INSIDE JEB

Stuck woodpeckers ‘walk’ their beaks free for liberty

A black woodpecker (*Dryocopus martius*) in the Alpine Zoo Innsbruck, Austria. Photo credit: Sam Van Wassenbergh.

Carpenters have depended on the ability of wood to grip onto pegs and nails for centuries when constructing ships and furniture. ‘Wood clamps around penetrating sharp objects and, when they are pulled back, exerts shear forces that resist this movement’, says Sam Van Wassenbergh, from the University of Antwerp, Belgium. But how do excavating woodpeckers liberate their beaks when pecking wood? If the birds’ beaks were to become fastened in the same way, ‘it would strongly compromise their pecking performance’, he says. Intrigued by the mystery of how woodpeckers free their beaks when they become stuck, Van Wassenbergh and Anick Abourachid from the CNRS-MNHN 7179 Research Unit, France, filmed two caged black woodpeckers (*Dryocopus martius*) – one at the Alpine Zoo Innsbruck, Austria, and the second at the Natur- und Tierpark Goldau, Switzerland – with high-speed cameras to find out how the determined borers release their beaks.

‘We ended up shooting hand-held as the birds constantly switched between pecking spots and we quickly had to adjust the camera aim’, says Van Wassenbergh, adding that continually adjusting the aperture and focus of the high-speed camera made filming a nightmare. Then, Tim Andries and Evy Pauly from the University of Antwerp selected 10 clips with the best image quality to begin deconstructing the process. First, the duo identified six natural spots on the bird’s head – two each on the upper and lower beak, one on the eye and one on the top of the head – to track their movements. ‘This was not easy, as we had to play around with different contrast enhancement settings to track each spot as accurately as possible’, says Van Wassenbergh. Next, Andries and Pauly analysed the manoeuvre in the context of the beak being withdrawn from the wood and as if the wood was being pulled away from the beak, to really see how the birds release their beaks.

However, instead of simply yanking their beak free, each bird essentially ‘walked’ it out of the tree trunk, by first sliding the upper bill back ∼1.4 mm, while raising the head-end ∼1 mm to open a slight gap between the upper and lower bills, as the tip remained trapped in place. Then, the head tipped slightly forward while the upper and lower bills tipped upward, closing the gap between them as the lower bill slid back beneath the upper, allowing the woodpecker to withdraw the beak from the wood. And the entire manoeuvre was completed in 70 ms, allowing the birds to perform approximately three pecks every second. In addition, the team calculated how often the birds’ beaks became trapped, and it happened more than you might think, with the woodpeckers having to extricate themselves 36% of the time.

So, the beak hinges (the nasofrontal hinge and the joint at the quadrate bone – where the upper and lower beak connect to the skull) are the key to the bird’s escape, explaining why woodpeckers maintain flexibility in these joints, even though it would be better for hammering if the joints were more rigid.

But why do woodpeckers shuffle their beaks when gripped by a tree instead of wrenching them free? The team suspects that there is simply too much friction between the wood and beak to drag it loose. However, the beak surfaces that come together when it is closed are lined with smooth keratin scales, which make it significantly easier to slide the top and bottom mandibles past each other to ‘walk’ the beak free and liberate the bird.

10.1242/jeb.244092

Van Wassenbergh, S., Andries, T., Pauly, E. and Abourachid, A. (2022). Cranial kinesis facilitates quick retraction of stuck woodpecker beaks. *J. Exp. Biol.* **225**, jeb243787. doi:10.1242/jeb.243787

Kathryn Knight
kathryn.knight@biologists.com