INSIDE JEB

# First two weeks crucial for white-nose syndrome survivors

A hibernating little brown bat (*Myotis lucifugus*) with white-nose syndrome. Photo credit: Nate Fuller.

With only a few grams of fat to sustain them through their 9-month winter hibernation, there is little flexibility in little brown bat (*Myotis lucifugus*) energy budgets. So, when white-nose syndrome strikes – a disease caused by the *Pseudogymnoascus destructans* fungus – the consequences can be dire. 'Over 90% of hibernating populations have been lost at some sites', says Nate Fuller from Texas Tech University, USA, adding that the starving survivors, which are left with tattered wings, are vulnerable when they attempt to build themselves up again. But, little was known about the length of time it takes the mammals to heal and the long-term impact of their winter infection. To begin understanding how bats survive white-nose syndrome, Fuller and Liam McGuire set out on a 1300 mile road trip between Ottawa and Winnipeg in the weeks before the hibernating bats emerge, to collect infected animals from their overwintering sites in order to chart their road to recovery.

'The most difficult aspect of the study was transporting the bats in a battery-operated refrigerator … on a 24 h, nonstop drive around Lake Superior', says Fuller, recalling encounters with moose, wolves and snow along the way. The bats were also in bad shape thanks to the infection when they arrived at Craig Willis's University of Winnipeg lab.

Housing the sick animals in a comfy roost with access to a spacious flight chamber, Fuller and Heather Mayberry handfed the creatures initially on fat mealworms, until they got the hang of feeding themselves. Fuller also monitored the grumpy animals' recovery for 40 days, collecting samples from their wings, as well as keeping track of their mass and overall health. Initially, the bats' wings appeared quite healthy, but they began deteriorating markedly 5 days later, with holes and sores appearing. In addition, he knew that the bats' mass had fallen from ∼12 g at the start of hibernation to ∼6 g when collected from their roosts; however, the animals soon began gaining mass as they recovered. 'Their individual personalities started to become apparent', chuckles Fuller, who was also impressed by how well the wings then healed. 'I have numerous scars from injuries I received years ago, but bat wings rarely reflect large holes and injuries from the previous month, let alone years past', he adds.

Cataloguing other details of the bats' recoveries with McGuire, Mayberry, Evan Pannkuk, Todd Blute and Catherine Haase, Fuller realised that the bats often dropped their body temperature significantly (18°C) when roosting, in a process known as torpor, early in their recovery to conserve energy. However, the bats seemed to depend less on torpor during the second week, only dropping their body temperature by a few degrees while they invested heavily in repairing the damage to their wings. In addition, the waterproofing lipids at the surface of the wing, which are likely to protect the bats from dehydration and infection, improved during their recovery. And, when the team tracked the extent of the bats' infection, most of the animals were almost completely fungus-free within 10 days, although they were concerned when they realised that some of the bats became reinfected several weeks later.

'It appears that there is a critical 2-week window during which surviving bats undergo a period of intense healing. If the bats make it through this process, their chance of survival goes way up', says Fuller. But, he is concerned that recovery takes a great deal out of the vulnerable animals, and he adds, 'We hope this will give us some indication of why some bat populations have not disappeared despite repeated seasonal infection'.

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**Fuller, N. W., McGuire, L. P., Pannkuk, E. L., Blute, T., Haase, C. G., Mayberry, H. W., Risch, T. S. and Willis, C. K. R.** (2020). Disease recovery in bats affected by white-nose syndrome. *J. Exp. Biol.* **223**, jeb211912. doi:10.1242/jeb.211912

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