LWEC
Living With Environmental Change

Living With Environmental Change
Polaris House, North Star Avenue
Swindon, Wiltshire SN2 1EU
United Kingdom

Email: office@LWEC.org.uk
www.lwec.org.uk

Managing the landscape to optimise pollinator nutrition

How can land managers, policymakers and the public help pollinators to meet their nutritional needs in the UK landscape?

Photo by Jon Carruthers

Living With Environmental Change Policy and Practice Notes

Note No.26 – Insect Pollinators Initiative
February 2016

The Living With Environmental Change Partnership brings together 22 public sector organisations that fund, carry out and use environmental research and observations. They include the UK research councils, government departments with environmental responsibilities, devolved administrations and government agencies. The private sector is represented by a Business Advisory Board.

Insect pollinators are critically important to ecosystems and human wellbeing. By transporting pollen between flowers of the same species they help to assure healthy wild plant populations and contribute to sustaining yields of many fruit, vegetable, nut and seed crops. In return, pollinators like bees obtain nectar and pollen foods from a wide range of wild, ornamental and crop plant species. Unfortunately there is evidence that pollinators are declining, probably as a result of multiple environmental threats. Land use change, management intensification, invasive species, and even climate change, have reduced the abundance and diversity of flowering plants throughout the growing season. This has reduced the availability of pollen and nectar foods for pollinators and this lack of nutrition makes bees more susceptible to other threats like diseases, parasites and pesticides. Inadequate nutrition is therefore likely to be a major cause of pollinator declines.

What are the key resources required for the nutrition of bees?

Bees require both nectar and pollen from flowers:

- Bee offspring require large quantities of floral resources which the adult females gather on many foraging trips.
- Plants make floral nectar as a sugary reward to attract pollinators. Nectar is the main source of energy for bees which they need to power flight, to incubate their larvae and to make wax. It is important because it:
  - Is the raw ingredient of honey.
  - Contains amino acids which may be an important nutritional resource for adult bees and also for hoverflies.
  - Contains other compounds which serve a multitude of purposes eg anti-microbial activity, deterrence of unwanted flower visitors, pollinator attraction.
- Pollen carries the plant's male reproductive cells, and bees need it because it contains proteins, fats, sterols and micronutrients, which they require to produce eggs, to mature into adults and to develop their flight muscles. Two essential fatty acids, a-linolenic acid and linoleic acid - and the proportions of these - are crucial for supporting bee development and foraging performance.

What challenges do bees face in meeting their nutritional needs?

Bees require flowers throughout their active period. Some solitary bees are active for just a few weeks but honeybees and bumblebees forage throughout spring and summer, and need continuous sources of pollen and nectar from a wide variety of flowering plant species:

- Bees need pollen from a diverse range of plant species; honeybee resistance to disease is impaired when they are fed pollen from a single species.
- Flowering crops such as oilseed rape provide a massive, much needed source of both nectar and pollen in the agricultural landscape for bees. However this is a short lived synchronous burst of food that does not meet their full nutritional needs over the season.
- Exposure to pesticides, including via contaminated nectar and pollen, is one potential threat to pollinator populations, but the effects of exposure to multiple pesticides, and impacts on the majority of wild bee species and their ecological interactions, is still uncertain.
- Intensively-managed cereal and grass monocultures are "deserts" for pollinators, with very scant floral and nesting resources, but field margins and hedgerows in these landscapes can be important bee habitats if these are managed sensitively by allowing flowers to bloom throughout the season.
- In areas where many honeybee hives are kept there may be competition with wild bee populations to find nectar and pollen.
- Periods of extreme weather like drought and cold temperatures put additional stress on bees as they increase the need for nectar, prevent foraging and reduce some floral resources.

How do plants vary as sources of nutrition for pollinators?

The amount and nutritional content of pollen and nectar can vary between plant species and even between individuals within a species and are affected by a range of factors:

- Variation can depend on the time of day, soil type, competition with other pollinators, and weather conditions (particularly water availability and temperatures).
- Some flowers, like poppies, produce no nectar while others, like bramble flowers, produce a large amount. Some flowers produce large amounts of pollen eg willow.
- The nutritional value of pollen depends on plant species and can be affected by plant stressors including drought, temperature, humidity, ozone and other pollutants.
- The protein content of pollen varies. Some species of plants do offer pollen with the full complement of essential nutrients, like amino acids, that bees require but generally bees must collect pollen from several species to acquire all their essential nutrients.

How can the landscape be improved to provide better nutrition for domesticated and wild bee species?

A range of approaches can be beneficial:

- Conservation and creation of semi-natural habitats, like hedgerows that contain flowering plants such as brambles, provide food and nesting sites for pollinators, supporting a greater abundance and diversity. This can be done without impact on agricultural production.
- Several agri-environment schemes have benefits for pollinators, particularly planting of nectar- and pollen-rich flower mixes in field margins. The effectiveness of these schemes depends on the landscape and crop type in which they are placed, ie simple versus complex; arable versus grassland. Therefore, to get value for money the placement of such schemes must be carefully considered.
- Organic and other diversified farming systems of lower management intensity can promote pollinator populations by increasing wild flower densities and diversity at the margins and centres of fields.
- Some cultivars of agricultural crops provide better and more abundant nutrition than others. Careful breeding of plants for traits that produce good crops and also abundant nectar and pollen would improve habitats for bees and other pollinators.
- Developing alternative pollen substitutes that could provide sufficient nutrition for domesticated bees during times of dearth would aid beekeepers throughout the world.

What actions could help meet pollinators' nutritional needs?

National and local policymakers can help by:

— Promoting agri-environment schemes that support pollinators.
— Maintaining populations of native deciduous trees in urban and rural landscapes that are sources of nectar and pollen for many pollinator species such as willow.
— Encouraging breeding of crop varieties to produce more nectar and pollen including crops such as oilseed rape.
— Including the testing of nectar production in variety trials to inform farmers about making pollinator-friendly choices.
— Supporting schemes to help consumers identify products grown with consideration for pollinators.
— Reducing destruction of natural habitats with a large diversity of flowering plants and encouraging land reclamation for native plants.

Land managers can help by:

— Joining the Countryside Stewardship agri-environment scheme which includes payments to farmers for taking action to help pollinators such as planting pollen- and nectar-rich flower strips in field margins.
— Conserving semi-natural areas.
— Allowing hedgerows to flower throughout the spring and summer.
— Planting tree species that produce an abundance of nectar and pollen in spring and summer.
— Minimising use of pesticides by employing technological solutions to target application only when it is needed.
— Employing integrated pest management schemes to target pesticide use or use alternative biocontrols.
— Selecting longer crop rotations that create more complex landscapes and require less chemical control of pests.
— Providing a mix of different habitats such as grassland, scrubland, woodland, bare ground, hedgerows, dead wood and watercourses where possible to encourage a diversity of pollinators.

The public can help by:

— Pollinator-friendly gardening, planting a range of cottage-garden and native flowers that bloom over the season.
— Choosing flowering plants that provide nectar and pollen.
— Growing flowers of different shapes and sizes (eg open flowers, tubular flowers) that will attract a diversity of different pollinators.
— Cutting lawns less often to allow them to bloom with buttercups, daisies and clovers.
— Encouraging local councils to help bees and save money by allowing flowers to bloom in hedgerows, road verges and parks and cutting them less frequently over the summer.

Further information

This Policy and Practice Note was written by Geraldine Wright, Eileen Power and Jon Carruthers drawing on the Insect Pollinators Initiative project: Can bees meet their nutritional needs in the current UK landscape? The Insect Pollinators Initiative is funded by the Biotechnology and Biological Sciences Research Council, the Department for Environment, Food and Rural Affairs, the Natural Environment Research Council, the Scottish Government and the Wellcome Trust under the auspices of the LWEC partnership.

Useful resources:

Insect Pollinators Initiative: http://www.insectpollinatorsinitiative.net
All the Insect Pollinators Initiative notes in the LWEC Policy and Practice Note series may be found at http://www.nerc.ac.uk/research/partnerships/lwec/products/ppn/
The British Beekeeping Association: http://www.bbka.org.uk/
Reversing Insect Pollinator Declines POSTnote: http://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-442/

Scheper et al. (2013). Environmental factors driving the effectiveness of European agri-environmental measures in mitigating pollinator loss - a meta-analysis. Ecology Letters 16: 912-920. http://onlinelibrary.wiley.com/wol1/doi/10.1111/ele.12128/abstract
National Pollinator Strategy: https://www.gov.uk/government/publications/national-pollinator-strategy-for-bees-and-other-pollinators-in-england
Bumblebee Conservation Trust: http://bumblebeeconservation.org/
Potts et al. (2009). Enhancing pollinator biodiversity in intensive grasslands. Journal of Applied Ecology 46: 369-379. http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2009.01609.x/full
Countryside Stewardship Manual: https://www.gov.uk/guidance/countryside-stewardship-manual

Contact: Professor Geraldine Wright email jeri.wright@ncl.ac.uk
Series editor: Anne Liddon, Newcastle University
Series coordinator: Jeremy Phillipson, Newcastle University