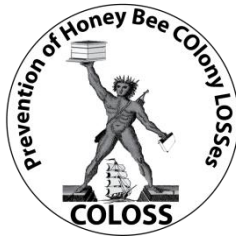


KARL-FRANZENS-UNIVERSITÄT GRAZ
UNIVERSITY OF GRAZ



Naturwissenschaftliche Fakultät
der Karl-Franzens-Universität Graz

The C.S.I. Pollen workshop – Training the national coordinators

Proceedings of
the workshop in Graz, 6.-7. February 2014



Dear colleagues,

On behalf of the local organizing team, it is my personal pleasure to welcome you to the workshop "The C.S.I. Workshop – Training the national coordinators" in Graz, Austria.

The supply of honey bee colonies with pollen is important for brood rearing and colony health. In C.S.I. Pollen, researchers from many countries conduct a study investigating the pollen supply with the help of Citizen Scientists. This demands good planning, clear communication and motivation of the participating beekeepers. Let us go and make this a successful study!

I would like to thank all the people who have helped to organize and conduct this meeting and of course all contributors for submitting their abstracts, which I hope will stimulate rewarding discussions on the method standardization and progress in establishing this unique study.

Financial support is granted by COLOSS, University of Graz and the Dean of the faculty of Science.

I am looking forward meeting all of you, and hope you will enjoy this workshop in Graz.



Robert Brodschneider

Graz, Austria, February 2014

The local organiser for the workshop and editor of these proceedings:

Robert Brodschneider, Department of Zoology, Karl-Franzens-University Graz

International coordinator of C.S.I. Pollen: Jozef (Sjef) van der Steen
Dean of the faculty of Science, University of Graz: Karl Crailsheim

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Program:

Wednesday, 5th of February

Arrival

Mixer with monitoring workshop participants (19:00 in the hotel lobby) and optional dinner in the old town

Thursday, 6th of February

9:00 -9:15: Registration

9:15-9:30: Welcome and organizational matters

9:30-12:00: Talks by

1. **Søgaard Jørgensen et al.**

2. **Moosbeckhofer et al.**

Coffe break

3. **Odoux et al.**

4. **González-Porto et al.**

5. **Bozic & Podrižnik**

Lunch break

13:30-15:00: Workshop interaction: First level and second level of C.S.I.

Pollen – pt. 1 (van der Steen & Brodschneider)

Coffee break

15:30-17:00: Workshop interaction: First level and second level of C.S.I.

Pollen – pt. 2 (van der Steen & Brodschneider)

Optional old town walk, social dinner at <http://www.goesserbraeugraz.at/>
(included in registration fee)

Friday, 7th of February

9:00 Talks by

1. **Crailsheim & Brodschneider**

2. **Gray & Peterson**

3. **Ion et al.**

4. **Tosi et al.**

5. **Carreck**

6. **Ruiz & Gutiérrez**

Coffee break

11:00-12:00: open discussion, Outcome of the workshop

Lunch break

13:30-15:00: Extended discussions

15:00 Coffee break, end of workshop

Bee pollen diversity research in Slovenia

Janko Bozic*, Blaž Podrižnik

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Early research was done in 80's during youth beekeeping research camps. At that time we noticed high variability of foraging strategies between colonies at the same location. Some recent research was also focused in the same topic, especially during AmcPromoBID project's activities (SI-AT project). We were trying to evaluate potential effect of invasive plant species on the diversity of bee pasture through collection of pollen samples at different locations. We can discuss about experience with techniques and potential value of obtained results as well stored samples. There has been proposed some future activities in the report of the AmcPromoBID project.

Pollen sources in the UK

Norman Carreck*

* International Bee Research Association

The UK is fortunate that there is a fair amount of information available on pollen sources available to honey bees, and a number of books have been published such as those by Dorothy Hodges and William Kirk on pollen load colours, and Rex Sawyer on pollen analysis. Nonetheless, to date there has been no large scale survey by beekeepers such as is proposed by CSI pollen.

The floral sources of pollen and nectar of honeybees in Ireland

Mary F Coffey*, John Breen

* University of Limerick, Plassey, Limerick

The most recent study on the floral sources of pollen and nectar used by honeybees in Ireland was carried out in the late 1990s. Pollen and nectar samples were collected at approximately two week intervals over two foraging seasons. Samples were analysed using dry weight and melissopalynology and the relative abundance of pollen types was expressed as a percentage of the total number of pollen grains counted. High floral diversity was observed with a total of 76 different pollen types found in the pollen loads and 72 in the nectar samples. Native nectariferous species were identified as the most important pollen sources, but pollen from introduced entomophilous/anemophilous species was also gathered. Pollen from trees and shrubs was predominantly collected early in the season, but as the season progressed herbs and shrubs increased in importance. Since this study was carried almost 20 years, a further study is warranted, to assess if changes in farming practices in Ireland or the increase in prevalence of invasive species such as Himalayan balsam, which are often rich in nectar and pollen is reducing the floral diversity of the pollen and nectar foraged by the honeybee.

Honey bee nutrition

Karl Crailsheim*, Robert Brodschneider

* Department of Zoology, Karl-Franzens-University Graz, Universitätsplatz 2, A-8010 Graz, Austria

Honey bee nutrition has been a topic of study for many centuries and surprisingly some aspects are still a relatively unexplored field. The biodiversity of pollen, the original study matter of the C.S.I. Pollen group, is discussed as a potential factor in colony development and honey bee health and well-being. We know about the amino acid requirements of honey bees, and also the amino acid content of selected pollen sources, but the situation as applicable to the field is rather unknown. A diverse pollen diet is thought to be superior in compensating the deficiency of essential amino acids in one pollen species. Land use and habitat type are often named but poorly quantified drivers of colony losses. Here we will give an overview on the established knowledge and new findings on honey bee nutrition.

C.S.I. Pollen project in Norway

Bjørn Dahle*

* Norwegian Beekeepers Association, Dyrskuev. 20, 2040 Kløfta, Norway

In Norway, honeybees collect most of their pollen from wild flowers, which contrasts the situation in many European countries where the landscape is dominated by agriculture. Beekeeping in Norway is solely focusing on honey production, although a few beekeepers move their colonies for crop pollination. By joining the C.S.I. on pollen diversity we hope to increase our knowledge on pollen diversity used by honeybees in Norway, contribute to the international data collection on pollen diversity, and also initiate the collection of pollen as a supplement to honey production.

C.S.I. Pollen monitoring in Croatia

Janja Filipi*, Maja Marica Dražić, Nikola Kezić, Dragan Bubalo

* Marko Marulic Polytechnics of Knin

Since the workshop in Bled we have announced CSI pollen monitoring in several associations, and beekeepers showed interest to participate in the study. Goals of the network, protocol and expectations from monitoring will be presented to beekeepers on various meetings that we have scheduled in winter period. Materials supplied by CSI network coordinators are in process of translation to Croatian language and will be submitted to national beekeepers journal "Hrvatska pčela", as well as posted on several beekeeping portals. Our intention in the forthcoming period (January, February) will be to involve CS beekeepers from different Croatian regions.

Botanical sources of bee pollen in the European Mediterranean region and its protein content

Amelia-Virginia González-Porto*, Raquel Martín-Hernández, Mariano Higes, Cristina Pardo

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After studying almost 300 of European samples of bee pollen (FP7-APIFRESH), important information for understanding which are the main resources used by bees for their nutrition was obtained. The geographical origin for Mediterranean bee pollen is marked by presence of at least one of the following species: Cistaceae, Cytisus, and Quercus. However, in the North or in mountain regions of the Mediterranean countries, the presence of Rosaceae and Castanea pollen is common. Similarly, in cultivated areas, pollen from Brassicaceae and Helianthus can appear. Bee pollen has been attributed part of its value as an important source of proteins. Protein content of European bee pollen has been mostly measured in dry samples at 40 °C (Kjeldahl method) and expresses the results as percentages of protein in dry basis. The average values, between 14-24% (with a standard deviation of 3.75 and an uncertainty of 1.14), are very variable between samples and between countries. This study shows variability between samples obtained from different plant origin. Proteins are very variable depending on the pollen type and it is a factor related to the nutritional value of bee pollen. According this observation, we analyzed the protein content of bee pollen balls, grouped by each particular botanical origin. For instance, the lower protein content corresponds to the taxa belonging to the family Cistaceae which have a value around 13%.

Possibilities for implementing the C.S.I. Pollen project in Scotland

Alison Gray*, Magnus Peterson

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Monitoring surveys have been carried out in Scotland since 2006. From 2006 to 2012 these were postal surveys. Random selection of the survey sample has been used since 2008. In 2013 the survey was mostly carried out online, using LimeSurvey (<http://www.limesurvey.org/>), making use of email contact addresses in the membership records of the Scottish Beekeepers' Association (SBA). Typically about 85% of the participants voluntarily provide contact details, some including email contacts, as part of their survey return, indicating that they are willing to be contacted to provide follow-up information. Therefore one possibility is to combine the details of these participants from the various surveys, to remove any duplicates and any stated non-beekeepers, check that the resulting beekeepers are still SBA members and still beekeepers, contact those remaining on the list and invite participation for those with pollen traps or who are prepared to acquire one. This may well not provide a very large sample, but would enable linking of pollen diversity to loss rates. Linking the CSI Pollen data collection to a single annual sample may not be successful as random selection may well not include those with pollen traps. As good geographical coverage is more important for a picture of pollen diversity than random selection, for estimation of biodiversity alone, two other possibilities are to publish an invitation to participate online and in the SBA publication for beekeepers, or to make use of local associations to recruit participants for better coverage of Scotland. This last option is the most likely to enable mapping of the number of pollen sources to postcodes. We are investigating recoding of the existing forage data from past surveys to obtain the number of forage sources to relate that to colony losses, however the stated number of sources in questionnaire data is likely to be unreliable owing to variation in keenness of observation of the beekeeper of their bees and their environment. We will briefly discuss these matters and known forage sources in Scotland.

Melliferous flora, as basic support for Romanian stationary beekeeping

Nicoleta Ion*

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Since ancient times, Romania is a country with great tradition in beekeeping, today ranking among European countries with a well developed beekeeping sector. The emergence of and access to European funds gave many opportunity for the Romanian beekeepers to increase bee colonies number/apiary. Today, in Romania there are over 40.000 beekeepers and over 1.000.000 bee colonies.

Generally, it is considered that the climate and biodiversity from all over the country allows the Romanian beekeepers to practice stationary beekeeping anywhere in the urban and rural areas. But, here comes a question, respectively whether there are sufficient quantities of nectar and pollen for stationary colonies. The profitability and health of a stationary apiary are directly related to some fundamental principles of stationary beekeeping, including melliferous balance of stationary apiary. A good equilibrium between number of bee colonies/stationary apiary and quantity of nectar and pollen offered by spontaneous and cultivated flora (that is growing within an area of 3-5 km around the stationary apiary) is essential for stationary beekeeping.

Some researches conducted during STUPAS research project shown that amateur beekeepers have a great preponderance in South Romania, and they practice only stationary beekeeping. For example, out of the total number of beekeepers, over 55% own 30 honey bee colonies/apiary and only 0.4% of the total number of beekeepers own over 100 honey bee colonies/apiary, which means that more than 80% of the beekeeping patrimony from South Romania is managed by amateur beekeepers, in a stationary system. This means that the profitability of these stationary apiaries rely only on the sources of nectar and pollen that exist locally. The vast majority of them are located in agricultural regions, where the equilibrium relationship between honey bee colonies and the local habitat is not very good, according to several studies.

To solve the problems outlined above, Beekeeping Research and Development Institute of Bucharest (ICDA Bucharest) and Romanian Beekeepers Association (ACA Romania) try to develop technical and scientific solutions, with the view to lead at supporting stationary beekeeping, based on well defined scientific criteria and in accordance with the principles of sustainable development of ecosystems. One of them is developing a model of melliferous habitat capable to exploit inadequate lands for agriculture, according to basic principles of stationary beekeeping, respectively to be capable to provide a favourable flowering (in time and space) and to be able to provide a minimum amount of annual harvestable honey and pollen, for each bee colony. Our approach seeks to convince beekeepers - landowners - to integrate various plants rich in nectar and pollen on their own lands.

C.S.I. Pollen project in Sweden

Preben Kristiansen*

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So far no such project has been carried out in Sweden, but it is my intention to be the national coordinator for the C.S.I. Pollen project. Information on the project is going to be sent out to the beekeepers who have answered the questionnaires on colony losses and who have provided us with their e-mail addresses. Information is also going to be given as well on the webpages as in the magazines of the beekeepers organisations in Sweden.

PONET - our online pollen database to be used for second step analysis of C.S.I. pollen samples

Rudolf Moosbeckhofer*, Helmut Heigl, Waltraud Auer, Josef Mayr*

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Principles of PONET are given as well as preparation and analysis of C.S.I.-pollen samples are outlined. The pollen database PONET facilitates the identification of pollen sources of honeybees as well as the botanical or geographical origin of honey. Each data set is based on reference specimens of pollen grains from plant species which have been classified by botanists to species level. Morphological characteristics of pollen grains - corresponding to the publication by Günther Vorwohl (1968) are measured or evaluated and used to generate a numeric key of 6 digits. This key could be used to search the database. According to the key the search output of PONET is a preselection of possible hits, showing botanical names and microscopic pictures of pollen grains to be considered. Thus it is possible to make an immediate comparison of the microscopic image of interest and profiles with reference images in various views. PONET makes the morphological characteristics of pollen grains of all recorded plant species available online via the internet, and offers users simple means for data searching. However, users conducting such searches must first 'classify' the unknown pollen or must have some knowledge about typical pollen types of different plant families. If this is the case, they also can search by terms of plant family, genus or species. PONET is a steady growing 'living' tool for free on the internet. Thus it enhances worldwide collaboration on pollen analysis. Try it: <http://ponet.ages.at>

Pollen diversity in agricultural landscape and bee health

Odoux, J.F.¹; Requier, F.^{1,2}; Henry, M.³; Feuillet, D.⁴; Fortini, D.¹; Mateescu, C.⁵; Bretagnolle, V.²; Aupinel, P.¹

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Traditional apicultural practices have been replaced by intensive ones in order to compensate colony losses and yield decreases. Agricultural landscapes do not provide to pollinators a regular pollen resource. The pollen diet can be considered both for its nutritional characteristics as well as health support of immune-components. Pollen is essential for the honey bees' development and is the main source of lipids. Some fatty acids are known for their antibacterial activity, and major lipid components of pollen contain some of them. We hypothesize that the pollen diversity could contribute to bee health when a balanced supply in fatty acids is supplied to bees.

Our study used bee pollens harvested in a farming landscape at different times of a year. We performed palynological and physico-chemical analysis of these multi-floral samples. Some pollen foraged by the honey bees naturally contained high rate of C18:2n-6 and C18:3n-3.

We carried out antibiograms on *P. larvae* cultures using lipid extract of these pollens in order to screen candidates for further trials. The antibacterial activity of total or fraction lipid extracts has been assessed by inhibition area in dishes. The effect was improved with the single saponifiable fraction, and some of the unsaponifiable components could limit it. We suggest that some bee-harvested pollen can be particularly active in bee health and that the floral environment has to be considered in order to benefit from antimicrobial properties of some species.

The choice of the best locations to set up beehives in farming plains for honey production is largely empiric today. ECOBEE is a monitoring design allowing to an ecological approach to honeybee biology on a 45,000 ha area. The design contains data acquisition concerning environmental variables in land use, floral resources or agricultural features in one hand, and colony responses variables concerning colony parameters, life history and collection in the other hand.

The succession of flowering crops leads to strong spatio-temporal dynamics of food resources along the year, and we clearly assume that a bimodal temporal pattern of pollen harvest exists. In an intensive cereal cropping system, our study concluded to a food shortage for the honeybees in the end of spring, between the rapeseed and sunflower blooming. We described the kinetic cycle for several honeybee parameters, and a general pattern over several years can now be used to test different environments all along a landscape gradient. We showed a gradient of foraged diversity of pollen within a short distance during a period where floral diversity is expected to play a role. We observe that species which are present in hedgerows and forest edges were strongly selected as well as weeds such as the poppy. On the contrary, the rapeseed is little selected for its pollen resource while the maize, is strongly chosen.

CSI Pollen in Spain. Present and future.

José Antonio Ruiz* & Miriam Gutiérrez

* Apoidea, Universidad de Córdoba. Font del Riego, 38. 14009 Córdoba.

We'll talk about the context of research and beekeeping in Spain conditioning this project. Dissemination done so far will be discussed, confirmed participants and funding issues.

Pollen availability for honeybees in an agricultural landscape and mitigation of pollen scarcity by planting of bee forage

Asger Søgaard Jørgensen*, Flemming Vejsnæs, Rolf Theuerkauf

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Lack of high quality pollen for honey bees throughout the season is supposed to be an important factor in the major losses of bee colonies seen in many countries. Denmark should with its intensive agricultural landscape be an excellent area to investigate if this is so. Pollen loads of hoarding bees has been collected and analysed from several observations bee yards throughout the season. A total number of 122 plants were represented in the pollen loads but from all the bee yards only 41 plant species contributed with more than 1% of the single pollen loads. In the individual bee yards the number of important pollen plants were even as low as 12, with only 2 – 3 species represented at any time of the season. Potatoes were shown to be an important pollen provider in some areas with intensive production of potatoes for industry. Data from 1941 are compared with data from 2011 showing marked decrease in the number of important pollens and even total disappearance of pollen of Corn flower.

Pollen diversity and protein content of beebread sampled all over Italy

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Pollen is the main source of protein for honeybees and ensures their proper development and growth. Its nutritive value can vary widely according to the botanical origin: a pollen diet should contain pollen collected from different plant species to guarantee the presence of all 10 essential amino acids that honeybees need.

The aim of this work is to investigate how the protein content and pollen diversity of beebread vary among different Italian environments. Within the framework of the national monitoring project BEENET, which includes about 300 apiaries, beebread samples are collected 2 times a year and both the botanical origins and percentage of proteins of each sample are defined. Preliminary results will be shown.

Within the framework of the CSI Pollen Project, in the 2014 season we are organizing the collection of curbicular pollen too: comparisons between beebread and curbicular pollen will provide insight for future studies.

C.S.I. Pollen – Citizen Scientist Investigation on Pollen Diversity Forage available to Honey Bees

Jozef van der Steen¹ & Robert Brodschneider²

¹ Plant Research International Wageningen UR

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We will present the materials prepared and methods applied for C.S.I. Pollen. We will also outline results of C.S.I. Pollen pilot studies conducted in Austria and Netherlands in 2013. Since then, we have increased the number of citizen scientists in both countries. We coordinated the publication of articles in several national beekeeping magazines and on the internet to promote the study among beekeepers. The international study will be conducted in several European countries in 2014 and 2015 using the same, standardized web-tool (limesurvey) for the first level of investigation (citizen scientists' colour analysis of pollen pellets). Funding of both first level and second level (palynological) analysis is in the responsibility of national coordinators. However, those countries that conduct palynological analysis should use the same methods to allow comparison. We welcome all countries to join and make this the first and largest project investigating pollen diversity with the help of Citizen Scientists and their honey bee colonies throughout Europe.

COLOSS CSI Pollen - Swiss Style

Geoff Williams*, Gina Tanner, Peter Neumann, Vincent Dietemann

* University of Bern

The influence of the environment on honey bees has received considerable attention of late. In particular, loss of habitat has been implicated in increased honey bee colony losses because reduced nutritious and diverse foraging opportunities may increase honey bee susceptibility to disease. Here we present preliminary data obtained from 3 experimental apiaries in Switzerland in 2013 whereby we examined diversity of honey bee-collected pollen for the COLOSS CSI Pollen Task Force initiative. We additionally discuss future directions for this task force in 2014.

Outcome of the workshop: C.S.I. Pollen – Training the national agents in Graz

Robert Brodschneider, Janko Bozic, Norman Carreck, Mary F. Coffey, Karl Crailsheim, Bjørn Dahle, Jiří Danihlík; Janja Filipi, Alison Gray, Amelia-Virginia González-Porto, Nicoleta Ion, Nikola Kezic, Zdenek Klima; Preben Kristiansen, Nataša Lilek, Josef Mayr, Piotr Medrzycki, Rudolf Moosbeckhofer, Jean-François Odoux, Magnus Peterson, José Antonio Ruiz; Asger Søgaard Jørgensen; Simone Tosi, Flemming Vejsnæs, Geoff Williams, Jozef van der Steen

On 6th and 7th of February 2014, 26 researchers attended a workshop in Graz, Austria. The workshop was supported by COLOSS, the University of Graz and the Dean of the Faculty of Science. Pollen is the only source of proteins for honey bee colonies and is needed to feed brood, for organ development of adult honey bees and build-up of reserves to become long lived winter bees. All participants welcomed the initiative and agreed that the pollen nutrition of honey bees is of great importance for colony health and survival, and needs to be adequately studied. A means to study the biodiversity of pollen in the supply of honey bee colonies on a large scale is through the involvement of beekeepers as Citizen Scientists (C.S.). As beekeepers cannot perform full palynological analyses, we have developed a simple estimation of pollen diversity according to the colour of corbicular pollen pellets. This allows us to obtain information on a large number of samples, but also requires standardized protocols in all participating countries. National coordinators from the following countries agreed to conduct a common investigation in 2014 and 2015 using the protocols developed for C.S.I. Pollen in pilot studies in 2013: National coordinators of the following countries were present: Austria, Croatia, Denmark, England, France, Ireland, Italy, Netherlands, Norway, Romania, Scotland, Slovenia, Spain, Sweden, Switzerland and Wales. We will re-evaluate the protocols after one year, and also invite other countries to join. As a second step, samples collected by the beekeeper can be analysed to connect pollen diversity derived from colour differentiation of pollen pellets, to the number of plant species identified by palynological analysis. The funding for this second level investigation is to be left to the national coordinators. Traditional melissopalynological methods are not as suitable for the analysis of corbicular pollen pellets compared to honey, so standardized methods for this will be developed. The methods of sub-sampling, storage and transport need to be developed. The first level C.S. Investigations in the different countries will be coordinated and data collected for joint analyses and publication.

List of Participants and Email addresses

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