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INSIDE JEB

Unconventional star-nosed moles can't bear low oxygen

A star-nosed mole (*Condylura cristata*), shortly after collection. Photo credit: Maiah Devereaux.

What's the first thought that springs to mind when you think of moles? Small furry excavators perched blinking atop a fresh mound of soil? Probably, but one member of the family doesn't entirely fit the bill. Even though star-nosed moles (*Condylura cristata*) are determined excavators, they are equally adept at swimming. 'Naturalists had even observed star-nosed moles diving under the ice by the late 1800s', comments Kevin Campbell from the University of Manitoba, Canada. And one consequence of the creature's extraordinarily active lifestyle is their voracious appetite. 'Even in captivity, star-nosed moles eat more than their body mass every day', says Maiah Devereaux from the University of Ottawa, Canada. However, animal burrows can be notoriously low in oxygen, leading many subterranean dwellers to reduce their body temperature and metabolism in order to conserve oxygen. Yet, no one had measured the oxygen levels in star-nosed mole burrows to find out whether they are short of breath, so Matt Pamenter and Daniel Munro (both from University of Ottawa) invited Campbell to help investigate how well the frenetic burrowers cope when oxygen becomes scarce.

And this was when another of the mole's other star features came into play – its nose – which is equipped with 22 exquisitely touch-sensitive tentacles. 'The nose is incredibly sensitive and fast, touching the ground 10 or more times per second while searching for prey', says Campbell, making it almost impossible to disguise the traps that he, Devereaux and Munro buried to capture the animals. Instead, the team had to cunningly extend the moles' tunnels directly into the traps, in an effort to outsmart the animals. Even then, the wily creatures, which tend to live in waterlogged ground in humid mosquito-infested areas, frequently filled the traps with mud before excavating their own passages through. 'I'm not surprised there are so few studies on this species', Campbell chuckles, recalling the difficult week he spent trying to outwit the beasts. However, once the trio had successfully captured eight of the reclusive creatures – returning with them to Pierre Blier's laboratory in L'Université du Québec à Rimouski, Canada – they were ready to measure the moles' breathing and metabolism as the oxygen dwindled.

Even then, the moles weren't particularly cooperative. 'They almost never do what you want in the lab!', Campbell exclaims, remembering how the animals rarely sat still as Deveaux tried to measure their metabolic rates while reducing the oxygen in their chamber. 'We expected to see a severe reduction in metabolic rate starting early in hypoxia [low oxygen] with a coordinated drop in body temperature, and an increase in the breathing rate and inhaled volume', says Devereux, explaining that this is the typical strategy used by animals that cope well with low oxygen to eke out the supply. Instead, the star-nosed moles continued scurrying around as the air began to grow thinner and they soon became breathless, breathing harder and faster to sustain their hectic pace of life. In addition, they maintained a costly warm body temperature of 37.7 deg.

'Initially, I found the minimal hypoxia response to be surprising', Campbell says, adding, 'I expected that they would eventually suppress their metabolism and body temperature'. The team suspects that the dynamic mammals have traded in their ability to withstand low oxygen to sustain their high-octane lifestyle, fervently pursuing insects with their super-sensitive snouts. And Devereaux is keen to see how other moles deal with low oxygen, to find out whether this is just one other aspect of the star-nosed moles' unconventional lifestyle, which makes them stand out from the rest of the family.

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Devereaux, M. E. M., Campbell, K. L., Munro, D., Blier, P. U. and Pamenter, M. E. (2021). Burrowing star-nosed moles (*Condylura cristata*) are not hypoxia tolerant. *J. Exp. Biol.* **224**, jeb242972. doi:10.1242/jeb.242972

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