

## Does loss of flight affect the sense of smell?

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In insects, flight and a sophisticated olfactory system go hand in hand, and are essential to survival and evolutionary success. However, females of many Lepidopteran species have secondarily lost their flight ability, which could lead to changes in the olfactory system of both larval and adult stages. The gypsy moth, *Lymantria dispar*, is an important forest pest worldwide and has flight-capable and flightless populations making this an ideal system to investigate the relationship between flight and olfaction. In the present study we used next-generation sequencing to obtain female antennal and larval head capsule transcriptomes to investigate the differences in expression of olfaction-related genes among one flightless and two flight-capable populations. We also used multiple behavioural assays to establish the effect of flight loss on the use of chemical cues in host-plant selection. A principal component analysis revealed that the gene expression patterns of female antennal transcriptomes are very similar, whereas those from larval head capsules are different from one another. These differences in olfactory gene expression in the larvae appear to be unrelated to the mother's ability to fly, yet they may indicate unique chemosensory adaptations for each population. Behavioural assays suggest that females (both flight-capable and flightless) are unable to make suitable host-plant choices, transferring this responsibility to their offspring. The larvae of the three populations display distinct behaviours in their search for host-plants making use of olfactory, gustatory, or other cues. The climate and host-plant availability from the sites of provenance of these populations suggest that the observed differences are responses to particular ecological pressures. This work supports the theory that secondary loss of flight only occurs when the females no longer play a role in host-plant selection, but provides no conclusive evidence for changes in the olfactory gene repertoire or its expression as a result.

