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Beekeeping Science

Public Participation In Bee Science: C.S.I. Pollen

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“C.S.I. Pollen” aims to be the largest investigation on pollen diversity available to honey bee colonies in Europe. This should be accomplished by an international approach involving beekeepers to participate as citizen scientists.



“C.S.I. Pollen” is an international pollen diversity project which was first announced with this title, at the COLOSS conference in Kyiv on 29th September 2013 (van der Steen & Brodschneider, 2013). No, it is not about crime scene investigations but C.S.I. in our case means “Citizen Scientist Investigation”. The importance of pollen diversity available for honey bee colonies was intensively discussed at a previous COLOSS workshop on honey bee nutrition in Bled (Slovenia). There it was concluded, that an international inventory of pollen diversity linked to land use and the bee season is needed. In other words, we

want, together with beekeepers acting as citizen scientists, to conduct a scientific study in which we determine whether lack of pollen diversity is a real problem and if so, in which regions or habitat types and at what times within the season this is prevalent.

Why a Citizen Scientist project, why international and why pollen diversity?

To start with the last, a diverse pollen diet is an essential condition for the vitality of the honey bee colony. An insufficient or monofloral pollen diet is considered as a possible factor of winter

losses because it results in weaker colonies, less brood, diminished brood care and decreasing resistance against pathogens (Alaux *et al.*, 2009; Brodschneider and Crailsheim, 2010; Höcherl *et al.*, 2012; Di Pasquale *et al.*, 2013). Availability and diversity of pollen are under risk because of large scale agriculture, animal husbandry and urbanisation. Up-scaling of agriculture and animal husbandry has resulted in peaks and nadirs of pollen flow and maybe of diversity. In urban areas in general diversity is thought to be not the problem but quantity might be.

Why choose an international approach? Simply, because reduced biodiversity is an international problem and large scale research provides more data and more reliable results than small scale studies.

Finally, why did we launch this as a study with public participation? To answer this question, we will give you first a



Fig. 1. Few standardized simple tasks commonly performed by a large number of citizen scientists allow broad scale investigations of pollen diversity available for honey bees to an extend never seen before . (Photos: Bernd Niederkofler, Uni Graz)

short explanation of what citizen scientist (CS) studies are about.

Citizen scientist studies are, like the name says, scientific studies in which citizens are actively involved. In CS studies citizens are asked to help collect data on a large scale, coordinated by scientific instructors who also analyse the data. Well known examples of CS studies are the annual butterfly and garden bird counts ("Christmas bird count").

Many biological research projects involving citizen scientists have produced benefits before the full scientific results have been analysed, because the group increases their biological knowledge (such as pollen diversity available for their bees) and gains insight into the nature of empirical studies. Vice versa, crowdsourcing (obtaining content from a large group of people) can stimulate academic research and lower barriers among the players.

Furthermore, it is obvious that, both for practical and financial reasons, it is impossible for a small group of researchers to sample a big number of honey bee colonies on the same date, especially

when this has to be repeated in regular intervals. Therefore we call on the help of beekeepers to act as citizen scientists. In our project, beekeepers are not just the ones that take samples, but are active participants in this study and the main stakeholders of this project. In the wide field of pollen diversity and honey bee nutrition, we reduced the study objective to one question: how many different colours are brought to the hive in one day? This is investigated every 3 weeks, from spring to fall. All the work that needs to be done by the CS is described in detail in order to obtain comparable results from the participating CS in different countries.

The abovementioned possible link to winter losses is not part of this study. This study is focussed on mapping of pollen diversity both spatial and temporal. The diversity is linked to physical geographic features and land use. Also the amount of pollen collected in a certain time frame is not part of this study, not because it is not important, it is simply because public participation demands focusing on one topic only that can sufficiently be handled by everyone, without any laboratory equipment.

The study set-up?

The experimental part of the study is designed to be accomplished by beekeepers all over Europe using readily available equipment. In case a participant has no pollen traps, pending on funding

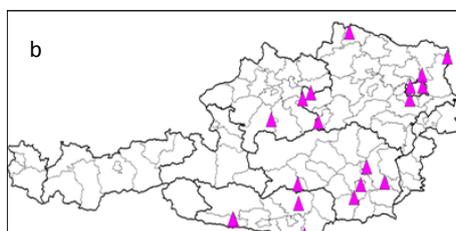
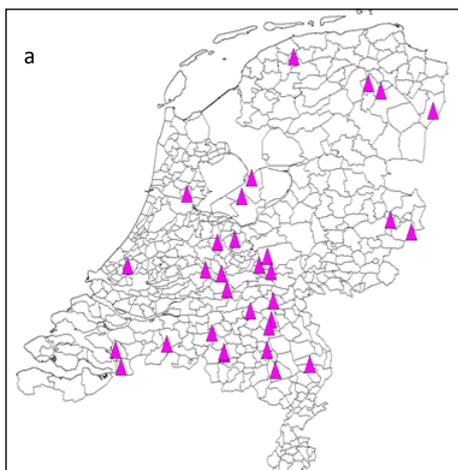
in different countries, he/she might receive pollen traps for free and is invited to sample up to three colonies according to the scheme and dates which are identical for all participating countries.

Preceding sampling, the CS receives an electronic picture manual and description of how to sample and how to do the colour discrimination and ascertainment of number of colours. Before every sampling date, the participant receives an email with a personal link to a database to provide the exact location of the apiary with Google maps and simply assess the land use immediately surrounding the apiary from a series of options (urban, forest, agricultural, heather, alpine etc.) provided in the database. Subsequently the practical work begins.

Of the pollen samples from the traps on each of the three colonies a standardised subsample is taken: we suggest a widely -used standard lid of a 500g honey jar (Fig. 1). Subsequently CS divide the sampled pollen pellets in the gauged subsample by colour. The number of colours from each of the three colonies is also submitted to the database via the personal link. Details about making the subsample and discrimination of the coloured pellets are provided in an electronic manual including a colour-blindness test and a FAQ list.

Who can participate?

In principle, every beekeeper is eligible to participate. Honey bee colonies, interest in research and an email address are the only requirements. Tests of our experimental design and protocol for the citizen scientists, were conducted in pilot studies in 2013 in the Netherlands, Austria, Switzerland and Greece (see Figs. 2a and b). The results and experiences with citizen scientists have been used to improve the manual in order to have a



Figs. 2a and b: Locations (pink triangles) in which C.S.I. participants evaluated pollen diversity in the 2013 pilot study in the Netherlands (a) and Austria (b). Per location one to three colonies were investigated by citizen scientists. (Maps not to scale)

perfect start in 2014. For 2014 and 2015 beside the mentioned countries, citizen scientist and national coordinators in Norway, Denmark, Croatia and France will participate in our study and more countries are expected to follow. The search for CS and the coordination per country will be accomplished by one national coordinator for each country. He/she will also deal with frequently asked questions from the participating beekeepers, provide (pending on funding) pollen traps and incentives for participants. In February 2014 a COLOSS workshop was held for the national coordinators in Graz, Austria.

What will be the scientific outcome of the CSI pollen project?

Firstly, a description of the pollen diversity in the participating countries, in the different geographic areas, different types of land use in the course of the honey bee season will be given. In singular cases, the used methodology allows beekeepers to judge the supply to their colonies in different habitats and hence could give clues where to locate their colonies for best development. Second, potential differences in pollen foraging features between three colonies in one apiary can be detected.

What were the results of the 2013 pilot?

The results of the pilot study should not be over-interpreted. Due to the small sample only over-all, not habitat-specific analyses, were made. Preliminary results show that in the Netherlands the median number of different coloured pollen pellets in May, June and July was 5, with outliers of up to twelve and down to two. In August this number diminishes to four and in September the majority of the colonies collected pollen pellets of three different colours. The decrease of available pollen species in autumn was also seen in the Austrian pilot study and could be one of the not so surprising, but still scientifically very interesting and unique findings.

Is every colour a different botanic family?

No, unfortunately not. By discrimination only on colours, we probably get only a rough estimation. Therefore, a second level has been proposed to add to the CS field analyses. In the laboratory microscopic slides will be made of a random selection of samples collected by the CS to precisely determine pollen

diversity and compare this with the simple first level analysis. In this way we can confirm or correct the CS results by palynological analyses.

What's in it for the citizen scientist/beekeeper?

The CS gets a picture of the pollen diversity in the proximity of their own apiary. However, the meaning of this study goes beyond the apiary of the private participating CS. The results will provide us with data about pollen diversity and gaps which can result in mitigation measures by the beekeepers and land users/owners to improve the habitat of the honey bee colonies.

What makes this project so special that you, as a beekeeper, should participate?

It is one of the largest international citizen scientist projects organised to date. Within COLOSS, the worldwide network of bee researchers, this project is considered as a showcase for future research in which, especially for practical orientated studies, the participation of citizen scientists/beekeepers and co-operation between the beekeeper and the scientist will be needed.

What about the funding of the C.S.I. pollen project?

There is no pot filled with gold to pay all the costs. Therefore, the financial matters must be arranged per country by the national coordinator. In the Netherlands the pilot project 2013 was financed by the seed firm Rijk Zwaan and the beekeepers association Algemene Bijenhouders Imkervereniging. Other companies and beekeepers' organisations have promised small financial support in 2014 and 2015. Besides public funding, every beekeeper can provide funding to this project via "crowd funding", which could be organised by the national coordinator. In the Austrian pilot study voluntary beekeepers with their own pollen traps participated. Funding for the full version of the study in 2014 and 2015 to equip more CS with pollen traps and sample vials (to conduct palynological analyses) has been requested of the government.

Do we need more citizen scientists?

Yes we do, and we are not afraid of handling big amounts of data. So if you receive a call from the national coordinator in your country asking you to

participate please sign in. Based on the region or country, the national coordinator will select the Citizen Scientists and communicate all relevant documents and dates. If you have the opportunity to join, please take the chance and become a member of a great citizen scientist beekeepers society.

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