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INSIDE JEB

Songbirds customise physiological strategies to reach migration destinations

A red-eyed vireo (*Vireo olivaceus*) in flight in Long Point, ON, Canada. Photo credit: Brock and Sherri Fenton.

Migrating songbirds are like souped-up racing cars. Performing at peak condition, the tiny aviators embark on extraordinary journeys covering thousands of kilometres powered by the oxygen they inhale, while burning fats to fuel their flight muscles. Some even migrate at altitudes up to 5000 m, where oxygen is scarce and the air thin. Yet little is known about how these extraordinary birds enhance their oxygen supply during their epic journeys. 'Our understanding of high-altitude migrations is based primarily on the bar-headed goose', says Catherine Ivy from Western University, Canada, but the geese have a radically different lifestyle from smaller songbirds. Ivy and Chris Guglielmo (Western University), decided to find out how six songbird species – three that migrate south within North America and three that voyage on to South America – that pass through their London, Ontario, backyard prepare their bodies in readiness for their incredible journeys.

Capturing 100 birds from all six species while they travelled south during the late autumn migration (August and September), Ivy allowed half of the animals to settle into their new laboratory home. She then measured their breathing as she increased the proportion of nitrogen in the air – to reduce the oxygen available – as if the birds were ascending to altitude. In addition, she checked their blood and flight muscles. Ivy also adjusted the sunrise and sunset in the remaining birds' accommodation, shortening the daylength to allow their bodies to readjust to a non-migratory lifestyle before running all of the tests again to find out whether the birds tweak their physiology in preparation for their marathon expeditions.

Instead of responding identically to the physical challenge of migration, the six species all came up with different strategies to enable their odysseys. During the migratory season, the vireos and warblers changed their breathing patterns, taking deeper breaths and breathing more slowly – to inhale more oxygen – during their impressive journeys. However, the Swainson's thrushes breathed more heavily when their bodies had adjusted to no longer migrating. The vireos and warblers also consumed less oxygen – reducing their metabolism – when migrating but raised their metabolism in winter to keep their bodies warmer. The hermit thrushes and Swainson's thrushes, on the other hand, did not vary their metabolism between the seasons.

Ivy also checked the birds' blood to find out whether there were any changes between the seasons and found that blackpoll warblers didn't alter the ability of their blood to transport oxygen. In contrast, myrtle yellow-rumped warblers extracted oxygen from the lungs more efficiently during the migration season, while the two thrush species altered their blood to deliver oxygen to their muscles more efficiently when migrating. The length of the migrants' journeys also impacted the structure of their muscles, with myrtle yellow-rumped warblers and hermit thrushes – which only migrate within north America – reducing the distance oxygen has to travel from the blood to individual muscle fibres, to make flight more efficient when migrating. In contrast, the red-eyed vireos and blackpoll warblers, which travel to south America, did not adjust their muscles in preparation for their trips.

All of the birds adapted their bodies to some extent when undertaking their astounding journeys, but each species customised their strategy. There is no 'one way' to extend the distance over which a bird can travel when preparing for migration, although breathing more effectively, adjusting the oxygen-carrying capacity of the blood and subtly modifying the flight muscles all help migratory birds to reach their destinations.

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