

Spatial genetic structure and behaviour of common and declining bumblebees across an agricultural landscape

Seirian Sumner^{1,2§}, Stephanie Dreier^{1,2}, John Redhead³, Ian Warren^{1,2}, Matt Heard³, William Jordan², Jinliang Wang², Andrew Bourke⁴ & Claire Carvell^{3*}

¹School of Biological Sciences, University of Bristol, BS8 1UG, UK [§]Seirian.Sumner@Bristol.ac.uk, ²Institute of Zoology, Zoological Society of London, Regent's Park, London, NW1 4RY, UK, ³Centre for Ecology and Hydrology, Crowmarsh Gifford, Wallingford, OX10 8BB, UK ^{*}ccar@ceb.ac.uk, ⁴School of Biological Sciences, University of East Anglia, Norwich, NR4 7TJ, UK

Questions

Bumblebees are key pollinators
Populations are declining worldwide

Ecology of wild bumblebees is little understood

For effective management we ask:

Q1. How genetically mixed are colonies at fine spatial-scales?

Q2. How far do workers forage?

Q3. How does landscape composition affect bumblebee space use?

Methods

Five bumblebee species

Short tongued

Medium tongued



Long tongued

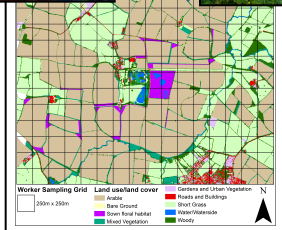


We studied five species with a range of tongue lengths and colony sizes. *B. ruderatus* is declining in the UK; the other four are common and widespread.

Non-lethal DNA sampling at mapped locations



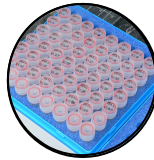
Sampling from a sown floral margin



We sampled tarsi from >3000 bees across 19km² of mixed land use at Hillesden, Buckinghamshire, UK in 2011. Each bee location was GPS mapped. We genotyped all bees at 10-14 microsatellite loci.

Analyses

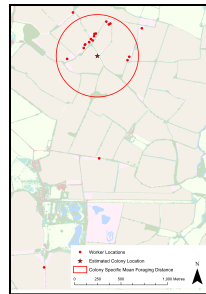
Sibgroups and nest locations



We used the program COLONY to assign workers to single full-sister sibgroups using probability of allele sharing. Queen genotypes were reconstructed from these colony genotypes.

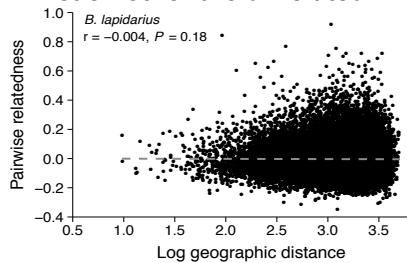
We estimated nest locations from the worker data. Landscape modelling using habitat surveys and remote sensing images was used to map habitat parcels.

Locations of 19 sister workers (red dots), estimated colony location (red star), and colony-specific mean foraging distance (dotted circle).



Result 1

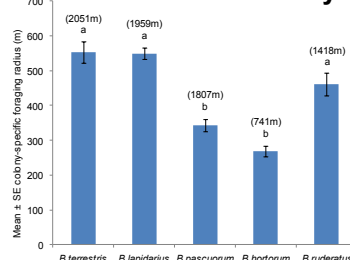
Q1: Queens nesting near each other are unrelated



We found no relationship between pairwise relatedness of queens with geographical distance at a scale of 5km in all species (Dreier et al 2014)

Result 2

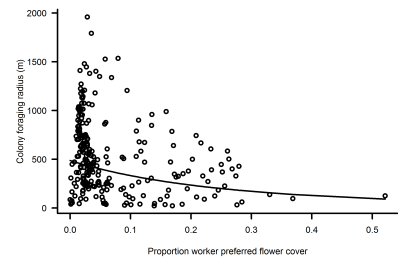
Q2: Workers forage up to 2km from their colony



Mean colony-specific foraging radii from estimated colony locations. (max foraging radius). 'a', 'b' - significant differences in colony-specific foraging radii.

Result 3

Q3: Workers forage close to home in habitats with high flower cover, and further from home in arable land



Conclusions

Both common and rare species were genetically well-mixed at a fine spatial scale, confirming the importance of well-connected habitats.

High plasticity in foraging distances allow bees of all species to exploit diverse local floral resources.

Sown flower margins may reduce foraging distances (and energy expenditure) and so enhance survival of wild bumblebees.



Reference

Dreier S, Redhead J, Warren I, Bourke A.F.G, Heard M. S., Jordan W.C., Sumner S., Wang J., Carvell C. (2014) Fine-scale spatial genetic structure of common and declining bumble bees across an agricultural landscape. *Molecular Ecology*, in press.

Acknowledgements

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