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Recipe for energy saving unravelled in migratory birds

Pointed wings together with carrying less weight per wing area and avoidance of high winds and atmospheric turbulence save a bird loads of energy during migration. This has been shown for the first time in free-flying wild birds by researchers at Princeton University, the University of Montana, and the German Max Planck Institute for Ornithology. They state in PLoS ONE's May 14th edition that climate change might have a critical impact on small migrants' energy budgets if it causes higher winds and atmospheric instability as predicted.

The costs of migration are enormous: in small songbirds, flight increases energy expenditure by approximately 50 % during the migratory period. Biologists Melissa Bowlin and Martin Wikelski examined the energetics of Swainson's thrushes, which are often used to study migration. Some of these small songbirds of only 30 g travel an amazing distance of about 4800 km from their winter site in Panama to breed in Canada, and back again.

In total, a one-way trip takes 3.2 million wing beats and about 1300 kJ of extra energy. As they can not take much fuel 'on board' and can only afford short stops, the thrushes have to fly very efficiently. Birds with rounder wingtips and a higher 'wingloading' – a high body mass compared to the wing area – were found to have a higher heart rate, and therefore a higher rate of energy expenditure.

Also, heart rates increased with wind speed, but surprisingly it did not matter whether it was a tailwind or a headwind. Heart rates also went up with increasing atmospheric instability. Avoidance of high winds and turbulence may therefore reduce flight costs for small birds during their migration.

"We think that climate change may have severe consequences for small intercontinental migrants," says Martin Wikelski, co-author from Princeton, USA and the Max Planck Institute for Ornithology in Germany. Migration is thought to be the most dangerous event of the year for small songbirds, even before the effects of climate change are considered. Over continents, the frequency and severity of high winds might increase, as might the occurrence of atmospheric instability.

"As this affects the energy budgets of the birds, the need for and locations of stopover sites would change," Wikelski explains. The birds may arrive too early or rather late, thereby messing up the onset of breeding and wintering. In the worst case, they would run out of energy en route above the Sahara or the Atlantic Ocean and never arrive at all.

The pointed wingtips of migrating bat, bird, and insect species alike were thought to have evolved to cut down energy expenditure during flight. Some researchers also predicted that carrying less weight for a given wing area and flying in certain atmospheric conditions should decrease the flight costs. Bowlin and Wikelski were finally able to put these ideas to the test in free-flying migrants.

"Until now, research on the energetics of small birds in flight was largely confined to individuals flying in artificial wind tunnels," says lead author Melissa Bowlin, a post-doctoral fellow at the University of Montana. "Now, we can study small, free-flying birds making actual migratory flights in the wild."

To track the thrushes during their spring migratory flights over the central USA, the researchers applied some modern technology. A temporary radio-transmitter, weighing less than one gram, fastened to the bird's back sent the heart beat rate to an antenna on the ground. In order to receive these signals, Bowlin and Wikelski had to follow the sometimes rapidly moving birds with a radio-tracking vehicle. "We lost a few birds because we had to obey the speed limits on the roads but they didn't," says Bowlin.

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