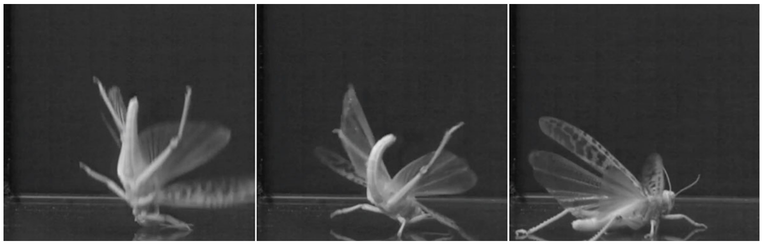
INSIDE JEB

Landing locusts crash head first for speedier getaways



Time-lapse image of a warm locust completing a successful landing after crashing head first. Photo credit: Simon Reichel.

As Jan-Henning Dirks observes, what goes up must come down. But when Dirks attended conferences, he was struck that most biomechanists that study creatures leaping only seemed to be interested in the first stages of this manoeuvre. ‘Almost all of them focus their work on the take-off phase or maybe the aerial phase; only a few looked at landing’, says Dirks from Bremen City University of Applied Sciences, Germany. But a successful touchdown can be a survival essential; many insects leap repeatedly to evade predators and Dirks says, ‘Having a controlled landing would improve their chance of escaping as they can prepare quicker for the next jump’. With very little information about how insects alight after being airborne, Dirks, Susanna Labisch and Simon Reichel began filming crash landing locusts (*Schistocerca gregaria*) to find out whether they control their landing impact.

However, as each locust leap is unique, the trio decided to level the playing field and drop all of the insects from a height of 60 cm, to see how they coped. ‘Colder insects react slower than warm locusts; we therefore tested warm, cold and dead locusts to see if they actively control their movements’, says Dirks, who also launched the insects from three different angles – horizontally, tipped down head first and tipped tail first – as they filmed the descents. ‘Dropping the insects right into the field of view of the camera was difficult; it needs a good aim’, says Dirks, describing how Reichel lined up his hand with a marker mounted on a stand to drop the insects from a consistent height.

Inspecting the high-speed movies, the trio expected to see the airborne locusts twist in the air to land on their legs. Instead, the locusts all crash-landed head first. However, when the team analysed the insects’ unorthodox landing posture, they realised that it put them in the ideal position for a quick getaway, allowing them to get onto their feet speedily for the next leap. The team also compared the insects’ impact speeds and were surprised that the warm insects – which were flapping frantically in the instants before impact – were not slowing down. ‘We were quite confused’, admits Dirks, who had assumed that the flapping locusts would be decelerating. In fact, they were actively accelerating, hitting the ground at a speed of 3.74 m s^{-1}, in contrast to the dead insects, which only reached 3.33 m s^{-1}. The scientists realised that the active locusts were using their wings to reposition their bodies as they fell while inadvertently increasing their speed, although Dirks adds that the higher impacts shouldn’t concern the robust insects, thanks to their tough protective exoskeletons. It was also clear that the chilled insects, with the slowest reaction times, struggled the most to right themselves when landing. ‘We believe that this is because the cooled insects try to control their descent using their wings and legs; however, due to their slower reactions, they over/undercompensate … [like] a drunk person, who tries to walk a straight line and staggers’, says Dirks.

So, locusts prefer to crash land head first to give them the best chance of a fast getaway and Dirks is keen to find out whether the insects have any specialised exoskeleton adaptations to protect them from their violent impacts.

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