**Pollination – more than having living honeybees**



You might have come across the photo of a supermarket with full shelves of fruit and vegetables, and then the same one without most of them, stating: “life with vs life without bees”. Knowing the importance of pollinators for food production, the losses in bee population are alarming1, 2, and scientists and world organizations and local beekeeping communities in many countries are raising awareness on our dependency on pollinators3-7. Pollinators, indeed, as their name indicate, allow the plants to fulfil their reproduction cycle by bringing the pollen to the female parts of the flowers, precursor for the formation of the fruit, that we consume. About two-thirds of the crop plants that feed the world rely on pollination8. FAO's Director-General José Graziano da Silva reminded on the occasion of this year's World Bee Day8 that "the absence of bees and other pollinators would wipe out coffee, apples, almonds, tomatoes and cocoa to name just a few of the crops that rely on pollination. Countries need to shift to more pollinator-friendly and sustainable food policies and systems." The increased cultivation of crops for energy, also depending on pollination, just raises the needs3.

Not only are bees sensitive to pesticides from the neonicotinoids class, but they are also dying because of diseases or the still puzzling colony collapse disorder, or killed by invasive species as the Asian hornet (*Vespa velutina),* a globally distributed predator of European honey bees and other insects.

Pollination is a time-consuming, highly specialized service whose value can be counted in billions of dollars9-12, dispensed for free, that we compromise with more or less harmful pesticide applications since long time13, 14 and the loss of natural and diverse ecosystems15.

So, if it is known that

* Bees are essential for our food production,
* Pesticides can kill bees,
* Bee populations are dramatically shrinking,

Why can’t we just deposit a couple of beehives in a field - avoiding neonicotinoids and similar treatments - to solve the pollination question? Many crop growers actually DO use beehives or bumblebee boxes in their greenhouses or fields to benefit from their action. Is it just a matter of encouraging those methods and eliminating pesticides that are dangerous to bees?

Is that why there are apple fields in China that have to be still, since the 90s, entirely pollinated by hand16? Having at the same time huge numbers of blooming trees, plenty of beehives and still a collapsing fruit production does not seem to make any sense.

There is still a lot to learn and information to be shared about the connection between bees, crops, wildflowers and pollination dynamics in general.

# Did you know…?

* **Not all crops that need pollination do need a pollinator** (wind pollination is another form of pollination common for conifers or grasses as cereals)
* **Some of the crops that we can consume are only seemingly pollination independent**. If they are grown only for their roots or leaves they do not require pollination to be eaten. But they do if we need to produce their seeds.
* **Not all crops that need insect pollination can be pollinated by bees.**
* **Pollinators can be different species of bees, flies, birds, butterflies, moths, bats and less commonly non-flying insects as beetles or ants.**
* **Some plants are very specialized,** so the disappearing of their partner is fatal for fruiting and sexual reproduction7.

This is the case for the vanilla plant, a luxury item that is pollinated by hand outside of its native range. The *Melipona* bees, its natural pollinators, stingless species native to the Yucatàn region of Mexico, are almost extinct. Another know case is the orchid *Angraecum sesquipedale* whose strange features led Charles Darwin to specifically search for its pollinator – with success: he found the moth *Xantopan morgani predicta*. Indeed, the specificities of the flower, required precise and rare characteristics from the pollinator.

* **Different pollinators also react to different flower characteristics**, from shape to colour to smell to seasonality. The set of flower features (colour, shape, size, nectar type and odour) that attract pollinators is called the flower's pollination syndrome. Similarly, bees, flies, butterflies have different body shapes, habits and preferences. Therefore, even if many bees are rather generalists, they simply cannot pollinate every flower.

But what about those who are perfectly fine with bees, would a hive and the reduction of bee-detrimental chemicals be enough? How do we know how many bees is enough? How can one say there are enough or not enough bees? Even in places where it is said that there are not enough, crops still get pollinated and grow fine. And if there are “enough” bees on average, are we safe?

* **Bees only fly that far, so the density and repartition of colonies/nesting sites is more important than the actual total number of individuals**, or the size of one colony/nesting site17, 18.
* **Bee is often understood as *Apis mellifera*, the honeybee. But there are thousands of bee species, many of them that are specific to a region or a continent7, 8, 19**.
* **Not all crops have the same pollinator number needs**, and we don’t know yet the needed pollinator density of each of them.
* **An average density over a whole country does not mean so much**, because of the heterogeneous repartition of crops and colonies. Often, they are not synchronized (different immediate interests of farmers and beekeepers). Indeed, an insufficient average does indicate that there is a real need for increase, even though a high presence of colonies over the whole territory does not imply the needs are really met everywhere3.
* In calculations, **wild pollinators are often not counted or little studied**, so the numbers can be false. In other words, the real need is very likely to be much higher than calculated in the field because of the “hidden” pollination already taken care of. So if the field size allows it (a maximal size given by the distance for flying and foraging), the surroundings – if well preserved - will compensate for the biodiversity desert.

Therefore, numbers are often a combination of estimates of present populations, the counting of beehives, the calculation of surface cultivated with crops needing pollination, estimation of the distance pollinators need to fly, comparison with previous years or decades, or with other places in the world with similar conditions. Indeed, the wild pollination - the services given by a range of wild living organisms, often solitary living insects, are a **precious ally for pollination** of agricultural crops. It goes beyond the multiplication of pollinated flowers because of a multiplication of the number of agents. They have different efficiencies, weaknesses and strengths, so that their action is synergetic rather than additive. **Insect diversity allows for multiplied beneficial effects.**

* **There is synergy between wild bees and introduced, cultivated ones.** Between solitary and colony-living ones17, 20.
* **Some bee species are less affected than others by competition/predation by wasps or changing conditions18**.
* **Some bee species are adapted to different temperatures**, so a change in climate can mean some of them loose their ecological niche18, 21.
* **Shifts in land use and habitat fragmentation cause the decline of more specialized bee species and favour more generalist, highly mobile bee species.**

Can we then conclude that introducing several bee species for one crop would be the solution? A hive, and some sand or insect hotels for the others would be perfect. Why still take agricultural valuable land to plant only flowers and other economically and culinary uninteresting plants? What is biodiversity all about?

* **Pollination of fruit trees for example is complex because most trees are not self-fertile, i.e. they can only be pollinated by the pollen from a tree of a different variety. Moreover, the varieties need to be compatible for the precise time orchestration of flower opening and closing.**

Biodiversity is a complex matter and needs for fruit trees for example are not that trivial. The right combinations of trees, that are compatible with regard to their flowering times and flower opening times. The pollinator trees are often less interesting with regard to their fruits, so their economical advantage must be calculated in another way.

* **Bees are subject to diseases, stress and young, weak, stressed and /or unexperienced bees are less efficient than healthy, mature, strong ones.**
* **Bees need also variety for a balanced diet to stay strong and healthy, not only the absence of chemical stress factors.**
* **Bees need food for the whole growing season, not only during the flowering season of one single crop22**.

Even an organically farmed monoculture plantation can be a biodiversity desert, that, if its surface is large enough, will not support any bee pollination. In other words, vegetal diversity ensures a solid nutrition for the beneficial insects. Biodiversity in general supports several functions from nutrition, nesting, microclimate, protection among other services23. This is one of the main reasons why there is a need for hand pollination of gigantic fruit monocultures16. As the foraging range of bees is limited, the effects of this type of agriculture are visible sometimes only at a larger scale (cf. *habitat fragmentation*).

To maintain the ecosystem functions, the pollinators and their host plants need to be both taken care of; if one loses its partner, there must be at least one alternative organism for that function. For instance, changes in climate have also consequences on fine-tuned mechanisms as flowering times, affecting pollinator survival in critical times21. This is one of the basics of resilience on ecosystem level24, 25.

* **Wild bees and other wild pollinators are a guarantee for a maintenance of the pollination service even in case of decline of other species.**

The maintenance of wild spaces with various, native plants all year round, combined with elements to host the insects in the winter or to breed, are essential on the long term, and have to be included as a necessary standard in agricultural practices, not only as a philanthropic beekeeper sustaining activity or romantic nature-lover pleasure. It ought to be a normal practice like maintaining machines in function or checking for enough water supply.

To make this happen in practice, there are many steps that are still to be successfully walked and questions to be answered. A broad nature protection and conservation effort depend on a large-scale knowledge availability from farmers, over governments and industries, to consumers. How do you protect something you don’t know, something you are not able to recognize, something you think is useless, or something you mistake for dangerous? Citizen-driven conservation is a powerful tool that can be further developed.

Also, some lessons can be learned from the hand pollination practice in China. Education on hand pollination instead of information about dynamics, and low-cost, efficient human pollinator did not bring back natural pollinators, as another motivation - economic viability of hand pollination – was chosen and supported with adequate training and measures.

Give key knowledge, give a reason and give some first means and ways, and the potential of a broad action can be unlocked.

***What do YOU know about pollination? Test yourself!***

Can you spot all pollinators?

Which plants on this list do not depend on a pollinator?

How many bee species are there approximatively? 300-500 1500-2000 20’000-30’000

Answers next time… 😊

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