INSIDE JEB

Why bark beetles roam near and far

A mountain pine beetle (*Dendroctonus ponderosae*) flying circuits in the flight mill.

Bark beetles are the forester's nemesis. Burrowing beneath the bark of trees to feed and lay their eggs, the beetles weed out weakened trees naturally. However, in the rolling lodgepole pine forests of North America, epidemics of mountain pine beetles (*Dendroctonus ponderosae*) doom stands of trees to a slow death. Kelsey Jones from the University of Alberta, Canada, explains that some female bark beetles fly tens of kilometres in search of fresh trees, while others fly only a few metres before settling and summoning backup with pheromone scents. Yet it wasn't clear what advantage the combination of long- and short-range strategies bestows on the pests. Jones and Maya Evenden teamed up with Nadir Erbilgin, Rahmatollah Rajabzadeh and Guncha Ishanguyyeva, also from the University of Alberta, to find out how the distance a bark beetle flies affects their selection of a new home and the pheromones they produce, to understand why the insect population produces roamers and others that remain closer to home.

First, the team had to get their hands on some bark beetles. Driving to remote Alberta locations during the autumn, Jones, Antonia Musso and Victor Shegelski searched for trees covered in the tell-tale balls of solidified sap produced when a tree is under attack, before felling and cutting 50 cm long sections from the trunks. Back in Edmonton, the team kept the logs in cold storage through the winter, before allowing them to warm in spring and collecting the beetles as they emerged. Jones then tested the females' endurance as they embarked on their maiden flights by attaching each beetle to the rotating arm of a flight mill and recording the number of circuits completed over a 23 h period, discovering that, on average, the insects covered a distance of 4 km, ranging from 2 m to over 22 km. Then, she weighed the females, to find out how much body mass they lost during their odyssey, before offering them a fresh log to burrow into. Timing how quickly the beetles began burrowing – an indication of how much energy they had in reserve to set up home – Jones then inserted a funnel into the mouth of the freshly carved beetle gallery to collect the pheromone (*trans*-verbenol) that the female produced during the first day. Finally, she tethered males in the flight mill for a day, to simulate their pursuit, before uniting each with a female in her channel and collecting the pheromones, *trans*-verbenol and the male pheromone *exo*-brevicomin, over the following 4 days.

Jones discovered that the distance flown by the female beetles had little bearing on their interest in burrowing into new logs. However, the females that had lost the least mass (less than 10%) seemed the most enthusiastic about boring into the log, although they also produced the least *trans*-verbenol pheromone. In contrast, the females that flew the furthest and lost the most mass produced the most pheromone, advertising their arrival. Meanwhile, the heaviest males at departure and the males that flew the furthest produced the most *exo*-brevicomin, regardless of how much mass they lost during flight.

So, it seems that using a large amount of energy when venturing afar sets back pioneering females, favouring females that have more energy to provide their eggs after remaining closer to home. However, females that embark on a long-haul flight produce more pheromone; they have a better chance of attracting males from distant populations, improving the genetic health of their offspring. 'Both flight strategies are beneficial to mountain pine beetle reproduction in different ways. As short- and long-distance fliers reproduce successfully, both strategies will remain in the population, maintaining genetic variability', says Jones.

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