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Critical temperature window sends migratory black-headed buntings on their travels

Male black-headed bunting (*Emberiza melanocephala*) on the island of Lesvos, Greece. Photo credit: Mark S. Jobling, CC BY 3.0 <https://creativecommons.org/licenses/by/3.0>, via Wikimedia Commons

Packing for that glamorous summer holiday may have been a remote prospect during the 2020 Covid pandemic, but nothing stops migratory birds from preparing for departure in spring. In readiness, the birds load up on fuel and become restless at night, and the males get their reproductive organs in order while also increasing their testosterone levels. But what triggers these preparations for action? As increasing day length in spring is a sure sign that it's time to get ready to go, Vinod Kumar, from the University of Delhi, India, wondered how much of an influence increasing warmth may have on the birds' transition for their travels. Knowing that black-headed buntings (*Emberiza melanocephala*) overwinter in India before migrating to their breeding grounds in southeastern Europe and central Asia, Kumar, Sayantan Sur and Aakansha Sharma, from the University of Delhi, with Khushboo Chaturvedi, Shalie Malik and Sangeeta Rani, from the University of Lucknow, India, investigated how much of an effect increasing temperatures in spring might have on male birds' departure preparations to find out whether warmth is an essential migration trigger factor.

'We captured birds from the overwintering flock in late February 2018 using mist nets', says Kumar, who only selecting the vivid yellow-breasted males to be transported back to the lab. There, the team recreated the day length and temperature conditions of late winter days (8 h of light at 22°C) for a week, before fast-forwarding 10 birds to April with a 13 h long day, 11 h night, at 22°C. Then the scientists turned up the mercury to 35°C for five of the spring birds to simulate the conditions experienced in the run-up to their departure. After monitoring whether the cool and warm birds became restless at night in readiness to leave, the team measured the birds' pectoral muscle fibres and testosterone levels to find out whether the warmer conditions played a role in their preparations.

Impressively, the temperature had a dramatic effect on the buntings' activity pattern, with the warm late-spring birds switching to a nocturnal lifestyle in preparation for their migration. In contrast, the cooler spring buntings were unready to migrate as they were equally active by day and night, while the hot and cold late-winter birds were even less well prepared, only being active during the daylight hours; temperature seemed to play a dramatic role in preparing the spring birds for their departure. In addition, the muscle fibres of the buntings that experienced the spring heatwave were ~56% thicker than those of the birds that remained in the cooler winter conditions. However, temperature did not seem to affect the amount of testosterone produced by the spring birds.

Sur and Sharma also analysed the activation pattern of genes that could be involved in the birds' preparations, and found that genes that sense temperature were more active in the skins of the hot spring birds, in addition to genes in the brain that contribute to the birds' ability to navigate and muscle-building genes in the bird's flight muscles.

The spring rise in temperature seems to be an essential trigger for the physical changes that migrating black-headed buntings undergo before embarking on their spring migration, and Kumar says, 'We speculate that songbirds use a spring temporal window of favourable temperature for departure from wintering areas'. However, he is concerned that climate change could impact the bunting's ability to depart on time if the critical period of warmth after winter falls out of sync with the daylight clock that also schedules their departure.

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