

## Article Addendum

# Antennal responses of an oligolectic bee and its cleptoparasite to plant volatiles

Stefan Dötterl

Department of Plant Systematics; University of Bayreuth; Bayreuth, Germany

**Key words:** *Macropis fulvipes*, *Epeoloides coecutiens*, *Lysimachia punctata*, oligolectic oil-bee, floral scent, dynamic headspace, GC-EAD, cuckoo bee, host nest finding

Cleptoparasitic or cuckoo bees lay their eggs in nests of other bees, and the parasitic larvae feed the food that had been provided for the host larvae. Nothing is known about the specific signals used by the cuckoo bees for host nest finding, but previous studies have shown that olfactory cues originating from the host bee alone, or the host bee and the larval provision are essential. Here, I compared by using gas chromatography coupled to electroantennographic detection (GC-EAD) the antennal responses of the oligolectic oil-bee *Macropis fulvipes* and their cleptoparasite, *Epeoloides coecutiens*, to dynamic headspace scent samples of *Lysimachia punctata*, a pollen and oil host of *Macropis*. Both bee species respond to some scent compounds emitted by *L. punctata*, and two compounds, which were also found in scent samples collected from a *Macropis* nest entrance, elicited clear signals in the antennae of both species. These compounds may not only play a role for host plant detection by *Macropis*, but also for host nest detection by *Epeoloides*. I hypothesize that oligolectic bees and their cleptoparasites use the same compounds for host plant and host nest detection, respectively.

Bees are the most important animal pollinators worldwide, and guarantee sexual reproduction of many plant species.<sup>1,2</sup> This is especially true for female bees, which collect pollen and mostly nectar for their larvae and frequently visit flowers. For finding and detection of suitable flowers, bees are known to use, besides optical cues,<sup>3,4</sup> especially olfactory signals.<sup>5-8</sup> However, c. 20% of bees do not collect pollen for their larvae by their own, but enter nests of host bees and lay eggs into the broodcells.<sup>1,9</sup> The parasitic larvae subsequently feed the food that had been provided for the host larvae. These so called cuckoo or cleptoparasitic bees can be generalistic, indicating that they use species of several other bee groups as host, whereas

others can be highly specialized, laying eggs in cells of only few host species.<sup>1</sup> Until now little is known about the cues used by the cuckoo bees for finding host nests. Nevertheless, Cane<sup>10</sup> and Schindler<sup>11</sup> demonstrated that parasitic *Nomada* bees use primarily visual cues of the nest entrance holes for finding possible nests, and olfactory cues for detection of suitable host nests. The chemical cues used by the cleptoparasites originate from the host bee<sup>10,11</sup> and also pollen,<sup>10</sup> the main larval provision. In most bee species, pollen is mixed together with nectar as larval provision, and both floral resources are known to emit volatiles.<sup>12,13</sup> It is unknown, whether cuckoo bees in search for host nests also use volatiles originating from nectar. While the odours of the host bee used as signal by the cleptoparasites, e.g., cuticular hydrocarbons and glandular secretions, are often species-specific,<sup>14</sup> the chemical cues from the larval provision may just indicate the presence of pollen in the nest without more specificity. As a consequence cuckoo bees could use species-specific host odours to detect nests of a suitable host, and odours released from the larval provision could indicate to them that broodcells are foraged. However, especially those cuckoo bees with oligolectic hosts foraging pollen only on few closely related plant species,<sup>1</sup> may also use the olfactory signals from host broodcell supplies as more specific cue for host nest detection. Thus the same signal from certain flowers may be used for different informations: for the host bee for host plant and for the cuckoo bee for host nest detection.

In this concern I tested oligolectic *Macropis* (Melittidae, Melittinae) and its specific cuckoo bee, *Epeoloides* (Apidae, Apinae) by using gas chromatography coupled to electroantennographic detection (GC-EAD) on floral scent of *Lysimachia* (Myrsinaceae). *Macropis* is highly specialized on *Lysimachia*, because it is not only collecting pollen from plants of this genus, but also floral oil. Both floral products are the only provision for the larvae.<sup>1,15</sup> Recently, we have shown that the oil bee *Macropis* is strongly attracted to floral scent of its oil host *Lysimachia* though the compounds used for host plant finding are still unknown.<sup>7</sup> *Macropis* is the only host of *Epeoloides*, and larvae of this cleptoparasite only feed on the *Lysimachia* pollen-oil mixture provided for the larvae of *Macropis*. Worldwide, there are only 2 species of this genus, one in North America and the other in Europe/Asia.<sup>1,16,17</sup> I hypothesized that both bee species respond to specific *Lysimachia* compounds, which may be used for host plant as well as host nest detection.

Correspondence to: Stefan Dötterl; Department of Plant Systematics; University of Bayreuth; Bayreuth 95440 Germany; Tel.: +49.921.552466; Fax: +49.921.552786; E-mail: stefan.doetterl@uni-bayreuth.de

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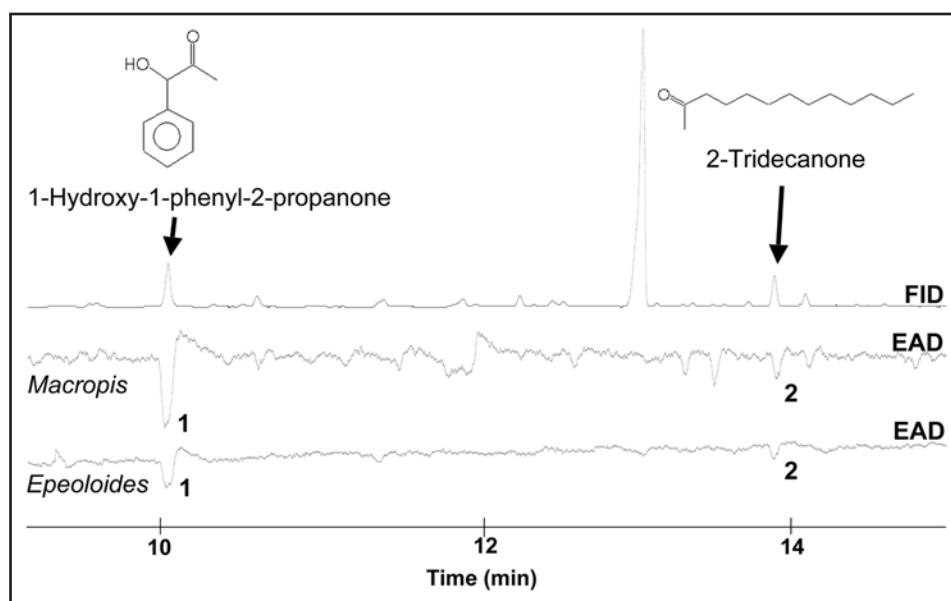


Figure 1. Coupled gas chromatographic and electroantennographic detection of a *Lysimachia punctata* headspace scent sample using antennae of a female oligolectic *Macropis fulvipes* and a female cleptoparasitic *Epeoloides coecutiens* bee. (1) 1-hydroxy-1-phenyl-2-propanone, (2) 2-tridecanone.

The measurements with *M. fulvipes* (F.) and *E. coecutiens* (F.) antennae demonstrate that both bees, host as well as cuckoo bee, respond to some scent compounds emitted by inflorescences of *Lysimachia punctata* L. (Fig. 1), a plant being an important pollen and oil source for *M. fulvipes*. *Macropis* responded to much more *Lysimachia* compounds compared to the cuckoo bee, however, two compounds elicited clear signals in the antennae of both bee species: the benzenoid 1-hydroxy-1-phenyl-2-propanone, and the fatty acid derivative 2-tridecanone. Interestingly, both compounds are also emitted from the floral oil of this plant,<sup>7</sup> and both compounds were also detected in scent samples collected by dynamic headspace in the entrance of a *Macropis* nest (Dötterl, unpublished data). Therefore, an *Epeoloides* female being in search for a host nest can detect volatiles emitted from the provision of the host bee at the entrance of a bee nest, and may use these specific compounds for detection of a *Macropis* nest provisioned with *Lysimachia* pollen and oil.

Present results show that an oligolectic oil-bee as well as its cleptoparasite detects volatiles originating from the host plant of the pollen collecting bee, and that oligolectic bees as well as their cuckoo bees may use the same specific signals for host plant and host nest finding, respectively. Biotests are now needed to test this hypothesis.

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