

From The Sunday Times

February 1, 2009

Plight of the humble bee

Native British bees are dying out — and with them will go flora, fauna and one-third of our diet. We may have less than a decade to save them and avert catastrophe. So why is nothing being done?

Richard Girling

Midwinter. In a garden not far from the sea in Plymouth, there is a splash of pale sunlight and a sound both familiar and strange. Familiar, because if we close our eyes and think of English gardens it's the sound that fills our heads. Strange, because now it should be silent.

The drone of a bee.

It is a buff-tailed bumble, *Bombus terrestris*, a worker pottering among late-flowering fuchsias, heathers and mahonias like the ghost of summers past. All the textbooks say it should be dead. Only queens overwinter in holes in the ground. Yet here it is, at 200 wing-beats a second, energetically hawking the beds for nectar. And it is not alone. The man in whose garden it flits, Dr Mick Hanley, a lecturer in terrestrial ecology at Plymouth University, has recorded them in December and January all the way along the south coast as far east as Ramsgate. Others have found them as far north as Shropshire, Leicestershire and even North Wales.

Weird, you might think, but not something we should worry about. But aberrant behaviour in nature, especially when it happens suddenly, is rarely a sign of systemic good health. A bee in winter is no more proof of a thriving ecosystem than a flake of snow is disproof of global warming. The world is going haywire. If the very worst scenarios are to be believed, then the Plymouth bee is an early pathfinder en route not just to its own Armageddon but to our own.

Think of summer. Meadows and gardens daubed with so much colour it looks as if some giant hand has gone berserk with a paintbrush. Now expunge that picture and think of another. This time the giant hand has mislaid every pigment save brown and olive. There are no blooms, no insects, no birds. No visible wildlife of any kind. No fruit. No sound other than the mechanistic din of humankind harvesting fungi and the approaching cries of battle.

The first picture is a poetic fiction, a received vision of England as it never was, an idyllic land of apple-cheeked rustics singing in harmony with a bountiful Nature. The second is a piece of bleak futurology that assumes the process of environmental degradation will be irreversible, leaving hollow-cheeked starvelings to follow the rest of the world's fauna across the Styx. The creature that links the two visions — by its abundance in the first and absence from the second — is the same that now buzzes unseasonably among the dripping foliage of our winter gardens. The bee.

"The" bee, of course, is a gross oversimplification. There are many species of bumble as well as of honeybee. Or there were. In the bounteous days of teeming hedgerows and fields of clover, Britain had 25 kinds of bumble, all merrily gathering nectar and pollinating plants and trees. Three of these already have vanished, and seven more are in the government's official Biodiversity Action Plan (Uk Bap) as priorities for salvation.



It's the same right across Europe, and the reasons everywhere are the same — changes in agricultural practice that have replaced historic mixed farmscapes with heavily industrialised monocultures in which wild animals and plants are about as welcome as jackals in a pie factory. Insects in particular have been targets of intense chemical warfare. We are, at the eleventh hour, learning from our mistakes, but patching nature back together again is exponentially more difficult than blowing it apart.

Most people do now get the point about honeybees. Following the multiple crises that continue to empty the hives — foulbrood, varroa mites, viral diseases, dysfunctional immune systems, and now the mysterious but globally devastating colony-collapse disorder (CCD) — it is understood that the true value of *Apis mellifera* lies not so much in the sticky stuff that gives our favourite insect its name as in the service it provides as a pollinator of farms and gardens. If you add retailers' profit to farm gate prices, their value to the UK economy is in the region of £1 billion a year, and 35% of our diet is directly dependent on them. It is an equation of stark simplicity. No pollination: no crops. There is nothing theoretical about it. The reality is in (or, more accurately, not in) the hives. The US has lost 70% of its honeybee colonies over the past two winters. Losses in the UK currently are running at 30% a year — up from just 6% in 2003.

But fewer people realise that bumbles, too, are important not just to some remote, bug-ridden process called "ecology", of interest only to bearded men in anoraks. Growers of beans, oilseed rape and fruit especially have reason to feel alarm at their disappearance. So vital are they to the productivity of the fields, and so lethal the pressures on them, that farmers are having to import captive-bred reinforcements, many of them southern-European species raised in Slovakia. The total annual influx is reckoned at some 100,000 nests, each containing a queen and 200 workers, priced around £50 a time.

As the example of honeybees shows, this is a strategy of literally incalculable risk. International trade in honeybees has spread pests and diseases that imminently threaten their survival. In November 2007 the then food-and-farming minister, Lord Rooker, declared in the House of Lords that if things went on as they were, the honeybee in the UK would be extinct within 10 years. The situation since then has worsened, so at the best estimate the 10 years have shrunk to eight.

For bumbles, too, time is running out, and nobody knows whether the introduction of alien bees will delay the end or bring it closer. The signs are not encouraging. In the US, wild-bumblebee numbers have collapsed dramatically since the 1990s — they have been killed by parasites carried by European species brought in to pollinate greenhouse crops such as tomatoes and peppers.

"There is a high likelihood of interaction between wild and commercially reared bees at flowers," says Dave Goulson, professor of biological sciences at the University of Stirling and a world expert on bumblebees. This creates the ideal conditions for what ecologists call "pathogen spillover". Nor is disease the only risk. There is also the "grey-squirrel effect", in which native species are driven out by more aggressive foreigners. This is happening in Japan, where, ironically, imports of *Bombus terrestris* — the same bumblebee now humming in southern England — have escaped and are outbreeding the locals. And it may already be happening in the UK.

As in Japan, the aliens are better foragers and breed more rapidly than the natives, whose health and territory they threaten, while there is no guarantee that the immigrants themselves will not be poleaxed by local infections. This is bad news for more than just the bees themselves. In the complex world of inter-species relationships developed over millennia, small changes can have massive effects. In addition to his general theory of relativity, Albert Einstein had a specific theory about the relativity of man and bee. "If the bee disappears off the surface of the globe," he is supposed to have said, "then man would only have four years of life left."

If other scientists are more cautious, it is only in terms of the timescale.

On the face of it, the midwinter appearance of *Bombus terrestris* looks encouraging — a harbinger of the all-year summers that optimists look forward to. But this is precisely the problem. Contrary to what one might expect, says Goulson, a warming climate will not set the hedgerows buzzing. "Bumblebees evolved in the Himalayas. They are unusual among insects in that they don't like warm weather." Their thick fur coat is an aid to survival in a cool climate but an energy-sapping body-broiler in the heat. "This is why the southern hemisphere has no bumblebees."

Once upon a time, for example, the great yellow bumblebee, *Bombus distinguendus*, which thrives in the cold and wet, was common throughout Britain. Now it has been driven so far northwards that it occurs on the mainland only within half a mile of the extreme north coast of Caithness and Sutherland. "So," says Goulson, "it can go no further. It is probably doomed as a result of climate change." Other species, too, are shrinking into local redoubts. The shrill carder bee, *Bombus sylvarum*, is now limited to the Somerset Levels, Salisbury Plain and the Thames Estuary, where much of its habitat is on brownfield sites and impossible to protect. Since 1980, the formerly common large garden bumblebee, *Bombus ruderratus*, has been recorded at fewer than 10 sites in the UK.

And so it goes on. As the entire insect world is being forced inexorably northwards, it may be hoped that other pollinators from southern Europe may be sucked into the vacuum behind them. Hoped, but not expected. Bumblebees are not like migrating birds — they do not fly for hundreds of miles between remote habitats. They are more like mammals, needing a continuous corridor of suitable habitats to move through. Without a linked route up through France, they are more likely to die out where they are.

Even if new species did arrive, they would be unable to take on all the work of the old. Many bumblebees, including all those under threat, are specialist feeders that depend upon — and pollinate — particular groups of plants. By the miracle of evolution, some species have developed long tongues, with which they can reach the nectar of deep-throated flowers. Without them, the plants could not reproduce. The incomers can offer no solution: their tongues are too short. The first casualties of the bumblebee exodus, therefore, will be some of the best-loved British wild flowers such as foxgloves, irises, red clover, comfrey, toadflax, tufted vetch? Soft fruit, oilseed and bean crops would also take a hit.

And that is the thin end of the long-term catastrophe that now stares us in the face. You take one brick out of the ecological wall, others crumble around it. Then more crumble, on and on until the edifice collapses. Ecologists call it an extinction vortex. You lose bees, you lose plants. You lose plants, you lose more bees. Then more plants, then other insects, then the birds and animals that depend on them and on each other, all the way up the food chain. But never mind animals — if you stretch the process far enough, you're talking about humans.

The more extravagant, ocean-boiling scenarios of climate science have drama on their side, but the entomologists in their quiet way are just as scary. In his book *The Creation*, the world's most celebrated biologist, E O Wilson, has spelt out what would happen if the vortex swallowed insects. "People need insects," he says, "but insects do not need us. If all humankind were to disappear tomorrow, it is unlikely that a single insect species would go extinct, except three forms of human body and head lice? In two or three centuries, with humans gone, the ecosystems of the world would regenerate back to the rich state of near-equilibrium that existed ten thousand or so years ago? But if insects were to vanish, the terrestrial environment would soon collapse into chaos."

Flowering plants would go first, then herbaceous plants, then insect-pollinated shrubs and trees, then birds and animals and, finally, the soil. Wilson corrects the generally held misapprehension that the principal "turners and renewers" of the soil are worms. That distinction more properly belongs to insects and their larvae. Without them, bacteria and fungi would feast on the decaying plant and animal remains, while — for as long as it was able to support them — the land would be recolonised by a small number of fern and conifer species. The human diet would be wind-pollinated grasses and whatever remained to be harvested from a fished-out sea. It would not be enough. Widespread starvation would shrink the population to a fraction of its former size.

"The wars for control of the dwindling resources, the suffering, and the tumultuous decline to dark-age barbarism would be unprecedented in human history." Wilson concedes that we might survive quite happily without body lice and malarial mosquitoes. Otherwise, he says: "Do not give thought to diminishing the insect world. It would be a serious mistake to let even one species of the millions on Earth go extinct."

But here again is a parallel with global warming. Changes have taken place that cannot be reversed, and further change is unstoppable. Unlike global warming, however, loss of insects has not inspired national governments or the UN to take expensive action to forestall it. The plight of the honeybee has been well documented if not well understood. The causes of colony-collapse disorder, in which bees disappear without trace from their hives, are debated as fiercely as the causes of climate change, with opinion dividing

along very similar fault-lines determined often by vested interests.

Bee farmers and the European parliament blame arable farmers for killing or poisoning their bees with GM crops and careless use of insecticides. The arable farmers say their critics don't know what they are talking about. Others suspect viruses, parasites or fungi. Some even blame radiation from mobile telephones for disrupting the insects' navigational systems. Many think it likely that a combination of factors is at work — pesticides perhaps weakening the bees' immune systems and rendering them defenceless against common pests and diseases (though again the arable boys won't have it). Tim Lovett, president of the British Beekeepers' Association (BBKA), suspects a combination of varroa mites, viruses and a vicious parasite called *Nosema ceranae*, a microsporidium that occupies some strange biological niche between animal and plant.

What all outside the government are agreed upon is that more money is needed for research. Until recently the UK government committed only £1.2m a year to the bee industry, most of which was spent by Defra's own National Bee Unit on site inspections, though in January it announced another £400,000 a year for research.

"The government blames poor beekeeping," says Lovett. "But there is absolutely no reason to suppose that standards in the last few years have got worse. On the contrary, they have got better because beekeepers are aware of the problems." The BBKA argues that effective research into prophylactics and treatments for bee disease would cost £8m over five years — which, given the economic returns from improved crop yields and the knock-on benefits of jobs and taxation on profit, has all the hallmarks of a bargain. But nothing is certain. The economic cavalry may or may not arrive before the last honeybee flops onto its back, and it may or may not do the trick if it does.

With bumblebees the situation is even worse. Beyond their inclusion in the Biodiversity Action Plan, where they are just seven among 1,149 listed species ranging from mosses to whales, the government offers no direct funding for their protection. Artificial nitrogen fertilisers mean there is no need for the old-fashioned rotation crops, most importantly clover, that they used to forage on, and herbicides have eliminated most of the wild alternatives. Their nesting sites have gone too. Some species live in dense grass above ground; others prefer underground cavities — typically abandoned rodents' nests. The removal of hedgerows and unploughed field margins has put paid directly to the upstairs bees and indirectly to the downstairs ones by starving out the voles and mice that create their homes. Any that do find nesting places are likely to have them smashed by farm machinery or zonked by pesticides.

Even that is not the end of it. Many surviving populations of bumblebees are small and isolated. This results in inbreeding, which weakens the gene pool and increases the threat of extinction. Goulson reports that the highly virulent small hive beetle, *Aethina tumida*, whose larvae have devastated tens of thousands of honeybee colonies in the US and Canada, has spread into bumblebee nests, along with deformed-wing virus (which has the effect implicit in its name and is carried by mites). The small hive beetle has not yet appeared in the UK but it has reached other parts of Europe, and its transmission here via imported bees is a matter of "when", not "if".

Good news? There is a little. Government subsidies are available to farmers who replant hedgerows, restore grassland or sow wildflower strips. This is for "biodiversity", but bees will get some benefit. But it is nowhere near enough. "Most bumblebees," says Goulson, "cannot be conserved by managing small protected islands of habitat within a sea of intensively farmed land. Large areas of suitable habitat are needed to support viable populations in the long term."

If the worst happens and Lord Rooker's requiem for the honeybee reaches its solemn conclusion some time around 2017, the burden of responsibility heaped upon the bumblebee will be unsupportable. Bookmakers would give very long odds against the survival of long-tongued bumblebees and the plants that depend on them, and even longer odds against their short-tongued cousins filling the void left by honeybees. Given that a bumblebee nest contains only a few hundred insects, while a honeybee hive contains thousands, it would require a population explosion on the scale of a biblical plague.

Already, says Goulson, crop yields are beginning to suffer. Bald spots are appearing at the centres of bean fields where bumblebees are failing to penetrate. As in so many other aspects of global life, it is China that

lights the way ahead. In Sichuan province, the most important crop is pears, which depend on pollination by bees. But there are no bees. A blunderbuss approach to pesticides has all but wiped them out. Result: thousands of villagers have to turn out with paintbrushes to pollinate the trees by hand. "It's just about possible in a country where labour is cheap," says Goulson, "but it wouldn't work in Europe."

Bombus terrestris meanwhile chugs happily along the Channel coast, following its scrambled instincts and ignoring the calendar. Not since the sirens tempted Odysseus has a mellifluous sound raised such a lethal echo.

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