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Social temperature homeostasis in a breeding honeybee colony

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Social colony temperature homeostasis allows honeybees to promote a constand speed of brood development even in the variable environment of temperate climatic zones. Beside endothermy on demand bee density is an important parameter of colony homeostasis. We investigated the interaction of thermoregulatory and behavioral measures for brood temperature stabilisation in a broad range of environmental temperatures (T_{env}=13-41°C). Bees (*Apis mellifera carnica*) were kept in an 8-comb observation hive. Opening of the hive between the two central combs gave fast access to the interior for thermographic snapshots. We measured the location and surface temperature of all bees visible on the central comb, and the comb surface temperature. Air temperature near the bees (T_a) was interpolated from a mesh of 26 thermocouples. On the brood nest, the mean thorax surface temperature (T_{th}) increased from 34.3°C to 36.3°C at T_{env}=13 and 40°C, respectively. T_{th} was lower than T_{comb} at T_{env}<30°C, and higher at T_{env}>30°C. T_a remained always below T_{th} and T_{comb}. Total bee density decreased with increasing T_{env}, from ~285 to ~137 bees per comb at T_{env}=13-40°C, respectively. In a similar way, the density of endothermic bees (thorax at least 0.2°C warmer than other body parts) decreased with increasing T_{env}, from ~106 to ~40 bees per comb. Our experiments deliver the first quantitative approach to the degree of endothermy and regulation of bee density in a honeybee colony in reaction to environmental changes. The bees coordinate both parameters to achieve optimal brood development in a variable environment. Supported by Austrian Science Fund FWF-P20802.

The viability loss of spermatozoa in drones during eversion of endophallus

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Earlier studies showed that the viability of spermatozoa in the seminal vesicles of drones is higher than in the lateral oviducts of the queens. Accordingly, we thought that there must be viability loss during eversion of endophallus. We aimed to determine whether the process of eversion of endophallus causes the viability loss of spermatozoa in ejaculates of drones. To do this, we detected the viability of spermatozoa in semen samples obtained from intact seminal vesicles and partly and fully everted endophalli of drones, since the eversion of the endophallus during mating occurs at two steps; as partial eversion and full eversion. The results showed that the mean viability of spermatozoa in the bulb of partly everted endophallus (97.7%) did not differ significantly from that of spermatozoa in the intact seminal vesicles (98.1%). Thus, no significant spermatozoa viability loss was detected during the partial eversion of the endophallus. In contrast, the spermatozoa viability diminished significantly ($P<0.01$) from 98.1% to 94.8% (viability loss: 3.3%), when the eversion was completed. Further, the viability of spermatozoa diminished significantly

(P<0.01) to 87.0%, when the semen in the bulb of the partly everted endophallus was artificially exposed to additional pressure. However, the viability of spermatozoa on fully everted endophallus (94.6%) did not diminish, when the ejaculate on the endophallus was exposed to aeration for 1 minute. We, therefore, concluded that the acting factor decreasing the viability of spermatozoa was the increased pressure in the organ necessary for full eversion.

Influence of the presence of young workers and of brood on worker longevity in honeybees *Apis mellifera*

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Honeybees (*Apis mellifera)* distribution ranges from tropical to temperate climate zones. In order to cope with important environmental variations in temperate regions, honeybees have evolved a complex life history strategy based on short living summer bees and long living winter bees. Multiple external factors and within-hive stimuli, such as colony population dynamics, influence worker longevity. Brood presence and therefore the performing of brood care has been shown to affect workers longevity. However, experiments testing this effect through brood removal also prevented the emergence of new generations of workers, which influences population dynamics and might affect individual longevity. We tested the effect of the presence of freshly emerged workers on nest-mate longevity. We show, using survival analyses, that the addition of freshly emerged bees under brood-free conditions reduces workers longevity. This effect seems to be stronger in reducing worker longevity than that of brood care. Our results bring new insights in the regulation mechanisms of worker longevity, a parameter of high plasticity, which is central to the life history of the honeybee society.

Influence of environmental factors on the behavior of the stingless bee *Melipona subnitida* in the Brazilian tropical dry forest

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Environmental conditions exert a strong effect on internal and external activities of social bee colonies. Here, we evaluated the influence of environmental factors on pollen foraging and brood cell construction of colonies of the stingless bee *Melipona subnitida* (Apidae, Meliponini), one of the few social bee species naturally occurring in the Brazilian tropical dry forest. The climate of this ecoregion in northeastern Brazil is classified as