Marked inter-specific differences in the male olfactory system of honey bees (genus Apis)

Author(s): Jean-Christophe SANDOZ , Florian Bastin , Antoine Couto , Virginie Larcher , Mananya Phiancharoen , Gudrun Koeniger , Jean-Christophe SANDOZ

Institution(s): Evolution, Genomes, Behavior and Ecology, CNRS,Gif-sur-Yvette, France ; Evolution, Genomes, Behavior and Ecology, CNRS,Gif-sur-Yvette, France ; Evolution, Genomes, Behavior and Ecology, CNRS,Gif-sur-Yvette, France ; King Mongkut's University of Technology Thonburi, Bangkok, Thailand ; Behavioral Physiology and Sociobiology, Biocenter, University of Würzburg, Germany ; Evolution, Genomes, Behavior and Ecology, CNRS,Gif-sur-Yvette, France ; Evolution, Genomes, Behavior and Ecology, CNRS, France

All honey bee species (genus Apis) display a striking mating behavior with the formation of male (drone) congregations, in which virgin queens mate with many drones. Bees' mating behavior relies on olfactory communication involving queen- but also drone pheromones. To explore the evolution of pheromonal sex communication in the Apis genus, we analyzed the neuroanatomical organization of the antennal lobe (primary olfactory center) in the drones of five species from the three main lineages (dwarf honey bees: A. florea, giant honey bees: A. dorsata, cavity-nesting honey bees: A. mellifera, A. kochevnikovi and A. cerana) and from three populations of A. cerana (Borneo, Thailand and Japan). In addition to differences in the overall number of functional units, the glomeruli, our data reveal marked differences in the number and position of macroglomeruli, enlarged functional units putatively dedicated to sex pheromone processing. Dwarf and giant honey bee species possess 2 macroglomeruli while cavity-nesting bees present 3 or 4 macroglomeruli, suggesting an increase in the complexity of sex communication during evolution in the genus Apis. The three A. cerana populations showed differing absolute numbers of glomeruli but the same three macroglomeruli. Overall, we identified 6 putatively homologous macroglomeruli in the genus Apis. One of these, which is dedicated to the detection of the major queen compound 9-ODA in A. mellifera, was conserved in all species. We will discuss the implications of these results for our understanding of sex communication in honey bees and propose a putative scenario of drone antennal lobe evolution in the Apis genus.