# How do nocturnal mosquitoes escape from being swatted?

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**Abstract (227 words)**

When attacked, flying nocturnal insects cannot rely on vision to detect a threat. To evade from predators, insects such as moths, praying mantis or cockroaches rely on other senses such as hearing or airflow-sensing. Some flying insects, such as mosquitoes, also must escape from the defensive behaviour of their blood hosts. Nocturnal malaria mosquitoes are capable of escaping from swatting in the dark, but how they achieve this is still unknown.

Here, we show that flying mosquitoes escape from being swatted by using the airflow induced by the attack both passively and actively. By tracking free-flying mosquitoes in real time, we were able to simulate attacks using an automatic mechanical swatter. In both dark and low-light conditions, we showed that the faster the air movements induced by the attack, the less malaria mosquitoes were hit by the swatter. Then, using airflow simulations and measurements of wingbeat kinematics, we estimated the aerodynamic forces involved during the escape manoeuvres.

We found that, although seemingly going with the airflow, mosquitoes actively surfed the bow wave induced by the swatter. We estimated that the mosquitoes' active contribution explained about two-thirds of their escape acceleration when the swatter was almost invisible. This indicates that the passive effect of the airflow still significantly contributed to the escaping success of mosquitoes. We anticipate that similar escape strategies must be common in small lightweight insects.