Assessing the potential impact of declining insect pollination service to crops in Europe

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In Europe, 80% of crop species are dependent upon or benefit from pollination by insects, and mostly bees. Insect pollination is both a major ecosystem service that contributes to human well-being and a production practice used by farmers. Wild bees contribute to the pollination of most crop species and their importance are increasingly recognised since their foraging activity as well as their interaction with honey bees can significantly enhance the overall pollinating activity. Yet significant declines have been reported for wild bee populations and honey bee colonies alike in Europe. We quantified the relative importance of autonomous self-pollination, wind pollination and the pollination service provided by insects in annual entomophilous field crops over 7 to 10 sites located over a gradient of increasing semi-natural habitats in five pairs of crop-European country (ALARM EU project) : buckwheat *Fagopyrum esculentum* in Poland, cantaloupe *Cucumis melo* in France, field bean *Vicia faba* in the UK, spring oilseed rape *Brassica napus* in Sweden, and strawberry *Fragaria x ananassa* in Germany. Pollination service was measured on a whole plant basis, rather than using flower samples, so as to have direct access to yield data as

well the quality and value of the production. Based on these results and also a larger review (Klein *et al.* 2007. Proc. Roy. Soc. B. 274:303-313), the potential impacts of pollinator decline on European agriculture will be presented in agronomic terms and also in terms of economic vulnerability.

Impact of pollen feeding on the pollinating activity of honey bee colonies in enclosures

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Most of the crop species that provide our food worldwide are dependent upon or benefit from pollination by insects, and mostly bees. Honey bees are indigenous to the Old World, but are used extensively for crop pollination all over the world. Yet there has been rising concern over the sharp decline in honey bee colonies (e.g. CCD) and the possible negative impact on the wild bee fauna of high colony stocking rates used for crop pollination. However, there has been remarkably little work done to date to try to improve the pollinating activity of honey bee colonies. In enclosures, pollen can be a scarce resource that must be shared between the bees for food and the stigmas for pollination. Feeding pollen to honey bee colonies is known to reduce pollen collection and so we inferred that it might also affect their pollinating activity for crops where nectar foragers are effective pollinators. We tested over several years the impact of feeding pollen to honey bee colonies placed in greenhouses with monoecious cantaloupe and measured the effect on the individual pollination effectiveness of foragers as well as the overall pollinating activity of the colony. Feeding pollen significantly increased both the amount of conspecific pollen deposited onto a stigma following individual visits as well as the overall amount of conspecific pollen deposited onto the stigmas of the open-pollinated flowers in the enclosure. The consequence of these results will be explored as well as their applicability in the open.

Pitfalls on the way to passive bioindication and biomonitoring of atmospheric deposition of heavy metals with honey bee colonies (*Apis mellifera* L.)

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Bioindication is basically interpreting the concentration of substances in organisms. Bioindication of the atmospheric deposition of the heavy metals As, Cd, Cr, Mn, Ni, V, Cu, Pb, Zn and the non heavy metal Mg was evaluated in perspective of the biological baseline concentration (BBC) and the environmental memory of the individual honey bee and of the colony. It was concluded that, because there is little knowledge of the BBC and because of long time storage of food and indirect feeding of the brood, bioindication with honey bees of pollution of metals that have a BBC in bees is hard to interpret. Metals that are assumed to have no BBC in bees can be bioindicated. To evaluate the biomonitor capacity of honey bee colonies for these

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