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INSIDE JEB

Pied flycatcher fathers compensate for moult at take-off

A male pied flycatcher after completing a flight test. Photo credit: Barbara Tomotani.

When Barbara Tomotani, at the Netherlands Institute of Ecology (NIOO), noticed that climate change was having an effect on pied flycatcher (*Ficedula hypoleuca*) nesting, she was concerned: it was occurring earlier in the season. However, she was even more shocked when she realised that the timing of the moulting season, when the males shed their feathers, was also shifting. 'But it was advancing faster', says Tomotani, which might impact the birds' flight and could impair their ability to raise their chicks. Yet it was unclear how much of a toll moulting takes on flycatcher fathers. The loss didn't appear to impair their flight once airborne, yet the fathers that had begun early moults seemed to take a back-seat feeding their young, leaving most of the work to mum. So when a new researcher at Wageningen University, Florian Muijres, gave a guest talk at NIOO about his work comparing the flight of bats and birds, Tomotani realised that she had found the ideal collaborator to investigate the challenges faced by moulting pied flycatcher fathers as they struggle to feed their chicks.

'We were studying flycatchers breeding in nest boxes', says Tomotani, who collected returning males when their chicks were 7 days old to remove two primary feathers from each wing (the second and third from the wing tip) to simulate the disruption caused by moulting. Tomotani then returned when the chicks were ready to fledge (5 days later), only this time she took the males to NIOO to test how well they took off after losing the feathers. 'The most difficult part was the logistics of running this experiment. The indoor flight tests were done at the same time as the fieldwork, so it required a lot of planning and coordination to make sure things ran smoothly', Tomotani recalls. Fortunately, the birds were extremely cooperative when in captivity. 'Almost all of the birds flew immediately upwards as soon as we opened the release box', says Tomotani, who filmed the departures in 3D before painstakingly tracking the positions of 14 points on each bird's wings and body to reconstruct the manoeuvre in fine detail.

However, when Muijres measured the take-off speeds, he was astonished that the birds that had lost wing feathers were taking to the air as fast as the fathers with intact plumage (~2.5 m s^{-1}). Also, they were somehow generating similar lift forces. 'We expected that the birds with moult gaps would fly upwards less quickly', the pair says. So how had the birds made up for their lost feathers?

Muijres calculated the size of the gap in the wing's feathers and realised that it was 31% smaller than the distance between the same feathers when the plumage was intact; the flycatchers had reduced the gap, although it wasn't closed entirely. But what other mechanisms were the birds using to compensate for their feather loss?

Analysing the angle of the wing surface relative to the oncoming air throughout the wing beats, Muijres realised that the birds with gaps in their wing feathers were tipping the wings more (increasing the angle of attack) to compensate for the reduced wing surface area, which, in turn, increased the force generated by the wing. He suspects that the additional effort required for the birds to become airborne while moulting could account for the fathers' dereliction of duty. 'These wingbeat adjustments might be energetically costly', says Muijres, and Tomotani is keen to learn more about the impact of moulting on the ecology of songbirds and how climate change is altering their behaviour.

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