Apidologie 36 (2005) 411–412
© INRA/DIB-AGIB/ EDP Sciences, 2005
DOI: 10.1051/apido:2005029

Scientific Note

Evidence for alloethism in stingless bees (Meliponinae)[1]

Dave GOULSON*, Lara C. DERWENT, James PEAT

Evolution and Ecology Group, School of Biological Sciences, University of Southampton, Biomedical Sciences Building, Bassett Crescent East, Southampton SO16 7PX, UK

Received 15 September 2004 – Revised 16 December 2004 – Accepted 20 December 2004

Published online 7 July 2005

size variation / polyethism / foraging

Many ant species and some social bees display size-related polyethism, often referred to as alloethism (Wilson, 1971). For example bumblebees (*Bombus* spp.) exhibit alloethism; there is great size variation within the worker caste, and large bees tend to be foragers, while smaller bees tend to perform within-nest tasks (reviewed in Goulson, 2003). In contrast, honeybees workers are approximately uniform in size, and they exhibit age-related polyethism; young workers remain in the nest, older workers forage. Here we assess whether three stingless bee species exhibit alloethism, something which to our knowledge has never been examined. The size of foragers and nest bees was compared for *Melipona beecheii* Bennett (4 nests), *Scaptotrigona mexicana* (Guérin-Méneville) (3 nests) and *Tetragonisca angustula* Illiger (2 nests). All nests were kept in private apiaries near Tapachula, Chiapas, Mexico. Approximately 30 bees were netted as they returned to the nest. Henceforth these bees were termed "foragers" for brevity, but some may have been returning from trips to dump waste products from the nest. Once a sample of foragers had been taken, the nest was opened and an approximately similar number of workers taken at random from within the nest using a aspirator (this sample is likely to include some foragers that happened to be within the nest at the time). Bees were stored in alcohol and thorax widths subsequently measured under a dissecting microscope with an eyepiece graticule. Data were analyzed separately for each species using two-way Anova, with nest and forager/nest bee as explanatory factors

For all three bee species, average sizes differed greatly between nests ($F_{3,209} = 21.5$, $P < 0.001$ for *M. beechii*; $F_{2,164} = 50.5$, $P < 0.001$ for *S. mexicana*; $F_{1,109} = 9.81$, $P = 0.002$ for *M. augustula*). For *M. beechii*, the size of foragers and nest bees did not differ (Tab. I). However, for *S. mexicana* and *T. angustula*, foragers were significantly larger than nest bees (Tab. I). This suggests the possibility that these bee species exhibit alloethism. Alternatively, selective mortality of small foragers may result in the survivors being on average larger than nest bees. Another possibility is that these bee species exhibit age-related polyethism, as some stingless bees are known to do (Sommeijer, 1982), and that food availability to the colonies had recently declined (assuming, as seems plausible, that worker size declines when food is scarce). This could result in older bees being larger. Unfortunately we have no means of determining age. Wing wear is often used as an indicator of age, but it accrues at higher rates in foragers than nest bees. Thus we would expect foragers to have more wing wear than nest bees regardless of their age. More detailed studies using individual marking of bees as soon as they eclose

* Corresponding author: dg3@soton.ac.uk
[1] Manuscript editor: Marla Spivak

Table I. Mean thorax widths (mm SD) of nest bees versus foragers in three stingless bee species.

	Nest bees	Foragers	D.F.	F	*P*
M. beecheii	2.90 ± 0.15	2.86 ± 0.19	1, 209	0.01	ns
S. mexicana	1.98 ± 0.16	2.17 ± 0.14	1, 164	89.1	< 0.001
T. angustula	1.06 ± 0.09	1.12 ± 0.10	1, 109	9.55	0.003

would make it possible to distinguish between these hypotheses.

Our results are preliminary in nature, and clearly further research is needed to determine the causes of the patterns we observed. It would be surprising if stingless bees were to exhibit alloethism because like honeybees they exhibit rather little size variation within nests (Waddington et al., 1986; Ramalho et al., 1998; Roulston and Cane, 2000). In contrast, large bumblebee workers are more efficient foragers than small ones, so that alloethism is apparently adaptive (Goulson et al., 2002; Spaethe and Weidenmuller, 2002). It remains to be seen how widespread this phenomenon is in the Meliponinae, and whether it has an adaptive explanation.

Note scientifique sur les preuves d'alloéthisme (division du travail liée à la taille) chez les abeilles sans aiguillon (Meliponinae).

Eine wissenschaftliche Notiz über die Belege für Alloethismus (größenbezogene Arbeitsteilung) bei Stachellosen Bienen (Meliponinae).

REFERENCES

Goulson D. (2003) Bumblebees; Their Behaviour and Ecology, Oxford University Press, Oxford.

Goulson D., Peat J., Stout J.C., Tucker J., Darvill B., Derwent L.C., Hughes W.O.H. (2002) Can alloethism in workers of the bumblebee *Bombus terrestris* be explained in terms of foraging efficiency? Anim. Behav. 64, 123–130.

Ramalho M., Imperatriz-Fonseca V.L., Giannini T.C. (1998) Within-colony size variation of foragers and pollen load capacity in the stingless bee *Melipona quadrifasciata anthidiodes* Lepeletier (Apidae, Hymenoptera), Apidologie 29, 221–228.

Roulston T.H., Cane J.H. (2000) The effect of diet breadth and nesting ecology on body size variation in bees (Apiformes), J. Kans. Entomol. Soc. 73, 129–142.

Sommeijer M.J. (1982). Division of labor and social food flow in the stingless bee *Melipona favosa* (F), in: Breed M.D. (Ed.), the Biology of Social Insects, Westview, Boulder, p. 255.

Spaethe J., Weidenmuller A. (2002) Size variation and foraging rate in bumblebees (*Bombus terrestris*), Insectes Soc. 49, 142–146.

Waddington K.D., Herbst L.H., Roubik D.W. (1986) Relationship between recruitment systems of stingless bees and within-nest worker size variation, J. Kans. Entomol. Soc. 59, 95–102.

Wilson E.O. (1971) The Insect Societies, Belknap Press, Cambridge, Mass.