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BACKGROUND

Most of the crops depend on pollinators, so declines in both managed and wild bees with associated loss of pollination services raise concerns about food security. In the light of an increasing global human population and global climate change, the demand for food is increasing and is becoming more and more challenging.

Managed honeybee colonies are essential for agriculture and the environment, they ensure plant reproduction by pollination, whilst beekeeping contributes to the development of rural areas. It is a small sector but very important for pollination. Although over the past 10 to 15 years beekeepers have been reporting unusual weakening of bee numbers and colony losses, the total number of beehives in the EU is continuing to rise. This number in 2020 reached 18,9 million of beehives, which is +3,9% comparing to 2019. High degree of intensity of beekeeping have resulted in a variability of interactions and impacts between managed bees and different pollinator populations.

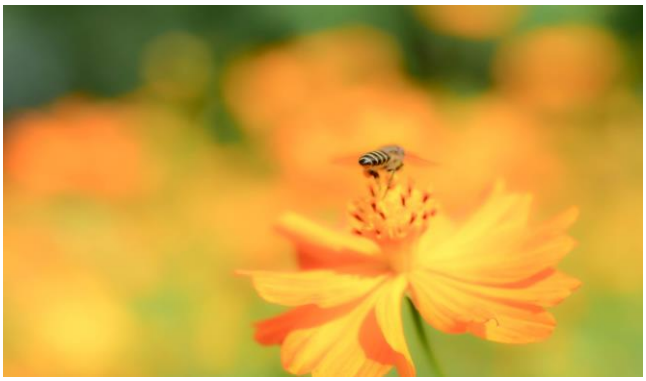
This article brings some thoughts about implementing more resilient and sustainable beekeeping practices as well as about protecting wild bee's species.

BEEHIVE IOT MONITORING

Pesticide use, invasive species, habitats around colonies, poor nutrition and foraging, climate change, landscape transformation and alien species are all external factor influencing overall's hive health and productivity. Along with external stressor, there are destructors which are inherent to the bees like pathogens and parasites (like Varroa mite). The same as it applies for a human health, an early detection and notification is vital for bees' health, and their survival.

In recent 5-6 years we have witnessed to the emerge of many IoT monitoring systems and applications. A whole beehive monitoring idea is about the tool which will ensure beekeepers are more proactive about hive's health and productivity. However, could just collecting and presenting some sensor's data (temperature, humidity, pressure, weight scale, GPS tracking …), even with some form of predictive analytics, be enough? Another aspect is beekeeper's willingness to adopt new technologies. Our surveys showed more complex data to be processed and analysed higher adopting resistance it produces. Nice features, like our bee counter (in/out flight) and data correlation functionalities, are raising by far more attention within academic community, than amongst ordinary beekeepers who are often not profound in technical skills for analysing data.

So, did beekeepers become more proactive upon implementing IoT monitoring systems? In our opinion no, they aren't.



BEEKEEPING PROCESSES AUTOMATIZATION AS A SOLUTION

What if, instead beekeeper processing and analysing measurement data, it is done by technology? Could AI driven technologies analyse all external stressor impacts and react? Or in other words, is it easier if beekeeper can receive notification created by system on his mobile.

One of the most used action in facing external stressor threat, like intensified pesticides and other chemical spraying in surrounding areas, is closing of the hive entrance. Upon closing, bees feel a bit fuzzy, but is usually for the sake of their health. Is it possible to create an IoT system with the new hive entrance module which can be automatically closed, embedded even with a bee counter functionality, with entrance closing action remotely initiated or/and automatically triggered? We think, it is.

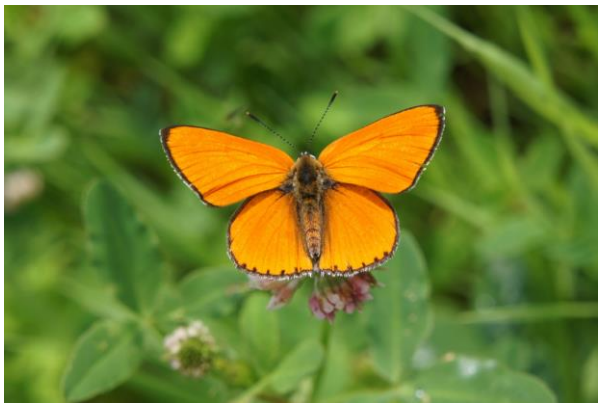
Furthermore, closing decision itself can be based on the AI enabled algorithms with underlying data correlation analytic. In the next stage more advanced mathematical modelling and predictive analytics about what and how different external stressors are impacting hive, shall be developed, and tested.

PARASITES AND PATHOGENS

One of the main threats to bee health is the proliferation of pathogens and parasites infecting both managed and wild bees. Concerning just honeybees, the parasitic Varroa destructor mite appears to be the most harmful to colonies overall. The first thing beekeepers need to do is to learn how to set the right diagnosis. Not knowing the diseases symptom leads to not taking corrective action and to possible colonies lost. The surrounding area contamination with the pathogens could be a final consequence.

There are several ways of combating parasites and pathogens. One of the most promising is developing the new breeding programmes, supported by technology and genetics findings. The aim is to breed a selective honeybee which will be more resistant and robust bees against their main destructors.

INTERACTIONS WITH SOLITARY BEES



Along with all previously mentioned honeybee's stressors, solitary bees face in addition the large-scale habitat destruction because of human land use. Replacing natural habitats with cities and monocultures of crops has a huge impact on them. Unlike honeybee beehives, wild bees' habitats can't be easily restored or purchased. Having said all that, it is essential to safeguard and manage healthy bee population to ensure pollinators survive when conditions become even worse for them.

The protection action for wild bee population is noy a simple task though, as there are more than 20,000 different bee species living. Only a few of them are honeybees, meaning producing honey. The most of wild bees do not make colonies, living solitary and nest underground. The female spends most of her life searching for suitable nesting sites. Some species will nest in holes in the ground, while others will look for old beetle holes or hollow stems in which to lay their eggs. Determining which wild bee species are in decline and what threats cause harm to their populations is the prerequisite for any specific protection action.

Studies report that different degrees of beekeeping produce a different variability of impacts to the wild bees. There is increasing evidence that high densities of honeybees, related to beekeeping, can exacerbate declines in wild pollinators. Outcompeting wild pollinators for floral resources and diseases transmission have been the most studied impacts so far.

IN CONCLUSION

Most of the crops depend on pollinators, so declines in both managed and wild bees with associated loss of pollination services, raise concerns about food security. In the light of an increasing global human population and global climate change, the demand for food is increasing and is becoming more and more challenging.

In relation to the managed honeybees' protection, in this article we hypothesized the need for more efficient beehive monitoring systems and faster reaction against stressors. The main message is that technology can support beekeeping sector to become more robust and resilient. There is also the need for more sustainable and responsible beekeeping practises, specially while considering supplemental pollination services, aiming to reduce negative impact to wild pollinators.

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