

Sweet honeybees get all the column inches, but it's their scruffy cousins who need a spell in the spotlight now, says Anthony King

Plight of the bumblebee

INSECTS don't have too many fans, but bees are a huge exception. Who can resist the cute, stripy fluff-balls that buzz in the arrival of spring? Add to that their crucial role in pollinating crops and flowers, and it is not surprising that the mysterious collapse of beehive populations has caused widespread alarm. The crisis has garnered massive media attention, much hand-wringing and a load of campaigns aimed at saving the honeybee. But are our concerns misplaced?

It may sound like heresy, but some bee experts are now arguing that honeybees' role as pollinators has been much exaggerated. "There are those who think that all pollination is carried out by honeybees, which is complete nonsense," says Dave Goulson at the University of Stirling in the UK. By focusing on domesticated bees, the claim goes, we are neglecting a far more endangered pollinator, the wild bumblebee. Bumblebees – along with hoverflies and other native insects – pollinate most insect-pollinated crops. Perhaps more importantly, they also pollinate many wild-flower species, making them crucial for maintaining biodiversity.

Sure, honeybees do good work in the field and they are invaluable as providers of the sweet stuff, but it is bumblebees we should really be worried about. Their numbers have been in decline for decades and things are getting worse. Although colony collapse does not affect bumblebees, they are under much greater threat of extinction than honeybees.

Beekeeping has seen a big decline in the US and much of Europe since the 1970s, but globally, it has increased – most honey production now occurs in Asia, Africa and South America. By increasing the numbers of "domesticated" honeybees we keep, we could even be exacerbating the problem for our native bumblebees. If we lose them, we will pay a high price.

There are 250 species of bumblebee, all big and hairy, although they come in many hues. There is the classic yellow-and-black strip, the black body with red tail, and even one with an all-orange pelt. Overall, patterns of yellow, orange and red stripes predominate. Bumblebees evolved about 30 million years ago, close to the Himalayas. Today they are common throughout the northern hemisphere, less plentiful south of the equator and absent altogether in Australia. They prefer cooler climates as they produce lots of heat when revving their flight muscles – which is where their buzz comes from. There is even an Arctic bumblebee (*Bombus arcticus*).

While honeybee hives regularly contain between 10,000 and 50,000 bees and endure for several years, bumblebees take a different tack. Queens hibernate in the ground during winter, emerging in spring to set up a colony that expands during the summer, although usually to no more than 100 individuals. Colonies are comprised of small nest bees that never venture out, and larger foraging bees that gather pollen and nectar. Sometimes the two look so different they are mistaken for >





Tricks of the trade: hairs and “pollen baskets” help bees snag their prize

separate species. Some bumblebees nest underground, others gather moss and build surface dwellings, still others use trees or compost heaps. The red-tailed or stone bee (*Bombus lapidarius*) nests in stone walls and, occasionally, bird boxes. Nests persist for three to six months, depending on the species. Compared with the meticulously kept hives of honeybees, they are somewhat shambolic.

All adult bees drink nectar for energy and feed protein-rich pollen to their grubs, but honeybees and bumblebees forage in different ways. Honeybees send out scouts, which do a waggle dance upon their return to tell hive-mates where to go. Bumblebees do not dance, so each forages independently. What’s more, they are “not clean and well groomed like honeybees”, says pollination ecologist Jane Stout at Trinity College Dublin in Ireland. Their scruffiness makes them better at snagging pollen and moving it between flowers. Their size and furriness also means they can brave the elements. “When it’s pretty windy and damp, they can be out there pollinating our crops and wild flowers,” says Simon Potts at the University of Reading, UK. “Honeybees hole up for days when the weather is bad.”

Bees, along with other insects, pollinate around three-quarters of the most important crop species. But the mantra that honeybees are the most important pollinators is not true, says Potts. Last year, he published research which concluded that in the UK, honeybees now pollinate just one-third of crop plants, at most (*Agriculture, Ecosystems and Environment*, vol 142, p 137). The other two-thirds are pollinated by wild bees, including bumblebees and solitary bees, and by hoverflies, of which there are about 6000 species worldwide. As for wild plants, honeybees pollinate only 3 per cent in the UK, according to recent unpublished surveys.

Potts’s paper sparked abuse from beekeepers, and drew criticism from some scientists. He stands by his findings, and his message has since received backing from Goulson, Stout and other authorities on bees who believe that the focus on honeybees is potentially damaging (*Trends in Ecology and Evolution*, vol 27, p 141).

Nobody doubts that in some situations honeybees are essential pollinators. Every February, for example, a million hives – perhaps 10 billion bees – are moved to California to pollinate the valuable almond crop. “If you have an intensive system of agriculture where wildlife is effectively being excluded and then you have a period of bloom lasting a month, you can’t expect whatever is living locally to do that job,” says honeybee biologist Francis Ratnieks at the University of Sussex, UK.

But there are also situations in which bumblebee pollination is essential. Some crops, such as tomatoes, hold their pollen in pepper-pot-like containers which are tricky to access. But bumblebees have a trick up their sleeve – they “buzz pollinate”, grabbing the pepper pot and rattling it at high speed, showering themselves in pollen. Every tomato

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you have ever eaten was almost certainly pollinated by a bumblebee. The same goes for blueberries, strawberries and field beans. There are also indications that some plants benefit from mixed pollination by honeybees, bumblebees and other pollinators. One study found that when wild bees are around,

honeybees move between sunflowers more often, increasing the efficiency of pollination.

Overall, crops and wild plants benefit from a variety of pollinators because they all play slightly different roles in the ecosystems. Honeybees have short tongues whereas bumblebees’ tongues vary in length, and their different body sizes and shapes suit particular flowers. “Honeybees can’t do everything, though it would be nice if they could, because they would be easier to manage,” says Juliet Osborne at the University of Exeter, UK. “We need a variety of bees.” And that is where the problem lies, because with all the focus on honeybee colony collapse, we are ignoring the fact that bumblebees are under threat.

Osborne’s work highlights why bumblebees are so vulnerable. While at the Rothamsted Research facility in Harpenden, UK, she fitted some with transmitters to study their peregrinations as they foraged. She found that while individuals occasionally ranged up to 4 kilometres of home, they mostly stayed within a few hundred metres of their nest. “If they are living between two fields, it only takes the farmer to change how he manages one field, or for no flowers to be in bloom, and that colony is going to be vulnerable because it can’t spread across the landscape,” she says. Worse still, the effects can kick in rapidly because bumblebees store just a few days’ worth of backup honey, in small wax pots. That puts them at a disadvantage compared with honeybees, which keep much larger food stores in their hives and get syrup from their keepers when stocks run low.

Bumblebees appear to be in decline in most places and Osborne’s findings support the idea that changes in land use and farming practices are responsible. Quantifying the decline is tricky, though. “A beekeeper is going to notice if all his bees disappear,” says Stout. “Whereas with wild bees it is difficult to say they’ve gone, unless somebody is out there counting them and has the population data over a number of years.” Counting bumblebees traditionally involves counting their nests, and that entails finding them. Goulson had the idea of using sniffer dogs for the job, but the scheme has not been as successful as he hoped: students were often more effective than his trained canines.

Another method uses genetic markers to estimate a region’s nest density. All foragers from a single nest are sisters, so by counting the number of non-sisters in a field, you can do the sums and estimate the number of nests.

What research there is suggests that in Europe bumblebees have not fared well over

the past 60 years. Some of the firmest evidence comes from the UK, where there are currently 25 native species. Four or five of these are still common, but the rise of intensively managed farms has hurt most species and helped drive two to extinction in recent years. Those that specialise in particular plants seem to be most sensitive to changes in land use (*Annual Review of Ecology, Evolution, and Systematics*, vol 42, p 1). The reduced coverage and numbers of their food plants, especially favourites such as red clover and legumes, gets much of the blame. Similar reductions and localised extinctions of such plants have been recorded in Ireland. In both nations, solitary bees have suffered a similar fate.

Bumblebees in the US are also in trouble. A study comparing current and historical distributions of eight species found that four were doing reasonably well but the others had seen numbers decline by up to 96 per cent, with their geographic ranges shrinking by between 23 and 87 per cent. These species also had low genetic variability and high prevalence of a fungal parasite (*Proceedings of the National Academy of Sciences*, vol 108, p 662). The infection could be a signal that the bees were already in serious decline, rather than a cause of it, according to Mark Brown at Royal Holloway, University of London. He points out that small populations can lead to low genetic diversity, increasing susceptibility to parasites.

A salutary tale

"If wild pollinators are in serious trouble in North America and Europe, I would say they are in serious trouble in many other parts of the world, but we can't quantify that at the moment," says Potts. A salutary tale comes from south-west China, where bees have all but disappeared in places, meaning pear and apple trees now have to be pollinated by hand. The few studies from China and Japan confirm that bumblebees are declining. Goulson blames intensified farming, overgrazing and pesticide use.

Until recently, the idea that pesticides are killing bees was contentious. Goulson had his doubts until he ran his own studies. This year he reported that an insect-killing chemical related to nicotine, called neonicotinoid, is affecting bumblebee colonies and their rearing of new queens (*Science*, vol 336, p 351). First sold in 1994, it coats seeds and is absorbed by the growing plant. Inevitably, small amounts enter pollen and nectar. The

"Worker bees become poisoned when they feed on sprayed crops, and can't find their way home again"

Bee careful: hand-pollination is a necessary chore where bumblebees die out



IMAGINE CHINA

pesticide is then ingested by bees and scrambles their navigation systems. "The worker bees go out, become slightly poisoned when they feed on the crop and can't find their way home again," says Goulson. "It doesn't kill them, but a lost bee is as good as dead." A recent study found that the pesticide decreased foraging success and survival in honeybees too.

Goulson also claims that bumblebees suffer from a lack of food in areas where there are honeybee hives. "The honeybee folk will sometimes get upset if you say their bees are harmful, but there is only so much pollen and nectar to be collected," he says. In one study he carried out in Scotland, worker bumblebees of four species were significantly smaller – "a bit runty" – in places where there was a high density of honeybees (*Journal of Insect Conservation*, vol 13, p 177). Other scientists, including Osborne and Potts, are not convinced that competition is a big deal for bumblebees.

What is not in doubt is that a decline in wild pollinators, combined with a loss of honeybees, will pose significant economic problems. Potts has estimated that pollinators contributed £510 million to UK agriculture in 2009. This is the value of crops thought to arise directly from pollination. If you were to replace them with hand pollination by people – Potts enlisted his students to run a test – it would cost a whopping £1.8 billion, he

reckons. That would have huge consequences for food prices, and these estimates do not include the pollination of crops such as clover and alfalfa that feed cattle, or the plants in our allotments and gardens. "We are just starting to get some signals from farmers and fruit growers that they are having deficits or there is not quite enough pollination," he says. It is estimated that the farm-gate price of apples in the UK, for instance, would double without bees.

Fortunately, pollinator protection is becoming part of the environmental lexicon as calls for sustainable agriculture and food security climb the political agenda. If we want to maintain this natural, free service, says Potts, the most sustainable and cost-effective solution is to have good bee habitat, in and around farmland. Hay meadows in northern Europe once offered such sanctuary, but are a yesteryear memory of older farmers. Although we cannot turn the clock back, if we are serious about preserving our valuable native pollinators we can make our countryside more bumblebee-friendly. "A good bee habitat flowers throughout the year, with different species coming in and out of flower, so it is not completely dominated by one plant," says Stout. It's not rocket science. ■

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