

The allure of DRACULA

KEW SCIENCE

Mycologist Bryn Dentinger follows his nose into the Andean cloud forest to investigate the intimate relationship between mushrooms, insects and *Dracula* orchids, reports **Rachel Mason Dentinger**

Our bus has barely skirted the hills around Ecuador's capital, Quito, when traffic comes to a standstill and we have our first taste of the rain's dominance over life here in the wet season. No one seems surprised or upset. Across the aisle, a man claims it will take hours to clear the landslide that blocks the road in both directions. Some years, he tells us, the road crews give up and allow erosion to reclaim the road, at least until the rains diminish. Luckily, we wait only an hour before our bus continues into the western foothills of the Andes, heading toward Reserva Los Cedros. Straggling passengers run alongside, carrying ears of steamed corn and bags of tree-tomato juice, shedding their makeshift umbrellas of giant *Gunnera* leaves just before jumping back on the moving bus.

The onslaught of rain fells forest giants and wipes out the Reserva's bamboo bridges, but it also ignites a burst of bloom. This is the season of *Dracula* – the orchid genus that brings Kew mycologist Bryn Dentinger and his collaborators (including myself, as a field assistant) to this sodden corner of the Andes. For a mushroom expert, orchids may seem an unexpected research subject – until you consider the world from the perspective of a fruit fly. Despite the name 'fruit fly', most such drosophilids seek fungi for feeding and breeding. As a graduate student, Bryn became fascinated with the relationships between mushrooms and insects. The *Dracula* orchid project was conceived when he learned of the orchids'

resemblance to mushrooms and the untested hypothesis that *Dracula* orchids lure pollinators with a 'mushroomy' promise. When orchids entice insects into pollination, it's often with a flower that resembles food or a female. Fooled insects leave unsatisfied, but none the wiser, carrying pollen on to yet another orchid. In *Dracula*, a specialised petal bears a remarkable visual and tactile resemblance to a mushroom, tantalising both bugs and biologists.

Mimicry is a three-way relationship, and understanding the exchanges between two of its players can inform biologists indirectly about their exchanges with the third. What mushroom-like elements of these orchids attract drosophilids? And can their tastes in orchids tell us something about their tastes in mushrooms? This is the allure of *Dracula* for Bryn, that a mushroom-mimic could tell him more about being a mushroom than the mushroom itself – or at least about being a mushroom in the eyes of a fly.

The fascinating flora and fungi of Ecuador's Reserva Los Cedros are under threat from illegal mining



Dracula orchids (here *D. morleyi*) derive their name from 'little dragon' rather than Bram Stoker

It's easy to see how drosophilid flies might mistake *Dracula* orchids (right) for *Coprinellus* mushrooms (below)



The team ventured deep into Ecuador's cloud forest to collect scent molecules from orchids such as *Dracula chiroptera*

But how can you see the microscopic details of a fly's world from our macroscopic level? The answer is to follow your nose. Beneath the physical contours of the cap and gills, a mushroom is a complex geography of chemical cues. One imperative for Bryn and his collaborators, Dr Bitty Roy of the University of Oregon and her graduate student Tobias Policha, is to tease apart the threads that weave together a drosophilid's sensory experience, distinguishing between the myriad cues that might motivate fly behaviour. Scent collection is part of their strategy.

High in the forest, huddling under an umbrella, we set up a portable olfactory laboratory. Using methods devised by a perfumist, we encase an orchid in a glass sphere, sealed as tightly as possible without damaging the flower. We insert a glass tube into the sphere, which is attached to a vacuum pump, pulling air out of the sphere and through a filter in the tubing. This specialised filter is designed to trap scent molecules, preserving them for analysis. Later, in a laboratory thousands of miles away, the team's chemists profile the orchids' scents and confirm the presence of classic mushroom scent molecules. The astonishing result is that *Dracula* orchids not only look like mushrooms, they also smell like them, making it all the more probable that the orchids are true mushroom-mimics. For Bryn, the orchids' exploitation of mushroom scents has implications for the mushrooms themselves. 'Mushrooms produce an astounding variety of scents, for reasons largely unknown, and these drosophilids may help us to understand why,' he says.

Before the team can draw any conclusions, however, they must better understand the insects and mushrooms that interact with the orchids. Watching insects visit orchids and mushrooms requires only a waterproof notepad and a poncho, while a simple insect aspirator can pull insects into a jar, powered only by human suction. Armed with these basic tools, we see drosophilids congregate on the mushroom-like labella of orchids, flicking their wings back and forth in a repetitive dance. It's possible that male flies use the orchids to 'lek', staking out territories as they compete with each other for females. This is an intriguing twist on the team's original hypothesis – if males derive a benefit from visiting *Dracula*, then the orchids' mimicry is far from deceptive.

A thrilling moment comes when Bryn is collecting flies on a mushroom. One of the flies carries orchid pollen on its back. This means that flies travel freely between mushrooms and orchids – a prerequisite for establishing the evolution of mimicry that suggests flies may not be able to distinguish between a mushroom and an orchid. 'It all comes down to a fly's view of taxonomy,' Bryn tells me. 'To a fly, *Dracula* orchids are extremely similar to mushrooms. It's not much different from our own pre-Linnaean taxonomy,' he says. 'For centuries mushrooms were thought to be plants. But when molecular tools gave us access to mushroom DNA, we could finally trace out the evolutionary lineage of fungi and see how far removed from plants they really are.'

One of the most intriguing aspects of mimicry is how it transgresses what biologists now know about the evolution

of distantly related organisms. Fungi, plants and animals diverged in the very distant past, heading off along distinct evolutionary trajectories. But when a fly's subtle senses cannot detect the difference between plants and fungi, 'it pushes the boundaries of how we think natural selection normally operates,' Bryn says. 'On the molecular level, we will always know the difference between a mushroom and an orchid. But on a very real ecological level – from the fly's perspective – the flowers are evolving into mushrooms.'

It's fitting that an orchid should be appreciated for its 'mushroominess', even if only by mycophiles like Bryn and the drosophilids. While conservationists often mobilise around compelling species, like orchids, true conservation requires a better understanding of their relationships with less charismatic organisms. 'This study is demonstrating that cloud forest mushrooms are fundamental to the conservation of *Dracula* orchids, but we know dangerously little about

them.' And for places like Reserva Los Cedros, where mining and illegal logging threaten the health of the forest, knowledge about mushrooms can't come soon enough.

- Rachel Mason Dentinger is a freelance science writer – she is also Bryn Dentinger's wife and *de facto* field assistant
- » This expedition was funded with help from the National Geographic Society and the National Science Foundation
- » Reserva Los Cedros is a 17,000 acre biological reserve in the Andean cloud forest of Ecuador – for more details, go to reservaloscedros.org

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