How dung beetles navigate

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Scarabaeus viettei (syn. Madateuchus viettei, Scarabaeidae); picture taken in dry spiny forest close to Mangily, western Madagascar. Credit: Axel Strauß/Wikipedia

Researchers got right into the brains of dung beetles to find out how they use celestial cues such as the sun, the moon and the polarisation pattern of skylight to navigate their dung balls along straight paths across the savanna.

By recording the activity of the dung beetles' compass neurons directly from the brains, researchers have for the first time shown that this celestial cue preference differs between nocturnal and diurnal beetles in a manner that reflects their contrasting activity time and visual ecologies.

Wits Professor Marcus Byrne and other researchers form the Department of Biology at the Lund University in Sweden demonstrated how these cue preferences are reflected in the activity of compass neurons in the brain.

Although nocturnal beetles move in the same manner through the same environment as their diurnal relatives, they do so when light conditions are at least one million-fold dimmer.

"At night, polarised skylight is the dominant orientation cue for nocturnal beetles. However, if we coerce them to roll during the day, they instead use a celestial body (the sun) as their primary orientation cue," said the researchers.

Diurnal beetles, however, persist in using a celestial body for their compass, day or night. Compass neurons in the central complex of diurnal beetles' brains are tuned only to the sun, whereas the same neurons in the nocturnal species switch exclusively to polarised light at lunar light intensities.

Thus, these neurons encode the preferences for particular celestial cues and alter their weighting according to ambient light conditions. This flexible encoding of celestial cue preferences relative to the prevailing visual scenery provides a simple, yet effective, mechanism for enabling accurate visual orientation at any light intensity.

"Being able to relate a real behaviour in the field to the brain activity of an animal is the exciting novelty of this work," said Byrne.

The research is published in the *Proceedings of the National Academy of Sciences*.

Provided by Wits University

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