Homebody queen ants help preserve family ties in large populations

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Ant and bee colonies have long fascinated biologists because of their hierarchical social structure and the apparently altruistic behaviour of female workers in rearing the queen's young rather than reproducing themselves. In colonies headed by a single queen, this makes evolutionary sense in that the workers are as closely related to the princesses and princes they nurture as they would be to their own children. Thus the genes underlying this behaviour would be successfully transmitted through the generations due to "kin selection".

But to what extent, if any, can kinship ties account for the evolutionary maintenance of altruistic behaviour in large unicolonial ant populations in which nests contain hundreds of queens? Researchers, writing in the open access journal BMC Evolutionary Biology, have investigated this question in alpine wood ants.

Michel Chapuisat, Laurent Keller and Barbara Holzer at the University of Lausanne analysed the gene flow and population genetic structure in seven populations (86 nests across the Alps and Jura Mountains) of the native and non-invasive Formica paralugubris ant, using geo-referenced microsatellite genotypes and mitochondrial haplotypes. The latter allow an assessment of gene flow through the maternal line, while the former are nuclear markers which reflect the genetic ancestry from both male and female parents.

The authors found that breeding was not occurring freely within these large populations, even though they are made up of interconnected nests

between which the ants appear to move without provoking aggressive behaviour. Instead the genetic analyses identified the presence of several cryptic genetic clusters of nests within each population. Individuals within clusters were found to be significantly more related to each other than to ants in other clusters.

The mitochondrial haplotypes show that matrilineal ties are strongest within an individual nest, but almost as strong with members of other nests in the same cluster, whereas maternal links to individuals from other clusters were a great deal more distant. This suggests that the queens often move to another nest in their cluster to breed, but rarely move further afield. However, the authors found that the four mitochondrial haplotypes they identified were exhibited in various combinations across the populations, suggesting that queens who do venture outside their own cluster are occasionally accepted into foreign nests.

Fixation indices indicate that whilst mating is non-random at the population level, it is random at the cluster level. With higher fixation indexes across all three populations for mitochondrial haplotypes than for the nuclear markers, the authors suggest that gene flow is male-biased. Though long-distance gene-flow appears to be rare, males are 3-9 times more mobile than females.

According to Chapuisat, 'the saturated nature of the ants' population may favour females staying within clusters rather than dispersing. This, in combination with competition between clusters and male-biased dispersal, may help to maintain altruism in unicolonial species.'

Genetic clusters and sex-biased gene flow in a unicolonial Formica ant, Barbara Holzer, Laurent Keller and Michel Chapuisat, *BMC Evolutionary Biology* (in press), www.biomedcentral.com/bmcevolbiol/

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