Who's who on the AgriLand project?

Continued from previous page

Dr Nigel Boatman is Head of Agri-Environment at FERA. He is an agricultural ecologist with interests on the environmental impacts of agriculture and their mitigation

Dr. Andrew Crowe is a Senior Land Use Change Scientist at FERA. Educated here in York he works on the spatial analysis of socio-environmental data including land use change.

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For more information about the Insect Pollinators Initiative, go to www.insectpollinatorsinitiative.net

The AgriLand project is an Insect Pollinators Initiative project, and is a collaboration between:

The Insect Pollinators Initiative projects are funded by:

Insect Pollinators Initiative

The AgriLand Project final workshop

2nd September 2014, FERA, Sand Hutton, N. Yorks

Linking agriculture and land use change to pollinator populations

Welcome to the final project workshop of AgriLand, one of the research projects supported by the UK Insect Pollinators Initiative (IPI) to help understand the causes and consequences of pollinator decline and inform future action.

The AgriLand project aims to contribute to the IPI by taking a landscape scale view of the problem of pollinator declines. Over the last three years we have been examining the importance of current and historical land use and management for British insect pollinators using a range of methods. The project is coming to an end soon, so at this workshop, we will explain our methods and present some of our most important results. We will also discuss the impacts our findings are likely to have for future landscape management, conservation and government policy decisions.

The people attending this workshop represent a variety of interests in relation to insect pollinators, with delegates drawn from farming, conservation and industry. We hope this will result in a broad range of viewpoints when we hand the discussions over to you during the afternoon. Don't be afraid to speak your mind!

Agenda for the day

The AgriLand Project final workshop
2nd September 2014, 10am – 5pm

10.00am:	Arrival, Tea and Coffee
10.30am:	Welcome and Introduction: Threats facing pollinators and the challenges for research *(Prof. Simon Potts, Reading University)*
10.45am:	Introduction to the AgriLand project *(Prof. Bill Kunin, Leeds University)*
11.00am:	Impact of historic land-use change on shifts in pollinator communities *(Dr. Deepa Senapathi, Reading University)*
11.20am:	Quantifying nectar resources from the flower to the national scale *(Prof. Jane Memmott, Bristol University)*
11.40am:	Current land use and pollinator populations 1: site selection and dataset ground truthing *(Dr. Simon Smart, Centre of Ecology and Hydrology and Prof. Bill Kunin, Leeds University)*
12.00pm:	Current land use and pollinator populations 2: the impact of the field campaign results *(Dr. Mark Gillespie, Leeds University)*
12.20pm:	Current land use and pollinator populations 3: experimental honeybee hives and Agri-Environment Schemes *(Dr. Nigel Boatman, Food and Environment Research Agency)*
12.40pm:	Question Time
1.00pm:	Lunch served on mezzanine
2.00pm:	Reconvene for explanation of the afternoon session
2.15pm:	Parallel breakout sessions and bee tours

Tea and coffee will be available on the mezzanine from 3.15pm

3.50pm:	Presentation of breakout session conclusions and questions
4.30pm:	Final discussion
4.45pm:	Closing remarks *(Prof. Bill Kunin, Leeds University)*

Who's who on the AgriLand project?

The AgriLand project is led by a team of researchers with expertise spanning a range of disciplines. Here are the members of the team you may meet today.

UNIVERSITY OF LEEDS

Prof. Bill Kunin is the lead investigator of the AgriLand project. Educated in the USA, he has been working in the UK since 1993 on spatial patterns in plant populations, and how they affect insect populations.

Mark Gillespie is a Research Fellow on the AgriLand project. Educated in the UK and New Zealand, his research interests are in insect ecology and plant-insect interactions under environmental change.

University of BRISTOL

Prof. Jane Memmott's research includes pollination ecology, agro-ecology, biological control and restoration ecology. Jane is the team leader for another of the UK Insect Pollinator Initiatives: Urban Pollinators: ecology and conservation.

Dr. Mathilde Baude was a Research Fellow on the AgriLand project,and is currently working at Université d'Orléans in France. She has been investigating the role of floral resources in pollinator decline in the UK.

University of Reading

Prof. Simon Potts' research focuses on the relationship between land use, biodiversity and ecosystem services, with particular emphasis on pollination and pest regulation, and developing evidence-based mitigation options.

Dr. Deepa Senapathi is a Research Fellow on the AgriLand project. Educated in India and the UK, her research interests include understanding environmental change impacts on populations and communities.

Centre for Ecology & Hydrology

Dr. Simon Smart is a plant ecologist and was responsible for up-scaling sugar production values per plant species to the national scale using plant species compositional data from the Countryside Survey of Great Britain

Dr Dan Morton is an Earth Observation Scientist and was responsible for quantifying changes in habitats from satellite imagery. He led the production of the Land Cover Map 2007 as part of the last Countryside Survey of Great Britain

Continued overleaf…

Project impact: What does it all mean?

The AgriLand project has been an extremely large undertaking as evidenced by the range of results shown here and presented in today's talks. As a result of this complexity, analysis and the interpretation of results are still on-going so any conclusions should still be viewed with a little caution. However, there are some themes occurring throughout today's presentations that are likely to feature in future publications and recommendations. In particular, the habitat composition of the landscape at various scales appears to be important to insect pollinator abundance and diversity and pollination services.

Our re-surveys of historical pollinator records showed that the amount of "edge" between particular habitats, and the composition of habitats surrounding a source of pollinators are historically important drivers of species richness. Similarly, our assays of floral resources have demonstrated that differential levels of pollinator food resources are provided by a different habitats, with the most productive habitat type, Calcareous grassland, conspicuously rare in the British landscape. This work is complemented by our field surveys where it is clear that low levels of habitat diversity in the landscape are not supportive to bee populations and communities, or to the effectiveness of pollination, probably because floral diversity is correspondingly poor in such landscapes. The management within landscapes also has a large role to play, but the effects of different management types are likely to be species specific.

Determining the ideal mix of habitats in a landscape in general is unlikely to be helpful because of the wide regional environmental variation in landscapes in the UK (e.g. recommendations to farms in Inverness-shire should differ to those to farms in Suffolk). However, the AgriLand project results are likely to be instrumental in highlighting poorly structured landscapes and in developing a set of guidelines for improving such areas to enhance pollinator conservation and biodiversity in general.


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The AgriLand Project: the threats facing pollinators and the challenges for research

Prof. Simon Potts
Contact: s.g.potts@reading.ac.uk

The importance of conserving pollinators, and safeguarding the pollination services they provide, is increasingly recognised by land owners, farmers, politicians, NGOs and the general public. A key step to achieving this is to understand how various environmental pressures affect pollinator populations and communities so that interventions can be effectively targeted to reduce any adverse impacts. There are a number of different pressures known to affect pollinators including loss and fragmentation of habitat, reduced availability of floral resources, agrochemicals (e.g. pesticides and herbicides), pests and diseases, competition between managed and wild pollinators, and climate change. Most studies to date have only investigated the effects of a single factor, yet those few studies that have looked at two or more pressures often suggest that combinations of pressures may be particularly potent in causing insect pollinator declines. Furthermore, it isn't clear how well small-scale experiments predict pollinator responses in the field at landscape scales.

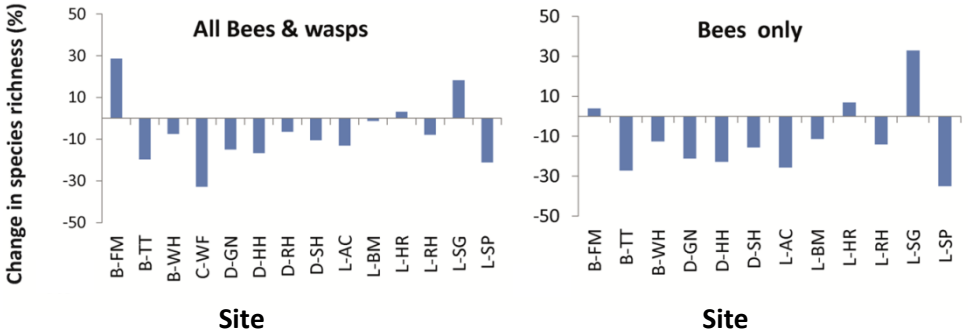
An outstanding challenge is therefore to quantify the relative contribution of multiple pressures on the UK's pollinators in different sorts of landscapes so that appropriate action can be taken to help reduce the greatest negative effects. The AgriLand project helps bridge this knowledge gap by simultaneously looking at four pressures on wild bee and hoverfly communities and the pollination services they provide across Britain. This is the first project to attempt to study such factors in combination to disentangle the complex relationships between land use, pollination populations and pollination services.

Findings from the AgriLand project will help underpin the development of pollinator-friendly management practices on farmland and in natural areas; they will support Defra's National Pollinator Strategy and identify further research topics to improve the health of British pollinators.

Reading University: Impact of historic land cover change on pollinators

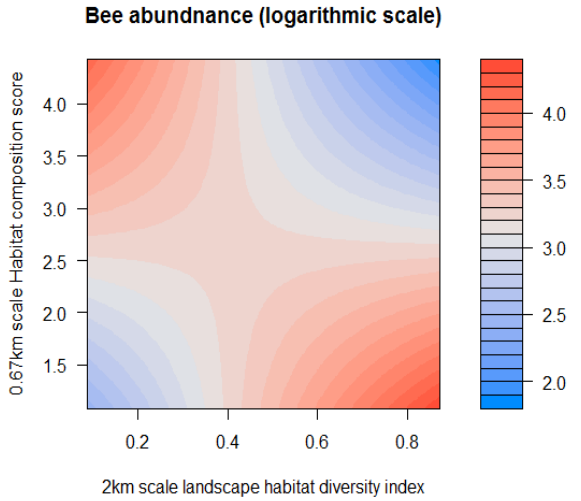
Dr. Deepa Senpathi and Prof. Simon Potts
Contact: g.d.senapathi@reading.ac.uk; s.g.potts@reading.ac.uk

We used data from 20 sites across four English counties to quantify how land cover changes from the pre-war era (1930s) to the present day have impacted bee and wasp species richness. The majority of our sites were predominantly heathland with protected status and 75% of them showed a decline in species richness (see graphs below). However, increases in the amount of "edge" habitat between heathland and woodland were positively associated with increased bee and wasp species richness. Changes outside the site at a 1km radius have also had a significant impact with sites surrounded by urban expansion losing fewer species than sites with intensive arable surroundings (see maps on opposite page). This could be due to the fact that urban environments with their parks, gardens and green spaces provide a diversity of nesting and foraging resources and also provide a longer more diverse flowering period than arable landscapes. Our results show that habitat around protected areas also needs to be considered for improving biodiversity and that more diverse habitats may benefit pollinator species diversity.



The changes in species richness for all bee and wasp species together (left) and for bees only (right) across a selection of study sites. A negative bar indicates a decline in species richness between the 1930s and the present day.

In addition to collecting data to check our site selection method, we completed a comprehensive field campaign over the last two summers, sampling the 96 field sites for insect pollinator abundance and diversity. These data can then be analysed against the ground truthed data of the landscape variables mentioned above, to determine which variables are most important in driving species composition and pollinator abundance. As today's talk will attempt to show, the results are complex due to differences in individual species. Overall, the abundance of all bee species and the number of different bee species are strongly affected by the diversity of habitats and the composition of the habitats in the landscape. For example, the graph to the right shows total bee abundance (on a logarithmic scale) from low (blue) to high (red) numbers among all combinations of two of our factors under consideration: Habitat diversity at the site level (2 x2 km) along the horizontal axis, and a habitat composition score at a smaller scale on the vertical axis (a high score indicates a large percentage of habitat types considered good for bees). This graph shows that on their own, high levels of each factor are important for bees – follow the grading of the colours along each axis. When both factors are high however, the combination is not so important, probably because a high degree of habitat diversity among good semi-natural environments indicates habitat fragmentation.



Our analyses have also shown that floral resource provision and management Intensity are important to bee populations. Furthermore, experiments we conducted using potted plants to assess the effectiveness of local insects at pollinating show some supporting patterns: the average number of seeds produced per experimental plant were strongly affected by landscape diversity and the diversity of bees in the local area. This demonstrates the interlinked nature of flower-pollinator ecology, and the need to disentangle the strongest links to populations and community composition.

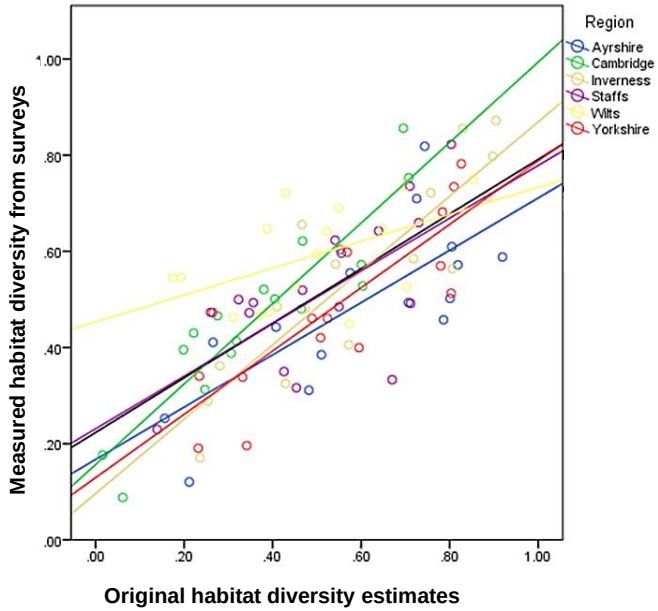
Leeds University: Current Land Use and Pollinators

Prof. Bill Kunin and Dr. Mark Gillespie
Contact: w.e.kunin@leeds.ac.uk; m.a.gillespie@leeds.ac.uk

In order to study the impacts of current land management practices on insect pollinators, we devised a unique site selection protocol to test the importance of the most likely landscape scale drivers of losses. These drivers are usually inter-related, but our design enabled us to decouple them in subsequent analyses. The landscape variables we studied were: 1) habitat diversity, 2) honey bee density, 3) floral resources and 4) pesticide usage. National datasets were used to estimate these variables, which were then used to carefully select 96 sites clustered in 6 regions chosen to be representative of Britain as a whole.

As the site selection was based on crude estimates, we first needed to collect data on the ground in these 96 sites both to evaluate our site selection method and to 'ground-truth' the estimated values of the landscape variables for use in analyses. The estimation of habitat diversity from satellite imagery performed well against the ground truthed data (graph below). The remaining variables were not quite so accurate, but they do provide a wide range of values to test their impact on pollinator populations.

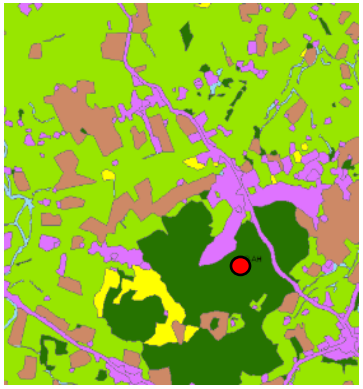
The orignal habiat diversity index data (horizontal axis) vs the ground truthed index (vertical axis). The accuracy of estimates differed between the 6 regions, but overall estimates were good. There was much more variability in some of the other axes.



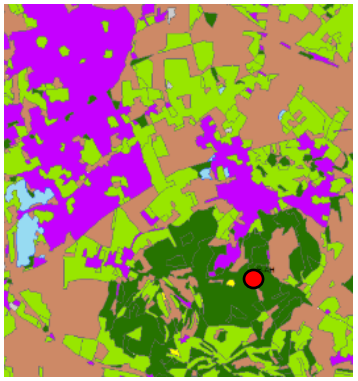
Two example sites (red dots) from the historic land use study. Both were and still are predominantly wooded, but changes in the surrounding landscape have coincided with losses in species richness. Note the differences in species loss and main land changes.

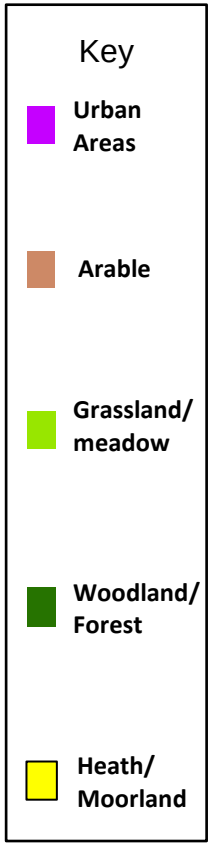
Aspley Heath

HISTORIC LAND USE



CURRENT LAND USE





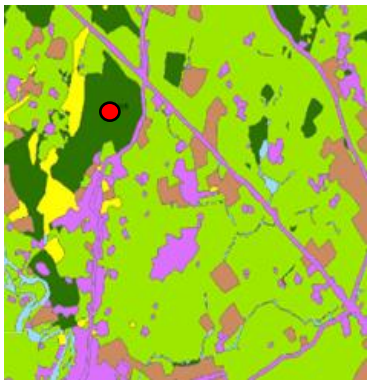
Site original habitat
Loss of 8%

Bee Species Richness
Loss of 17%

Main change around site
Urbanisation Increase of 26%

King's Wood

HISTORIC LAND USE



CURRENT LAND USE

Site original habitat
Loss of 5%

Bee Species Richness
Loss of 27%

Main change around the site
Arable land Increase of 30%

Bristol University: Quantifying nectar resources from the flower to the national scale

Dr. Mathilde Baude and Prof. Jane Memmott
Contact: mathilde.baude@univ-orleans.fr; jane.memmott@bristol.ac.uk

Nectar and pollen are essential forage resources for pollinators and a lack of floral resources is suspected to be one of the main factors involved in pollinator decline. However, these resources are rarely quantified at large scales making it difficult to assess the value of plant species and habitats in feeding pollinators. We collected and analysed nectar for 162 common species in the field and we counted flower density in order to scale up the amount of sugars offered by each species from the flower to the landscape scale. We also used these values to estimate nectar sugar values for 144 more plants based on their traits to expand the nectar database. We then combined this nectar database with data from the CEH Countryside Survey, a field assay of representative samples of British plant communities conducted in 2007.

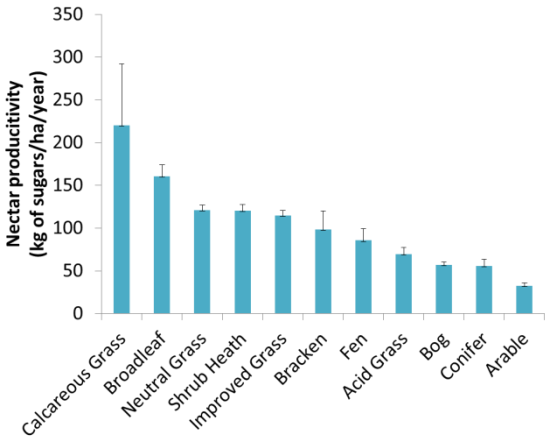
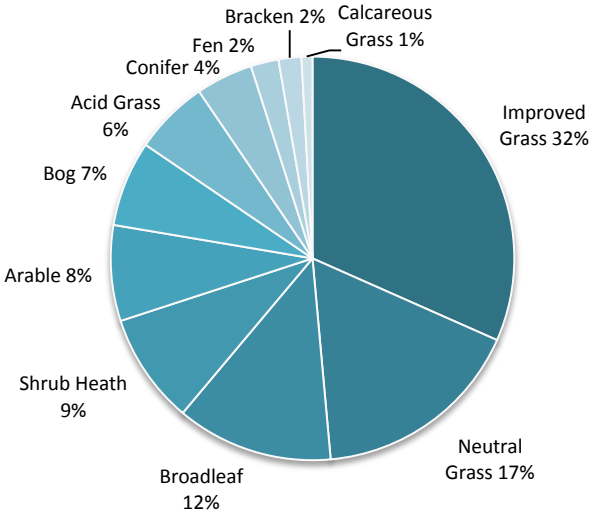


Figure 1: Habitat nectar productivity (kg of sugars/ha/year)

Figure 2: Habitat contribution to the national nectar provision (% of kg of sugars/year)



We identified thistle, willow, knapweed and heather (below) as some of the best plants in providing nectar per unit area per year, and after taking into account the national land cover of each species, we found that only three species make up almost 50% of national nectar provision. We also found that calcareous grassland, broadleaf woodland and shrub heath are the best habitats in providing nectar per unit area per year (figure 1), whereas arable and improved grassland showed the lowest productivity and the lowest diversity of nectar sources. Nevertheless, despite their low nectar productivity, such intensively managed habitats contribute significantly to the national nectar provision (figure 2). These results offer interesting opportunities for conservation and restoration efforts dedicated to pollinators and promising perspectives for the understanding of the links between floral resources and pollinator declines.

TOP 5 of nectar plants (kg of sugars/unit of area/year)

Cirsium palustre

Salix cinerea

Centaurea nigra

Erica cinerea

Symphytum officinale