Therefore we addressed the following questions: How diverse is the wild bee fauna of cemeteries with special attention to rare and endangered species? What are the responsible factors for diversity and frequency of bee species?

In total, the wild bee fauna of four cemeteries located in the western peripheral area of Vienna was investigated from April until late August 2013. Alleys, ruderal areas, trees and bushes, well maintained and neglected graves were recorded separately.

Overall there were found 19 different genera with 99 different species of wild bees. Common species like *Bombus lapidarius* followed by *Lasioglossum marginatum* and *Lasioglossum pauxillum* dominated, but also rare species like *Anthidium septemspinosum* and *Andrena combaella* were found. Graves, well maintained as well as neglected ones, and ruderal areas were identified as most species rich areas. These findings can be directly associated with the richness of flowering plants in those areas, from which specially oligolectic bee species (18) benefited.

The results show that cemeteries in cities have high potential to provide habitats for wild bees. Awareness of the people, that cemeteries also can function as an area of nature conservation, is an important part to implement bee friendly management to cemeteries.

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Anschrift der Verfasser: Lisa-Maria KASPER
Ulrich NEUMÜLLER
Stephan SCHABELREITER
Marie-Luise SCHLEDERER
Dipl.-Ing. Dr. Bärbel PACHINGER
Universität für Bodenkultur Wien, Department für Integrative Biologie und Biodiversitätsforschung, Institut für Integrative Naturschutzforschung
A-1180 Wien, Gregor-Mendel-Straße 33, Austria
E-Mail: baerbel.pachinger@boku.ac.at

ASSISIbf: Honeybees and robots form a bio-hybrid society
ASSISIbf: Honigbienen und Roboter bilden eine biohybride Gesellschaft

M. SZOPEK, S. HAHSHOLD, R. THENIUS, M. BODI, K. CRAILSHEIM & T. SCHMICKL

Most young honeybees will fail in locating themselves at their temperature preferendum of 36 °C in a thermal gradient if they run alone in an arena. In contrast to that, groups of such young bees aggregate at the optimum in such an environment. Thus we infer that groups of honeybees choose the optimum in a collective process by making collective decisions: To test that, we confronted them with a thermal field having one optimum spot (36 °C) and one sub-optimum spot (32 °C). It showed that groups of bees were capable to discriminate this sub-optimum from the optimum during gradient exploration. They collectively chose the optimum place without getting stuck in the sub-optimum. In another experiment, we deliberately modulated the bees' decision by introducing a "social gradient" by caging some bees in the sub-optimum to favor social interaction in the sub-optimum spot. In this setup the bees collectively neglect the preferred temperature of 36 °C and aggregate in the sub-optimum around the caged bees.

In the EU-funded project ASSISIbf we will further investigate how different stimuli types, e.g., vibration and temperature, can trigger specific individual and collective behaviours in bees. One important aspect of ASSISIbf is that it closes the feedback loops between the natural society and the artificial one, thus it allows selforganisation of the mixed collective. For the honeybee experiments we will generate an array of 64 static robotic nodes, each one equipped with a set of sensors and actuators (vibration, light, sound, temperature). Instead of moving robots we will move ‘patterns of actuation’ across the arena to motivate the bees to perform specific behaviors. The main goal of ASSISIbf is to enable novel communication between animals and robots, creating a mixed, bio-hybrid, and self-organising society of animals and machines.

The findings will have impact on the development of robotic devices that are capable to interact with bees autonomously. We expect novel automated systems for behavioural biology. By introducing artificial agents into animal societies we can test individual and group reaction to various stimuli. By combining robots with automated modeling we can achieve an unparalleled automation of animal behaviour experimentation. Such intelligent automated and robotized systems may significantly improve the field of biomedical research using model animals. A potential field of application can be the management of domestic animal stocks. All bred animal species are social animals, e.g., poultry, cattle, sheep, goat. The concepts proposed here can be applied to animal societies whose behaviour and interactions are more complex, potentially leading to various agricultural applications such as low-stress management of livestock. These systems could also be put at work to manage wildlife animal pests or resources in particular living species. One can envision artificial intelligent systems capable of modulating the behavior of unwanted pests to drive them away from specific places. Or, on the contrary, to attract valuable animals.

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Anschrift der Verfasser:

Mag.[a] Martina SZOPEK
Mag.[a]Sibylle HAHSHOLD
Dr. Ronald THENIUS
Mag. Michael BODI
Prof. Dr. Karl CRAILSHEIM
Ass.-Prof. Dr. Thomas SCHMICKL
Forschungsgruppe Stoffwechsel, Verhalten und Modelling
Karl-Franzens Universität Graz, Institut für Zoologie
Universitätsplatz 2, 8010 Graz
E-Mail: martina.szopek@uni-graz.at