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SHORT COMMUNICATION

## Age structure of male *Euglossa imperialis* (Hymenoptera: Apidae: Euglossini) at nectar and chemical sources in Panama

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Bees in the tribe Euglossini (Apidae) form an important component of the pollinator fauna in lowland, Neotropical forests (Dressler 1982, Janzen 1971, Williams 1982). The community structure and seasonality of male euglossine bees are relatively well known because they can be attracted to chemical baits (Ackerman 1983a, Dodson *et al.* 1969, Janzen *et al.* 1982, Pearson & Dressler 1985). The male bees are important pollinators of many orchids (Dressler 1968, Williams 1982) from which they collect fragrant chemicals; these chemicals are also collected from other plants and decaying vegetation (Ackerman 1983b, Dressler 1982). Male bees are known to store collected chemicals in hind tibial organs (Dressler 1982) and, it is presumed, use these chemicals to synthesize sex pheromones (Williams & Whitten 1983). Mating occurs in territories to which males attract female bees (Dodson 1966, Kimsey 1980).

Recently, Schemske & Lande (1984) found that captive male *Euglossa imperialis* show elevated levels of territorial behaviour when provided with cineole, a fragrant chemical that readily attracts male bees, compared to control bees maintained without a chemical source. Although the exact function of the fragrant chemicals is still unknown, these were the first results that clearly implicated fragrance collection in male reproductive behaviour.

Schemske & Lande (1984) noted that the male *E. imperialis* provided with a daily source of cineole actively collected the fragrance only on the first day of the 11 day experiment. One potential explanation for this observation is that males require only one collection of chemical fragrance before establishing territories. Thus, only the youngest bees in the population would be expected

to actively forage for chemicals. Alternatively, male bees may forage for chemicals throughout their lifetimes, periodically abandoning territories to replenish chemicals presumably used in attracting females.

To test these hypotheses, we have compared the distributions of wing damage, as an estimate of bee age, of male *E. imperialis* collected at chemical baits and nectar host plants. We also consider data on the sex ratio and comparative age distributions of male and female bees at nectar hosts since data of this type are rare for euglossine bees (Ackerman 1985).

*Methods.* The study was conducted on Barro Colorado Island (BCI), a lowland moist tropical forest site (see Croat 1978 and Leigh *et al.* 1982 for descriptions of the area). We collected male and female *E. imperialis*, between mid-July and mid-August, 1986, at plants of *Costus guanaiensis* var. *macrostrobilis*, *C. laevis* (Zingerberaceae), *Calathea latifolia*, and *Ischnosiphon pruinosus* (Marantaceae) located along the NW edge of the Lab Clearing. In addition, we collected male *E. imperialis* using chemical baits (cineole, methyl salicylate, and eugenol) at sites near or in the Lutz Watershed (to the SE of the Lab Clearing) and at two forest sites at least 1 km distant from the Lab Clearing. All bees were scored for damage to the forewings using the following classes: 1-2 'nicks', 3-5 nicks, and >5 nicks or 'tattered'. Presumably, wing damage results only from 'wear and tear' and not from predation attempts as might be more likely for Lepidoptera.

Frequencies were statistically analysed using the log-likelihood ratio, G (Sokal & Rohlf 1981). Where results produced significance levels near  $P = 0.05$ , G values were adjusted for sample size using Williams' correction (Sokal & Rohlf *op. cit.*).

*Results.* The sex ratio of *E. imperialis* at nectar hosts was close to 1:1 ( $G = 0.36$ ,  $P = 0.58$ ), although there was a slight predominance of females (Table 1). These results are similar to Ackerman's (1985) results for *E. imperialis*, also reported from BCI. Age distributions of bees collected at nectar hosts, as indicated by wing wear, were similar for both sexes (Table 1,  $G = 2.19$ ,  $P = 0.535$ ).

Differences in age distribution between male bees collected at nectar hosts and chemical baits (Figure 1) were nearly significant ( $G = 6.75$ ,  $P = 0.084$ ). Differences in age distributions appeared largest in the classes with the least and

Table 1. Distributions of female and male *Euglossa imperialis* across four wing damage indices: 1=no damage, 2=1 to 2 nicks, 3=3 to 5 nicks, 4=>5 nicks. Bees were collected at four species of nectar hosts over a one month period.

	Wing damage index				Total
	1	2	3	4	
Females	17	7	1	3	28
Males	9	8	2	3	22
Total	26	15	3	6	50

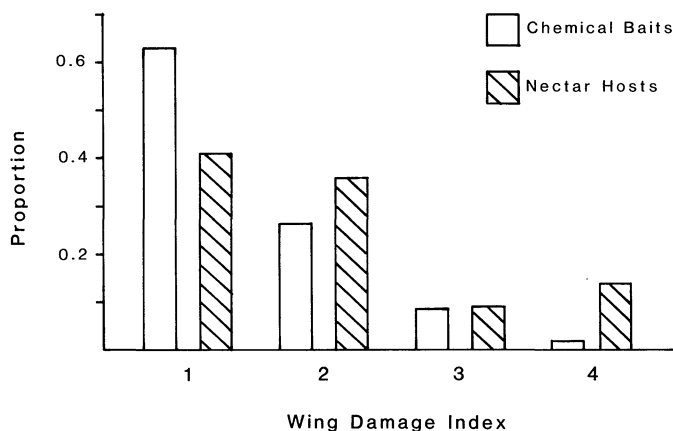


Figure 1. Frequency distributions of male *Euglossa imperialis* collected at chemical baits (N=162) and nectar hosts (N=22), across wing damage index: 1=no damage, 2=1-2 nicks, 3=3-5 nicks, and 4=>5 nicks.

most amount of wing wear and suggested the data would be better analysed by combining the two central classes (Snedecor & Cochran 1980, p. 209). Re-analysing frequencies using three classes (no damage, 1-5 nicks, and >5 nicks, see Table 1) indicated a significant difference between the two distributions ( $G=6.59$ ,  $P=0.039$ ). The results indicated that bees with no wing wear were relatively more common at chemical baits than at nectar hosts, the proportions of bees from either source were roughly equal for bees with 1-5 nicks, and those with the greatest amount of wing wear were relatively more common at nectar hosts than at chemical baits (Figure 1).

*Discussion.* Differences in the age distributions of male *E. imperialis* at chemical and nectar sources were significant, but small. Foraging for chemicals was not restricted to the youngest bees in the population (those with the least amount of wing wear). Relatively older bees (1-5 nicks) foraged for chemicals in proportions similar to those foraging for nectar, which we consider as an index of the proportions in the general population. Even the oldest bees, those with the greatest amount of wing wear, were collected at chemical baits. Therefore, it is likely that bees periodically abandon territories throughout their lifetimes to forage for chemicals.

There was evidence that the youngest bees were relatively more active at chemical baits than at nectar hosts. This class of bees with no wing wear undoubtedly includes newly emergent bees which, having no chemical stores with which to establish a territory, would be expected to commit all available time to foraging for chemicals (Ackerman 1983b, 1985).

We also observed that the most damaged bees, presumably the oldest, were relatively more common at nectar plants than at chemical baits. Euglossine bees are generally long-lived (Ackerman & Montalvo 1985) and the oldest bees in this study may be well over two months old. The observed difference may represent age dependent decline in the reproductive activity of the male bees.

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