Inbred bumblebees less successful

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Declining bumblebee populations are at greater risk of inbreeding, which can trigger a downward spiral of further decline. Researchers writing in the open access journal *BMC Evolutionary Biology* have provided the first proof that inbreeding reduces colony fitness under natural conditions by increasing the production of reproductively inefficient 'diploid' males.

The sex of bumblebees is normally determined by the number of chromosome sets an individual receives. Males, born from unfertilised eggs, are haploid (just one chromosome set), while females receive genetic material from a father and a mother and so are diploid (two sets of chromosomes). In situations of inbreeding, however, the likelihood of generating a 'freak' diploid male is increased.

Penelope Whitehorn, from the University of Stirling, UK, led a team of researchers who sought to investigate the effects of a generation of these diploid males on the fitness of bumblebee colonies. She said, "The study of genetic diversity and inbreeding in bumblebees is currently of particular importance as many species have been suffering from significant population declines. The intensification of agriculture and the associated loss of flower-rich meadows and other habitats on which bumblebees depend has led to isolation of groups of bees and a consequent loss of their genetic diversity, increasing their susceptibility to possible deleterious effects of inbreeding".

The researchers mated fertile female bees in the laboratory with either their brothers or with unrelated males. Those queens that established

colonies in the laboratory could be divided into three groups - inbred queens producing diploid males, inbred queens producing normal colonies without diploid males and a control, non-inbred group. After monitoring the initial founding of the colonies in the laboratory, the researchers then compared the development and survival of these three colony groups under natural field conditions. According to Whitehorn, "A number of fitness parameters were severely negatively affected by diploid male production, including colony growth rate, total offspring production and colony survival. However, no significant effects of inbreeding in the absence of diploid male production were detected".

This study demonstrates that diploid males are extremely detrimental for wild bumblebee colonies. Diploid males are produced at the expense of industrious females, but unlike these female workers, they do not contribute to colony growth and productivity. In fact, they do not function very well as males either, as they are much less fertile than normal males and any offspring they do produce are always unviable or infertile. The researchers conclude that diploid males may act as indicators of the genetic health of populations, and that their detection could be used as an informative tool in bee conservation.

More information: Impacts of inbreeding on bumblebee colony fitness under field conditions, Penelope R Whitehorn, Matthew C Tinsley, Mark JF Brown, Ben Darvill and Dave Goulson, BMC Evolutionary Biology (in press), www.biomedcentral.com/bmcevolbiol/

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