

The *Paussus favieri* beetle: a polyglot parasite

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‘...And ere three shrill notes the pipe uttered, /You heard as if an army muttered; /From street to street he piped advancing, /And step for step they followed dancing...’.

The Pied Piper of Hamelin
Robert Browning (1842); Verse lines:
106–107; 119–120 (ref. 1).

Usually, *Pheidole pallidula* ants rip apart ‘strangers’ who try to infiltrate their nest. But *Paussus favieri* beetles simply stride into the nest right under the watchful eyes of the ants; and, once inside, they do as they please with impunity.

The beetles go wherever they wish, even into the queen’s chamber; they mate and reproduce at will; and even receive royal treatment from the worker ants. Indeed, the worker ants groom the beetles, protect them, and rear their larvae.

In return for their services, however, the beetles eat them. They bite deep into their abdomen, lift them up, and suck out their blood and soft tissues. Such is the subservience of the worker ants that even while being eaten alive they never once exhibit any hostility.

Verily, the *P. favieri* – ant nest beetle – is a parasite. A social parasite. It lives off the ant society by preying on workers, and on ant larvae alike.

So, how do the beetles do it? How do they infiltrate the nest and live, unscathed, inside it? The only answer till recently is that the beetles masquerade as ants by indulging in ‘chemical mimicry’.

P. pallidula ants, like most other ant species, communicate with individuals of the colony through the sense of smell – using a chemical language. The beetles mimic this language of the ants by secreting certain ‘ant-like’ chemicals. Thus, under the guise of these chemicals, the beetles deceive the ants into believing that they are their colony comrades². *A beetle in an ant’s clothing*.

But considering how deceptively complete the beetles’ masquerade is (these beetles even interact physically with the queen ant) one wonders whether the beetles hack even into the other communication channel of the ant: the auditory communication channel.

The auditory communication channel of the *Pheidole* ants, like other ant spe-

cies belonging to the Myrmicinae subfamily, is composed of ‘stridulations’. These ants stridulate, i.e. rub their legs against the ridges of their abdomen to create sounds, chirps, to ‘talk’ with one another.

But *Paussus* beetles are also endowed with stridulatory organs similar to those of the ant. So, it is not naive to assume that the beetles, using these sound organs, mimic the stridulations of the ants – acoustic mimicry – and thus make their masquerade more nuanced. More insidious. A study by Di Giulio *et al.*¹ testifies that this indeed is the case.

‘Our results suggest that, by mimicking the stridulations of the ants, the beetles dupe the ants and gain acceptance into the colony,’ said Andrea Di Giulio, the lead author of the study, and entomologist at Roma Tre University, Italy.

To test their hypothesis – whether the beetles exhibit acoustic mimicry – Di Giulio *et al.* performed two groups of experiments. In the first group of experiments, the stridulations of the worker ant, soldier ant, queen ant, and the beetle were recorded in a small enclosure equipped with a sensitive microphone. It was observed that the stridulations of the queen, worker, and soldier differed from one another. Each caste spoke a different language; they chirped a different sound. This observation was expected. Studies have long reported similar acoustic behaviour in other ant species.

But the beetle, surprisingly, through its mimic stridulations, could ‘speak’ not one but all the three ant languages.

‘We were stunned! We expected the beetles to produce only a simple sound, and could have never imagined that these beetles could mimic the sounds of all the three ant castes,’ said Di Giulio. ‘Never before has such a complex acoustic behaviour been observed in invertebrates.’

In the second group of experiments, the recorded stridulations of the ant castes and the beetle were presented to worker ants, and their behavioural responses were examined. For this purpose, bespoke arenas were constructed. Each of these arenas had a speaker, which was covered with soil, attached to its base. Into these arenas, worker ants from the

same colony were introduced, and one by one all the recorded stridulations were played through the speaker.

The worker ants never once responded aggressively to the recordings.

On the contrary, they responded friendly to the recorded stridulations of both ‘friend’ and ‘foe’. Such non-hostile behavioural responses of the worker ants included walking towards the speaker, antennating the speaker, and digging the sand above the speaker. One noteworthy observation was that the stridulations of the queen and the mimic stridulations of the beetle elicited similar behaviour from the worker ants.

The workers ‘thought’ the beetle to be their queen.

The publication by Di Giulio *et al.*¹ is most aptly titled ‘The Pied Piper: a parasitic beetle’s melodies modulate ant behaviours’. The beetle is the Pied Piper and the worker ants, the swarms of rats that unquestioningly follow the command of the Pied Piper’s tune – which in this case is the beetle’s acoustic mimicry of the ant queen.

But what if a certain individual beetle’s acoustic mimicry is imperfect? Is incongruous with the stridulations of the ant colony? In such a scenario, according to Di Giulio, the ants would most assuredly tear the acoustically impaired beetle limb from limb³ and devour it.

Therefore, by smelling ‘familarly friendly’ (chemical mimicry) to the ant, and by trilling ‘chirps’ that sound similar to the ant queen’s chirps (acoustic mimicry), these beetles impersonate the queen herself, intermingle with the ant society, and enjoy the indefatigable services of the worker ants. Even their meat.

1. Di Giulio, A., Maurizi, E., Barbero, F., Sala, M., Fattorini, S., Balletto, E. and Bonelli, S., *PLoS ONE*, 2015, **10**(7), e0130541.

2. Maurizi, E., Fattorini, S., Moore, W. and Di Giulio, A., *Psyche: J. Entomol.*, 2012.

3. Davis, J., IFLScience, 19 July 2015; <http://www.iflscience.com/plants-and-animals/parasitic-beetle-mimics-ants-speaking-three-different-languages>

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