

caste-dependent sleep of worker honey bees



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introduction

Sleep is a major feature in the behavioral ecology of solitary animals. Sleep is also important in social animals, but may take a very different form than in solitary individuals.

Apis mellifera foragers exhibit diagnostic characters of sleep¹, but no one has explicitly documented sleep dynamics of non-foraging workers as they age and switch functional caste within the colony, leaving gaps in our knowledge of the form sleep takes within a bee colony.

I examined honey bee workers for caste-dependent sleep patterns.



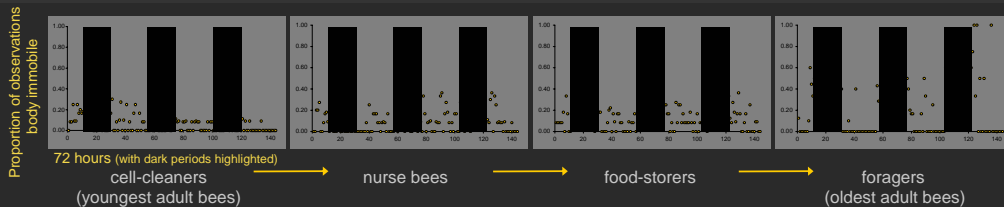
methods

I individually marked and observed adult worker honey bees for periods of 72h, 48h, and 24h to determine whether or not the frequency or duration of sleep* (proxy: antennal and body immobility while in relaxed posture) differs across age-based or functional castes.

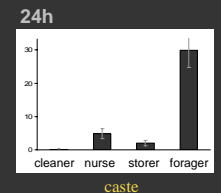
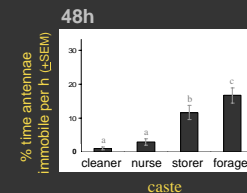
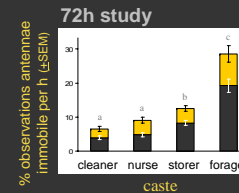
- 72h 3secs/bee x 40 bees (10 bees/functional caste) /h
- 48h 15min/bee x 2 bees (of 40 callows marked & introduced) /h
x 4 periods across lifetime
- 24h 30min/bee x 1 bee/h



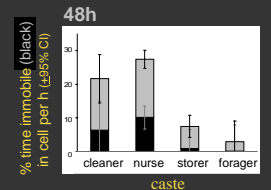
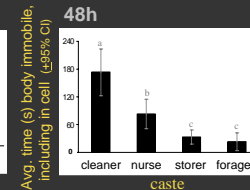
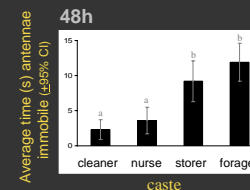
results



- 1 Who has a sleep schedule?
 Day-night patterns of immobility (body in relaxed posture) are not found in the young cell-cleaners or in the nurse bees, but exist in food-storers ($P=.025$) and foragers ($P<.0001$).



- 2 Who sleeps more?
 72h study: Older bees were observed more often in a relaxed, immobile state (bars) & with antennae immobile (black portions of bars).
 48h & 24h studies: Older bees spent more time in relaxed, immobile state with antennae immobile. (exception: food-storer spent less time in a sleep-state than did the nurse bee in the 24h study)



- 3 Who sleeps longer?
 Unbroken bouts of antennal immobility increased with age (max = 79s), but bouts of immobility irrespective of antennal movement (including time in cell) decreased with age (max = 894s).
- 4 Do bees sleep in cells?
 Younger adult workers spent more time in cells & immobile (discontinuously ventilating).

conclusions

All honey bee worker castes exhibit a sleep-state as adults. As bees age and exhibit a sequence of tasks, however, they spend more time in a sleep-state, and in a deep sleep-state (antennae immobile), increasing as nurse bees become food-storers, and again as foragers. Workers also exhibit a circadian sleep-state once they become food-storers. Workers, especially younger workers, may acquire sleep while in cells.

*A sleeping bee will slump in the direction of gravity, remaining immobile, except for occasional antennal or tarsal twitches, or respiratory pumping motions of the gaster. This posture can be sustained for extended, recurring periods, but is easily reversed. Arousing a sleeping bee requires some effort, and the condition is internally controlled, so sleep deprivation results in a sleep rebound.

¹Kaiser, W. 1988. J. Comp. Phys. A. 163:565-584
 Sauer et al. 2004. J. Sleep Res. 13:145-152



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