To male *Andrena nigroaenea* bees, *Ophrys lupercalis* flowers smell alluringly similar to female bees

On the scent of a new species

European orchids are among the natural world's most notorious tricksters, luring male insects to their blooms by mimicking the alluring odour of the female insect's sex pheromone. Misled by their 'noses', the males pollinate *Ophrys* blooms while attempting to mate with them. Ingeniously, each orchid species emits a unique odour, intended to attract typically just one species of insect, therefore making cross-pollination with other local orchids rare.

Yet hybrids do appear in nature, as ecologist Nicolas Vereecken of the Free University of Brussels discovered when he stumbled on a strange orchid growing in the wilds of southern France. What would this hybrid smell like, he wondered, and would any insect be attracted to it?

The unfamiliar orchid turned out to be a cross between *Ophrys arachnitiformis* and *O. lupercalis*, which have overlapping ranges. 'Yet surprisingly, we discovered that the new hybrid produced a distinctive blend of odour molecules, quite unlike the mix synthesised by either orchid parent,' says Vereecken. Although the *Ophrys* floral scents are too subtle for the human nose to detect, laboratory analyses revealed that the hybrid contained novel odour molecules entirely absent from either parent's perfume.

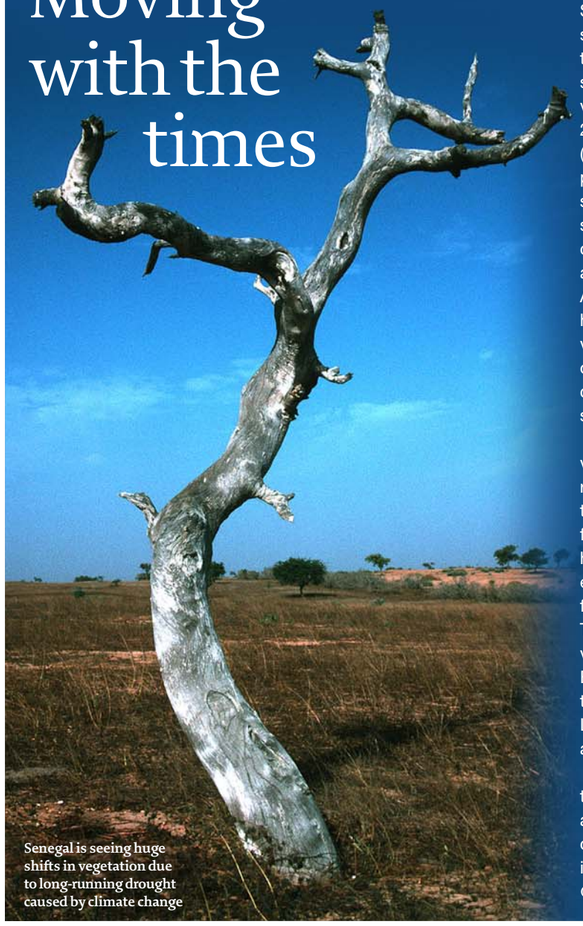
To find out what bees made of the new scent, Vereecken doused plastic beads on sticks with solvent extracts of unpollinated flowers from each of the orchids, and set up cameras to record any visiting insects. To his amazement, one particular species of solitary bee, *Andrena vaga*, visited the hybrid-scented beads frenetically. This bee normally pollinates willows on its pollen-collecting forays, and as far as anyone knows has never before had anything to do with orchids (*BMC Evolutionary Biology*, vol 10, p103).

So the hybrid orchid – equipped with a novel scent and its own exclusive pollinator – is potentially a new species in the making, reckons Vereecken. This particular hybrid is sterile, but there is always a chance that future crossings might lead to the formation of fertile seeds through processes familiar to plant breeders – such as chromosome doubling or polyploidy. 'The evolutionary potential of chemical novelties in floral scents has not been recognised up to now, but is clearly a very promising avenue for future research,' he concludes.
Gail Vines

The hybrid *Ophrys* gave off a unique scent, irresistible to male *Andrena vaga* bees

PHOTOGRAPHS: NJ VEREECKEN, PATRICK GONZALEZ, THOMAS MARLER

Moving with the times



Senegal is seeing huge shifts in vegetation due to long-running drought caused by climate change

Climate change is already shifting major vegetation zones up mountain slopes, towards polar regions and towards the equator, say forestry researchers in the US. 'Whole biomes – major vegetation zones, such as boreal forests and tropical woodlands – are shifting, not just single species,' says Patrick Gonzalez of the Center for Forestry at the University of California, Berkeley. 'If we continue to produce excessive amounts of greenhouse gases from power plants and cars, one-tenth to one-half of the world could be vulnerable to more major vegetation shifts,' he says. 'A billion people live in the most highly vulnerable ecosystems and depend on them.'

After hiking 1,900 km across the African Sahel, measuring thousands of trees and analysing climate data, Gonzalez is concerned by the scale of change that is already under way. 'In Senegal, decades of drought caused by climate change had shifted tree species 25–30 km southward from 1945 to 1993, towards areas of higher rainfall,' he says. Local farmers listed many species of trees once valued for their fruits, medicines and timber that had disappeared from their land.

Meanwhile, in the Sierra Nevada mountains of California, vegetation shows signs of retreating upslope, and further major shifts in vegetation may soon become apparent. 'Because vegetation often responds slowly to changes in environmental conditions, climate change can commit an ecosystem to biome change long before any response manifests itself,' he explains.

With colleagues in the USDA Forest Service, Gonzalez used real case studies such as these, collected from around the world over the past century, to supplement computer models of future vegetation patterns under projected 21st-century climate conditions (*Global Ecology and Biogeography*, published online). 'Whereas previous surveys had tallied cases of range shifts of individual species, I sought cases of shifts at biome level – such as boreal forest or tropical woodland.' After a systematic search of the literature, he found 15 cases of major changes in vegetation that could be attributed to observed climate change in the 20th century rather than deforestation or some other human action.

The aim was to identify the most vulnerable biomes and geographical regions. 'Our research indicates that tundra and alpine and boreal conifer forest biomes are the most vulnerable,' he says. 'Conditions favourable to alpine ecosystems may completely disappear from the tops of many mountains.' The regions identified as the most vulnerable included the Andes, the Baltic coast, boreal Canada and Russia, the Himalaya, the Iberian Peninsula, the Laurentian Great Lakes, northern Brazil and southern Africa.

The least vulnerable, mainly because they cover such large areas, are deserts and tropical rainforests – with human deforestation remaining the greatest immediate threat to that biome.
Gail Vines

When caterpillars devour the spent cone of *Cycas micronesica*, the plant rapidly grows another

Generosity reaps rewards

In any relationship between a plant and its pollinator, there's some give and take. For *Cycas micronesica*, native to the Pacific island of Guam, the giving seemed over-generous. Its pollinator is a tiny moth, which lays its eggs in spent male cones, where the emerging caterpillars make short work of the oil-rich cone tissue. New research by Thomas Marler at the University of Guam has shown that the plant's 'sacrifice' is anything but, because losing the cones prompts faster development of new ones.

Cycas micronesica grows only on a few Pacific islands. It is Guam's only native gymnosperm and until recently was the dominant plant of the forest understorey. Following the recent introduction of two cycad-eating pests – the cycad blue butterfly and the voracious *Aulacaspis* scale insect – it is fast disappearing. Within five years of the scale insect arriving, some parts of the island lost 90 per cent of their cycads.

This ecological disaster has prompted intensive research and monitoring of the now endangered cycads, leading to several important discoveries. In 2006, Marler discovered that *C. micronesica* is pollinated by an endemic species of micro-moth in the genus *Anatrachyntis*. No other cycad is known to be pollinated by a moth.

Marler also found that like other cycad-pollinating insects, the moth uses male cones as a nursery-come-larder, depositing eggs between the leafy sporophylls of the cones once they have shed most of their pollen. The larvae tunnel into the cones, eating the oil-rich tissue until the cone disintegrates. 'Under natural conditions – before the invasion of Guam by the *Aulacaspis* scale – the larvae consumed every male cycad cone,' says Marler.

Until now, the 'donation' of spent cones has been portrayed as a sacrifice the plant makes in return for pollination services, says Marler. He decided to check the size of that sacrifice by comparing the growth of moth-proofed cycads with those left exposed. What he found turned the 'sacrificial cone' idea on its head.

Moth-proofed cycads took much longer to produce their next cone, with a flush of new leaves appearing after 26 weeks, then the cone after 57–60 weeks. When a cycad's cone was consumed by caterpillars, however, everything speeded up: new leaves appeared after 14 weeks and a new cone at 39 weeks – only two-thirds as long (*American Journal of Botany*, vol 97, p841). Shorter intervals between cones means more chances to reproduce over the plant's lifetime. What was thought to be a payment for pollination proves to be a second benefit for the plant. When it comes to conserving this threatened plant, there's double the reason to conserve the moth as well.
Stephanie Pain