

## INSIDE JEB

## Climbing parrots push and pull to counteract gravity



Montage of X-ray images showing a green-cheeked conure (*Pyrrhura molinae*) climbing a ladder. Photo credit: Laboratory of Comparative Biomechanics, University of Nevada Las Vegas.

What animals would appear on your top 10 list of climbers: monkeys, bears, even snakes? I suspect that parrots may not make it, even if you did remember that the versatile birds appear to clamber through trees using only their feet and beaks. However, climbing parrots were definitely on the radar of Lindsey Reader, David Carrier and Franz Goller from the University of Utah, USA. Without arms to haul themselves aloft, parrots grapple with vines and branches using their beaks and feet. However, all climbers are at risk of pitching backwards if their centre of mass moves too far from the structure that they are scaling, and parrots could be particularly vulnerable. So, how do the resourceful birds overcome the risk of falling? Reader travelled to David Lee's lab at the University of Nevada Las Vegas, USA, to find out how green-cheeked conures (*Pyrrhura molinae*) climb.

'Climbing is at the core of what it means to be a parrot', says Reader, who put her green-cheeked conure, 'Frances Perkins',

through her climbing paces on a series of almost vertical force-sensing ladders built by Michael Isaacs, Alexis Moore-Crisp and Clinton Barnes at The University of Nevada Las Vegas, USA; one with thick (17 mm) rungs spaced 10 cm apart and the second with thinner (8.5 mm) rails. Reader recalls that the birds were so enthusiastic that they often began trying to ascend even before she had activated the X-rays to film their skeletons in 3D. "'Impish little tykes", pretty much sums them up; they can be very sassy', chuckles Reader.

And she quickly realised that the parrots started their ascents with their beak hooked over a rung and both feet located on the rung below. Then, the bird raised one leg to position its foot adjacent to its beak, clasping the rail with its claws before pulling itself up with the first leg while craning its neck to hook its beak over the rung above and raising the second foot to join the first on the rung that the beak had rested on originally. In contrast, when the birds were less sure of

their footing on wider slipperier rails, they waited until they had planted both feet on the rung alongside the beak, before pulling themselves up with their legs.

But how did the birds prevent themselves from tumbling backwards as they ascended? Analysing the forces exerted by the parrots on the rungs, the team realised that the birds were not counterbalancing their weight by twisting their feet on the rails. Instead, during the first part of the manoeuvre, the birds were pulling inward on the upper rung with the beak and the first foot while pushing outward on the lower rung with the second foot – resulting in an overall turning force that counteracted the tendency of gravity to pitch the birds away from the climbing ladder. Then, as they pulled themselves up during the final stage of movement, the parrot's tail came into play, pushing against the lower rung while one and then the other foot pulled inward on the upper rung.

Reader points out that the parrot's climbing prowess is even more impressive given that they are clambering using parts of the body, such as the tail, beak and feet, which evolved for other purposes, such as flight and feeding. 'It's striking that they seem so specialised for climbing in this unique way', she says. The team also suggests that the bird's head and tail could be considered as additional limbs in the context of climbing, despite their alternative primary *modus operandi*.

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Reader, L. L., Carrier, D. R., Goller, F., Isaacs, M. R., Moore Crisp, A., Barnes, C. J. and Lee, D. V. (2022). Climbing parrots achieve pitch stability using forces and free moments produced by axial-appendicular couples. *J. Exp. Biol.* **224**, jeb242305. doi:10.1242/jeb.242305.

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