jardí botànic
Parc de Montjuïc
nat museu de ciències naturals de Barcelona

EXHIBITION

# MORE THAN BEES
# POLLINATORS AND FLOWERS
# LIFE AT STAKE

## DID YOU KNOW THAT

The purpose of pollination is plant reproduction and it is essential for guaranteeing life on planet Earth

## Nine out of 10 flowers

**need an insect to pollinate them so that they can produce seeds and fruits**

## Global food production

**75%** **of the food produced worldwide relies on insect pollination, especially pollination from wild bees***

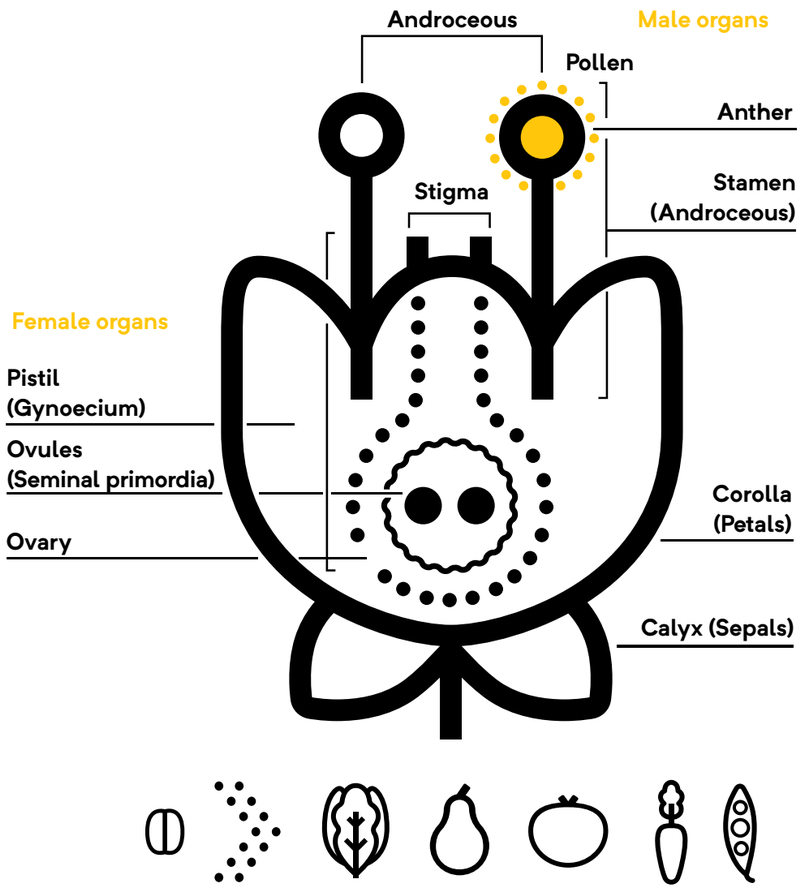
*Source: The Food and Agriculture Organization of the United Nations, better known as the FAO.

FAO from:
Klein, A.M., Vaissiere, B.E., Cane, J.H., Steffan-Dewenter,I., Cunningham, S.A., Kremen, C.,Tscharntke, T. 2007. Importance of pollinators in changing landscapes for world crops. Proceedings of the Royal Society of London B: Biological Sciences 274(1608) 303-313

Generalitat de Catalunya
Departament de Territori i Sostenibilitat
Ajuntament de Barcelona
Barcelona Capital Cultural i Científica

# POLLINATION

This is the process that makes the sexual reproduction of plants possible. It takes place inside flowers.
For plants to reproduce, pollen from the male organs of flowers must reach and fertilise the female organs.
The result of pollination are seeds and fruits.




## Flowers

Flowers may have female, male or male and female reproductive organs.
The female reproductive organs of the flower are called pistils. They form a bottle-shaped receptacle that includes the ovary, the style and the stigma.

The male reproductive organs of the flower are called stamens. These are filaments that have an upper part that is thicker than the lower part.
The upper part of the stamen is called the anther, and this is where pollen is formed.
Pollen has the same function as sperm in animals: it fertilises the female organ to ensure the reproduction of the species.

The reproductive organs of the flower are usually surrounded by one or more sterile parts:
- The calyx, often in the shape of a cup formed by leaves called sepals.
- The corolla, formed by the petals of the flower.

## The seduction game

Flowers need to attract and seduce biotic pollinating agents to come and pick up their pollen.
To attract the attention of insects, flowers adopt eye-catching shapes and colours. They also offer nourishment.

When insects visit flowers, they feed on:
- Pollen, which provides them with protein and energy in the form of starch and lipids.
- Nectar, an aqueous substance that consists essentially of concentrated sugars and amino acids.

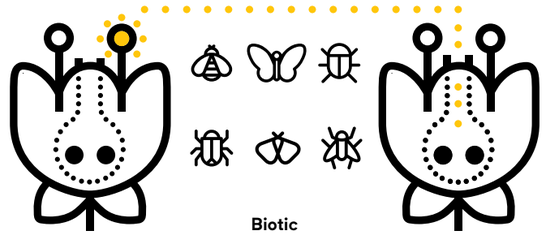
Insects are attracted primarily to flowers by their nectar and pollen and so pollinate them unwittingly.
The pollination of flowers by insects is therefore accidental.

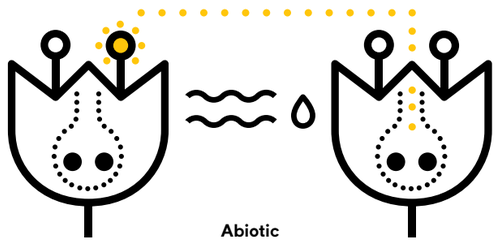
## Pollinating agents

These are responsible for transporting pollen from the male organs of the flower to the female organs of the same flower or another flower.

Pollinating agents can be one of two types:
- Abiotic, which embraces non-living phenomena like wind and water.
- Biotic, which are living beings such as insects, lizards, bats and birds.

The size and appearence of pollen grains vary depending on the pollinator that transports it.
Thus, wind-borne pollen grains are smooth and tiny, while those that are transported by animals are larger and coarser.


Biotic


Abiotic

# INSECTS

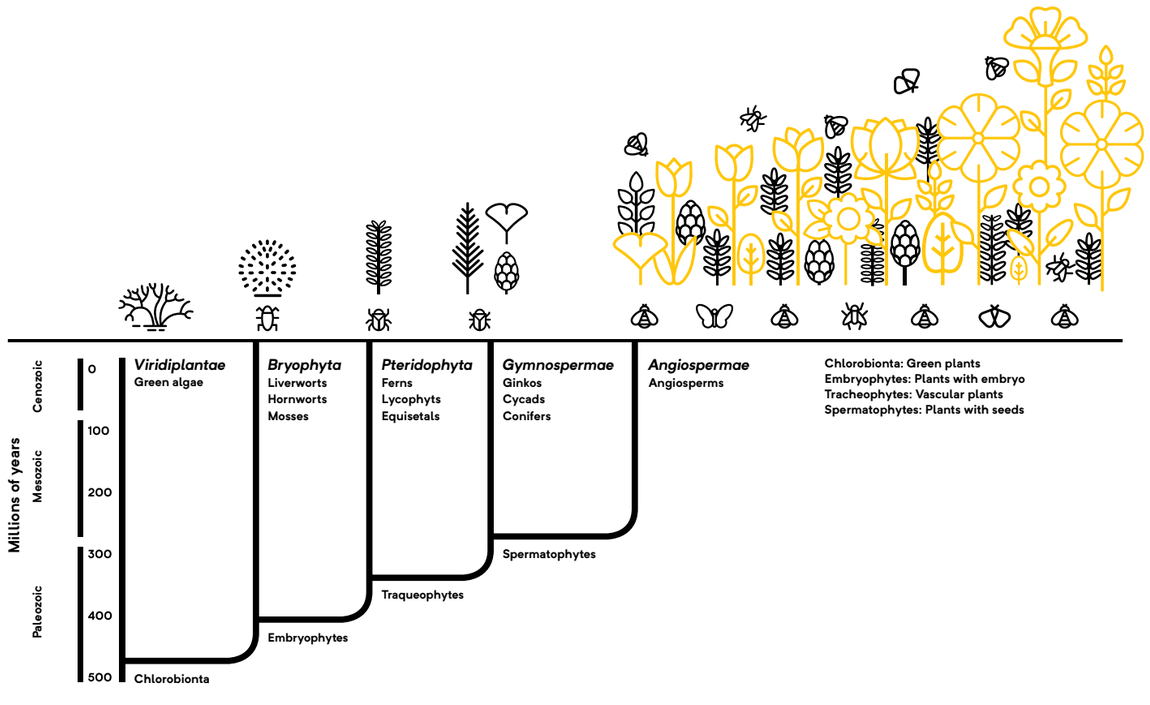
For tens of millions of years, the most successful adaptations have imposed themselves on the less efficient ones.
This phenomenon, contained in Charles Darwin's theory of evolution, affects all living beings on our planet.
Insects are the most efficient pollinating agents for plants.
As a result, thanks to evolution, plants that depend on insects to reproduce dominate our surroundings.
Indeed, nine out of 10 plants require insects to produce fruits and seeds.

## The relationship between plants and insects

Plants and insects have evolved together in mutually beneficial relationships.
This is known as coevolution.
As a result of coevolution, pollination by insects is the predominant and essential form of plant reproduction.
Thus, if we disrupt the relationship between plants and insects, we will jeopardise one of the foundations of life on Earth.

FIND OUT MORE
Plants and insects: phased coevolution

The first flowering plants emerged more than 200 million years ago.
We call them gymnosperms.
Gymnosperms had primitive flowers and fruits and were the first to come into contact with insects.
The first flowering plants resembling today's plants appeared about 100 million years ago.
We call them angiosperms.
Angiosperms rapidly came to dominate the gymnosperms and spread throughout the planet.



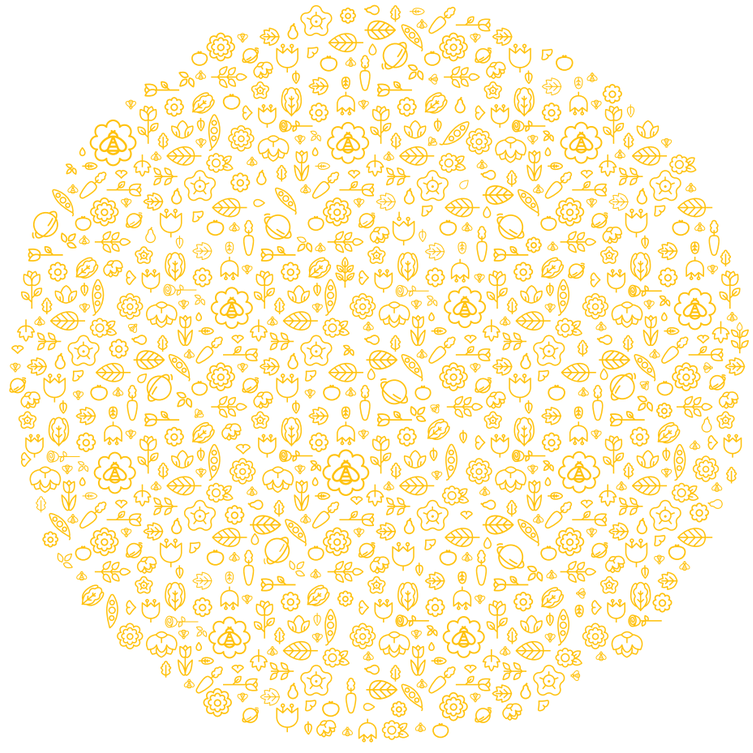

# WILD BEES

## WILD BEES ARE THE KEY PLAYERS IN POLLINATION

It is estimated that 90% of the pollination of flowering plants is done by insects, especially bees.
This is because, unlike other insects that visit flowers just to feed, bees also collect food to take to their larvae.
This is why wild bees require large amounts of pollen and visit flowers with much greater frequency than other insects.

## What is a bee?

Most of us relate bees to honey and beehives.
We envisage them living in complex societies made up of a queen bee, a few male bees and an army of worker bees.
And this is true... As long as we are talking about honey bees.
But honey bees are just one of many bee species.
In the Iberian Peninsula alone, there are more than 1,000 species of wild bees.
Most of these species do not live in hives or produce honey.
Nor are they organised in societies. We shall call these "other" bees.



## What are these “other” bees like?

It is estimated that there are between 25.000 and 30.000 species of wild bees on Earth.
There are so many that some species are still unknown.
In fact, there are more species of bees than mammals, birds and reptiles put together.
Some wild bees resemble honey bees, with yellow and brown stripes.
But most differ in terms of:

- Colour: bees can be red, white or black, with an iridescent sheen, or with speckling.
- Size: they can have thin or thick bodies, be large – like bumblebees – or tiny (less than 3mm in size)

FIND OUT MORE
Bumblebees

These bees live together in colonies of between 100 and 500 individuals.
Just like honey bees, they have a social structure, with a distribution of roles and close collaboration in the caring for their offspring.
The lifespan of the female queen is a little more than a year.
This means that the colony does not become particularly large.
The worker females are born first, followed by the males and the new queens.
Bumblebees nest in abandoned burrows underneath grass, where they accumulate a sugary liquid similar to honey.




75% of plants depend on bees



30.000
Species

## One year of life

Bees live for about one year.
They spend most of that year as larvae inside the nest.
The adult life of a bee lasts just a few weeks.
It is a very intense phase of activity as they move relentlessly from flower to flower to collect pollen and nectar.
As well as feeding themselves, they also carry food to the nest to provide nourishment for their brood.

FIND OUT MORE
What are the nests like?

Female bees are responsible for making the nest.
They first search for a suitable location, then build different larval chambers.
Each of these chambers is an individual cell in which they lay a single egg.
Before laying their eggs, bees make sure that the larvae will have enough food in their chambers to be able to develop.
They make an estimated 10 trips to supply each of the cells with “bee bread”, a mixture of pollen and nectar.



Life cycle: 1 year

## Morphological adaptations

### How do they transport pollen?

Almost all female bees have scopae, very hairy specialised organs where they acumulate the pollen they collect.
The tibia and metatarsals of their hind legs are wide and hairy.
These hairs are branched and pick up pollen, which remains stuck to the hairs until they reach the nest, and loses none of its freshness or any of its nutritional properties.


### How do bees see?

Bees have a range of color vision reaching further towards the ultraviolet spectrum than humans.
To ensure they catch the attention of insects, many flowers are brightly coloured and emit ultraviolet light signals.
This ultraviolet light is invisible to us.
But bees are able to see it and they follow this light until they reach the pollen.

### Vision spectrum



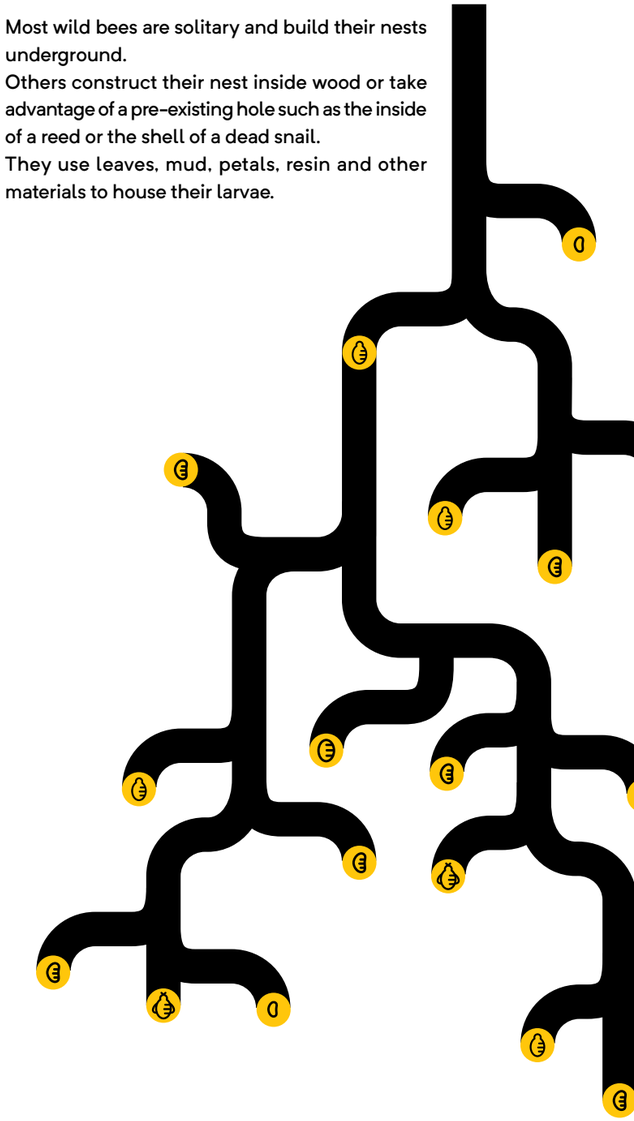

### How do they reach the pollen?

Some flowers have a deep corolla and there are bees with a very long tongue that can reach the pollen that accumulates within.
This is an example of coevolution.
If this were not so, plants with this type of flower would have become extinct since no insect would be able to pollinate them.




## What are the nests like?

Most wild bees are solitary and build their nests underground.
Others construct their nest inside wood or take advantage of a pre-existing hole such as the inside of a reed or the shell of a dead snail.
They use leaves, mud, petals, resin and other materials to house their larvae.



# HUMAN NOURISHMENT

## Pollination and human nourishment

Pollination also affects humans.
Plants and insects are not isolated elements of nature.
They are merely components of natural ecosystems. And our food supplies and, consequently, our very survival depends, among other things, on keeping a balance in these ecosystems.
In all, 75% of the food produced worldwide depends on pollination by insects, particularly by bees.

### Human health

Pollinator health is related to human health.
Plants produce several essential vitamins and micronutrients. Some plants store large quantities of vitamins A, C and E, folic acid and minerals.
For thousands of years, humans have been taking advantage of these essential elements provided by plants through food.
The extinction of pollinators would reduce the number of crops and wild plants, and, consequently, our health would suffer.

How we can go blind without pollinators

### Pollination, a quantifiable service

Aggressive agricultural practices and the destruction of natural habitats have led in some places to the disappearance of pollinating insects.
In California, for example, honey-bee hives are imported to ensure that almond trees are pollinated and so produce almonds.
The costs this practice enables us to calculate the monetary value of pollination.

Honey bees diminish wild bees especies

## Are domestic bees the solution to the problem?

Introducing honey bee hives to locations where natural pollinators have disappeared is not the solution.
On the one hand, wild bees are just as efficient as – or more efficient than – domestic bees when pollinating the majority of crops.
On the other hand, though, honey bees are not responsible for pollinating the majority of wild plants. This means that if the insects that pollinate them disappear, these plants will be doomed to extinction.
In conclusion, it is fair to say that honey bees complement the pollinating activity of other insects in some crops.
But they will never act as a substitute that will compensate for the progressive disappearance of wild plants that have run out of pollinators.

FIND OUT MORE
Almond tree pollination in California and Catalonia

In California there are 300,000 ha of almond trees.
We know that nine out of 10 flowering almond trees only bear fruit if a bee pollinates them.
To be able to pollinate all of these almond trees artificially we would need one and a half million bee hives.
Given that each hive costs 100 euros per year, the cost of this operation would be in the region of 150 million euros every year!
Luckily, in Catalonia the pollination of almond trees occurs naturally: since most almond trees are found in agricultural areas where natural vegetation is preserved along field margins and in nearby areas, pollination is performed by unseen agents such as solitary bees!

FIND OUT MORE
The most vulnerable crops

The main export crops in Spain depend on pollination by insects.
Hence, the crops that are most threatened by the decline in pollinators are fruit, vegetables and nuts.
Studies suggest that the economic value of the pollination of these crops exceeds annually 2,400 million euros.
This equates to 70% of the economic value of Spanish agricultural production (2013).

Most essential crops for human consumption are dependent on insect pollination

# BIODIVERSITY IN DANGER

Pollinating insects are under threat worldwide.

According to studies conducted in recent years, the presence of pollinating insects is declining on all continents.
As we have seen, this has direct consequences for pollination, the survival of plant species, the production of food and human life.

- From an environmental perspective, the disappearance of pollinating insects may disrupt the balance of natural ecosystems, thereby endangering life as we know it.
- From an economic standpoint, a decline in pollinators may result in huge losses for agricultural and food sectors. Furthermore, it may mean that many communities lose their main source of income.
- Socially, the decrease in food availability may lead to an unprecedented food crisis.

But how did we get into this situation?
A diverse range of causes explain the disappearance of pollinating insects.

These include:
Industrial agriculture
Habitat loss and fragmentation
Environmental pollution
Global spread of viruses and bacteria
Climate change

## Industrial agriculture

This type of agricultural activity seeks to achieve the maximum yield from the land.
It involves the use of aggressive methods to ward off pests that affect crops, as well as an increase in the amount of land worked.
Pest control methods rely on the systematic application of a huge quantity of pesticides.
In addition, field margins and the patches of natural vegetation that surround them are eliminated to increase the cultivated area.
These practices collectively contribute to reducing biodiversity in crops and in the surrounding ecosystems, that is, what is known conjointly as the agroecosystem.

One of the main causes of bee mortality is insecticides derived from synthetic nicotine (neonicotinoids)

Goulson D. An overview of the environmental risks posed by neonicotinoid insecticides. J Appl Ecol. 2013;50: 977—987Lundin, O. et al. 2015 PLoS ONE 10(8) "Neonicotinoid

Insecticides and Their Impacts on Bees: A Systematic Review of Research Approaches and Identification of Knowledge Gaps"

Van der Sluijs JP, Simon-Delso N, Goulson D, Maxim L, Bonmatin JM, Belzunces LP. Neonicotinoids, bee disorders and the sustainability of pollinator services. Curr Opin Environ Sustainability. 2013;5: 293—305

Clear evidence of recent declines in both wild and domesticated pollinators

## Fragmentation and loss of habitats

In recent decades, the expansion of infrastructures has resulted in two major consequences for biodiversity.
Firstly, natural habitats have disappeared.
A large number of animals, including insects, have had to leave the habitats where they once lived.
Secondly, these natural habitats have been modified and animal and plant species have had to adapt to an environment with less surface area and fewer resources.
The infrastructures such as roads and highways that connect urbanised areas pass through and divide natural habitats.
As a result, new habitats become isolated in small areas, thereby endangering the survival of many species, including insects.

**46%**
**of bumblebee species are declining**

**24%**
**of these species are in danger of extinction**

The exponential increase in construction is also a reason for the loss of habitats and diversity

Fattorini, S. 2011 Biological conservation insect extinction by urbanization: A long term study in Rome

## Climate change

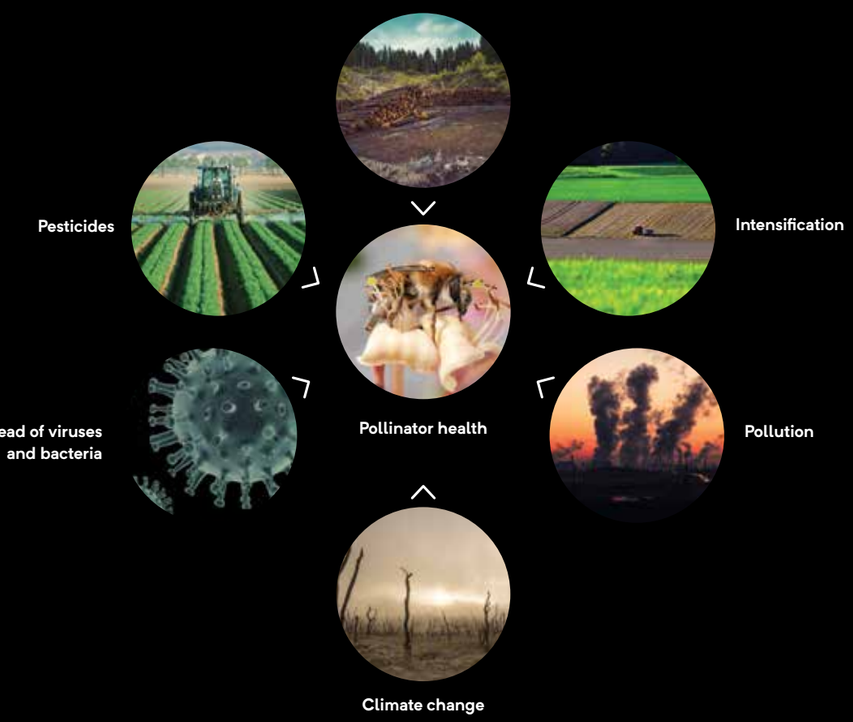
The scientific evidence accumulated year after year seems to confirm that human activity has a direct impact on the planet's climate. This effect, known as climate change, has been caused by the widespread burning of fossil fuels such as coal, oil and natural gas since the beginning of the industrial revolution.
Climate change leads, among other things, to changes in rainfall, maximum and minimum temperatures and flowering seasons. These changes disrupt the life cycles of animals and plants, leading to imbalances in our ecosystems.
Our collective ignorance of the functioning of ecosystems makes it difficult to accurately predict the consequences of these changes. This in turn may make us very vulnerable to such changes.

Climate change disrupts flowering time and the most active period of bee species responsible for flower pollination

## Viruses and bacteria globalization

As a consequence of economic globalization, viruses, bacteria and entomopathogenic fungi have also increased considerably over the past decades. The enormous and rapid exchange of people and goods highlights the vulnerability of individuals in a globalized world.
Globally, there has been a significant increase in the Colony Collapse Disorder, a sudden disappearance of honey bee colonies that occurs even if hives have sufficient food reserves. The cause or causes of the syndrome are not yet clear, but some studies attribute it to diseases provoked by microorganisms or the acute paralysis virus (APIV). However, other scientists suggest that environmental changes or the toxicity of certain pesticides are the main causes of colony disappearance.

Emerging infectious diseases can have devastating impacts on both managed and wild species and indirectly threaten human wellbeing by depleting ecosystem services



# WHAT CAN YOU DO FOR BEES?

We are facing a major problem that can be overcome if we work together.
Large-scale projects are not necessary for preserving wild pollinator species.
In this respect, responsible consumption is very important.
Our preferences as consumers can have a huge impact.
If we buy organic or local products, we will be helping to protect bees.
But let's not stop here.
We can help populations of wild bees and other insects by undertaking small-scale actions on our balconies, in our patios and in our gardens.
Think about the benefits they bring us, and lend them a hand!

### Buy local and seasonal food

### Buy organic food

Organic farming uses natural pesticides (macerated products, infusions, etc.) and organic fertilisers and gives new life to traditional varieties that are better suited to local conditions.

### Aromatic plants for local pollinator species

When you grow plants on your balcony, terrace or in your garden, make sure you choose native species.
These are the plants that adapt best to the characteristics of the area and the needs of local wild pollinators.
Rosemary, thyme, sage and winter savoury are examples of such plants.

### Create a garden at home or at school

A garden, however simple, helps you learn from plants.
It is the best educational tool for learning about plant life cycles and for understanding how to take care of them.

### Avoid the use of pesticides

When organisms such as insects, herbs or fungi annoy us, we tend to resort to pesticides.
But pesticides are dangerous products and contain toxic substances, many of which are carcinogenic.
What's more, these substances disperse and can contaminate soil and water.
Since they are not biodegradable, they do not disappear and they tend to concentrate in the environment and in organisms.
We must, therefore, replace pesticides with plant extracts that take advantage of the natural chemical reactions used by plants to protect themselves from herbivorous species.

### Build an insect hotel

You can build hotels for insects using natural materials such as logs, pine cones, branches, bark, straw, reeds, porous bricks and mud.
The more materials we use, the more varied our insect clientele will be. And diversity is always beneficial for ecosystem conservation.
The aim of these hotels is to provide insects with a protected space that they can use as a nest during long periods of hibernation.
For insects to become residents, our hotel must reproduce the natural habitats in which they live.
If we successfully attract insects, we will have pollinators next to our gardens and balconies.
In addition, in exchange for food and a place to live, these insects will help our plants reproduce.
Some of them will even help us eliminate the natural pests that attack them.

No pesticides

Sustainable energy

Green area

Local products

Wind power

No insecticides

Bio products

KM 0

Bio products

Sustainable energy

A garden at home or at school

Solar energy

No pollution

Recycling

No pollution

Sustainable energy

# ACTIONS TO SAVE POLLINATORS

## DIRECCIÓN GENERAL MEDIO AMBIENTE COMISIÓN EUROPEA

We cannot afford to lose our pollinators: we must act now to prevent a major risk for nature and our own existence. The EU and its Member States are jointly addressing the problem.

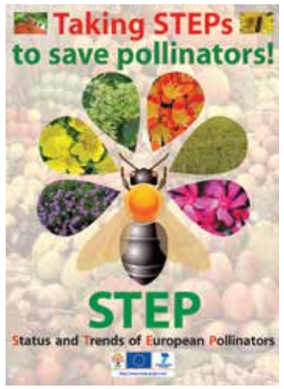
Through its first-ever EU Initiative on Pollinators, the EU mobilises action across the board to address the decline of pollinators in the EU, and contribute to global conservation efforts. The Initiative, adopted in 2018, consists of more than 30 actions.

Key actions include plans and priority measures for the most threatened species, protection of pollinator habitats in rural and urban areas and mitigation of the impacts of pesticides and invasive alien species on pollinators.

In support to these actions, the EU is developing a monitoring system to enable accurate assessment of the state of pollinator populations. Citizen science is pivotal for the monitoring, and the EU strongly supports it.

The European Green Deal, adopted in December 2019, provides a strong boost to all these actions, and more broadly to EU's efforts to stop biodiversity loss. It puts the EU on an ambitious path, but real action has to follow. Only with joined efforts of all actors — citizens, businesses, farmers, scientists and others — will we be able to conserve pollinating insects and their precious contribution to our wellbeing.


The SAPOLL project, funded under the European Territorial Cooperation programme France-Wallonie-Vlaanderen, implemented an action plan for the conservation of wild pollinators in Belgium and the north of France, mobilizing citizens, farmers, teachers, politicians etc.




The STEP project generated the knowledge that was key to the development of the EU Pollinators Initiative

EU Pollinators Initiative

# MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

Pollinators are crucial to biodiversity conservation and the maintenance of key ecosystems and ecosystem services for society. MITERD is strongly committed to the protection of pollinators and their habitats in order to stop their decline and contributing to the EU Biodiversity Strategy objectives for 2030.

Spain was one of the first EU members to join the International Pollinator Conservation Coalition, created in 2016 to promote actions in response to the decline of pollinators.

Aligned with this commitment and within the framework of the EU Pollinators Initiative, in September 2020, the Sectorial Conference on the Environment has approved the National Strategy for the Conservation of Pollinators, proposed by MITERD.

The strategy identifies actions to improve the status of pollinators in Spain, focusing on: the conservation of the most threatened pollinators; the promotion of their habitats; the improvement of pollinator management; the reduction of risks derived from pests, pathogens and invasive species and the use of phytosanitary products; and the promotion of research and improvement of knowledge.

With this strategy, the MITERD reinforce and complete their actions favouring pollinators such as the elaboration of the Spanish Atlas and the Red List of threatened invertebrates Atlas and Red Lists for the improvement their knowledge, initiatives of monitoring at urban areas supported by the Foundation Biodiversity, or research on pollination in National Parks.

Small cabbage white butterfly. Lepidoptera, Pieridae, ***Pieris rapae*** (L. 1758)
© Ricardo Gómez Calmaestra

Checkered beetle. Coleoptera, Cleridae, ***Trichodes leucopsideus*** (Olivier, 1795)
© Ricardo Gómez Calmaestra

**Directiva 92/43/CEE del Consejo, de 21 de mayo de 1992, relativa a la conservación de los hábitats naturales y de la fauna y flora silvestres**

**Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad**

**Real Decreto 139/2011, de 4 de febrero, para el desarrollo del Listado de Especies Silvestres en Régimen de Protección Especial y del Catálogo Español de Especies Amenazadas**

**Real Decreto 1274/2011, de 16 de septiembre, por el que se aprueba el Plan estratégico del patrimonio natural y de la biodiversidad 2011-2017, en aplicación de la Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad**

Generalitat de Catalunya
**Departament de Territori i Sostenibilitat**

# GENERALITAT DE CATALUNYA
# DEPARTAMENT DE TERRITORI I SOSTENIBILITAT

Pollinators are key pieces of the nature. Of them depends the integrity of the ecosystems and many of the services that provide us for free.

In 2018, the Catalonian government approved the Natural Heritage and Biodiversity Strategy of Catalonia 2030, that foresees the elaboration of plan of conservation of wild pollinators with different sectors and other indirect measures that have to contribute to this objective.

Likewise, the Catalonian government had elaborated a guide to favour pollinators in environmental restoration and a specific cartography to select the species of plants more useful for this purpose.

Natural Heritage and Biodiversity Strategy of Catalonia

Flowered meadow in the Montseny
© Santi Pérez

Blue mason bee, *Osmia caerulescens* (L. 1758))
© Santi Pérez

Ajuntament de Barcelona

# AJUNTAMENT DE BARCELONA
# INSTITUT MUNICIPAL DE PARCS I JARDINS

Barcelona is committed to the conservation of pollinators by promoting and creating habitats of interest for wild bees and the installation of structures to encourage their refuge and nesting.

Barcelona City Council is changing how the city manage its green areas, reducing the surface of lawns and promoting the presence of different natural areas of great interest to pollinators.

It is creating gardens of interest for the biodiversity. The city has planted vegetal species with interesting flowers for pollinators and has created structures to offer substrates for refuge and nesting.

Cork oaks have been planted to act as a biological control of pests and diseases that affect the city's trees. Those trees also act as small habitats for useful fauna and pollinators, offering long-lasting blooms with a large quantity of nectar.

40 insect hotels have been installed in green spaces in the city such as urban gardens, parks, gardens, etc. Their occupation is also being monitored.

Barcelona City Council participates in the Urban Butterfly Monitoring Scheme (uBMS), a network of volunteers who collect data on butterfly populations in Barcelona and Madrid. The data serves to evaluate and understand urban biodiversity, and also as a management tool.

Pollinator workshop at the Auró's school in the biodiversity refugy in the Joan Miró Park

Tree pit planting project in the urban tree line in the square of Doctor Letamendi

Stimulus programme for the city's urban green infrastructure: Government measure

Climate Plan

Mesura de Govern per aplicar la eradicació de l'ús del glifosat en els espais verds i la via pública municipals de Barcelona

Bones pràctiques de jardineria a Barcelona: conservar i millorar la biodiversitat

# CITIZEN INITIATIVES IN EUROPE

**When it comes down to saving our biodiversity, no action is too small or unimportant. Our wildlife will respond quickly if we go out of our way to help it. Here you have a selection of just some of the thousands of possible activities that can help save our biodiversity.**

## ENTITIES OR ASSOCIATIONS THAT PROMOTE AGROECOLOGY

Escola agrària de Manresa

Mercat de pagès

Hortec

ICHN

Associació l'Era

ADV Fruiters

ADV Ecològica

CAECyL

CAERM

CAECV

CRAEGA

CCPAE

Ecoalternativa

ADV Terres de Ponent

Custòdia del territori

La Grana

Observatori del paisatge

Projecte ICGC

SEAE

CAAE

Organic Farming

Ecocert

XCN

CBPAE

Monitoring of rare species
© Oscar Aguado

School activities

Build insect hotels

## WHO IS HELPING POLLINATORS?

## ACTIVITIES TARGETING POLLINATORS

## ENTITIES OR ASSOCIATIONS THAT PROMOTE SUSTAINABLE CONSUMPTION

Opcions

Consum conscient

Biocultura

Katuma

La Directa

Sostenible

Natexpo

Ets el que menges

EFTA Fair trade

FLO Fair trade

WFTO Fair trade

Fairtrade maerket

Slow food

Nordic organic food fair