

Scientific note

A scientific note on the dynamics of labor devoted to nectar foraging in a honey bee colony: number of foragers versus individual foraging activity

Corinna THOM^{a, b*}, Thomas Dyer SEELEY^b, Jürgen TAUTZ^a

^a Lehrstuhl für Verhaltensphysiologie und Soziobiologie, Zoologie II, Biozentrum der Universität Würzburg, Am Hubland, 97074 Würzburg, Germany

^b Department for Neurobiology and Behavior, Cornell University, Ithaca, New York 14853, USA

(Received 6 June 2000; accepted 15 July 2000)

***Apis mellifera* / division of labor / nectar foraging**

Division of labor is common to all insect societies and is regarded as one of the most important factors in their ecological success. A key feature of the division of labor in insect colonies is its plasticity. Changing the labor effort devoted to a task with regard to its urgency enables a colony to respond adaptively to changes in external and internal conditions [1, 2]. Honey bee colonies (*Apis mellifera*) can be expected to adjust the labor devoted to nectar foraging, because foraging conditions strongly fluctuate. The proportion of a colony's workers engaged in nectar foraging and the activity of each nectar forager are two parameters that might be involved in the adjustment [2]. In this study we measured for the first time both the proportion and the activity of nectar foragers in a honey bee colony. From May to July 1999, 6 random samples of each 50 bees were taken from a colony with about 4 000 bees that was housed in a 3-frame observation hive. The bees in each sample were individually marked, and observed over a period of 3 successive days (except the first period lasting 2 days). Observations started at 05.00 and lasted without interruption until 19.00–21.00 or until foraging activity stopped.

The identity of each marked bee that left or entered the hive and both the departure and arrival times of the trips were recorded. A nectar forager was defined as a bee that, after a trip of 10 min or longer, unloaded at least once a day liquid to a receiver bee. Between 0 and 67% of the workers engaged in nectar foraging on a given day, with a mean of $34 \pm 18\%$ per day. The percent nectar foragers in the colony changed significantly between days in 5 of 6 observation periods (Fig. 1), most likely as a reaction to changing nectar availability. Overall, 66% of the nectar foragers made 1–4 foraging trips per day, 34% made 5–10 trips, and no bee made more than 10 foraging trips per day. The mean number of trips per nectar forager per day was 3.5 ± 1.3 . The majority of the nectar foragers (over 70%) foraged for 4.5 h or less, even though there were approximately 15 h of daylight each day. The mean activity level (number of foraging trips·bee⁻¹·day⁻¹) of the nectar foragers in the colony changed significantly between days in only 1 of the 6 observation periods (Fig. 1). The results of this study suggest that the honey bee colony adjusted its daily foraging effort mainly by changing the number of nectar

* Correspondence and reprints
E-mail: thom@biozentrum.uni-wuerzburg.de

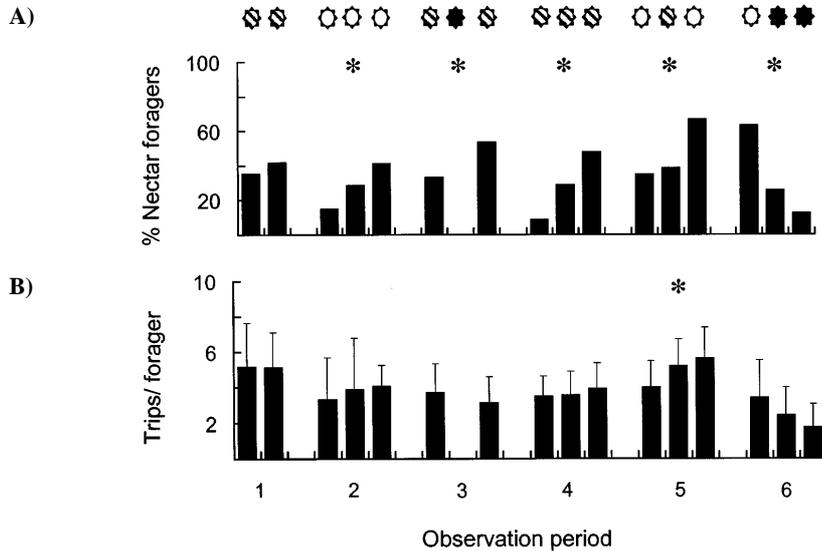


Figure 1. **A)** presents the percentage of the colony that foraged for nectar. Good weather ($> 18^{\circ}\text{C}$, no rain) is indicated by an open sun, medium weather ($15\text{--}18^{\circ}\text{C}$, light rain showers) by a half-filled sun, and bad weather ($< 15^{\circ}\text{C}$, rain) by a filled sun. **B)** shows the mean number of trips per nectar forager per day with one standard deviation. Stars indicate observation periods with significant changes ($p < 0.05$) of values between days.

foragers rather than the activity of the nectar foragers. Increasing the number of foragers that collect simultaneously might enable the colony to exploit ephemeral nectar sources faster and thus more efficiently than an individual increase of necessarily successive foraging flights.

ACKNOWLEDGEMENTS

We thank Dr. Robin Kimmerer for providing space and facilities at the CLBS where pilot studies were done, David C. Gilley for reading the manuscript and discussion, and Kathrin Schomerus for help with the observations. Financial support came from the German Merit Foundation, the U.S. NSF grant (IBN 96-30159), and the GK 200 of the University of Würzburg.

Note scientifique sur la dynamique du travail consacré à la récolte du nectar dans une colonie d'abeilles domestiques : nombre de butineuses par opposition à l'activité individuelle de butinage.

Eine wissenschaftliche Notiz zur Arbeitsdynamik des Nektareintrags in einem Honigbienenvolk: Anzahl von Arbeiterinnen versus individueller Sammelaktivität.

REFERENCES

- [1] Robinson G.E., Regulation of division of labor in insect societies, *Annu. Rev. Entomol.* 37 (1992) 637–665.
- [2] Seeley T.D., *The wisdom of the hive*, Harvard Univ. Press, Cambridge, MA, 1995.