

INSIDE JEB

Flung-back forelimbs help some lizards flip up



A racerunner (*Aspidoscelis sexlineata*). Photo credit: Chase Kinsey.

Lizards rarely slouch: they're either on full alert or dashing for cover; and sometimes, when they pull out all the stops, they even flip up and run on two legs. 'Many species run bipedally ... at the start of a sprint', says Lance McBrayer from Georgia Southern University, USA, explaining that rapid acceleration can shift their centre of mass back, lifting their forelimbs off the ground. But after 20 years of watching the creatures fleeing from his shadow, McBrayer suspected that there was more to their bipedal antics than simply pulling a wheelie. Many seem to prefer hurdling obstacles at high speeds on two limbs, with some holding their free forelimbs in specific positions while scrambling over an obstruction. 'I wanted to know, does the position that the forelimbs are held in make much difference in bipedal running?' says McBrayer.

Teaming up with Master's student Chase Kinsey, McBrayer headed south to the Ocala National Forest in Florida to collect two distantly related species with radically different statures; stout Florida scrub lizards (*Sceloporus woodi*) and slender racerunners

(*Aspidoscelis sexlineata*). 'The logistics were challenging', chuckles Kinsey, adding, 'We would check the weather for a trip and see a sunny forecast. Yet, once we arrived, it would rain the whole time'. Despite setbacks, the duo collected enough lizards to film them dashing for cover along a 1 m unimpeded race track or hurdling a wooden obstacle – fine tuned to each lizard's height – 80 cm from the starting block. 'It was fairly easy getting the lizards to run towards their hide', says Kinsey, but he adds, 'Capturing a clean run for the camera was much more difficult', recalling how he placed an angled mirror beside the track so that he could film the sprinting reptiles from two perspectives simultaneously.

Kinsey then painstakingly analysed each sprint and the differences between the two lizards couldn't have been more stark. The stocky scrub lizards preferred scampering along on all fours, only occasionally lifting up onto two, while the slender racerunners frequently favoured sprinting on two limbs. Kinsey also categorised the positions adopted by the scampering lizards' forelimbs when they lifted up and he was impressed that

the racerunners always shifted their forelimbs back towards their hips. In contrast, on the rare occasions when the stout scrub lizards took to their hindlimbs, their forelimb postures ranged from swinging to and fro at their sides to being held in front of their chests; they never opted for the racerunners' pinned-back strategy.

Intrigued by the differences in the reptiles' bipedal running postures, Kinsey measured how their centres of gravity shifted when their forelimbs were tucked back toward their hips versus protruding forward or placed in alternating positions. Impressively, the racerunner's centre of mass shifted 8 mm back toward the hips with the limbs held back. 'The limbs account for such a small proportion of the total mass of the animal, yet they have a significant effect on the position of the centre of mass', says Kinsey, adding that the movement allows the bipedal racerunners to become more upright. More surprisingly, the scrub lizards could shift their centre of mass even further (12.2 mm) by holding their limbs behind their backs. However, they choose instead to hold their limbs forward, increasing their chances of toppling over.

By stowing their limbs effectively, racerunners are able to rear up to take individual obstacles in their bipedal strides, while stocky scrub lizards prefer scrambling on all fours. However, McBrayer and Kinsey point out that even the best bipeds resort to scampering on four limbs when obstructed by multiple obstacles and they are keen to understand why.

10.1242/jeb.195784

Kinsey, C. T. and McBrayer, L. D. (2018). Forelimb position affects facultative bipedal locomotion in lizards. *J. Exp. Biol.* **221**, jeb185975.

Kathryn Knight
kathryn.knight@biologists.com