15th COLOSS Conference

Condensed Proceedings

Montréal, Canada, 7th & 8th September 2019
@ Université Laval – Bureau de Montréal

In partnership with

15th COLOSS Conference

TOPICS

- International annual conference of COLOSS to provide an update on the network's achievements and future directions, including meetings for COLOSS Core Projects and Task Forces
- Annual General Assembly Meeting, including elections for the Executive Committee
- Strategic discussions with the Bee Informed Partnership and Canadian Tech Transfer Teams

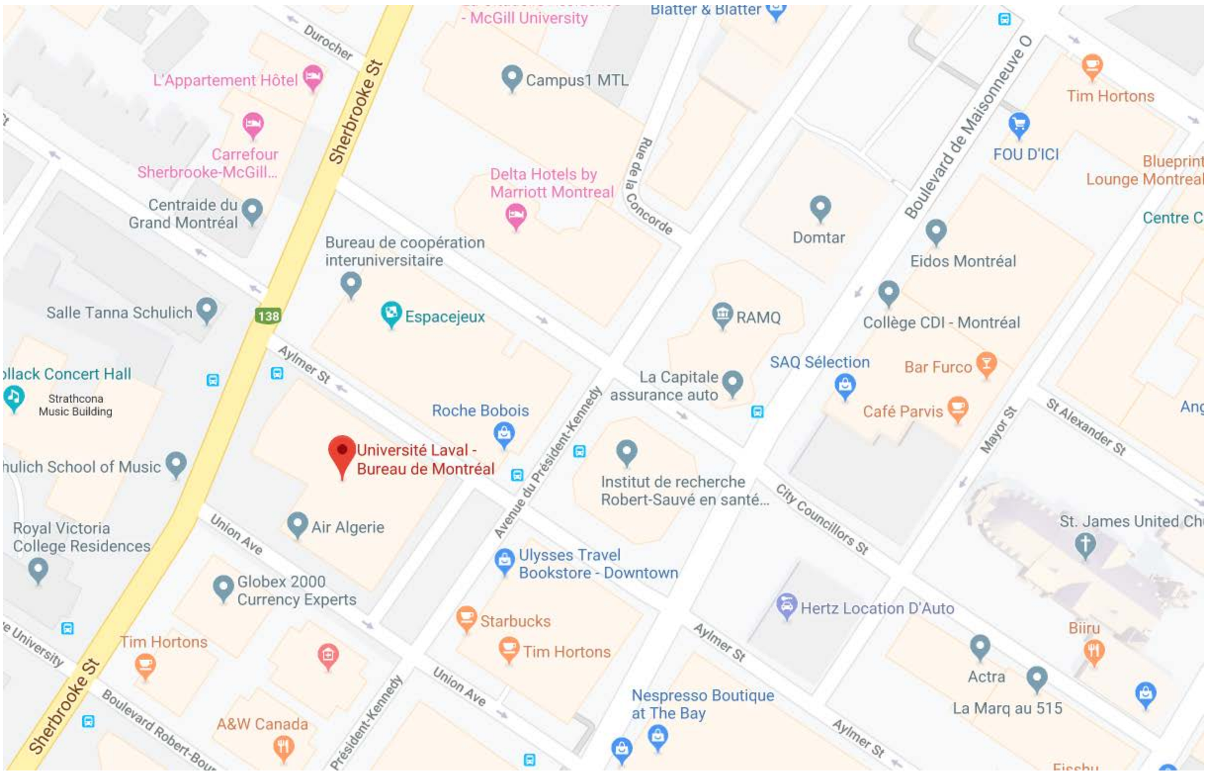
WHEN

6 September Executive Committee Meeting in the evening (open to EC members only)

7 & 8 September COLOSS General Assembly and discussions (open to all COLOSS members); see detailed schedule below.

WHERE

Université Laval – Bureau de Montréal
550 rue Sherbrooke Ouest, Tour Est, local 300 (3rd floor)
Montréal, QC H3A 1B9, Canada



ORGANIZER CONTACTS

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REGISTRATION

- Registration fee is 60.- CAD (~40.- Euros equivalent); please pay with exact change in $CAD during meeting 'Sign-in.'
- Registration fee will cover all coffee breaks, lunches, and the social dinner.
- Due to limited financial support, participants will NOT be reimbursed for travel and accommodation.

POSTER SESSION

- All submitted abstracts must be accompanied by a poster.
- Poster dimensions should be no larger than A0 (84.1×118.9 cm).
- An abstract should be submitted only once by the lead/presenting author.
- If the first author is a student, mention this during registration. You should receive a "Student Poster" sticker to place on your poster. The best student poster will receive the prestigious COLOSS award.

TRAVEL & ACCOMMODATIONS

Consult Apimondia 2019 (apimondia2019.com/accommodations) for information concerning accommodations and travel.

A note from the president

Dear colleagues,

On behalf of the local organizing team, I would like to welcome you to the 15th COLOSS conference in Montréal, Canada.

This is the first annual COLOSS conference outside of Europe, reflecting our strategic decision to become a truly global association. We will continue to work on this vision to ensure that our association will be able to adequately address all matters whatsoever concerning managed honeybee health globally.

I am therefore delighted to announce that our conference will be held in parallel with a meeting of the US-based Bee Informed Partnership, thereby fostering exchange and supporting our common goals.

I would like to sincerely thank all the people who made this meeting possible. In particular, it would have been impossible without the exceptionally organized efforts of Pierre Giovenazzo and his team.

Appreciation is also addressed to all contributors for submitting their abstracts, which I hope will stimulate rewarding discussions. Please be so kind and consider in advanced potential future activities, in particular enhanced dissemination to stakeholders and joint fund raising.

Financial support for this meeting is kindly granted by the Eva Crane Trust, the Ricola Foundation *Nature and Culture*, Veto Pharma, and the Vinetum Foundation.

I am looking forward to fruitful discussions with all of you, and hope you will enjoy this conference. In particular, I am delighted to see many new faces from the other side of the Atlantic!

Yours sincerely,

Peter Neumann, President, COLOSS Association

A note from our conference sponsor

Dear COLOSS Members,

Once again, the **Eva Crane Trust** is pleased, as on several previous occasions, to support your meeting.

Dr Eva Crane's main contribution to bee science was her great ability to gather, compile, edit and then disseminate information and the results of research. It is this ability to share knowledge that was so important to Dr Crane and consequently our emphasis at the **Eva Crane Trust**, remains on the interchange and spread of information.

As a grant giving Trust, it is a privilege to support unique scientific projects that cover all aspects of bee science and indeed bee species around the world. We appreciate that everyone involved with COLOSS, meet and communicate regularly throughout the year, but this gathering is a great opportunity to share your knowledge and ideas, and for the first time venture away from Europe!

As always, we wish you a successful conference and congratulate you on the work you have done so far – long may we both continue.

Richard Jones
Chairman

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DETAILED SCHEDULE

Friday, 6 September 2019

COLOSS Executive Committee Meeting 1 (for EC members only)	
19:00-20:30	Preparatory meeting of the COLOSS EC

Saturday, 7 September 2019

Session 1 – COLOSS General Assembly 1	
08:30-09:00	**Sign-in & coffee**
09:00-09:05	Welcome by COLOSS President and Local Organizing Committee Chair
09:05-09:30	General Assembly discussions
09:30-09:45	Executive Committee election
09:45-10:15	**Break**, with drinks & snacks
Session 2 – COLOSS Updates	
10:15-12:15	COLOSS Core Project & Task Force updates (3 CPs & 9 TFs; 6-8 min ea.)
12:15-13:30	**Lunch (covered) & poster set-up**
Session 3 – COLOSS General Assembly Meeting 2	
13:30-13:40	Executive Committee election results
13:40-14:00	Bee Informed Partnership introduction
Session 4 – Concurrent Discussion Groups 1	
14:00-16:00	A. Monitoring, B. Small Hive Beetle, C. *Vespa velutina*, D. Apitox
16:00-16:30	**Break**, with drinks & snacks
Session 5 – Concurrent Discussion Groups 2	
16:30-18:30	A. Nutrition, B. Viruses, C. Bee Breeding, D. *Varroa* control & Survivors, E. B-RAP
Session 6 – Posters & Social Dinner	
18:30-19:30	**Poster session** with apéro
20:00-	**Social dinner @Bar Furco (425 Mayor St.)**

Sunday, 8 September 2019

Session 7 – Concurrent Discussion Groups 3	
08:15-10:15	Additional time for concurrent CP and TF discussion groups if necessary (5 rooms are available for use)
10:15-10:45	**Break**, with drinks & snacks
Session 8 – COLOSS General Assembly Meeting 3	
10:45-12:45	Updates from Core Projects & Task Force discussions (3 CPs & 9 TFs; 2-3 min ea.) & General Assembly discussions
12:45-14:30	**Lunch**
Session 9 – "Bridging the Atlantic" Session	
14:30-15:30	Strategic discussions: COLOSS-Bee Informed Partnership-Canadian Tech Transfer Teams
Session 10 – COLOSS General Assembly Meeting 4	
15:30-16:30	Final wrap-up and goodbyes
Executive Committee Meeting 2 (for EC members only)	
TBD	Debrief meeting of the COLOSS EC with newly elected members

A note from our network & poster session sponsor

Poster Presentations

	Authors*	Abstract title
1	**Aldea, Patricia**; Bozinovic, Francisco	Interplay between environmental temperature and infection by the parasite *Varroa destructor* on the physiological performance of *Apis mellifera*
2	**Berg, Stefan**; Kabla, Arne	Hyperthermia against *Varroa destructor*?
3	**Blacquière, Tjeerd**; Tom, Jolanda; Boot, Willem; Calis, Johan; Moro, Arrigo; Neumann, Peter; Panziera, Delphine	Darwin's Black Bee Box put in action
4	**Bordin, Fulvio**; Baratto, Chiara; Mutinelli, Franco; Granato, Anna	Characterization of microsatellite loci for the Italian small hive beetle, *Aethina tumida*
5	**Bromenshenk, Jerry**; Seccomb, Robert; Henderson, Colin; Firth, David; Sanford, Dr. Malcolm T.	Rapid Diagnosis and Mapping of Emergent Honey Bee Health Issues via an AI-Powered Smartphone App
6	**Brown, Pike**; Robertson, Thomas	Winter 2018 Colony Losses in New Zealand
7	**Bruckner, Selina**; Williams, Geoffrey R.; Steinhauer, Nathalie; Rennich, Karen; vanEngelsdorp, Dennis; Wilson, Michaela E.	The Bee Informed Partnership National Colony Loss Survey - how many died, and (maybe) why?
8	**Cabirol, Amélie;** Fayolle, Marie; Haase, Albrecht	Impact of a neonicotinoid on brain structural plasticity and olfactory memory in honey bees.
9	**Cazier, Joseph**; Hassler, Ed; Linton, Frank; Wilkes, James; Haefeker, Walter; Schoonman, Marten; Brodshneider, Robert; Brown, Lucy; Simon Delso, Noa	The Promise of Standardized Bee Data and How to Achieve It
10	**Dietemann, Vincent;** Carreck, Norman; Ellis, J.; Neumann, Peter	COLOSS BEEBOOK: an update
11	**Dupleix, Anna**; Jullien, Delphine	Beehive building material, multidisciplinary approach to understand its roles on bees and its relationship with beekeepers.
12	**Gray, Alison**; Brodschneider, Robert	Activities and achievements of the COLOSS monitoring group from 2018 to 2019
13	**Imran, Muhammad**; Ahmad, Munir; Sheikh, Umer A. A.; Nasir, Muhammad	Bumblebee colony development was affected by different diets

**Alphabetically listed according to last name as submitted for each poster*

	Authors*	**Abstract title**
14	**Jung, Chuleui**; Park, Seongbin	16 years since the invasion of *Vespa velutina* into Korea
15	**Kachanov, Paz**; Kamer, Yosef; Soroker, Victoria	Testing the efficacy of winter oxalic acid treatment
16	**Kevill, Jessica L.**; de Souza, Flaviane S.; Sharples, Christopher; Oliver, Randy; Schroeder, Declan C.; Martin, Stephen J.	DWV-A lethal to honey bees (*Apis mellifera*): A colony level survey of DWV variants (A, B & C) in England, Wales and 32 states across the US
17	**Kozii, Ivanna**; Wood, S. C.; Klein, C. D.; de Carvalho Macedo Silva, R.; Fabela, C. O.; Folkes, C.; Dvylyuk, I.; Medici de Mattos, I.; Guillemin, L.; Ferrari, M.; Simko, E.	Are all honey bee castes affected equally by exposure to thiamethoxam during late larval development?
18	**Lioy, Simone**; Laurino, Daniela; Manino, Aulo; Porporato, Marco	An integrated approach for a strategy against *Vespa velutina* in Italy
19	**Ljung, Magnus**; Fabricius Kristiansen, Lotta	Challenges for the beekeeping sector when building the future knowledge and innovation system
20	**Mitchell, Derek**	The extended phenotype of a honey bee colony, survival and research, a thermofluid perspective
21	**Morawetz, Linde**; Fabricius Kristiansen, Lotta; Kristiansen, Preben; Vejsnaes, Flemming	COLOSS-members and their activity in the COLOSS-network
22	**Papach, Anna**; Gonthier, Jérémy; Williams, Geoffrey; Neumann, Peter	The role of pupation in determining small hive beetle sex ratio
23	**Presern, Janez**; Mihelic, Jan; Kobal; Milan	Availability of natural resources and colony density influence beekeepers' profit
24	**Ryabov, Eugene V.**; Posada-Florez, Francisco; Childers, Anna K.; Lopez, Dawn; Grubbs, Kyle; Heerman, Matthew C.; Egekwu, Noble I.; Cook, Steven C.; vanEngelsdorp, Dennis; Chen, Yanping; Evans, Jay D.	Dynamic evolution in a mite-vectored virus of honey bees: Insight from reverse genetics for Deformed wing virus.
25	**Siceanu, Adrian**; Cauia, Eliza; Oana Visan, Gabriela; Cauia, Dumitru	Preliminary researches regarding the efficacy of formic acid and acetic acid in the treatment of varroa (*Varroa destructor*) found in bee brood

**Alphabetically listed according to last name as submitted for each poster*

	Authors*	Abstract title
26	**Spiegelberg, Maximilian**; Shinkai, Rika; Rupprecht, Christoph; Gan, Jingchao	"Let's create a Bee-friendly City"- a transdisciplinary research process in Kyoto
27	**Stoner, Kimberly**; Cowles, Richard; Eitzer, Brian; Nurse, Andrea	Using Color Sorting and Palynology to Track Pesticide Residues in Trapped Pollen to a Plant Genus
28	**Strogolova, Vera**; Gordon, Jennifer; Hoffman, Earl; Hoffman, Carol; Strogolov, Vyacheslav	A blend of Bacilli and Lactobacilli lowers Nosema spore counts in the field
29	**Tlak Gajger, Ivana**; Tomljanovic, Zlatko; Vlainic, Josipa	Efficacy of disinfection of apiary fittings contaminated with *Paenibacillus larvae* spores
30	**Tosi, Simone**; Nieh, James C.	Lethal and sublethal synergistic effects of stressors on bees
31	**Valizadeh, Pegah**; Tahmasbi, Gholamhosein; Parichehreh, Shabnam; Tajabadi, Naser	Iranian Honey Bee (*Apis mellifera meda*) Breeding Program and Varroa Mite Resistance Project
32	**Wagoner, Kaira**; Spivak, Marla; Pitts, Shaun; Jordon, Emily; Millar, Jocelyn; Bello, Jan; Schal, Coby; Rueppell, Olav	Brood chemicals as a new selection tool for hygienic behavior against Varroa?
33	**Wood, Sarah C.**; de Carvalho Macedo Silva, Roney; Dvylyuk, Ihor; Kozii, Ivanna V.; Klein, Colby D.; Medici de Mattos, Igor; Moshynskyy, Igor; Epp, Tasha; Simko, Elemir	Chronic neonicotinoid exposure decreases overwinter survival of *Apis mellifera* L.
34	**Yang, Sa**; Wu, Yanyan; Wang, Xinling; Yang, Dahe; Deng, Shuai; Li, Fei; Diao, Qingyun; Darrouzet, Eric; Hou, Chunsheng; Gayral, Philippe; Bigot, Diane; Herniou, Elisabeth A.; Zhao, Hongxia	*Vespa velutina*, as honey bee viruses reservoir

**Alphabetically listed according to last name as submitted for each poster*

Poster Abstracts

1.

Interplay between environmental temperature and infection by the parasite *Varroa* destructor on the physiological performance of *Apis mellifera*

Patricia Aldea [1,2], Francisco Bozinovic [2]

[1]Universidad Mayor, Chile, [2]Pontifical Catholic University of Chile, Chile

Global climate change poses one of the greatest threats to biodiversity. Anthropogenic activities are likely to lead to increased frequency of climatic extremes (e.g. heat waves), as well as increased climatic variability in certain regions of the world, where honeybee's success is not an exception. Within this context, the aim of this study is to test how higher temperatures affect the physiology and performance of honeybees when the parasite Varroa destructor is present. We recorded the temperature inside colonies under field conditions as well as we conducted laboratory essays using two different experimental temperatures: acclimation at 32° C and at with 38° C for 14 days (the last 7 as brood phase and 7 days as young workers). When the acclimation ended, we selected 30 honey bees and designed three treatment groups of bees: a) control bees (without mites), b) treated bees with 1 mite and c) treated bees with 2 mites. After one hour of direct and effective parasitization, we measured individually the metabolic rate during 3 hours of 10 bees per mite treatment and acclimation. We observed that the metabolic rate was significate higher when the mite number on the bees increased. The metabolic rate increased by 50%, compared between chambers.

In a second series of experiments, we measured the thermoregulatory capacity of parasite and control bees at ambient temperatures of conditions 15, 20 and 25°C. We could see that the capacity of thermoregulation is less efficient when the bees comes from the hotter chamber and with higher number of mites, we obtained similar results when we measured the maximum thermic tolerance (CTmax) between chambers and treatments. We conclude that the performance of bees correlated negatively with the temperatures and parasite load under laboratory conditions.

Funded by Fondo Basal FB0002-2014, Pontificia Universidad Católica de Chile.

2.

Hyperthermia against *Varroa destructor*?

Stefan Berg [1], Arne Kablau [1,2]

[1]Bavarian State Institute for Viticulture and Horticulture, Germany, [2]Freie Universitaet Berlin, Germany

The mite *Varroa destructor* is the major threat to honeybees world-wide. Several treatments against Varroa destructor have been developed with varying efficacy. In recent years, different devices using the method of hyperthermia for *Varroa destructor* control were placed on the market. Three of them were tested in our study for their efficacy and compatibility for bees: “Varroa Controller”, “Varroaeliminator plus” and “Varroa Kill II”. All three devices are using the hyperthermic treatment of capped brood combs. In addition, “Varroa-Kill II” can also be used for treatment of the entire colony too. With each device the brood combs of 3-6 colonies were hyperthermically treated. After treatment, the brood combs were reassigned to receiver colonies being free of own brood and mites. Over a period of 14 days, until all brood was hatched, the daily mite fall was recorded, followed by an oxalic acid treatment to determine the efficacy of the hyperthermic treatment. Also, with whole colony treatment (“Varroa Kill II”); the brood combs were removed after treatment and placed in receiver colonies as described above. The assignment of surviving mites in the donor colonies free of brood took place three days after treatment. The different hyperthermic treatments had an efficacy of 97% for the “Varroa Controller”, 87% for the “Varroaeleminator” and 59% for the “Varroa Kill II” (brood treatment) respectively 47% (colony treatment). Particularly, the treatment with “Varroa Kill II” showed great variability in the efficacy, obviously caused by inadequate isolation of the beehive. A retest with reinforced isolation increased efficacy to 97%. The effects on the reproductive mites and offspring were determined by daily brood inspections. The majority of mite offspring died within the first 24 to 72 hours after treatment. The mother mite mortalities ranged between 11% and 50% in average. The results suggest that hyperthermia treatment with the tested devices is an opportunity to control Varroa when integrated into a broad treatment concept.

3.

Darwin's Black Bee Box put in action

Tjeerd Blacquière [1], Jolanda Tom [1], Willem Boot [2], Johan Calis [2], Arrigo Moro [3], Peter Neumann [3], Delphine Panziera [4]

[1]Wageningen University & Research, Netherlands, [2]Inbuzz Beekeeping Company, [3]University of Bern, Switzerland, [4]University of Halle, Germany

Having learned from three independent naturally developed honey bee populations since 2007-2009 up to now, showing resistance towards Varroa destructor, in the TF 'Survivors' meetings in Athens, Avignon and Bern (2016-18) we called for joining our Darwin Black Bee Box approach aiming to allow nature to build new survivor populations from own local bee stocks. This approach can be used in addition to looking for reported survivor populations, may in a few years result in several well traceable and documented examples. The outline and rationale of the protocol has recently been published (Blacquière et al. 2019).In our institute we have now set up three new populations of honey bee colonies from local origins: in 2018 one in Burscheid (Germany), one in Zeewolde (Netherlands) and lately (2019) one in Kalmthout (Belgium). In all locations in the first year we mix as much as possible the genes / alleles of the colonies per location by within population mating and perform the last varroa control. To that aim we have split the initial 20-25 colonies per location each into three to four nukes with each their own virgin queen, drones and mites. This has taken place in the summers of 2018 and 2019. From then on, no Varroa control has been performed anymore, except in control / reference subpopulations at all locations (which mate separately and within the subpopulations). At the moment of this Coloss workshop we have young developing colonies almost at the strength that will allow them to survive the next winter in good shape, and to propagate next spring / summer to constitute the next generation. The Burscheid and Zeewolde population are in their second summer, so the last treatment was one year ago, and indeed we saw that the mating of the queens was slightly less successful than in the control colonies. There are (July 9, 2019) 24 colonies of the Zeewolde group (+ 17 controls), 25 in Burscheid (+ 15 controls) and 44 in Kalmthout (still one group, first year). Inside the black boxes and through exchange within the populations between colonies, the co-evolution between the honey bees, the varroa mites and the (micro-) biome takes its course. Let us see what comes out.This project will run for four years, financially and mentally supported by a number of companies and (anonymous) foundations and their as well as our unstoppable enthusiasm, but will probably and hopefully be sustained afterwards. Blacquière T, Boot W, Calis J, Moro A, Neumann P and Panziera, D 2019, Darwinian black box selection for resistance to settled invasive Varroa destructor parasites in honey bees. Perspectives and paradigms, Evolutionary applications 10, 226-230

4.

Characterization of microsatellite loci for the Italian small hive beetle, *Aethina tumida*

Fulvio Bordin [1], Baratto Chiara [1], Franco Mutinelli [1], Anna Granato [1]

[1]IZSVe - Italian health authority and research organization for animal health and food safety, Italy

The small hive beetle (SHB), *Aethina tumida,* native to South Africa and endemic in the sub-Saharan Africa, is an invasive pest of honey bee colonies responsible for considerable damage, from destruction of honeycombs to fermentation of honey until the collapse of the colony. Since its first official report outside its natural distribution area in Florida in 1998, it has now a worldwide dispersal affecting Americas, Australia, the Philippines and South Korea. The first field occurrence of SHB on the European Union territory was confirmed in September 2014 in the Calabria region (southern Italy), where it is still circulating. Given the worldwide dispersal of SHB, it is important to characterize the existing populations and the new introduced ones with the aim of understanding the history of the invasion and the expansion of its geographical distribution. Here we present the results of a preliminary study that aims to characterize the Italian SHB and compare them with South African and American specimens by means of 11 microsatellite markers (Evans et al, 2008). 138 beetles (adults and larvae) from South Africa (n=2), North America (n=19) and Italy (n=117) were analyzed and genetic parameters were calculated using GenAlEx v.6.5 software. A total of 70 alleles were detected across all considered loci and populations and all markers were lowly or moderately polymorphic except Atum5. Based on the allelic distribution of microsatellite markers we highlighted that: (i) in the Italian population the number of alleles per locus ranged from 3 (Atum20) to 11 (AtumB26), with a mean of 4.6, while in South African-American SHBs it is 2.1; (ii) AtumB83 and Atum25 loci were not informative within populations, but could discriminate among Italian and other origin; (iii) the American population had many alleles shared with South African samples, as described in literature; (iv) some markers (Atum20, Atum25, AumB14, AtumB35, AtumB92), even if low polymorphic, could effectively differentiate Italian specimens from the South African-American ones. Data obtained in this preliminary study, despite more samples of African and American origin are needed, will provide baseline information about Italian population structure and spreading pathways of this exotic beetle, helping to understand its further dissemination and possible new invasions.

5.

Rapid Diagnosis and Mapping of Emergent Honey Bee Health Issues via an AI-Powered Smartphone App

Jerry Bromenshenk [1], Robert Seccomb [1], Colin Henderson [1], David Firth [1], Dr. Malcolm T. Sanford [1]

[1]Bee Alert Technology Inc., USA

A newly developed smartphone app has now yielded a way to improve honey bee colony health by letting the bees communicate their health status directly to the beekeeper. In essence, the bees themselves become their own guru, indicating the status of colony health via the sounds they produce. The Bee Health Guru smartphone app requires two steps: (1) Colony recordings are made by beekeepers using their smartphone microphone; and (2) Automatic diagnosis of a colony's condition, without beekeeper interpretation, is performed via artificial intelligence (AI) software algorithms. The AI compares new beekeeper recordings with specific beehive audio recordings. These AI algorithms are not static but continue to learn, not only to diagnose specific situations in a beehive, but also to modify themselves, optimizing relevance over geographical regions and extended periods. The first step continues to build on referenced samples collected by research scientists and by experienced beekeepers. We will be asking beekeepers worldwide to download the application, inspect colonies and provide the app diagnosis along with their recordings. The Bee Health Guru smartphone application is configured to allow beekeepers to easily submit their own observations to our research scientists to supplement the diagnostics provided by the app. Based on a growing database of audio samples paired with observations, the Bee Health Guru smartphone application should continue to improve its accuracy for bee health factors including varroa mites, foulbrood, nosema, queen status and other potential indications of overall colony condition. In conclusion, the smartphone application automatically creates a copy of the recordings along with beekeeper observations, combining them into a comprehensive AI colony health analysis and subsequent report. All electronic records are to be stored in a common destination (cloud) and will have safeguards to protect data privacy, confidentiality, and security of beekeeper-reporters.

6.

Winter 2018 Colony Losses in New Zealand

Pike Brown [1], Thomas Robertson [2]

[1]Manaaki Whenua - Landcare Research, New Zealand, [2]Coco Analyti

The 2018 NZ Colony Loss Survey was used to estimate colony losses incurred between 1 June 2018 and the first spring inspection of 2018. The questionnaire built on the 2015, 2016, and 2017 NZ Colony Loss Surveys, and, in so doing, provided an opportunity for monitoring trends in national-level losses as well as regional-level losses. In total, 3,655 beekeepers completed the 2018 NZ Colony Loss Survey, indicating a response rate of 47.1% of all registered beekeepers with valid email addresses. Together, these beekeepers reported on 365,986 production colonies. This figure represents 42.5% of all colonies registered with an email address. 216 of the 540 New Zealand beekeepers with more than 250 colonies completed the survey, a response rate of 39.6% for this group. Together, these beekeepers reported on 44.0% of all colonies registered to beekeepers with more than 250 colonies. The overall loss rate, was estimated to be 10.21%, with a 95% confidence interval of [9.85%, 10.58%]. Although these estimates of overall loss rates are statistically indistinguishable from those in 2017, they are significantly higher than for winter 2015 and winter 2016, providing evidence that loss rates have increased at a national level. Moreover, evidence from trend analysis indicates a positive time trend in overall loss rates between 2015 and 2018, suggesting that future overall loss rates are likely to be higher still. Overall loss rates showed strong regional variation, ranging between 8.06% [7.45%, 8.71%] for the Lower North Island and 12.82% [12.00%, 13.68%] for the Upper North Island. Overall loss rates within regions also exhibited a great deal of fluidity over time. For example, overall loss rates for winter 2018 were statistically higher than overall loss rates for winter 2017 in the Upper North Island and across the South Island; only in the Lower South Island did winter loss rates fall significantly between winter 2017 and winter 2018. Again, evidence from trend analysis indicates a positive time trend in overall loss rates at the regional level between 2016 (the first year in which regional data were analysed) and 2018, although evidence for the Middle North Island is weaker than that for other parts of New Zealand.As with previous waves of the survey, average loss rates over winter were significantly higher for non-commercial beekeepers. Nevertheless, as in previous years, the survey results indicated wide variation in individual loss rates for commercial and non-commercial beekeepers across space. Colony losses were most frequently attributed to queen problems (38.5%) and suspected varroa and related complications (23.1%), followed by suspected starvation (9.3%), and wasps (9.2%). Losses were also frequently attributed to suspected disease (4.9%) and robbing by other bees (3.5%). Natural disasters, American Foulbrood, suspected exposure to toxins, thefts/vandalism, accidents, and Argentine ants were significantly less common.

7.

The Bee Informed Partnership National Colony Loss Survey - how many died, and (maybe) why?

Selina Bruckner [1], Geoffrey R. Williams [1], Nathalie Steinhauer [2], Karen Rennich [2], Dennis vanEngelsdorp [2], Michaela E. Wilson [3]

[1]Auburn University, USA, [2]University of Maryland, USA, [3]University of Tennessee, USA

For more than 10 years, the Bee Informed Partnership (BIP) has been conducting an annual survey of honey bee colony losses in the United States. In recent years, the survey not only included loss estimates for winter, summer, the calendar year. Here we present estimates for the last two years (2017/18 and 2018/19). To compare estimates across the country, the time periods were predefined as winter (1 October - 1 April), Summer (e.g. 1 April - 1 October) and Annual (e.g. 1 April - 1 April), respectively. During the 2017-2018 winter period an estimated 30.7% percent of managed honey bee colonies were lost in the United States. Compared to that, less colonies (17.1%) were lost in summer and more colonies (40.1%) were lost over the entire survey period. For the 2018-2019 winter period, we reported the highest colony loss estimates since the first survey in 2006-2007. Numerically speaking, beekeepers lost 37.7% of their colonies in winter which represents an increase of 7 percentage points from last years' estimate. Similarly, to the previous year, beekeepers lost less colonies in summer (20.5%) and more over the course of the entire year (40.7%).Apart from comparing distinct time periods, we also compared loss estimates between operation sizes. More specifically, we differentiated between backyard (managing 1-50 colonies) sideliner (51-500 colonies) and commercial beekeepers (>500 colonies), respectively. In both years, backyard beekeepers experienced higher winter losses compared to the other two categories.In both years, beekeepers thought that Varroa mites were responsible for winter colony losses. In the 2018/19 survey, we also asked about the perceived cause for summer colony loss. Interestingly, there was a seasonal difference and queen failure seems compromise colony survival in summer.

8.

Impact of a neonicotinoid on brain structural plasticity and olfactory memory in honey bees

Amélie Cabirol [1], Marie Fayolle [1], Albrecht Haase [1]

[1]University of Trento, Italy

The foraging efficiency of honey bee colonies has recently been related to the sophisticated cognitive skills of their individuals. Any damage to the brain and cognitive functions of foragers can therefore affect the whole colony equilibrium. In this context, it is critical to understand how neonicotinoid pesticides, which have been identified as partly responsible for the decline in pollinator populations, affect both brain structure and function. Here, we investigated whether imidacloprid, the most widely used neonicotinoid, could affect brain structural plasticity and thereby olfactory learning and memory in honey bees.Following a chronic oral treatment with field-realistic doses of imidacloprid (1 ng/g or 5 ng/g), the ability of bees to learn and memorise olfactory information was assessed using the well-established protocol of appetitive conditioning of the proboscis extension response. Since olfactory long-term memory has previously been associated with structural changes in specific brain centres, the mushroom bodies, we performed the same measures of structural plasticity after the imidacloprid treatment and after the memory tests. Long-term memory performance was reduced in bees treated with the high dose of imidacloprid only. In these bees, memory formation induced changes in the mushroom body volume that were not apparent in non-treated bees. Our study is the first to relate the impact of neonicotinoids on brain structural plasticity with cognitive performance. It highlights the dose of imidacloprid at which the brain fails to maintain high memory capacities.

9.

The Promise of Standardized Bee Data and How to Achieve It

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• Why - Data science has much to offer beekeeping. Machine learning algorithms have been shown to up end entire industries as artificial intelligence techniques are applied to large data sets to find unknown relationships, map possibilities, predict future events and prescribe optimal actions to achieve one's objectives. Bees and Beekeepers face the proliferation of pests, parasites, pathogens and poor nutrition on top of monocultures, international disease vectors, lack genetic diversity in bees and climate variability. This has pushed not just bees and beekeepers, but much of our agricultural system to the edge of a precipice.
• What - However, much of the data that could help us apply these advanced tools to these problems is not collected in a format that could be readily aggregated for this purpose. This makes it difficult to harmonize as every beekeeper that keeps records tends to keep them in their own way, reducing its value limited the possibility of analysis and use this data. This is also true of governmental institutions, academic research projects that gather data about bees and beekeepers. These databases often become data islands providing limited value for the beekeeping community. We need a way to bring this data together.
• How - There are several steps in this process. Level 0: Collect Data - Encourage the collection and definition of bee related data by started a peer reviewed Bee Data Journal to provide incentives for academics and others to share and define data in an open format while allowing for further data harmonization, aggregation and analysis. Level 1: Describe data - When datasets are shared, meta data and definitions must be shared by the data producer for the consumer of the data to be able to understand how the data can be used and, if needed, linked to other datasets. Without a common standard, linking datasets is a complex task. Level 2: Share data in central store - Datasets are usually used and shared within projects. How do others know datasets are available and where to find them? A central repository will greatly assist the findability, accessibility and use of datasets. Taking licenses and privacy regulations into account. Level 3: Definition of a common bee data standard - XML (eXtensible Markup Language) is a self-describing data format which is very suitable to define a bee data standard, especially as it is both human and machine readible. Datasets can be created using this standard, making data use and linking of dataset seamless.
• Who - The Apimondia Working Group 15 for the Standardization of data on bees and beekeeping is has been attempting to help define a standard, or at least a process to define one for this purpose. This presentation will report on our progress, challenges, recommendations and next steps and solicit feedback from this group of experts. A voluntary group is driving this initiative. You can join by signing up via http://beexml.org/

10.

COLOSS BEEBOOK: an update

Dietemann, V. [1], Carreck, N. [2], Ellis, J. [3], Neumann, P. [4]

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Six years after publication of the first two volumes of the BEEBOOK, a manual for standard honeybee research methods, we will present an update on how widely it has been used so far. We will also inform the participants about the progress of the volume 3 dedicated to honeybee product research.

11.

Beehive building material, multidisciplinary approach to understand its roles on bees and its relationship with beekeepers

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The closest environment for the bees, the beehive, is scarcely studied in the scientific community of researchers interested in apidology. As a research team specialised in wood sciences and its cultural heritage, we found in the beehive an interesting topic of study which requires a multidisciplinary approach conveying wood sciences, heat transfer scientists, ecologists and anthropologists to understand the role played by wood material in honeybees and beekeepers' life. Wood as the building material of beehives is indeed requested to both securing convenience and simplicity in beekeepers' management as well as to promoting the welfare of the bees in winter and summer. Anthropological surveys among beekeepers and beehive suppliers have taught us about their past and current knowledge and expectations around the beehives as well as the actual market of buying and selling beehives. The actual selling strategy is to reduce the production costs in low-wages countries making the hive to be a simple box made from the poorest wood quality but disposable after a couple of years compared to the "one-life" product that it used to be. We built our experimental hypotheses made about the physico-chemical roles of wood on bees on some collected traditional practices. They mention the role of the beehive wall thickness and chestnut wood extractives on respectively bees hygrothermal inner climate targets and varroa destructor parasite populations. Our results have shown that in lab conditions, the mite runs away from the chestnut wood odour. And field experiments have brought us to take part in the development of automated varroa naturally fallen on bottom boards based on artificial intelligence. Some current hygrothermal instrumentation on beehives inner climate also enable us to estimate the thermal power produced by bees to fulfill their needs function of the beehive building material.

12.

Activities and achievements of The COLOSS monitoring group from 2018 to 2019

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The activities of the COLOSS monitoring group continue to be a core aspect of the work of COLOSS, which attract ongoing interest, from potential national co-ordinators in countries new to the group who wish to join in this cost-effective colony loss monitoring, but also from others. The latest annual workshop of the COLOSS monitoring group was held in Gothenburg, Sweden, in February 2019, in conjunction with the COLOSS B-rap workshop, with some participants attending both meetings.
The COLOSS survey of 2018, studying winter 2017-2018 involved 36 countries, the largest number of countries so far participating in monitoring and aligning themselves with the monitoring group. A few other countries do make use of the COLOSS standardised monitoring questionnaire but work independently of the group. The responses from 2018 led to 25,363 beekeepers and 544,879 colonies going into winter being used in the analysis of loss rates, also the greatest numbers so far. The data returns for the 2019 survey are likely to involve most of these countries, and, it is hoped, the addition of Iran to boost the small numbers of non-European countries currently represented in this work. The analysis of the 2018 data, published in May 2019 in the Journal of Apicultural Research (Gray et al., 2019), confirmed the now well-established result that larger scale beekeeping operations suffer significantly lower loss rates than smaller ones. In a slight departure from earlier findings, for the combined data from all countries, it was also found that, overall, beekeepers migrating their bees experienced significantly lower losses than those who did not. Possible association of colony loss with access to six different forage sources was also investigated, leading to the finding that five out of six of these forage sources were associated with significantly higher risk of loss. This was the third short paper in an annual series reporting comparative winter loss rates across the participating countries. As the most extensive yet, the 2018 study quickly attracted considerable attention, achieving a current Altmetric attention score of 774, in the top 5% of all research outputs. These are widely read papers, with findings of great interest to scientists, beekeepers, the public and also the media. The analysis of the data from the latest survey, covering winter 2018-2019, will examine any possible link with the proportion of colonies going into winter with a new queen, which has been highlighted in some other studies in the literature as a potential risk factor for colony loss. Some results of this survey and also from some earlier years of the loss monitoring will be presented.

13.

Bumblebee colony development was affected by different diets

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Bumblebees are most important and efficient pollinators for greenhouse economical crops. To maintain their good colony structure and development, these require pollens and nectar for dietary needs. Fresh pollen pellets and pollen patties with 40, 50 and 60% of sugar and honey solutions do have any effect on life history parameters of Bombus terrestris was investigated. Pollen patties with 40% sugar solution exhibited to be the best at colony initiation stage with earlier pre-oviposition (6.6±0.97), maximum numbers of egg beads in first batch (1.4±0.22) and earlier emergence of first workers (28.3±1.02). At colony foundation stage, pollen patties with 50% sugar solution were suitable for colonies to reach earlier at this stage (51.4±2.53), late start of switch point and early new daughter queen emergence. At colony maturation stage, pollen patties with 40% sugar solution was the best than that of patties with different concentrations of sugar or honey solutions for total number of emerged males, daughter queens' workers, competition point and mother or foundation queen longevity. It can be suggested that pollen patties in 40% sugar solution at colony initiation and colony maturation stages and pollen patties in 50% sugar solution at colony development stage were the most suitable food mix levels for efficient rearing of bumblebees under controlled laboratory conditions.

14.

16 years since the invasion of *Vespa velutina* into Korea

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Vespa velutina is a predatory hornet distributing in Southeastern part of Asia. In 2003 this was firstly found nesting on the wall of port city Busan. Its distribution pattern showed typical species-invasion curve type with slow progress in the beginning and rapid expansion on ward. We determined the geographic spread of *V. velutina* with CLIMEX modeling. The model analysis indicates that the ecoclimatic indices (EI) increased as the projection year increased based on RCP8.5 scenario. Then the predicted EI values were further regressed with the field collected data from 2018. *Vespa velutina* population sizes were estimated from 230 points of sampling over the country and the sampling data were correlated with predicted EI values.

The results indicated that partial contribution of the climate factors for its abundance. Also, this could be a usual biological indicator of climate change in agroecosystem in Korea. Given the important risk and impact on beekeeping, socio-biological as well as ecosystem and biodiversity levels, careful monitoring of phenology, range expansion and preventive efforts mitigating the impact are further required.

Key words: CLIMEX, Invasive species, climate change, indicator.

15.

The Effect of Winter Varroa Treatment by Oxalic Acid Treatment by

Tricking and Sublmation (The title is not the same poster presentations)

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For the last ten years we evaluate and characterize colony losses and their major causes in Israel by beekeepers' surveys. Over the years, our survey data represented 34-50% of total colonies. From all the evaluated factors so far Varroa and its associated viruses were found to be the most significant causes of colony loss. As is practically no brake in the bee reproduction around the year and Varroa management is a big challenge. The main means against Varroa in Israel are treatment with synthetic acaricides, however most are no longer effective, apparently due to Varroa resistance. This winter, along with development of new modes of Varroa management, we tested the possibility to treat Varroa by Oxalic acid (OA). Two methods of OA treatments were tested: trickling and sublimation. In both cases with queen caging was performed. Standard treatment by locally produced Amitraz treated strips (Galbitraz) were used as a control. Varroa infestation, colony size and queen survival were monitored. The efficacy on Varroa and the effect on colony performance will be presented.

16.

DWV-A lethal to honey bees (*Apis mellifera*): A Colony level survey of DWV variants (A, B & C) in England, Wales and 32 states across the US

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The strong association between *Varroa destructor*, deformed wing virus (DWV), and high overwintering colony losses (OCL) of honey bees is well established. Three DWV master variants (DWV-A, -B, and -C) have been described, and their role in colony mortality remains an open question. Therefore, the aim of this study is to investigate the seasonal prevalence, viral load, and changing distribution of the three DWV master variants within honey bee colonies from England, Wales, and 32 states across the United States. Here, we report that in 2016, DWV-B was prevalent (100%, n = 249) and dominant (95%) in England and Wales, compared to the US. (56%, n = 217 and 23%, respectively), where DWV-A was prevalent (83%, n = 217) and dominant (63%). DWV-C was regularly detected in low viral loads (< 1 I— 10^7 genome equivalents per bee) and at lower prevalence (58% in England and Wales, n = 203, and 14% across the United States, n = 124) compared to DWV-A and -B. DWV-B prevalence and dominance in England and Wales coincided with low OCL (6%). Meanwhile, a 60% loss was reported by participating U.S. beekeepers. In the United States, DWV-A prevalence (89%, n = 18) and viral load were significantly (p = 0.002) higher (1 I— 10^8 - 1 I— 10^11) in colonies that died when compared to the surviving colonies (49% (n = 27), 1 I— 10^6 - 1 I— 10^10). DWV-B had low prevalence (56%, n = 18) in the colonies that died with viral loads of 1 I— 10^10) in surviving colonies from all sample locations, providing further supporting evidence of DWV-A exhibiting increased virulence over DWV-B at the colony level.

17.

Are all honey bee castes affected equally by exposure to thiamethoxam during late larval development?

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Honey bees provide essential pollination services and a number of products used in many industries (food, pharmaceuticals, dentistry, cosmetics, etc.). Out of the three honey bee castes (workers, drones, queen) workers are the most numerous and are extensively used in toxicity assays. As workers are non-reproductively active, their evaluation alone may overlook potential toxic effects on bee reproduction. However, a number of environmental contaminants were already shown to decrease reproductive potential of the honey bee drones and queens. The objective of this study was to evaluate if the honey bee castes were affected equally by exposure to thiamethoxam (THI) during late larval exposure. Five honey bee colonies were manipulated to produce synchronized age of worker, drone and queen brood. Larvae of each caste were exposed to one of 4 experimental treatments 1 day prior to capping (worker - day 8, drone - day 10, queen - day 7 of development from oviposition). The treatments consisted of 4 l of double distilled water containing 0, 5, 50, or 100ng of THI. Post treatment capping, eclosion, and emergence weights were recorded for all castes. Drone and worker post emergence survival was monitored in the laboratory conditions.

Emergence rate in THI100 group was 26.7% and 84.26% for queens and workers, respectively, but was not affected in drones. The emergence weights were significantly decreased in drones and workers exposed to THI100 and workers exposed toTHI50 but not in queens. No treatment affects were observed on drone and worker survival in laboratory conditions. The results of our study may suggest that honey bee castes are not equally susceptible to THI during late larval stages.

18.

An integrated approach for a strategy against *Vespa velutina* in Italy

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Invasive alien species can cause serious damage to biodiversity and ecosystems in areas where they are introduced. This is the case of the Yellow-Legged Asian Hornet, *Vespa velutina* Lepeletier 1836, accidentally introduced in France in 2004: the species is rapidly colonizing various European states. Its invasive potential and its predatory activity create serious damage to beekeeping, biodiversity and ecosystem services since honey bees, wild bees, and other native insects are among the prey of *V. velutina*. Moreover, the presence of nests in the environment generates concern among citizens and important economic costs for nest destruction. For this reason, the species has been included in the black-list of invasive alien species of union concern (IAS Regulation - EU 1143/2014, EU 1141/2016) and European Union (EU) countries are enforced to develop actions to limit its spread as well as control and containment strategies.

The LIFE programme is the main financial instrument supporting the EU's environmental policy, established in 1992. Projects for the protection of environment and climate are co-financed through this programme. LIFE STOPVESPA was funded by EU with the aim of containing the expansion of *V. velutina* in Italy, defining and developing a strategy of early warning and rapid response. LIFE STOPVESPA activities started in August 2015. The areas involved in the project are Liguria, the Region which is presently colonized at the highest level by the species, and Piedmont.
The integrated strategy developed by the project is based on the following tasks:

- increase the monitoring network with the involvement of beekeepers and other stakeholders;
- develop a strategy for the management of *V. velutina* reports and the containment of the species;
- limit the spread of the species by nest detection and destruction;
- develop a harmonic radar prototype for tracking hornets and detect nest position.

The efficacy of the containment strategy increased in the years, thanks to the increase of the percentage of nests destroyed before the reproductive period. The strategy contributed to reduce the spread rate of the species thus limiting its diffusion. The two harmonic radars prototypes are capable of tracking hornet flights and detect nest position, and their use in outbreaks were fundamental to rapidly remove *V. velutina* colonies.

19.

Challenges for the beekeeping sector when building the future knowledge and innovation system

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In Sweden one sector which experience an increased attention is beekeeping that through its businesses also contribute to pollination in specific areas. It involves many individual beekeepers but is, from a knowledge and innovation system, KIS, perspective, nevertheless highly informal, underfunded and unstructured. The challenges facing apiculture are many today. One of the most important is related to honeybee health issues, having consequences for rural economy and long-term sustainability. Increased competence and collaboration are seen as central to reach sustainable production systems. But in this respect today's KIS is not functional. Thus, beekeeping illustrates an area that demand social and institutional innovation to be able to deliver public goods as well as sustainable beekeeping businesses. We need to better understand the key functions enabling environments for responsive multi-actor co-innovation in new areas. The beekeeping sector has good preconditions and might function as a role model for the development of other ecosystem services benefitting the rural economy. If one succeeds in creating a functional and socially robust KIS in apiculture it might be instrumental for the development of KIS for ecosystem services in general. The implications are that policies need to be not only developed, but also fine-tuned to support 1) the unique characteristics of networks and platforms for learning and co-innovation in new areas of development, 2) systems for vertical integration of actors in the policy chain and 3) action evaluation for continuously improving pre-conditions and methods when scaling up and out social and institutional innovations. Relevant stakeholders are identified and participating in workshops as well as interviews. A qualitative analysis is made based on collected data as well as earlier research on KIS. The qualitative analysis is guided by triangulation of the different data input, including a Delphi-inspired methodology. The results include a) recommendations on how a socially robust KIS for the Swedish beekeeping sector might be organised and function, b) a critical analysis of the main challenges when building a KIS from scratch, and c) consequences for other, contemporary areas such as the development of new KIS for existing ecosystem services.

20.

The Extended Phenotype of a Honey Bee Colony, Survival and Research, a Thermofluid Perspective

Derek Mitchell [1]

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The extended phenotype of a honey bee colony, survival and research, a thermofluid perspective Honey bees spend over 80% of their lifetime within the nest, and possess very complex behaviours in finding, selecting and modifying it. Their level of attention to the nest parameters is indicative of their importance to survival, yet in both research and apiculture, attention and discrimination of these parameters are remarkably absent. Unlike the poster child for the extended phenotype, the beaver, the fluids the honey bee manipulates in the nest are invisible to the human eye, air, water vapour and the fluid-like heat. It needs Thermofluids, the science of liquid and gas flow, heat transfer and combustion, to make the full extent of the honey bees efforts evident.
This presentation analyses the impact of man-made nests and contrasts them to their natural abode using the author's recent thermofluid analyses and experimental results. It then poses the question of whether research should include the extended phenotype in the search for causes and solutions to honey bee colony loss.

21.

COLOSS-members and their activity in the COLOSS-network

Linde Morawetz [1], Lotta Fabricius Kristiansen [2], Preben Kristiansen [3], Flemming Vejsnaes [4]

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The COLOSS B-RAP (Bridging Research and Practice) core project was created in 2014 with the specific intention to deal with knowledge transfer and capacity building in the beekeeping sector. In the course of its 8 workshops so far, we created and conducted a survey in order to learn more about how the COLOSS-members are involved in knowledge transfer and which tools they use. A part of the survey questions was also dedicated to the COLOSS-activity of the members and gives thus an insight into the way members are attached to COLOSS. The survey was conducted online in May and June 2019 and was answered by 150 persons (12% of the COLOSS members) from 49 countries from all inhabited continents. We asked the participants about their engagement in workshops, COLOSS related publications and the promotion of the COLOSS network. 57 % of the participants stated that they attended at least one workshop. The group of workshop-participants (WP) were also active in COLOSS-related publications (72 %) and promoted COLOSS by citations (92 %), acknowledgements (92 %), and logo use (75 %). The other 43 % of the survey participants, which didn't attend any workshop yet (non-WP), were generally also less involved in other activities: 20 % of them were co-authors in COLOSS-related publications, 63 % cited COLOSS-publications, 54 % promoted COLOSS by acknowledgements and 17 % by logo use. Interestingly, the non-WP differ significantly in their interest in some of the COLOSS topics from the WP. 70% of them are interested in the 'Monitoring of Colony losses' (WP: 49%; Chi^2=6.04, df=1, P=0.014) and 45 % in the 'Sustainable Bee Breeding' (WP: 27 %; Chi^2=4.37, df=1, P=0.037).

The data shows two different groups of attachment in COLOSS: a group of actively participating COLOSS-members, who also promote the network strongly, and a second group of interested members, who show also dedication to the network through promotion work, but who may have different interests in the COLOSS-network than the 'visible' and more active members.

22.

The role of pupation in determining small hive beetle sex ratio

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Fisher's principle predicts that the sex ratio of sexually reproducing species should be 1:1 between males and females. However, differential mortality and intraspecific competition during pupation can result in a biased adult sex ratio in insects. The female-biased sex ratio of small hive beetles (Aethina tumida Murray, Coleoptera: Nitidulidae) is well known from both laboratory and field studies, but not well understood. Here, we used laboratory mass and individual pupation to test if differential mortality between sexes and/or intraspecific interactions can explain this sex ratio. The data show a significant female-biased adult sex ratio in both mass and individual rearing, even when assuming that all dead individuals were males. Our results therefore suggest that neither differential mortality during pupation nor intraspecific interactions are likely to explain the female-biased sex ratio of freshly emerged adult SHBs. Since we used autoclaved soil, we cannot exclude sex-specific susceptibility towards soil-borne pathogens influencing small hive beetle sex ratio in the field. However, we regard it as more likely that either intraspecific competition during the larval feeding stage or genetic mechanisms are responsible.

23.

Availability of natural resources and colony density influence beekeepers' profit

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Forests and woodlands are considered as the most important sources of honey bee forage in many European countries with several tree species providing nectar and/or honeydew flow. Slovenia boasts with high number of beekeepers and high colony count per square kilometer. We have investigated the impact of availability of natural resources and colony density on honey yield. Data presented here were collected on 57 locations with monitor hives, equipped with scales, over years 2011-2016. Locations were selected according to site vegetation, ensuring identified source of nectar or honeydew flow. The source of the flow was recorded and verified by contract beekeeper. We investigated (1) the relationship between abundance of the flow source expressed as the quantity of growing stock and net mass gain of the monitor colony during the flow and (2) the relationship between colony density expressed as the number of colonies against growing stock volume and net mass gain of the monitor colonies. We found an asymptotic exponential relationship between colony mass gain and growing stock of the species, providing flow. The exception was the spruce where the relationship was determined as linear. Colony density then limited the colony mass gain due to the flow. In cases of acacia, linden and spruce flow we have determined the relationship between colony density and mass gain as decaying exponential.

Most likely, another variable should be used in the case of spruce flow: population of dew-producing insects. Periodical monitoring of eight acacia locations show differences in mass gain between years, thus allowing prediction of colony densities which guarantee profit: these locations are determined as those with colony density less than 50 hives/103 m3 growing stock gained more than 10 kg/hive in 83% of cases, regardless of the year. Our results indicate that a cap on the total number of colonies at one location should be considered to maximize beekeepers’ profit.

24.

Dynamic evolution in a mite-vectored virus of honey bees: Insight from reverse genetics for Deformed wing virus

Eugene V. Ryabov [1], Francisco Posada-Florez [1], Anna K. Childers [1], Dawn Lopez 1, Kyle Grubbs [1], Matthew C. Heerman [1], Noble I. Egekwu [1], Steven C. Cook [1], Dennis vanEngelsdorp [2], Yanping Chen [1], Jay D. Evans [1]

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Virulence of Deformed wing virus (DWV) the major picorna-like viruses of honey bees, showed a sharp and significant increase following the introduction of its vector, the mite *Varroa destructor*. We designed and developed multiple infectious cDNA clones for DWV that captured the diversity of typical virulent population, effectively establishing the first reverse-genetic system for an invertebrate RNA virus quasispecies. Using these cloned isolates, we investigated interactions between co-existing DWV genotypes, impacts of virus diversification on RNAi targeting, and mechanisms of Varroa vectoring of the virus. We suggest that the introduction of Varroa results in an initial selective sweep of DWV diversity which is soon followed by DWV diversification driven by selection for new genotypes capable of evading host RNA defenses.

25.

Preliminary researches regarding the efficacy of formic acid and acetic acid in the treatment of varroa (*Varroa destructor*) found in bee brood

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The objective of the study was to establish the efficacy of formic acid and acetic acid on varroa (*Varroa destructor*), inside the capped brood cells, applied by special new methods. The experiments were carried out in 2018 - 2019, on honeybee colonies infested with varroa (*Varroa destructor*), in a research apiary belonging to the Institute for Beekeeping Research and Development in Bucharest. The tested substances were used in two, different concentration, using special methods for varroa control in bee brood combs. The researches were focused on establishing the mortality level of different stages of varroa found in the bee brood combs. The results show a high mortality of varroa (over 80%), in all the development stages which show that the new methods of applications provide a constant and high effectiveness for both used treatment substances. The presented methods of treatment assure the interruption of the life cycle of varroa, without affecting the bees and brood.

26.

"Let's create a Bee-friendly City"- a transdisciplinary research rocess in Kyoto

Maximilian Spiegelberg [1], Rika Shinkai [1], Christoph Rupprecht [1], Jingchao Gan [2]

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To grasp the challenges and potentials for beekeeping originating from the societal changes in Japan we chose a trans-disciplinary (TD) research process as method around the theme "Let's create a Bee-friendly City". This allowed not only beekeepers with diverse backgrounds, but also citizens and civil society groups to engage as bee-stakeholders. Furthermore, the TD process shined a light onto the under-represented and under-studied humanities and social science aspects of honeybees and beekeeping while still integrating the natural science base, as well as focused on the lesser regarded eastern A. cerana. The TD process started in fall 2017 and included in-depth interviews with experts and practitioners, participant observation, large-scale surveys of beekeepers (n= 386) and urban residents (n=700), as well as multiple stakeholder workshops. As TD aims at the integration of different kinds of knowledge and the cooperation between academics and non-academics in order to transform societal problems, this research process yielded 1) several research questions beyond the classical honeybee research with local, immediate policy relevance, 2) uncovered and documented previously ignored knowledge and practices of beekeeping, as well as 3) brought together actors beyond the typical 'beekeeping world'.

27.

Using Color Sorting and Palynology to Track Pesticide Residues in Trapped Pollen to a Plant Genus

Kimberly Stoner [1], Richard Cowles [1], Brian Eitzer [1], Andrea Nurse [2]

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In a project trapping pollen from honey bee colonies at ornamental plant nurseries, we found a few samples from one nursery with extraordinarily high levels of acute pesticide toxicity. One sample had 305 ppb thiamethoxam, 31 ppb clothianidin, 94 ppb of acephate, and 15 ppb of methamidophos. By sorting two of the pollen samples by color, testing each of the color components again for pesticides, and analyzing the color components using palynology, we were able to associate the high pesticide levels with pollen from the plant genus Spiraea. The nursery confirmed applications of thiamethoxam and acephate to this crop in the nursery. (Clothianidin is a metabolite of thiamethoxam and methamidophos is a metabolite of acephate.) This technique may be useful in tracking pesticide residues to plant sources in other studies.

28.

A blend of Bacilli and Lactobacilli lowers Nosema spore counts in the field

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The honey bee beneficial microbiota, in addition to known pathogens, represents a key variable in honey bee colony health. Soon after eclosion, adult honeybees are inoculated with core gut microbiome species, including those belonging to genera Bacillus and Lactobacillus. Bacilli and Lactobacilli inhibit bacterial honeybee pathogens and their presence is linked with good colony health, yet majority are susceptible to antimicrobial substances used in beekeeping. Lactobacilli feeding stimulates honeybee immune response, and several commercial feeds contain Lactobacilli. Exogenous Bacilli prolong honeybee lifespan and survival of Nosema challenge, yet does not lower Nosema spore counts. We demonstrate that feeding Bacilli and Lactobacilli together significantly improves colony health and overwinter survival and is associated with lower Nosema spore counts in the field. Direct and indirect modes of action are proposed to account for the additive effects of Bacilli and Lactobacilli supplementation on Nosema infection.

29.

Efficacy of disinfection of apiary fittings contaminated with *Paenibacillus larvae* spores

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American foulbrood disease is a fatal disease of honeybee colonies caused by highly resistant and infectious Paenibacillus larvae spores. After proper sanitation of apiary with clinical visible outbreak, the disinfection of beekeeping equipment and environment is crucial preventive measure of disease reappearance. As general chemical disinfectants are often recommended, the aim of this work was to analyze efficacy of disinfectants Sekusept Aktiv and Incidin Oxy Wipe S. We tested susceptibility of P. larvae to disinfectants Sekusept Aktiv, intended for manual cleaning and disinfection of thermostable and thermolabile devices, according to EUCAST disk diffusion method or microtiter well testing systems; while and Incidin Oxy Wipe S, sporicidal ready-to-use cleaner and disinfectant, was tested using adopted PET test. To test sporicidal efficacy, we seeded spores after exposure to disinfectant and monitored growth on blood agar plate after 24 and 48 h. Based on the obtained results Sekusept Aktiv at a concentration 0.5% killed all vegetative microorganism while at a 2% and following 15-minute exposure all spores were killed. There was no visible growth of microorganism after 5 minutes following inoculation of P. larvae at Incidin OxyWipe S cloth. In conclusion, mentioned disinfectants provide alternative for the disinfection of wooden, leather and other apiary structures, and are environmentally more acceptable.

30.

Lethal and sublethal synergistic effects of stressors on bees

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Bees are exposed to multiple stressors simultaneously, such as pesticides (including chemical mixtures of multiple active ingredients), nutrition deficiencies, and diseases. Combined exposure to multiple stressors can cause interactive effects, amplifying the risk if the two agents (i.e. two pesticides) interact synergistically altering animal survival and behaviour. However, research and regulatory pesticide Risk Assessment (RA) generally investigates the risks posed by only one agent at the time (i.e. one pesticide), and mainly addresses effects on animal survival. The difference between the complexity of real-world situations (i.e. exposure to multiple stressors affecting survival and behaviour) and the simplified experimental (RA) scenario can lead to uncertainties in conclusions about bee health. Thus, we investigated the synergistic effects of a chemical mixture on animal survival and behaviour, and tested if pesticide-nutritional stresses can cause synergism on the honey bee. Our first experiment demonstrated that the combination of field-realistic exposure to two major stressors for bees, pesticides and poor nutrition, can synergistically impair bee health. We also showed that these stresses, combined, reduced both glucose and trehalose concentration in bee hemolymph and food consumption. In a second experiment, we demonstrated that combined exposure to a novel insecticide (flupyradifurone, Sivanto®) and a common fungicide (propiconazole) synergistically increased bee abnormal behaviours and mortality. The synergistic interactions of stressors on bee health should be further investigated, as they likely contribute to alterations of bee health.

31.

Iranian Honey Bee (*Apis mellifera meda)* Breeding Program and Varroa Mite Resistance Project

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Honey bees have significant importance for humans and biodiversity and are considered as a highly valued genetic resource. *Apis mellifera* known as western honey bee is the most common species among the honey bees, which by its own it has numerous subspecies. Iranian honey bee or *A. mellifera meda*, classified in 1929, has been existing in the geographical region where currently is known as Iran, northern Iraq, southeastern Turkey and Syria, for millions of years. Species and subspecies are better adapted to the general conditions of the land of the origin and also there would be more resistance to diseases and pests of the native geographical region as well as Semi-arid climate and weak vegetation. Therefore, native subspecies have the potential of being substantially more beneficial in various terms compared to non-native ones. Native species and subspecies are considered as genetic resources of each country and must be well conserved and protected from extinction, which could be caused by malpractices such as uncontrolled import. Honey Bee Research Department of the Animal Science Research Institute of Iran has been conducting a National Mega Project for two decades called "Iranian Honey Bee (*Apis mellifera meda*) Breeding Program" and the side project of "Varroa Mite Resistance". The Mega Project has focused on improving the general performance of *A. mellifera meda* through breeding for three main traits of defensive behavior, swarming and honey yield. In the last two decades the program has been successfully improving the defensive behavior 21.4 times, the swarming 26 times, and the honey yield 2.74 times comparing the average of the first three generations to the last three generations. While the Program is still insisting in obtaining better performances in the above mentioned traits, it is also extending the goal to additional traits such as overwintering and other key features. Additionally, the program has also been technically educating the beekeepers of the country about apiary management, pest and disease control queen rearing the advantages of practicing beekeeping with the native subspecies, the irreparable risks of imported honey bees and to introduce the improved *A. mellifera meda* to the beekeepers of the country. Furthermore, the Varroa Mite Resistance Project has been aiming to increase the resistance of the Iranian honey bee against varroa mite, one of the most important global pests of honey bees, without using drugs. In the last 7 years of this project the resistance to varroa through grooming behavior has improved 5% and through hygienic behavior 0.35%, comparing the average of the first two and the last two generations. The Mega Program and the side project of varroa resistance, which can last for several more decades, have been quite successful in improving the four traits of calmness, swarming, honey yield and overwintering and also in reintroducing the Iranian honey bee to the beekeeping industry of the country. As long as the plan is successful one of the genetic resources of the country would be well conserved the critical risks which are involved with importing queen honey bees from abroad would be prevented.

32.

Brood chemicals as a new selection tool for hygienic behavior against Varroa?

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Sustainable control methods of Varroa to improve honey bee health remain elusive. One promising approach is selective breeding for improving hygienic behavior. However, currently employed selection methods have several disadvantages for common beekeepers. We report on the progress of developing a chemical assay that can be readily implemented for breeding or simple hygienic assessment of hives. This assay is a spray of a chemical mixture based on previously identified brood pheromones that we found elevated in response to Varroa infestation and Deformed Wing Virus. The relation of this assay to other assessments of hygienic behavior and to hive health will be described and discussed.

33.

Chronic neonicotinoid exposure decreases overwinter survival of *Apis mellifera* L.

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Since 2006, North American beekeepers have experienced increases in overwinter honey bee colony mortality. Overwinter, colonies rely on stored honey and pollen which is contaminated with the neonicotinoid insecticide thiamethoxam at concentrations from 1-20 ng/g. To determine whether dietary neonicotinoid exposure affects overwinter survival of Apis mellifera L., we chronically exposed winter bees to thiamethoxam in the field and in the laboratory and monitored survival. In winter 2017-2018, field colonies chronically exposed to 100 ng/g thiamethoxam experienced 65% overwinter mortality, which was significantly greater than the overwinter mortality of control colonies (10% overwinter loss, $P < 0.001$) and colonies exposed to 20 ng/g thiamethoxam (25% overwinter loss, $P = 0.011$). In winter 2018-2019, field colonies exposed to 5 and 10 ng/g thiamethoxam experienced 48% overwinter mortality, which was not significantly different from control colonies (36% overwinter mortality, $P = 0.6896$). Under laboratory conditions, chronic exposure to thiamethoxam significantly (X2(9) = 309.55, P

34.

Vespa velutina, as honey bee viruses reservoir

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In the present study, we investigated the occurrence of 13 honeybee virus species in 5 wasp species from 4 provinces of China and 2 hornet species from 4 locations of France. The results showed that all wasp species from 9 locations of China were infected by different types of honeybee viruses and particularly most of them carried Apis mellifera filamentous virus (AmFV), Deformed wing virus (DWV) and Israeli acute paralysis virus (IAPV), even some were infected by more than 4 viruses simultaneously. DWV was found to be the highest prevalent in France and only two and one sample was found infected by Black queen cell virus (BQCV) and Sacbrood virus (SBV), respectively. Phylogenetic analysis on BQCV and IAPV indicated that most of IAPV strains belonged to a single phylogenetic group, while BQCV strains from China and France belonged to several groups. This work is also the first report of detection of Lake Sinai virus (LSV) in hornet in China. These results could serve as a basis for further investigations of transmission and origin of honeybee pathogens in Vespidae species, especially their potential role as belonging as viral vectors for bees.

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