Hughes, David P*; Armitage, Sophie; Pontoppidan, Maj-Britt; Moltesen, Maria; Himaman, Winanda; Evans, Harry; Hywel-Jones, Nigel; Boomsma, Jacobus J. A tale of two Continents: *Cordyceps* in ants. In: **International Meeting on "Population and Evolutionary Biology of Fungal Symbionts**", Ascona, Switzerland, 2007. AB-12.

The parasitic genus *Cordyceps* is one of the most well known groups of highly specialised insect pathogens and, because of its medicinal qualities for humans, has received significant cultural attention. It is therefore puzzling that its host-parasite evolutionary ecology is poorly known. Ants hold great promise to definitively study the evolutionary ecology of *Cordyceps*. Here I report on a major project currently underway in our group which is examining *Cordyceps* evolutionary ecology in Old (Thailand) and New world ants (Panama/Brazil). I will briefly review why *Cordyceps* are interesting to medics, evolutionary biologists and social insect researchers. I will accompany this with an extraordinary BBC time-lapse film showing *Cordyceps* erupting from an ant's head.

Cordyceps adaptively manipulate the behaviour of ants causing them to abandon their colony, ascend plants and die on the underside of leaves in primary rainforest. We counted every dead ant in 540m^2 of the forest floor and have demonstrated that ant 'graveyards' exist as hotspots in the forest where ants die *en masse* (e.g. 26 dead ants/m^2). With GIS mapping we have built up a picture of the factors that predict the location of such graveyards. Our detailed collections and spatial accuracy, coupled with bi-monthly collections allows a good understanding of the relevant spatial and temporal changes in fungal population structure (see **AB-13** and poster by **M.-J. Pontoppidan**). We also relate fungal phenology, spore output and geographic position to arrive at a precise estimate of infection intensity within these graveyards. They are quite literally killing fields.

A highly novel finding was the presence of specialised parasites of *Cordyceps*. Behaviourally manipulated, and dying ants, are targeted by highly specialized gall midges (Cecidomyiidae) which eat the growing fungus. These flies oviposit on dying ants rather than healthy ants, which implies that they can discriminate infection status of individuals when the ant colony itself cannot. Fly damage may promote subsequent infection by hyperparasitic fungi (also a Clavicipitalean). In our study sites substantial diversity of such hyperaparsites exists. When one also considers mites and collembolans living on the dead ant it becomes evident that *Cordyceps* creates an ecosystem. We are beginning a project into hyperparasites with our Thai colleagues. I will also report briefly on our on-going work into *Cordyceps* co-evolutionary history with ants, which is making use of excellent herbaria material stretching back 17 years and comprising over 3,000 ants from 59 species of ants.

In the last section of the talk I will report our recent findings of *Cordyceps* in Panamanian and Brazilian leaf-cutting ants. Here the fungus acts completely different. We also report how we have successfully achieved artificial host-jumping under laboratory conditions across five diverse ant species (including one from Europe).

Keywords: Cordyceps, parasitism, evolutionary ecology, ants, behavioural manipulation

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http://www.path.ethz.ch/news/conferences/2006_ascona/Abstracts/David.Hughes