Sex determiner gene of honey bee more complicated that previously assumed

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Bee colonies consist of a queen bee, lots of female worker bees and some male drones. The gene that determines the sex of the bees is much more complex than has been assumed up until now and has developed over the course of evolution at a very high rate. This is the finding of an international team of scientists under the direction of Dr. Martin Hasselmann of the Institute for Genetics of the University of Cologne. The study has been published in the renowned Oxford journal *Molecular Biology and Evolution*.

Male honey bees (Apis mellifera) hatch from unfertilized eggs and females from fertilized ones. In these fertilized eggs, the condition of the complementary sex determiner (csd) gene is of crucial significance for the creation of female workers. The queen bee, who, in the course of their mating flight, mate with different drones multiple times, passes on to fertilized eggs a random combinations of two csd copies, so-called alleles. If these alleles are different enough, they develop into a female. If the csd gene, in contrast, is present in the fertilized eggs in two identical versions, diploid drones develop. These are, however, eaten by worker bees after they hatch.

Up until now, it was assumed that there were up to 20 csd alleles. In the dataset, which the research team under the direction of Hasselmann collected from all over the world and examined, there were, however, 53 csd alleles found in localities (in Kenya), and worldwide at least csd 87 alleles. Using an evolutionary model, the scientists extrapolated 116 – 145 csd alleles. New csd alleles were created in a relatively quick period

for evolution: ca. every 400,000 years. A region inside the csd gene in particular represents a hot-spot with a high evolutionary rate that, together with certain amino acid mutations, decisively contributes to the formation of new csd alleles in the flanking regions.

The vitality of a bee population depends on, amongst other things, the genetic diversity of sex determining alleles. These new findings are therefore very important for apiculture for minimizing the danger of inbreeding and thereby the production of diploid drones.

PD Dr. Martin Hasselmann has been the director of the research group "Population Genetics of Social Insects" at the University of Cologne as a DFG Heisenberg stipendiary since May 2012. His research foci include the social insects honey bees, bumble bees and stingless bees, the unique biology of which can be used as models to decipher the genetic fundaments of environmental interaction and evolutionary innovation.

More information: Lechner, S. et al. Nucleotide variability at its limit? Insights into the number and evolutionary dynamics of the sex-determining specificities of the honey bee Apis mellifera, *Mol. Biol. Evol.* 2013 : mst207v1-mst207

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