

Laboratory of Apiculture and Social Insects

Report October 2008 to January 2010



US

University of Sussex

LASI personnel

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Mission statement and goals

Research

- To carry out basic and applied research on honey bees and social insects.
- To be a world-leading research group and a key component in UK science infrastructure and expertise.

Teaching

- To train the next generation of honey bee and social insect scientists.

Community

- To extend practical knowledge, informed by high quality research, about honey bees and social insects to beekeepers, industry and others.
- To play an active role in the public communication of science.

Contacts

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Facilities

The Laboratory of Apiculture and Social Insects is housed in the Old Ancillary Building of the Department of Biology and Environmental Science within the Faculty of Life Sciences. This is a particularly convenient location as it is adjacent to the main Biology and Environmental Science building named after the evolutionary biologist John Maynard Smith. In spring 2008 a large area (140m²) of the building was completely renovated to provide working space for 10 researchers. This comprises four offices, a tropical ant room, and a large open plan laboratory, all in a self-contained area.



Professor Francis Ratnieks in the newly converted laboratory, March 2008.

Since the official opening of the Laboratory of Apiculture and Social Insects by Lord May of Oxford on 7th April 2009, much effort has been spent on establishing and consolidating the facilities of the laboratory. Plans are underway for an adjoining area (60m²) to be renovated and added to the laboratory which will provide a total working space for 15 researchers. Immediately outside the laboratory is a garden and apiary, a workshop for making bee hives and research equipment, and a storage shed for hive equipment. Within easy walking distance on the University campus are two other apiaries, one with a storage shed. Other apiaries in the surrounding countryside are also being set up, including one at Plumpton College and one at the Royal Botanic Gardens, Wakehurst Place. The number of bee hives being kept depends on the needs of the research. In spring 2009, there were fifty hives (forty-five standard hives and six observation hives) and this number is set to increase.

The campus location of the University of Sussex, surrounded by the newly designated South Downs National Park, provides an excellent habitat for the study of honey bees. It also enjoys one of the sunniest climates in the UK, giving an extended season for conducting research. The University of Sussex has particular strength in research in social-insect biology, with the largest concentration of social-insect researchers in the UK, which is highly beneficial for LASI. Moreover, the LASI team offers an unparalleled depth of knowledge and expertise in bee biology and beekeeping in the UK.

The projects in the Sussex Plan for honey bee health and well being are designed to provide practical solutions for the bee keeping community, which will in turn be of significant benefit to farmers and growers, as well as to biodiversity and the environment.



Hives in the LASI apiary, Summer 2009.

Research – The Sussex Plan for honey bee health and well being

Project 1: Breeding disease-resistant hygienic honey bees and providing breeder queens to beekeepers.

Background

Bees are susceptible to many pests and diseases, in particular bacterial brood diseases such as American foulbrood (AFB) and European foulbrood (EFB), the fungal disease chalkbrood, and the parasitic mite *Varroa destructor* (Varroa). These have traditionally been treated with a range of drugs including antibiotics and acaricides, but increasing problems with resistance have been experienced, leading to reduced efficacy. This has led to a search for chemical free alternatives (Carreck, 2009a).

So-called 'hygienic' worker honey bees remove dead or infected larvae and pupae from their cells, reducing the spread of disease within a colony. Previous research in the USA has shown that hygienic colonies may produce as much honey as other colonies, but are resistant to brood diseases such as AFB, EFB and chalkbrood. Hygienic behaviour can also disrupt the breeding cycle of Varroa, thereby slowing down mite population growth, so that beekeepers with hygienic hives will find it easier to control Varroa.

Hygienic behaviour is a naturally occurring genetic trait, meaning that it can be selected for using conventional bee breeding methods. Previous studies by Professor Ratnieks found that only about 10% of British hives are hygienic, so a more effective method of breeding for hygienic behaviour via 'intracolony selection' has been developed (Pérez-Sato *et al*, 2009). This involves keeping colonies known to exhibit hygienic behaviour in observation hives to determine which individual workers are the most hygienic. Molecular techniques are then used to determine the patriline (i.e. the identity of the drone father of the worker). Daughter queens are then reared that have the same father as the hygienic workers. In this way breeding for hygienic behaviour is more effective and rapid than breeding on a colony basis.

Main aim

- To selectively breed and then test under UK field conditions, a strain of hygienic honey bees, and to then make this available to UK beekeepers.



Dr Karin Alton performing freeze-killed brood test, June 2009.

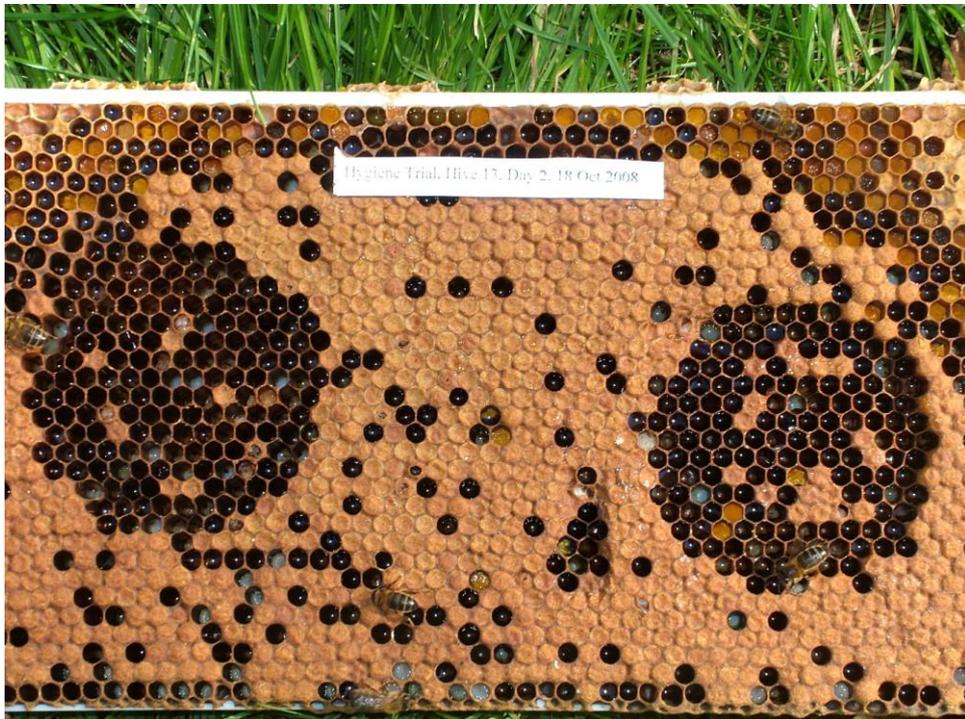
Progress

Thanks to donations from Mr Michael Chowen and Rowse Honey Ltd work on Project 1 commenced in autumn 2008 with the appointment of Norman Carreck and Karin Alton. In October 2008 the breeding work got underway when approximately 50 colonies of dark European honey bees *Apis mellifera mellifera* were tested for hygienic behaviour using the 'freeze killed brood' test, using liquid nitrogen. This test is known to suffer from variability between colonies and according to the time of year (Carreck, 2009b), so the test was repeated in November, and then on four occasions in the spring and early summer of 2009. When averaged out, the results demonstrated that a number of colonies showed an encouragingly consistent level of hygienic behaviour, removing 80 - 90 % of the freeze killed brood cells.

These colonies were then used for the next stage of the project, identifying which of the individual patriline (groups of half sisters among the workers, corresponding to individual drone fathers) within the colony actually show hygienic behaviour. Groups of newly emerged bees from the most hygienic colonies were marked and introduced to observation hives. Two weeks later, when those bees were of an age to perform hygienic behaviour, combs containing freeze killed brood were placed in the observation hives. The patches of killed brood were then observed for 48 hours using a video camera. Bees observed on the killed brood were recovered, and wing samples from them were then sent to Dr Annette Jensen at the University of Copenhagen, for DNA analysis.



Non-hygienic colony, October 2008.



Hygienic colony, October 2008.

Future developments

The next stage of the project, commencing in Spring 2010, is to rear queens from these particular hygienic lines. To do this, queens will be raised from the most hygienic colonies. On queen emergence, non destructive wing tip samples will be collected from each virgin queen, and subjected to the same DNA analysis. Only those queens corresponding to the hygienic patriline will be retained, and then inseminated with drones from hygienic colonies. We are very conscious of the limited gene pool currently available to us, so we are sourcing additional genetic material from various members of the Bee Improvement and Bee Breeders Association, which aims to conserve the dark European honey bee.

A PhD student will be joining the team working on Project 1 in Spring 2010, funded by the British Beekeepers Association. The student will assist in the screening of colonies for hygienic behaviour, in developing the methods that combine intra-colony selection with instrumental insemination, in developing improved methods for identifying hygienic bees, and comparison of queens inseminated by single males or brother males in the breeding programme.

Finally, it must be borne in mind that any breeding programme is open ended, and whatever we succeed in producing at the University of Sussex can only be of benefit to British beekeeping if facilities are available to rear queens in quantity and to then distribute them to beekeepers. The involvement and support of members of the Bee Farmers Association will be essential in order to achieve this.



Norman Carreck marking bees, August 2009.

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Carreck, N.L. (2009b), Varroa tolerant bees: dream or reality, Part 2. *British Beekeepers Association News*, 177, 3-4.

Pérez-Sato, J.A., Châline, N., Martin, S.J., Hughes, W.O.H., Ratnieks, F.W.L., (2009), Multi-level selection for hygienic behaviour in honey bees, *Heredity*, 102, 609-615.

Project 2: How good is the British countryside for honey bees? Decoding dances to determine where worker honey bees are foraging

Background

The number of managed honey bee colonies in the UK is thought to have declined by nearly 75% over the last century, from approximately one million to 280,000. One major reason for this has been changes in land use which have resulted in less forage for bees. Arable fields now have few weeds, and grassland now has few wild flowers or clover due to the use of nitrogen fertiliser (Williams and Carreck, 1994). Much heather moorland has been ploughed up or become degraded. To survive in business, commercial beekeepers need bee colonies to produce reasonable honey crops. Successful honey bee foragers dance when they return to the hive and these 'waggle' dances tell nest mates the direction and distance of profitable flower patches (von Frisch, 1968). The dances can also be decoded by researchers, by using observation hives and video cameras. In this way, honey bees literally tell the researchers where they have been foraging, and are the only animals that are known to do this.

Decoding dances provides an effective means of investigating honey bee feeding ecology. Previous research by Beekman and Ratnieks (2000) has shown that honey bees will fly up to 14km to highly rewarding patches of heather. The Sussex project will initially monitor three observation hives in Sussex to determine which habitat types (urban, rural, arable, woodland, nature reserve etc.) the bees visit, the distances travelled, and how this relates to season, month, weather and honey production (from weighing hives). Subsequently, the project will also investigate how changes in land use (e.g., set aside, headland strips) affect bee foraging and will instigate collaborations with other interested parties (e.g. the National Trust, the Forestry Commission, Royal Botanic Garden, Kew) to monitor hives in other parts of Britain and to further investigate honey bee foraging in urban and rural areas.

Main aims

- To determine the habitats and distances from the hive that honey bees collect food under current UK conditions, the plants that they visit
- To make recommendations for land use in both rural and urban areas that benefit honey bees and beekeepers.



Amanda Kuepfer studying bees dancing in observation hive, July 2009.

Progress

Project 2, mainly funded by donations from the Nineveh Charitable Trust and Burt's Bees (UK) Ltd, began in July 2009 with the arrival of Dr Margaret Couvillon and MPhil student Fiona Riddell, and aims to study the use that honey bees make of their environment, by decoding waggle dances. Data collection began in August 2009, with the establishment of observation hives located on the university campus at LASI.

A majority of the autumn was spent establishing the best techniques for capturing high quality video of returning foragers dancing for their nest mates. In all, over 150 hours of video were captured from three observation hives from August to November. Additionally, three scales were networked to log automatically the weights of the hives every hour into a computer. This monitors the weight gain or loss of the observation hives, which serves as a proxy for nectar flow or nectar dearth. Lastly, a weather station was installed, which also automatically tracks and downloads important information into a computer on current conditions. All these data will be useful to determine what environmental factors affect honey bee foraging.

Decoding began in August and involves determining the direction and duration of waggle dances from foragers. This is time-costly data collection, with each hour of video tape taking several weeks to decode. In September, four undergraduate students began to work on this research as part of their 3rd year projects. With five decoders, it has been possible to obtain 100 dances per hive per month from August – October. Having undergraduate workers is a huge bonus for both the project, which greatly benefited in terms of help in data collection, and for the students, who gain important experience in a research laboratory. These students are not only working towards their degree, but they are providing valuable assistance on a real research project with important implications for science and for conservation efforts.



Dr Margaret Couvillon decoding waggle dances, August 2009.

Future developments

The next step will involve statistical analysis and geographical surveys to tease apart details of the data. Specifically, investigations will focus on both basic science questions (e.g. how does foraging change from month to month?) and applied science issues (e.g. what type of land do the honey bees use for their forage?).

In 2010, we hope to expand our current experimental set-up to include other sites at the University, at the Royal Botanic Garden at Wakehurst Place and at Plumpton College. These additions will allow us to compare and contrast the foraging data from different locations.

This project has greatly benefited from the help of many experts: special thanks go to Professor David Waxman for his help with the mathematics of the foraging calibration curve, Phil Chitty and Dr. Martyn Stenning for their assistance with the weather station, and Peter Reed, who helped design software for our systems.

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Undergraduate Teaching

The research on honey bees at LASI also links into undergraduate teaching, thus helping to fulfil one of the LASI goals of training the next generation of scientists. In year 2 Professor Ratnieks teaches a course in Behavioural Ecology, giving lectures on animal behaviour including bee behaviour. The students also tour the lab and see demonstrations of honey bee behaviour, including waggle dancing, guarding and colour learning. Tutorials are run by members of the LASI team. In year 3 Professor Ratnieks teaches a course in social insects and also supervises final year research projects. The social insects course is relevant to all social insects (bees, wasps, ants, termites), with about one third of the material being specifically on the honey bee. The students also take four laboratory sessions one of which involves the students actually learning to decode honey bee dances, which is taught by Margaret Couvillon and Fiona Riddell. Sam Jones, Tomer Czackes, Christoph Grüter, and Martin Kärcher also help out in other labs in the course.

Honey bees and social insects are popular among the students for their final year projects, with Professor Ratnieks supervising seven project students in 2008-9 and six in 2009-10. In 2008-9 five of the project students studied honey bees, with two studying flower constancy using artificial flowers and three studying guarding. In 2009-10, four students are doing projects connected with Project 2 of the Sussex Plan, decoding dances to determine where bees from LASI observation hives forage month by month. In this way the students are involved in a real research project. Dr Couvillon and Ms Riddell are helping Professor Ratnieks to supervise the honey bee students.

Undergraduate students

2008-9

Flower constancy: Heather Moore, Nicola Firmin

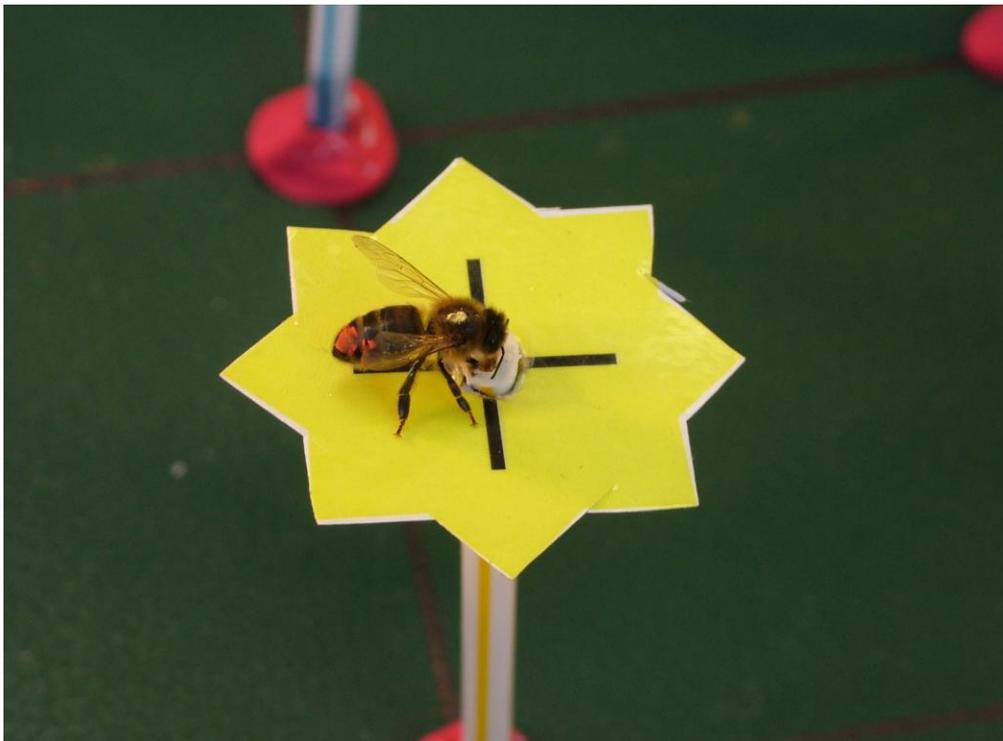
Guarding: Sarah Barton, Jennifer Cohen, Onna Fabricius

2009-10

Dance decoding: Samantha MacKenzie, Amanda Kuepfer, Buffy Harris-Jones, Laura Rozario



Heather Moore and Nicola Firmin conducting field work in their final year project study of flower constancy in honey bees using artificial flowers and syrup rewards



A worker honey bee visits an artificial flower. The bee is marked with a dot of paint as it forages to ensure that each bee is only used once. The bee is not harmed.

Extension

Public communication is an important aspect of the work of the Laboratory of Apiculture and Social Insects. LASI operates an open door policy whereby its research and expertise is communicated not only at an academic level but also to school children, MPs and bee farmers, and talks are given to colleges, beekeeping groups and WI meetings. During 2009 LASI had several visits from local primary school classes, where learning about bees and the environment has been an integrated part of their curriculum. The children enjoyed the experience of meeting real scientists and understood the importance of honey bees in the food chain and as part of our ecosystem.



Dr Karin Alton teaching a reception class about honey bees at LASI

In 2009 we hosted the winter meeting of the International Union for the Study of Social Insects. This was a great success and was attended by approximately 80 academics from many countries. In April 2010 LASI is holding a conference entitled 'What's the Buzz? Bees, land use and the community'. The guest list includes representatives from local authorities' parks departments, teachers and other educationalists, local MPs, farmers and growers, land managers, funders and interested local businesses. This will be an excellent opportunity to network and form collaborations, and to discuss the dangers facing bees and perhaps to address solutions to these problems.

In addition to our public communication drive, we have established a website, www.sussex.ac.uk/lasi which is accessible to all. Information about the research conducted at LASI, under-graduate teaching and pages of resources are available and we are in the process of developing more content for educators, land managers and beekeepers. This is also an opportunity to keep everyone informed about current news and forthcoming events at LASI. The site is a flagship website and will become a template for other research groups at the University of Sussex.

The public communication and outreach work is kindly supported by a donation for materials from the John Spedan Lewis Foundation.

Media engagement

During 2008 – 9 there was a great deal of media interest in the problems facing honey bees. The research being conducted at LASI was featured in the national and regional press, magazines and periodicals, online articles, radio and television programmes. Below is a list of just some of the items in which Professor Ratnieks or members of the LASI team were featured.

- Plight of the honey bee
Rowse Honey is to give £100,000 to the Laboratory of Apiculture and Social Insects at the University of Sussex for bee research. *The Times*, 31.10.08
- 'Clean-up' bees could save endangered hives
Professor Francis Ratnieks interviewed on the research with Rowse. *The Observer*, 08.11.08
- The bees are back in town
Professor Francis Ratnieks explains the decline of honey bees. *The Economist*, 05.03.09
- Dance of honey bee holds key to survival
Professor Francis Ratnieks is undertaking a study of honey bees' waggle dance to help reverse the decline of the bee population. *The Observer*, 05.04.09
- Dead bees
Norman Carreck and Professor Francis Ratnieks were among the scientists despairing over dwindling bee populations and lack of research funding.
BBC4 23.04.09, *ITN News* 21.04.09, *BBC Radio 4*, *World at One* 21.04.09
- If I was king for a day
Professor Francis Ratnieks talks about how he would thank the honey bee.
The Big Issue 13.04.09
- Eco the hero: The honey bee expert
Professor Francis Ratnieks is this week's hero because of his work with honey bees.
Daily Telegraph (magazine) 25.07.09
- The bees' needs
Professor Francis Ratnieks explains why he is raising money to develop cleaner bees.
Financial Times 22.08.09
- To keep bees you must be an optimist
Article about bee keeping, with a brief interview with Professor Francis Ratnieks.
The Times (Weekend supplement) 15.08.09
- No longer jam and Jerusalem
The WI highlights issues facing bees and refers to the work of Professor Francis Ratnieks at LASI at the University of Sussex. *Bee Craft*, 01.08.09
- Show me the honey
Is the bees' waggle dance the one to watch, say University of Sussex bee researchers.
New Scientist 19.09.09
- The waggle dance explained by Professor Francis Ratnieks.
The One Show, *BBC 1*, 12.11.09
- Hygienic bees
Norman Carreck (LASI) was interviewed about hygienic bees while at the National Honey Show.
The Food Programme, *BBC Radio 4*, 09.11.09

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Laboratory of Apiculture and Social Insects (LASI)

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Welcome to the Laboratory of Apiculture and Social Insects

The Laboratory of Apiculture and Social Insects (LASI) at the University of Sussex is the largest research group in the UK studying honey bees and other social insects the bees, wasps and ants that live in a colony with a queen and workers. LASI research studies the honey bee and other social insects "In the round" addressing

Latest news

18 November 2009
Dr Margaret Couvillon, LASI, Sussex University, tests the cognitive ability of Africanised honey...

Home page of the LASI website

Funding

The important research into honey bee health being conducted at the Laboratory of Apiculture and Social Insects would not be possible without the support of many companies, trusts and foundations and individuals. Generous donations have come from young and old alike; from benefactors who have a personal or professional interest in honey bees, like Rowse Honey and beekeeper's associations and from organisations with a wider interest in conservation and the environment. Between October 2008 and January 2010 over £660,000 has been donated and pledged to fund research at LASI, including Gift Aid and HEFCE Matched Funding. The University of Sussex has also made a considerable financial commitment by investing in refurbishing the laboratory space and employing Professor Ratnieks.

Everyone at LASI would like to thank all the donors for their generosity and hope that they might consider supporting this vital research in the future.

Major donors

Burt's Bees (UK) Ltd
David Read
Michael Chowen
Nineveh Charitable Trust
Rowse Honey Ltd

Donors

1155
Anna Appelmelk
Bucks County Beekeepers' Association
Dean Forest Beekeepers' Association
Dorchester and Weymouth Beekeepers' Association
Eliot Edmonds, Eleanor Palmer Primary School and 8th Hampstead Scout Group
Habitat Aid
Helen Wilson and Ealing and District Beekeepers' Association in memory of John Wilson MBE
High Wycombe Beekeepers' Association
Isobel Ponsford and Jasmin Bannister and Kingsbridge Primary School
Jill Hearn
John Spedan Lewis Foundation
Keith Jones
Margaret Ashworth
Marks & Spencer
Mrs M Crowhurst
Nutley WI
Pamela Morton
Philip King Charitable Trust
Shirley Fitch and Fleet Beekeepers' Association in memory of Colin Fitch
Sir Peter Daniell Charitable Trust
St Joseph's RC Primary School
The Tansy Trust
Vale and Downland Beekeepers' Association and Newbury Beekeepers' Association

Donors in kind

Silver Spoon
Weber Shandwick

LASI staff biographies

Professor Francis Ratnieks

Francis Ratnieks is Professor of Apiculture and head of the Laboratory of Apiculture & Social Insects at Sussex University. He obtained his PhD at Dyce Laboratory for Honey Bee Studies, Cornell University, and worked for the New York State Apiary Inspection Service and as a commercial beekeeper in California. He has studied honey bees on all continents, taught honey bee biology at 5 universities (Cornell, Berkeley, Sheffield, Sussex, Sao Paulo) and published 250 articles on honey bees and social insects.

Dr Karin Alton

Karin Alton is a Research Fellow at LASI. Following a career in commercial and retail finance, she obtained a Zoology degree at Nottingham University, then a PhD in Entomology. Karin has worked with hoverflies, aphids, tephritid flies, bugs and beetles of various grasslands, and now with honey bees. Her research interests include not only honey bee diseases and pollination but also habitat selection; looking at insect-plant interactions from both an intra- and inter-specific level. She is a keen beekeeper.

Norman Carreck

Norman Carreck is the senior technician at LASI and has been keeping bees since the age of 15. He read Agricultural Science at Nottingham University and worked as a research scientist at Rothamsted Research for nearly twenty years, working on both agronomy and apiculture. He sits on numerous committees for beekeeping associations and trusts, is secretary of the Examinations Board of the National Diploma in Beekeeping, is Senior Editor of the Journal of Apicultural Research and is Scientific Director of the International Bee Research Association. He is a fellow of the Royal Entomological Society.

Dr Margaret Couvillon

Margaret Couvillon is a postdoctoral researcher at LASI. She received her BSc from Loyola University (New Orleans) in Biology, where she was the highest ranked graduate in 2000. She was awarded a Fellowship from the National Science Foundation to study at the University of Sheffield, from which she obtained her PhD for work on mechanisms of nestmate recognition in bees. Afterwards, she won a fellowship to work at the University of Arizona (2007-2009). Her interests include behavioural ecology and evolutionary biology of social insects and science education & outreach.

Tomer Czaczkes

Tomer Czaczkes is a PhD student studying organisation and communication in ants at LASI. As an undergraduate at Oxford University he spent time volunteering, and later working at, the entomology department in the Oxford Natural History Museum. He began working with ants during his undergraduate research project, which was carried out on leaf cutter ants in Costa Rica. After spending six months studying parasitoid wasps at the applied entomology group in the Freie Universität in Berlin, he began his PhD studentship at Sussex.

Dr Christoph Grüter

Christoph Grüter is a postdoctoral researcher at LASI. He obtained an MSc in Biology at the University of Bern, Switzerland and a PhD at the University of Bern and the Universidad de Buenos Aires, Argentina. He works with honeybees (*Apis mellifera*) and ants (e.g. *Lasius niger*) to try to understand how workers use different types of information to adjust their behaviour according to the needs of the colony. Additionally, he is interested in the organisation of nest-defence in the stingless bee species (*Tetragonisca angustula*).

Martin Kächer

Martin Kächer is a PhD student at LASI studying conflicts and conflict resolution in societies of honey bees and stingless bees, specifically focusing on worker policing and nest-mate recognition. As a Zoology undergraduate at Karl-Franzens-Universität, Graz (where Nobel prize-winner Karl von Frisch conducted his ground breaking research) he studied the predator-prey interaction between drones of

Apis mellifera carnica and insectivorous birds. He started to keep bees when he was 16 and his other research interests include traffic organization in stingless bees and beekeeping in honey bees.

Pierre Nouvellet

Pierre Nouvellet studied for his undergraduate degree and masters at the University Paris XI (Orsay). His PhD at Sussex, which he started in 2007, currently includes two main projects looking at two very different animal species: ants (Pharaoh's ants) and badgers. The ant project focuses on foraging behaviour and animal movement. The badger project focuses on population dynamics. He has a wide interest in biology, specifically in quantitative biology, biological modelling and theoretical biology.

Dr Martyn Stenning

Martyn Stenning studied for his PhD at Sussex and is technical supervisor for LASI. He has supervised much of the renovation and ongoing expansion work at the lab. His research interests include the study of organisms (especially birds and dormice) in relation to their environment and he is particularly fascinated by the dependence of species on other species or their own for cues that lead to reproductive regulation. He also has an active interest in investigating effects of climate change on the local ecology and phenology.

Fiona Riddell

Fiona Riddell attended the University of Dundee, receiving a First Class Honours degree in Zoology. Her final year project investigated how house sparrows (*Passer domesticus*) regulate their body mass to prevent starvation and minimise risk of predation. Her project also had a modelling component examining the potential effects of global climate change on major crop species used by house sparrows. In July, Fiona joined LASI as an MPhil student. Her work on Project 2 analyses honey bee waggle dances to determine how the bees utilise the British landscape.

Appendix

Publications 2008-9 (LASI authors in bold).

Books.

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Appendix 2

Talks given 2008-9

- 18/1/08 *Organization of collective foraging in honey bee societies* to Department of Computer Science, University of Sheffield (FR).
- 2/08 *Evolution in social insects* to Evolution Theme meeting, University of Sussex (FR).
- 5/2/08 *Bee Research in the UK - past, present and future* at South West Joint Consultative Committee, Westport, Somerset (NC).
- 7/2/08 *Background on honey bees* to Syngenta, Bracknell, Berkshire (FR).
- 8/2/08 *Altruism in worker insects: voluntary and enforced* to Department of Biology, University College, London (FR).
- 16/2/08 *The importance of viruses* to Somerset Beekeepers Association Lecture Day, Cheddar (NC).
- 19/2/08 *Altruism in worker insects: voluntary and enforced* to Department of Biology, University of Manchester (FR).
- 20/2/08 *Problems of the hive...* to South Chilterns Beekeepers Association, Buckinghamshire (NC).
- 27/2/09 *Altruism in worker insects: voluntary and enforced* to Department of Biological and Environmental Science, University of Sussex (FR).
- 2/3/08 *How bees keep busy* to Brighton Science Festival (FR).
- 8/3/08 *LASI Research on improved beekeeping techniques, including queen introduction and breeding for hygienic behaviour* to Bee Farmers' Association, Annual Meeting, Harrogate, Yorkshire (FR).
- 8/3/08 *Is the honey bee native in Britain?* to Devon Beekeepers Association President's Day, Exeter (NC).
- 13/3/08 *Is the honey bee native in Britain?* to Worthing Beekeepers Association (NC).
- 28-30/3/08 *Voluntary and coerced altruism in insect societies: how natural selection can cause most individuals in a social group to completely forego reproduction in order to help one individual to reproduce more* to Conference on Dominance, levelling and egalitarianism in primates and other animals, Santa Fe Institute (FR).
- 5/4/08 *Is the honey bee native in Britain?* at Surrey Beekeepers Association 'Surrey Bee Day', Ewell (NC).
- 18-19/4/08 *'Colony Collapse Disorder' and 'Disappearing Disease' and all that...* at British Beekeepers Association Spring Convention, Stoneleigh (NC).
- 20/4/08 *Is the honey bee native in Britain?* to Bee Improvement and Bee Breeders Association, Stoneleigh (NC).
- 6/5/08 *Ants, bees and altruism* at Café Scientifique, Leeds (FR).
- 3/7/08 *The amazing honey bee: The world's most interesting animal is found in your garden* at the Bluecoat school, Liverpool (FR).
- 31/08/09 *Mechanisms of guarding and nest mate recognition in the honey bee and stingless bee* at European IUSSI, Belgium (MC)
- 10/9/08 *The contribution to hive products and bee management of Dr Eva Crane* to 3rd European Bee Research Conference, Queens University, Belfast (NC).
- 8/10/08 *Dr Eva Crane, IBRA and the value of bee research to practical beekeeping* to Central Sussex Beekeepers Association, Horsham (NC).
- 11/10/08 *LASI research on improved beekeeping techniques, including queen introduction and breeding for hygienic behaviour* (FR) and *Is the honey bee native in Britain?* (NC) to Hampshire BKA Autumn Convention, Bishops Waltham.
- 15/10/08 *Honey bee queen rearing, mating and breeding* to Brighton & Lewes Beekeepers, Lewes (FR).
- 29/10/08 *Honey bee health & well being: Sussex plan of research, development & extension* to Rowse Honey and University of Sussex representatives, University of Sussex (FR).
- 8/11/08 *'Colony Collapse Disorder', 'Disappearing Disease' and all that...* (NC) and *Bee research buffet* (FR) Sussex Beekeepers Association Centenary meeting, Plumpton College.
- 22/11/08 *Charles Darwin, bumble bees, cats, mice and old maids* at Central Association of Bee-Keepers Autumn Conference, Stratford upon Avon (NC).
- 25/11/09 *Colony losses in the UK* to First International Muğla beekeeping and pine honey congress, Muğla, Turkey (NC).
- 26/11/08 *Honey Bee health & well being: Sussex Plan of Research, Development and Extension* to the Worshipful Company of Wax Chandlers, City of London (FR).
- 4/12/08 *How the worker insects evolved their altruism* at University of Copenhagen (FR).
- 20/1/09 *Is the honey bee native in Britain?* to Bromley BKA (NC).
- 20/1/09 *The evolution of inequality in insect societies* at Discussion Meeting on 'The Evolution of Society', The Royal Society, London (FR).
- 21/1/09 *Charles Darwin, bumble bees, cats, mice and old maids* at Social Insects Satellite Meeting to Royal Society 'The Evolution of Society', University of Sussex (NLC).
- 22/1/09 *Darwin's special difficulty: insect workers* at Social Insects Satellite Meeting to Royal Society 'The Evolution of Society', University of Sussex (FR).
- 28/1/09 *Social Insects: A gateway for investigating important questions in basic and applied biology* at VII Curso de Verão em Entomologia (Summer Course in Entomology), University of São Paulo at Riberão Prêto, Brazil (FR).
- 30/1/09 *Colony Collapse Disorder update* to High Wycombe Beekeepers Association (NC).

2/09 Various talks at University of São Paulo (FR).

14/2/09 *Charles Darwin, bumble bees, cats, mice and old maids* to Middlesex Federation of Beekeepers Day, Harrow (NC).

19/2/09 *Declining bee populations - what are the causes?* to the Linnaean Society, London (NC).

7/3/09 *Is the honey bee native in Britain?* to Bee Farmers Association Annual Conference, Eastbourne (NC).

7/3/09 *Honey bee health & well being: Sussex Plan of research, development and extension* to West Sussex Beekeepers Association Convention, Pulborough (FR).

7/3/09 *Honey bee health & well being: Sussex Plan of research, development and extension* to East Dorset Beekeepers Association AGM (FR).

11/3/09 *Charles Darwin, bumble bees, cats, mice and old maids* to Institute of Biology, Down House, Kent (NC).

14/3/09 *Can human society learn from insect societies?* to Central Association of Bee-Keepers Spring Meeting, Lambeth, London (FR).

13/3/09 *What determines the size of a worker bumble bee?* to Department of Ecology and Evolutionary Biology, University of Arizona (MC)

14-15/3/09 *The value of bees in the economy and bee breeding; Understanding and preventing colony losses - the science; Understanding and preventing colony losses - the practical solutions* to Ulster Beekeepers Association Conference, Greenmount College (NC).

17/3/09 *Can human society learn from insect societies?* Professorial Lecture University of Sussex (FR).

28/3/08 *Current bee Research* at Norfolk Beekeepers Association, Norwich (NC).

1/4/09 *Should we conserve honey bees?* to Royal Entomological Society Insect Conservation Special Interest Group, Rothamsted (NC).

4/4/09 *Bee research; what do we really need?* to Surrey Bee Day, Ewell (NC).

7/4/09 *Honey bee and social insects: gateway to biology* at official opening of the Laboratory of Apiculture & Social Insects, University of Sussex (FR).

17/18/4/09 *Bee research; what do we really need?* at British Beekeepers Association Spring Convention, Stoneleigh (NC).

11/5/09 *Can humans learn from insect societies?* To Cambridge Society for the Application of Research (FR).

14/7/09 *Is the honey bee native in Britain?* to National Diploma in Beekeeping Advanced Beekeeping Course, CSL York (NC).

19/9/09 *Can studies of Kashmir bee virus and Varroa destructor aid our understanding of 'Colony Collapse Disorder'?* at XVIth International Apicultural Congress, Montpellier, France (NC).

10/10/09 *Pollination* to Essex Beekeepers Association, Braintree (NC).

24/10/09 *Is the honey bee native in Britain?* to Bee Farmers Association south west meeting, Okehampton, Devon (NC).

18/11/09 *Problems of the hive* to South Chilterns Beekeepers Association (NC).

27/11/09 *The honey bee: gateway to biology and vital friend of man* to Institute of Biology, London Branch, London (FR).

26/11/09 *The hows and whys of bumble bee size polymorphism* to NW Section IUSI, University of Sussex, Brighton (MC)

2/12/09 *Honey bee health & well being: Sussex Plan of research, development and extension* to Reigate Beekeepers Association (FR).

3-4/12/09 *Specialisation and optimisation of reproduction and work in insect societies* to Association for the Study of Animal Behaviour, Winter Meeting, London Zoo (FR).

9/12/09 *LASI at the University of Sussex* to Central Sussex Beekeepers Association, Horsham (KLA)