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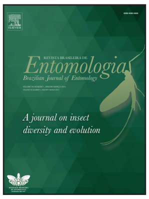

Short Communication

Observations on fragrance collection behaviour of euglossine bees (Hymenoptera, Apidae)

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ABSTRACT

Male bees of the tribe Euglossini collect volatile chemicals secreted by orchids using dense patches of hair on the front tarsi. After collecting chemicals, the bee hovers while transferring these fragrances to invaginations on the hind tibiae. The fragrance collection and hovering behaviours are repeated multiple times. Here I report preliminary field observations on the length of fragrance collection and hovering phases in bees of the *Eulaema meriana* (Oliver, 1789) mimicry complex visiting the orchid *Catasetum discolor* in Kavanayén, Venezuela. I observed that in extended visits with many cycles of fragrance collection and hovering, the length of each collection phase gradually increased, while the length of hovering phase was static. This suggests either that chemicals secreted by orchids are in limited supply or that efficiency of fragrance collection drops.

The interactions between male bees of the tribe Euglossini and the Neotropical orchids they pollinate have puzzled biologists for 150 years. Crüger (1864) commented that the male flower of *Catasetum* 'emits a peculiar smell' that attracts large bees; however, he thought that 'the substance they really come for... is the interior lining of the labellum, which they gnaw off with great industry'. Crüger was correct in highlighting fragrance as an attractant, but incorrect in his second assertion. It is now clear that euglossine-pollinated orchids provide no food reward, but instead the bees use their legs to collect volatile and fragrant chemicals produced by the flower. Many theories have been proposed for why male euglossines collect fragrance, including provision of metabolic precursors or modification for use as a female attractant (Williams and Whitten, 1983), but the currently favoured view is that they constitute a sexually-selected trait indicative of fitness (Eltz et al., 1999, 2003; Whitten et al., 1989). Since male euglossines invest time and energy in collecting fragrances, a complex species-specific scent could be a signal of male genetic quality compatible with Zahavi's (1975) handicap principle.

To collect fragrances from an orchid, a male euglossine bee lands on a flower and secretes lipids from cephalic labial glands, which act as a non-polar solvent for the volatile chemicals (Eltz et al., 2007; Whitten et al., 1989). The mixture of bee-derived lipids and plant-derived volatiles is then collected by brushing with dense patches of hair on the bee's front tarsi (Kimsey, 1984).

The bee then hovers close to the flower and undertakes a series of complex leg movements, during which the collected fragrances are transferred from the front tarsi to the middle basitarsi, and then to sponge-like storage organs in the enlarged hind tibiae (Evoy and Jones, 1971; Kimsey, 1984). Lipids are recycled within the bee, while volatiles collect in the hind-tibial pockets (Eltz et al., 2007). The bee will usually land on the same flower again, and the cycle is repeated, often several times. There are many reports of this behaviour in the literature, but few have paid attention to the timing of each phase of behaviour. Evoy and Jones (1971) reported that in *Eulaema cingulata* (Fabricius, 1804) visiting *Catasetum barbatum* (Lindl.) Lindl. each fragrance collection phase lasted 17 to 77 seconds (mean 47.23 seconds), and each hover phase was 1.8 to 7.0 seconds (mean 4.01 seconds). For the same euglossine species visiting *C. macrocarpum* Rich. ex Kunth, the same authors report mean collection and hovering times of 18.85 and 2.21 seconds respectively. Kimsey (1984) noted that the collection phase at paper treated with volatiles lasts 30 to 60 seconds. Dressler (1968) noted that an entire orchid visit can last up to 90 minutes.

Here I report complete timings of fragrance collection and hovering phases for euglossine bees visiting the orchid *Catasetum discolor* Lindl. (Fig. 1) growing on a marshy highland plateau close to tropical wet forest, 3 km north of Kavanayén, southeastern Venezuela (altitude 1,300 m). These field observations were made between 26 and 31 August 1984; despite the long delay they have not been previously reported. Since complete and undisturbed fragrance collection visits were studied, it was not possible to catch the same bees for identification. Bees visiting the same and adja-

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Figure 1. Male of *Eulaema* in the ‘hovering phase’ of behaviour at *Catasetum discolor.*

cent inflorescences were members of the *Eulaema meriana* (Oliver, 1789) mimicry complex, including *E. bombiformis* (Packard, 1869), which are morphologically similar (Dressler, 1979). I observed that many *Eulaema* visits to *C. discolor* inflorescences, especially around dawn, were brief, lasting 2 to 4 minutes and involving few cycles of fragrance collection and hovering. However, the longest visits recorded lasted 49, 65 and 60 minutes and included 43, 52 and 107 cycles of fragrance collection and hovering; these three are shown in Figure 2. The lengthiest was interrupted by aggressive interaction with another *Eulaema* individual on two occasions. The fragrance collection phase of behaviour was found to be very variable, ranging from 9 seconds to 99 seconds in duration, while the associated hovering phase ranged from under 2 seconds to 8 seconds. The longest timed visits afforded opportunity to observe if cycles of euglossine collection and hovering behaviour changed over the course of a visit. The most striking finding was that the length of the fragrance collection phase showed a gradual increase in duration during each visit (Fig. 2), while the duration of the hovering phase showed no such trend.

Although preliminary, these field observations raise intriguing questions. Are euglossine bees attempting to gather the same amount of fragrance in each collection phase? If they are, why are they taking more time to collect this fragrance the longer they spend at an orchid inflorescence? The phenomenon may be related to insect physiology, with bees becoming less efficient at fragrance collection the more potentially noxious chemicals they accumulate. Alternatively, the volatile chemicals secreted by the orchids may be in limited supply, and gradually exhausted by the visiting bee. These observations further emphasise the energetic demands that fragrance collection places on male euglossine bees, consistent with the model that the collected chemicals can act as an honest marker of male fitness.

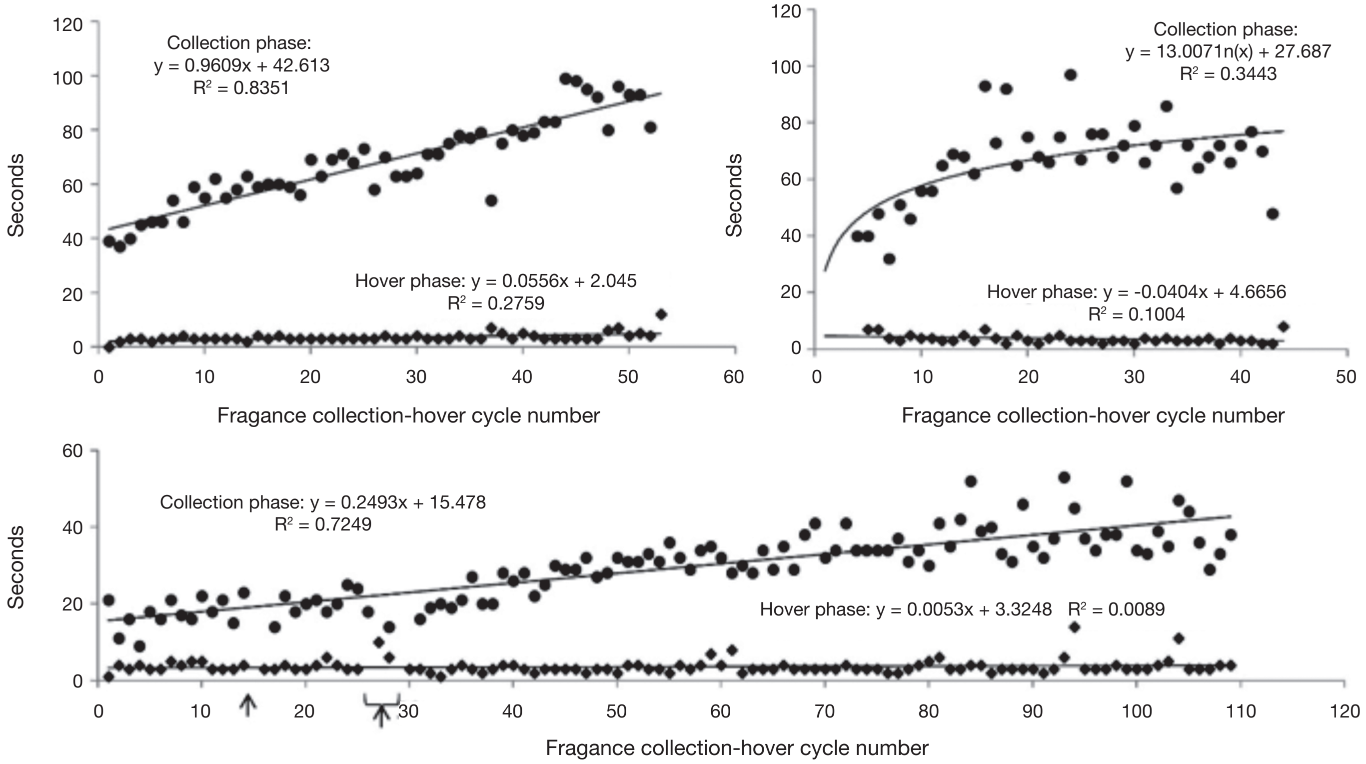

Figure 2. Timings of fragrance collection (circles) and hovering (diamond) phases over three complete collection visits by three *Eulaema* individuals. The first cycle of collection and hovering is denoted cycle 1. Linear or logarithmic regression lines were fitted to the data. Arrows mark male-male interactions.

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Conflicts of interest

The author declares no conflicts of interest.

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