overlook the potential risk of a honey bee sting, and nowhere more so than near beehives. All city beehives should be officially registered, well indicated (with a sign) and kept away from areas where people may be passing through - 5 to 10 m away is a safe distance.

Male mason bee *Osmia cornuta*

1. Communication on site and through the press

Once you have adopted a differential green space management strategy, or installed a wild bee hotel, it is important to then provide information tools, either permanent or temporary, that will explain to visitors what they see.

The **URBANBEES** devices are set with illustration panels that present wild bees, their diversity and their different nesting habits.

When it launched its zero-pesticide campaign, the town of Strasbourg installed hundreds of small information signs in its lawns and the inhabitants quickly adopted them and brought them back home to display in their yards.

To make the role of self-seeding plants more widely known, you can set up a botanical trail running through the city, aimed at helping the public get to know wild plants.

URBANBEES site - Parc de la Tête d'Or - Lyon

Zero-pesticide campaign Strasbourg city

Local districts can also rely on in-house tools: creating a webpage that gives information about green space management, making demonstration videos, putting up posters and using the municipal newsletter, handing out information booklets and free packets of seeds for growing native indigenous nectariferous flowers...

In 2008, the Rennes City Council produced a booklet, outlining the concept of differential green space management, and giving answers to the most frequently asked questions from local residents.

The local press can also be a good vehicle for spreading information about new green space management practices, as well as reporting on local projects to protect biodiversity or any other events being organized in this field along this theme.

"And why not?"

Focus your communication strategy on one particular species, animal or plant, or, indeed, a specific area on your local territory that was pinpointed during the inventory phase as being an emblematic natural heritage site. Then expand the theme further by weaving it into information tools, green space worksites, diverse activities and events or traditional festive events already on the local calendar. This way you will be helping to seal and strengthen the commitment of the local population as well as its involvement in actions to protect biodiversity.

Nest-building workshop

2. Open up a dialogue with the local population

"Passive" communication needs to be supplemented with face-to-face contact. Create opportunities for municipal green space professionals to meet the public and explain their land management proposal in the most interactive way possible. If you need help in leading these meetings, do not hesitate to approach local naturalist associations as they are usually happy to give valuable inputs.

Organizing public conferences or documentary film viewing with public debates is a direct way of informing city dwellers and bringing them into an open discussion about land management projects. Yet it also raises public awareness of wider themes, such as protecting biodiversity, bee decline, or the dangers of pesticides.

Outreach programmes geared towards young children and teenagers can be set up through organizing events in schools. Part of the **URBANBEES** project was to develop a set of tools to help organize such events, and you can find these on the **URBANBEES** website http://urbanbees.eu.

Finally, you can also gear activities towards families at weekends and during the school holidays: walking tours to discover biodiversity, bee nest-building workshops and treasure hunts...

School awareness raising event

Feedback on URBANBEES initiatives

Part of the URBANBEES programme involved organizing a host of awareness raising initiatives, conferences, exhibitions, nest-building workshops, and evening classes to teach techniques on how to pinpoint bee specimens and identify species... Findings from our quantitative and qualitative research enabled us to gauge the real impact of these initiatives, and measure their effects on the opinions, approach and behaviour of those taking part. One of the most interesting findings was the fact that building and owning a nest box is a key motivational factor in inciting other members of the public to play an active part in protecting wild bees. We therefore urge you to develop theseis nest-building workshops activity and promote it within your own local authority by using the small bee hotel models provided on our website.

F.3- Get the local population on board – from the design phase to implementation

Whether you are striving to set up an urban planning project, to bring about change in green space management, or to protect biodiversity, then the key to your success lies in securing public commitment and involvement at every step of the way. If the local population is on your side, then city dwellers will appropriate and respect the project much more readily, and as a result, it will be possible to blend the new elements into the urban landscape in a much more harmonious and sustainable way.

1. Let the end-users help to design the project

Getting city dwellers on board from as early on as the design phase is a way of ensuring your project is anchored in real local needs, as well as in the real use of urban green spaces. Do non't hesitate to get in contact with neighbourhood committees, resident associations or even members of community gardens. Organize public meetings to present the project, but also to listen to the comments and feedback of local residents and answer any questions they may have.

If you need tips on how to organize and lead meetings that are interactive and full of new ideas, then you can apply the wide set of tools developed by cities already involved in the drive towards change, most notably the use of open forums.

2. Act on the current craving for nature... and cut back on costs!

Today's city dwellers are showing a true thirst for nature. As a result, there are numerous community gardens being set up across the urban landscapes to help satisfy the desire to get one's hands dirty - but the waiting lists to become a member of these structures are getting longer and longer. Given this unmet demand, why not invite locals to take part in managing green space projects: free up plots of land in parks, orchards and herb gardens and make them 'self-service' for the public, and get people involved in planting workshops...

It was in this exact spirit that the local council of Saint-Priest city set up 'pocket gardens' in 2011 in the suburbs of Lyon. The concept is to give willing locals a free hand at planting shrubs and flowers, however they wish, on small fallow patches (at the base of trees, the front of buildings and along the edges of pavements...) using equipment and plants provided by the city. Technical staff from the Green Space department is on hand to help accompany the groups of gardeners in their efforts. This type of project is therefore an ideal way to foster links between green space gardeners and users, and give them an opportunity to exchange ideas and tips.

Feel free to approach local inhabitants and urge them to take part in group construction projects. This is what happened during the eco-volunteer days organized by the association ARTHROPOLOGIA, together with land operators from the various local authorities involved. Under their guidance, members of the community joined forces to use a mixture of stems and logs pierced with holes to help fill the large bee hotels walls that had been installed as part of the **URBANBEES** programme.

Filling the cell of a bee wall

3. Studying and protecting biodiversity

City dwellers can be major players in their own right in the drive towards safeguarding biodiversity. Consider organizing nest-building workshops, or even handing out packets of seeds of local nectariferous plants. As part of the **URBANBEES** programme, a Best Practice Guide was published to help guide private gardeners through the different stages of adopting pollinator-friendly and ecological gardening practices.

You can download this guide on the URBANBEES website
Download *Ressources > Grand Public > Guide des bonnes pratiques*
(currently only available in French)
http://www.urbanbees.eu/sites/default/files/ressources/guide_bonnespratiques.pdf

Tools have also been developed to enable those willing and motivated to take part in monitoring biodiversity. In France for example, the Vigie Nature participatory science programme, developed by the French Natural History Museum (Muséum National d'Histoire Naturelle - MNHN) in partnership with numerous other associations, provides a wealth of information to scientists at the MNHN on numerous groups of animals (birds, butterflies and bats...) and plants.

Given the vast diversity of wild bees, it very complicated for non-specialists to identify the different species. The SPIPOLL programme (Suivi Photographique des Insectes Pollinisateurs: photographic monitoring of insects pollinators), set up by the MNHN and the French Office for Insects and their Environment (OPIE), gets around this problem by suggesting a very simple protocol. Participants are invited to choose and identify a flower, and then take repeated photographs of it for 20 minutes to follow the process of the flower-visiting insects at work. These photos are then uploaded onto an internal platform. Technical notes on insects and plants have been drawn up to help the participants identify the different types of insects. The information is then checked and completed by the MNHN experts.

User-friendly, even for the inexperienced, these programmes provide the tools to gain skills and know-how, and eventually turn the whole community into first-class observers of biodiversity.

>> Conclusion

We hope that this guide has provided you with the necessary arguments and tools to instigate change in your cities, towns and villages. Are you now willing and ready to offer a home to wild bees and pollinators? This guide has given you the tools to launch and apply an ecological action plan for green space management within your local authority. Now feel free to go ahead and supplement these tools by referring to the section entitled "*To explore even further*…"

And above all, do not forget that every step counts, whether installing a bee hotel or stopping the use of pesticides, from the smallest gesture up to the most radical change.

Shifting mindsets is what sometimes takes the longest. So do not be discouraged, but gradually move forward step by step, and bring all the different players on board - elected officials, gardeners, local residents, local companies, schools, social centres... That is the key to success!

Please keep us updated with news and photos of all your projects for creating favourable habitats for wild bees, by writing to us at this address: contact@urbanbees.eu

>> Endnotes

[1] *Cf the IUCN Red List of Threatened Species – www.iucn.org*

[2] *The number of species per family is for Europe.*

[3] *« spp. »,.a genus of this .*

[4] *Williams, 1994 ; Klein* et al.*, 2007 ; Ollerton* et al.*, 2011*

[5] *Gallai* et al.*, 2009*

[6] *Garibaldi* et al.*, 2013*

[7] *Biesmeijer* et al.*, 2006*

[8] *Patiny* et al.*, 2009*

[9] *Source : AEE (2006)*

[10] *Henry* et al.*, 2012*

[11] *Source: Dr. Jean-Marc Bonmatin, CNRS*

[12] *Steffan-Dewenter & Tscharntke, 2000*

[13] *Potts* et al.*, 2010.*

[14] *Saure, 1996*

[15] *Fetridge* et al.*, 2008*

[16] *Tommasi* et al.*, 2004.*

[17] *Banaszak-Cibicka, Zmihorski, 2012.*

[18] *European Environment Agency, 2006.*

[19] *Excluding low risk natural products, and products used in organic farming – Law n°2014-110 of 6 February 2014 aimed at providing a better framework for the use of pesticides on the national territory.*

[20] *LIFE Focus, 2007. LIFE and Europe's wetlands: Restoring a vital ecosystem, p.3*

[21] *These two species are foraged exclusively by the* Macropis europaea *bee*

[22] *This list is non-exhaustive*

[23] *Colla et al. 2009*

>> Annex: Nectariferous and polliniferous plants in the area in and around Lyon

Mixture for wildflower meadow

Common name	Name	Family	Colour	Annual/Biennial/ Perennial
Harvest-lice	*Agrimonia eupatoria*	Rosaceae		Perennial
Crown-of-the-field	*Agrostemma githago*	Caryophyllaceae		Annual
Burdock	*Arctium lappa*	Asteraceae		Biennial
Field marigold	*Calendula arvensis*	Asteraceae		Annual
Cuckoo flower	*Cardamine pratensis*	Brassicaceae		Biennial / Perennial
Cornflower	*Centaurea cyanus*	Asteraceae		Annual or Biennial
Brown knapweed	*Centaurea jacea*	Asteraceae		Perennial
Chicory	*Cichorium intybus*	Asteraceae		Perennial
Wild carrot	*Daucus carota*	Apiaceae		Biennial
Viper's bugloss	*Echium vulgare*	Boraginaceae		Biennial
Sunflower	*Helianthus annuus*	Asteraceae		Annual
St John's wort	*Hypericum perforatum*	Hypericaceae		Perennial
Tansy ragwort	*Jacobaea vulgaris*	Asteraceae		Biennial
Daisy	*Leucanthemum vulgare*	Asteraceae		Perennial
Toadflax	*Linaria vulgaris*	Plantaginaceae		Perennial
Linseed	*Linum usitatissimum*	Linaceae		Annual
Birdsfoot trefoil	*Lotus corniculatus*	Fabaceae		Perennial
Musk mallow	*Malva moschata*	Malvaceae		Perennial
White sweet clover	*Melilotus albus*	Fabaceae		Biennial
Yellow sweet clover	*Melilotus officinalis*	Fabaceae		Biennial
Forget-me-not	*Myosotis arvensis*	Boraginaceae		Annual
Sainfoin	*Onobrychis viciifolia*	Fabaceae		Perennial
Poppy	*Papaver rhoeas*	Papaveraceae		Annual
Common tormentil	*Potentilla erecta*	Rosaceae		Perennial
Meadow sage	*Salvia pratensis*	Lamiaceae		Perennial
Small burnet	*Poterium sanguisorba*	Rosaceae		Perennial
White campion	*Silene latifolia*	Caryophyllaceae		Biennial / Perennial
Greater stitchwort	*Stellaria holostea*	Caryophyllaceae		Perennial
Common tansy	*Tanacetum vulgare*	Asteraceae		Perennial
Common mullein	*Verbascum thapsus*	Scrophulariaceae		Biennial
Cow vetch	*Vicia cracca*	Fabaceae		Perennial
Bush vetch	*Vicia sepium*	Fabaceae		Perennial
Heartsease	*Viola tricolor*	Violaceae		Biennial

Mix for road & path sides

Common name	Name	Family	Colour	Annual/Biennial/ Perennial
Soldier's woundwort	*Achillea millefolium*	Asteraceae		Perennial
Burdock	*Arctium lappa*	Asteraceae		Biennial
Officinal betony	*Betonica officinalis*	Lamiaceae		Perennial
Dane's blood	*Campanula glomerata*	Campanulaceae		Perennial
Spreading bellflower	*Campanula patula*	Campanulaceae		Biennial
Peach bell	*Campanula persicifolia*	Campanulaceae		Perennial
Common harebell	*Campanula rotundifolia*	Campanulaceae		Perennial
Greater celandine	*Chelidonium majus*	Papaveraceae		Perennial
Wild carrot	*Daucus carota*	Apiaceae		Biennial
Herb Robert	*Geranium robertianum*	Geraniaceae		Annual / Biennial
St John's wort	*Hypericum perforatum*	Hyperycaceae		Perennial
Birdsfoot trefoil	*Lotus corniculatus*	Fabaceae		Perennial
Tall mallow	*Malva sylvestris*	Malvaceae		Biennial, perennial
Rounded chamomile	*Matricaria discoidea*	Asteraceae		Annual
Oregano	*Origanum vulgare*	Lamiaceae		Perennial
Poppy	*Papaver rhoeas*	Papaveraceae		Annual
European cinquefoil	*Potentilla reptans*	Rosaceae		Perennial
Common selfheal	*Prunella vulgaris*	Lamiaceae		Biennial or perennial
Cut leaf mignonette	*Reseda lutea*	Resedaceae		Annual or perennial
Weld	*Reseda luteola*	Resedaceae		Biennial
Yellow rattle	*Rhinanthus minor*	Orobanchaceae		Annual
Small burnet	*Poterium sanguisorba*	Rosaceae		Perennial
White campion	*Silene latifolia*	Caryophyllaceae		Biennial / Perennial
Grass leaves starwort	*Stellaria graminea*	Caryophyllaceae		Perennial
Greater stitchwort	*Stellaria holostea*	Caryophyllaceae		Perennial
Wood stitchwort	*Stellaria nemorum*	Caryophyllaceae		Perennial
Comfrey	*Symphytum officinale*	Boraginaceae		Perennial
Common tansy	*Tanacetum vulgare*	Asteraceae		Perennial
Dandelion	*Taraxacum* sect. *Ruderalia*	Asteraceae		Perennial
Red clover	*Trifolium pratense*	Fabaceae		Perennial
White clover	*Trifolium repens*	Fabaceae		Perennial
Valerian	*Valeriana officinalis*	Caprifoliaceae		Perennial
Heath speedwell	*Veronica officinalis*	Plantaginaceae		Perennial
Dwarf periwinkle	*Vinca minor*	Apocynaceae		Perennial

Mix for shaded area

Common name	Name	Famille	Colour	Annual/Biennial/ Perennial
Wild angelica, wood angelica	*Angelica sylvestris*	Apiaceae		Biennial / Perennial
Black horehound	*Ballota nigra*	Lamiaceae		Perennial
Greater celandine	*Chelidonium majus*	Papaveraceae		Perennial
Eltrot, common hogweed	*Heracleum sphondylium*	Apiaceae		Perennial
Annual honesty	*Lunaria annua*	Brassicaceae		Biennial
Lemon balm	*Melissa officinalis*	Lamiaceae		Perennial
Blue lungwort	*Pulmonaria officinalis*	Boraginaceae		Perennial
Comfrey	*Symphytum officinale*	Boraginaceae		Perennial
Heath violet	*Viola canina*	Violaceae		Perennial

Mix for rockery

Common name	Name	Family	Colour	Annual/Biennial/ Perennial
Viper's bugloss	*Echium vulgare*	Boraginaceae		Biennial
Aegean wallflower	*Erysimum cheiri*	Brassicaceae		Biennial / Perennial
Herb Robert	*Geranium robertianum*	Geraniaceae		Annual / Biennial
Curry plant	*Helichrysum italicum*	Asteraceae		Perennial
Hyssop	*Hyssopus officinalis*	Lamiaceae		Perennial
English lavender	*Lavandula angustifolia*	Lamiaceae		Perennial
Toadflax	*Linaria vulgaris*	Plantaginaceae		Perennial
Cut leaf mignonette	*Reseda lutea*	Resedaceae		Biennial
Rosemary	*Rosmarinus officinalis*	Lamiaceae		Perennial
Garden sage	*Salvia officinalis*	Lamiaceae		Perennial
Winter savory	*Satureja montana*	Lamiaceae		Perennial
Wall pepper	*Sedum acre*	Crassulaceae		Perennial
White stonecrop	*Sedum album*	Crassulaceae		Perennial
Valerian	*Valeriana officinalis*	Plantaginaceae		Perennial

Mix to improve soil fertility (green manure)

Common name	Name	Family	Colour	Annual/Biennial/ Perennial
Kidney vetch	*Anthyllis vulneraria*	Fabaceae		Perennial
Axseed	*Coronilla varia*	Fabaceae		Perennial
Horseshoe vetch	*Hippocrepis comosa*	Fabaceae		Perennial
Perennial peavine	*Lathyrus latifolius*	Fabaceae		Perennial
Birdsfoot trefoil	*Lotus corniculatus*	Fabaceae		Perennial
Hop medic	*Medicago lupulina*	Fabaceae		Biennial
White sweet clover	*Melilotus albus*	Fabaceae		Biennial
Yellow sweet clover	*Melilotus officinalis*	Fabaceae		Biennial
Sainfoin	*Onobrychis viciifolia*	Fabaceae		Perennial
Spiny restharrow	*Ononis spinosa*	Fabaceae		Perennial
Kaber mustard	*Sinapis arvensis*	Brassicaceae		Annual
Red clover	*Trifolium pratense*	Fabaceae		Perennial
White clover	*Trifolium repens*	Fabaceae		Perennial
Cow vetch	*Vicia cracca*	Fabaceae		Perennial
Bush vetch	*Vicia sepium*	Fabaceae		Perennial

Vegetable garden

Common name	Name	Family	Colour	Annual/Biennial/ Perennial
Common daisy	*Bellis perennis*	Asteraceae		Biennial / Perennial
Borage	*Borago officinalis*	Boraginaceae		Annual / Biennial
Fennel	*Foeniculum vulgare*	Apiaceae		Biennial / Perennial
Hyssop	*Hyssopus officinalis*	Lamiaceae		Perennial
Wild chamomile	*Matricaria chamomilla*	Asteraceae		Annual
Lemon balm	*Melissa officinalis*	Lamiaceae		Perennial
Apple mint, woolly mint or round-leafed mint	*Mentha suaveolens*	Lamiaceae		Perennial
Basil	*Ocimum basilicum*	Lamiaceae		Annual
Cowslip	*Primula veris*	Primulaceae		Perennial
Summer savory	*Satureja hortensis*	Lamiaceae		Annual
Common thyme	*Thymus vulgaris*	Lamiaceae		Perennial
Heartsease	*Viola tricolor*	Violaceae		Annual / Biennial

Humid areas

Common name	Name	Family	Colour	Annual/Biennial/ Perennial
Wild angelica, wood angelica	*Angelica sylvestris*	Apiaceae		Biennial / Perennial
Hemp agrimony	*Eupatorium cannabinum*	Asteraceae		Perennial
Meadowsweet, mead wort	*Filipendula ulmaria*	Rosaceae		Perennial
Eltrot, common hogweed	*Heracleum sphondylium*	Apiaceae		Perennial
Spiked loosestrife	*Lythrum salicaria*	Lythraceae		Perennial
Common tormentil	*Potentilla erecta*	Rosaceae		Perennial
Cowslip	*Primula veris*	Primulaceae		Biennial / Perennial
Feabane mullet	*Pulicaria dysenterica*	Asteraceae		Perennial
Valerian	*Valeriana officinalis*	Caprifoliaceae		Perennial

Self-seeding plants to preserve

Common name	Name	Family	Colour	Annual/Biennial/ Perennial
Creeping bugle	*Ajuga reptans*	Lamiaceae		Perennial
Red bryony	*Bryonia dioica*	Cucurbitaceae		Perennial
Rough chervil	*Chaerophyllum temulum*	Apiaceae		Biennial
Canadian thistle	*Cirsium arvense*	Asteraceae		Perennial
Marsh thistle	*Cirsium palustre*	Asteraceae		Biennial
Spear thistle	*Cirsium vulgare*	Asteraceae		Biennial
Lesser Calamint	*Clinopodium nepeta*	Lamiaceae		Perennial
Field bindweed	*Convolvulus arvensis*	Convolvulaceae		Perennial
Bristly hawksbeard	*Crepis setosa*	Asteraceae		Annual
Daisy fleabane	*Erigeron annuus*	Rosaceae		Annual
Sickleweed	*Falcaria vulgaris*	Apiaceae		Biennial / Perennial
Ground ivy	*Glechoma hederacea*	Lamiaceae		Perennial
Ivy	*Hedera helix*	Araliaceae		Perennial
Common rockrose	*Helianthemum nummularium*	Cistaceae		Perennial
Flatweed, common catsear	*Hypochaeris radicata*	Asteraceae		Perennial
White deadnettle, white dead-nettle	*Lamium album*	Lamiaceae		Perennial
Red deadnettle, red dead-nettle	*Lamium purpureum*	Lamiaceae		Annual
Nipplewort	*Lapsana communis*	Asteraceae		Annual
Meadow pea, yellow vetchling	*Lathyrus pratensis*	Fabaceae		Perennial
Hawkweed oxtongue	*Picris hieracioides*	Asteraceae		Biennial
Narrowleaf plantain, ribble grass	*Plantago lanceolata*	Plantaginaceae		Perennial
Common milkwort	*Polygala vulgaris*	Polygalaceae		Perennial
Spring cinquefoil	*Potentilla tabernaemontani*	Rosaceae		Perennial
Meadow crowfoot	*Ranunculus acris*	Ranunculaceae		Perennial
Bulbous crowfoot	*Ranunculus bulbosus*	Ranunculaceae		Perennial
Creeping crowfoot	*Ranunculus repens*	Ranunculaceae		Perennial
Blackberry	*Rubus* sect *rubus*	Rosaceae		Perennial
Axseed	*Coronilla varia*	Fabaceae		Perennial
Dandelion	*Taraxacum* sect. *Ruderalia*	Asteraceae		Perennial
Common hedge parsley	*Torilis arvensis*	Apiaceae		Annual
Upright hedge parsley	*Torilis japonica*	Apiaceae		Annual / Biennial
Germander speedwell	*Veronica chamaedrys*	Plantaginaceae		Perennial
Creeping veronica	*Veronica persica*	Plantaginaceae		Annual
Narrow leaf vetch	*Vicia sativa*	Fabaceae		Annual

Biodiversity

The diversity of life among all its shapes and at all scales, of which there are 4 components.

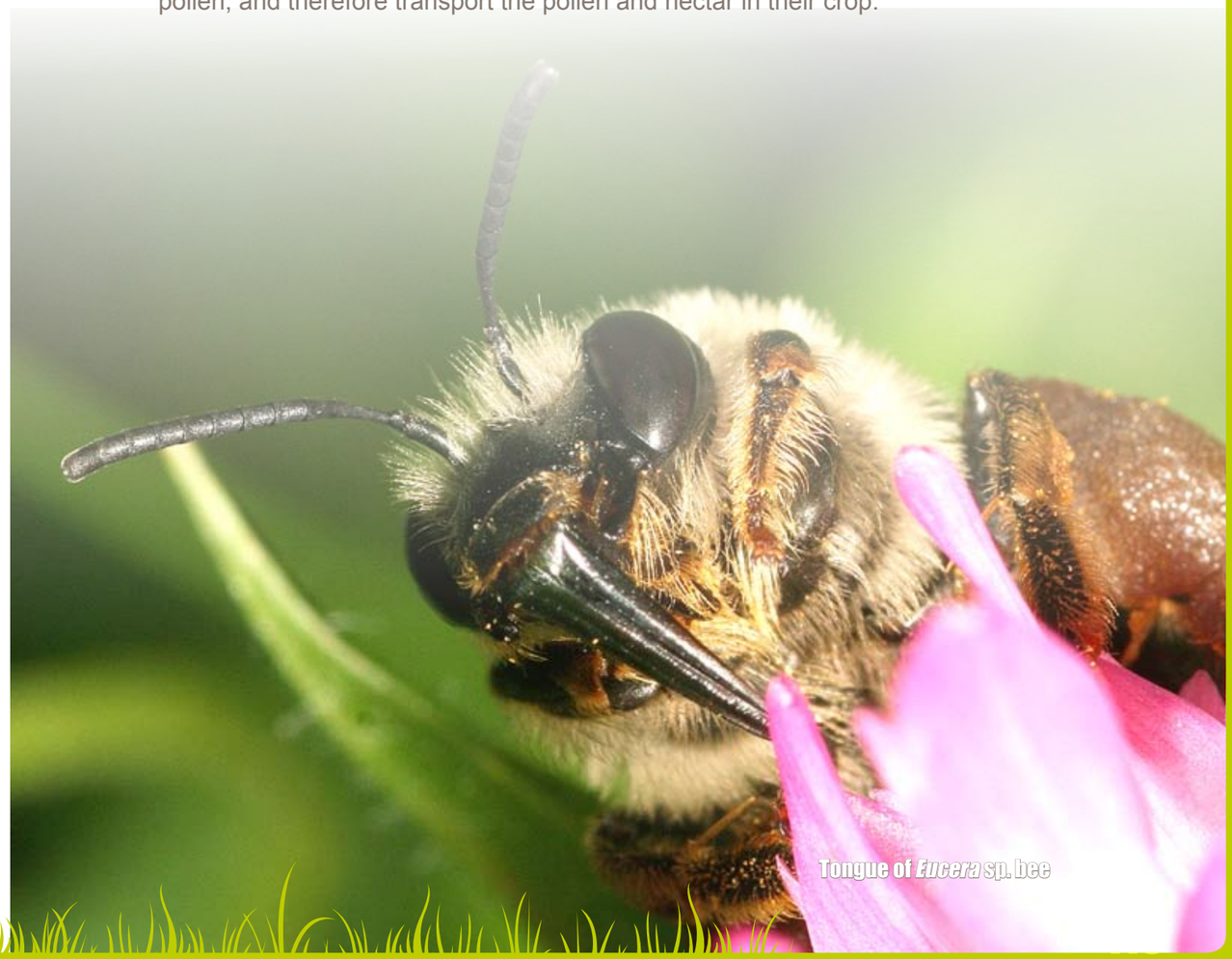
- The genetic diversity, which is the building bloc of adaptation and evolution;
- The diversity of organisms, both within and among species, and their interaction (biodiversity of wild and domestic organisms);
- The diversity of ecosystems: within them (habitats) and among them;
- and, across all the above, the diversity of the ecological and natural processes (chemical, hydraulic, climatic and biological ones).

Cavity-nesting species

Species that nest in hollow plant stems, wood burrows or any other forms of cavity (snail shells, rock crevices or cracks in walls...). The species that nest in hollow plant stems are called lignicolous, whereas those that bore in wood are called wood-boring xylicolous.

Crop

An organ beneath the oesophagus of a bee that is used to store nectar during foraging. Bees belonging to the genus *Hylaeus* spp., have no particular structure for carrying pollen, and therefore transport the pollen and nectar in their crop.



Tongue of *Eucera* sp. bee

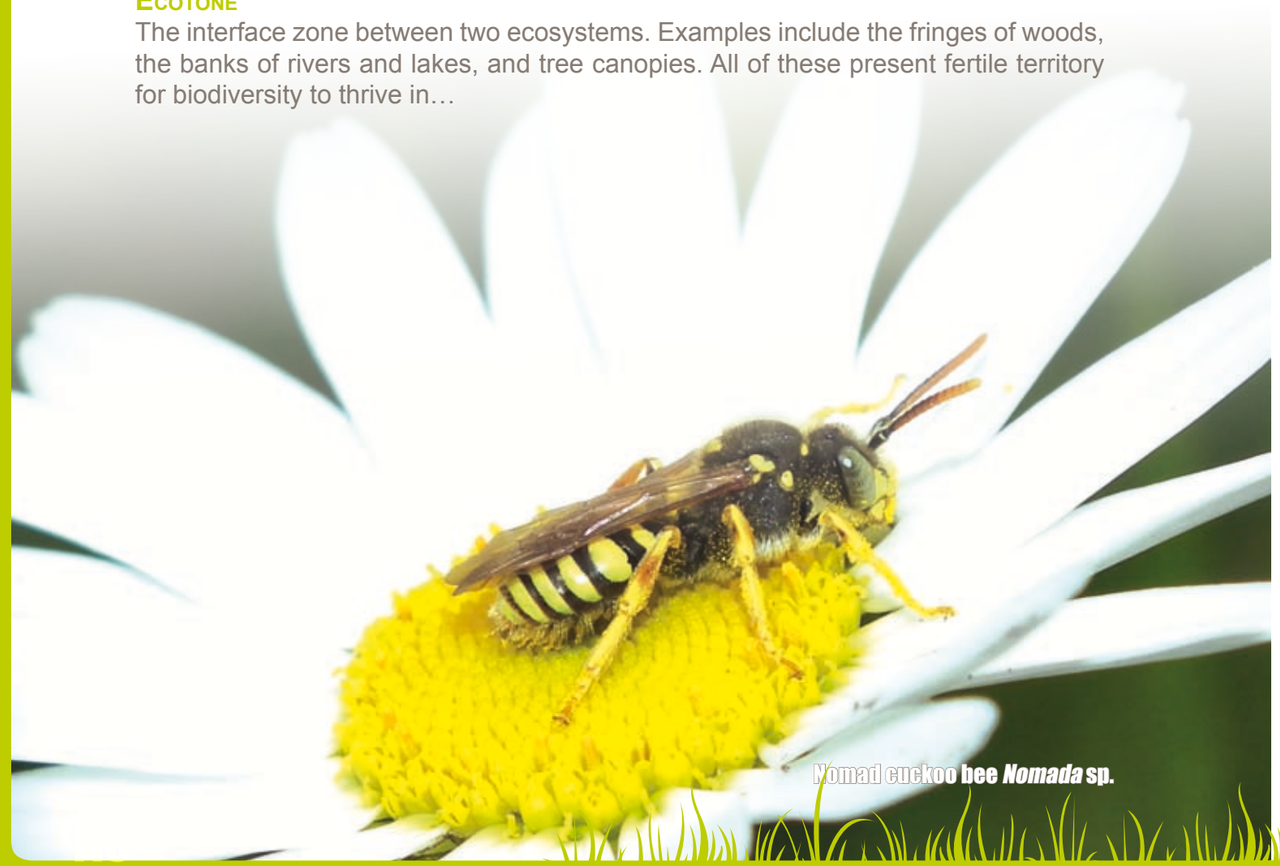
Cuckoo bees
Parasitic bees belonging to several families whose females lay their eggs in the nests of females from other bee species (host species). When these eggs hatch, the cuckoo bee larvae usually kill the larvae of the host species and eat up the food reserves. Around 20 % of French bee species are cuckoo bees, namely that is around 200 species. These bees are not equipped with pollen gathering apparatus and therefore they do not willingly collect any pollen. Unlike other females, they do not gather pollen (they are not equipped with scopa), nor do they store up food reserves. Instead, they feed themselves by assiduously flying from flower to flower, and in doing so they do contribute to the process of pollination process.
Cuckoo bees can be found in three families: Halictideae (*Sphecodes* spp.), Megachilidae (*Stelis* spp., *Dioxys* spp., *Coelioxys* spp.) and Apidae (*Melecta* spp., *Thyreus* spp., *Nomada* spp., *Epeolus* spp., *Epeoloides* spp.).

Ecological network / ecological continuity
The network created by a body of different habitats where species live, as well as the corridors that enable those species to move from one favourable habitat to another:

Reservoirs
Areas with a rich biodiversity that stand out for combining all the elements needed to maintain it (food sources, nesting opportunities).

Ecological corridors
Pathways used by fauna and flora that link biodiversity reserves together, and enable species to migrate and disperse.

Ecotone
The interface zone between two ecosystems. Examples include the fringes of woods, the banks of rivers and lakes, and tree canopies. All of these present fertile territory for biodiversity to thrive in…


Nomad cuckoo bee *Nomada* sp.

Exotic or exogenous species
Species that are not naturally present in the area under observation.


Flocculi

Flocculus / flocculi
The area on the scopa at the base of the hind legs that is covered with arched hairs, and used for gathering pollen in andrenid bees (*Andrena* spp.).

Green and blue infrastructure
A land planning tool, that was officially recognized in France during the Grenelle Environmental Summit in 2010, with the aim of reconstituting a coherent ecological network to preserve or restore the ecological continuity linking different natural habitats to curb the erosion of biodiversity. The ‘green network’ refers to the terrestrial network (forests, green areas, and hedgerows...) while the ‘blue network’ refers to the water network (lakes, ponds, rivers and streams ...).

Ground-nesting species
Bee species that nest in underground burrows.

Hemolymph
The circulatory fluid of arthropods that carries nutrients and the products of metabolism. However, contrary to vertebrates, it does not carry oxygen as this role is undertaken by the tracheae.

Hibernaculum
A protective structure installed to provide shelter for certain animals (mammals, reptiles, amphibians and insects...) for their hibernation or overwintering.

Invasive or introduced species
Exotic plant or animal species which, once introduced and because of its spreading, becomes a threat to indigenous biodiversity, and disrupt ecosystems. According to the IUCN, invasive species, generally introduced by man (fodder, ornamental species,…) are the third largest threat to wildlife species in the world.

Keystone species
Species whose contribution to the local environment is disproportionately large compared to its biomass or abundance, and whose removal would have a critical impact on the whole ecosystem. Just like a keystone in an arch, if this species disappears, the whole structure collapses.

Mimicry
A defence mechanism against predators, whereby certain animals have evolved to take on the appearance of venomous creatures. Examples can be found in many insects (butterflies and hoverflies...) that have evolved to look indistinguishable from more fearsome species of venomous hymenoptera (bees and wasps) when they do not even have a stinger. Other animals manage to survive by developing a close likeness to their environment, blending into the background as a hiding technique (stick insects, leaf insects and amphibians...).

Mycorrhizae
The collective group of fungi that live in the soil and interact with roots, and which are indispensable to maintaining the soil's health.

Native or indigenous species
Species that are naturally present in the area under observation.

Nectariferous plants
Plants that secrete nectar that attracts wild bees and other flower-visiting insects. It is more generic to talk about nectariferous or pollen plants (plants which produce pollen) than melliferous plants as this category qualifies only plants that are of apicultural interest. It is noteworthy that research generally focuses on measuring how attractive the plant is for bees, while the actual quality of the nectar and pollen for the bee larvae is still little known.

Pesticides
Products applied to plants or animals for protection or care. They come under two main categories - chemically produced pesticides, which are generally pollutants with a long lifespan, and natural pesticides, which are generally biodegradable, with a short lifespan. The term covers herbicides, insecticides, fungicides...

Pollination
The process of pollen transfer from the stamen (the male reproductive organ of a flowering plant) to the stigma (the receptive surface of the pistil, which is the female reproductive organ) of the same or another flower of the same species. Pollination occurs by different modes:

- Zoophilic pollination: via animals;
- Hydrophilic pollination: via water;
- Entomophilous pollination: via insects (the most common form);
- Anemophilous pollination: via the wind;
- Passive self-pollination: pollen transfer via gravity, or by contact with other parts of the same flower, due to movement from the wind, for example.

Saprophageous species
Species whose larvae or adults feed on partly decomposed organic matter such as some insects, millipedes, rolly polies (Armadillidiidae), bacteria and fungi.

Scopa(e)
Apparatus of bees for pollen harvest and transport such as, for exemple, the pollen baskets of honey bees and bumble bees, or the ventral hair brush of Megachilidae.

Self-seeding plants
Vegetation that appears and grows spontaneously, without any human intervention. Often termed as wild grasses, or "weeds", these plants can nonetheless offer a range of attractive characteristics for pollinators and herbivores, and some species have long been used by people as a reliable source of food, natural remedies and dyes.

Specialist or oligolectic species
Bee species that forage for pollen only on one particular plant species, or a group of species that are related such as *Andrena vaga* that only gathers its pollen on willow trees (*Salix* spp.) and *Colletes hederae* that only visits ivy (*Hedera helix*). On the other end of the scale, species that collect their pollen on a wide array of plant species are called generalist (polylectic), and these include the honey bee and most bumble bees.

Sphecid wasps
A group of hymenopterous insects whose adults hunt down and paralyse their prey, often honing in on particular species of cockroaches, grasshoppers, crickets, aphids, beetles, flies and spiders.... Sphecidae are believed to be the original ancestors of bees, which evolved into herbivores as they obtained all their protein from pollen.


Specid wasp
(*Ammophila* sp.)

Tongue or glossa (proboscis)
A tubelike organ that helps bees to suck the nectar out of flowering plants. Its length varies, depending on the species, thus enabling bees to gather nectar from flowers with both an open and fused corolla.

Umbrella species
Species whose protection entails the protection of a large number of other species.

Urban sprawl
The spread of the urban landscape beyond the edges of cities, notably caused by urbanization, the popular appeal of private housing estates and the expansion of commercial and industrial areas.

Wetlands
Stretches of marshland, fens, peatlands, natural or artificial water, either permanent or temporary, where the water is stagnant, or flowing, and consists of freshwater, brackish or salt water. This includes stretches of seawater that is no deeper than 6 metres at low tide. (Ramsar Convention,1971).

Wing venations
These are vein ducts that bring **hemolymph** to the wings, creating a distinctive network of cells of various shapes, numbers and sizes, that are used to identify bee genus and sometimes species.

>> To explore even further...

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The **URBANBEES** program was built on the collaboration between partners who had been working together for several years and who decided to join their forces and knowhow to achieve concrete large scope actions to conserve biodiversity.

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