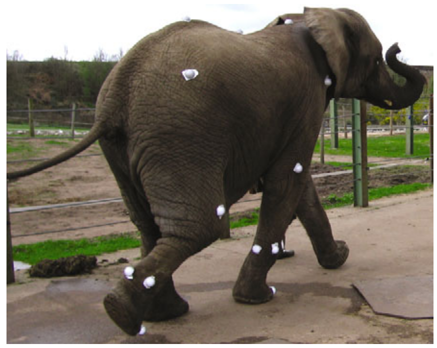
Inside JEB is a twice monthly feature, which highlights the key developments in the *Journal of Experimental Biology*. Written by science journalists, the short reports give the inside view of the science in JEB.

Inside JEB

ELEPHANTS ARE NOT SO INFLEXIBLE AFTER ALL



Throughout history, elephants have been thought of as 'different'. Shakespeare, and even Aristotle, described them as walking on inflexible column-like legs. And this myth persists even today. Which made John Hutchinson from The Royal Veterinary College, London, want to find out more about elephants and the way they move. Are they really that different from other, more fleet-footed species? Are their legs as rigid and 'columnar' as people had thought? Travelling to Thailand and several UK zoos, Hutchinson and his team investigated how Asian Elephants move their legs as they walk and run (p. 2735).

Striking up collaborations with elephant keepers at Colchester and Whipsnade Zoo, Hutchinson explains that the keepers were keen to know more about the animals' natural limb movements to develop training programmes and prevent the onset of arthritis. Fortunately for Hutchinson, the animals were fantastically cooperative when he turned their exercise enclosure into a film set to record their movements; 'this is the same 3D capture technology used in Hollywood blockbusters,' explains Hutchinson. After the team had stuck hemispheres covered in infrared reflecting tape to joints on the elephants' fore and hind limbs, the animals were happy to walk and run in front of the arc of infrared detecting cameras as Hutchinson and his team filmed their steps at speeds ranging from 0.62 $m\ s^{-1}$ to 4.92 $m\ s^{-1}$. 'The big problem was keeping the markers in place,' says Hutchinson, 'the little ones kept on pulling them off with their trunks.' Having filmed animals ranging in size from 521 to 3512 kg, Hutchinson, Lei Ren and Charlotte Miller travelled to Thailand to film the athletic elite; Thai racing elephants that easily outpaced the UK elephants at 6.8 $m\ s^{-1}$.

Back in the lab, Ren converted each elephant's movements into stick figures, and found that their legs are not as columnar as previously thought, with the shoulder, hip, knee and elbow joints flexing significantly. As the elephants swung their front legs forward they also flicked their feet up, bending their wrists by more than 80°, to keep them clear of the ground. Meanwhile, the elephants' ankles were far more rigid. Unable to bend the ankle as they swung their legs, the animals moved them out in an arc, to avoid dragging their hind feet along the ground. However, it was a different matter when the team analysed their joints during the stance phase; the apparently rigid ankle was relatively spring-like, whilst the previously flexible wrist became rigid while supporting the animal's weight.

Hutchinson also compared his Asian elephant data with Delf Schwerda and Martin Fischer's data from African elephants: the two species were indistinguishable. Most surprisingly, when Heather Paxton investigated the maximum swing range of each joint, she found that elephants were using almost all of their mobility range. And when the team compared the elephants' movements with those of horses, they found that the elephants' joints were almost as mobile as trotting horses'.

Best of all, when Hutchinson compared the athletic Thai elephants with their more sluggish UK cousins, their movements were essentially the same. Captivity had not modified the elephants' mobility range, just slowed them down a little. 'The keepers were very pleased,' says Hutchinson.

So elephant legs are far from the inflexible columns that Shakespeare would have us believe. And Hutchinson adds that as many people base simulations of dinosaur movements on how they think elephants move, they can now base their simulations on something more realistic.

10.1242/jeb.023390

Ren, L., Butler, M., Miller, C., Paxton, H., Schwerda, D., Fischer, M. S. and Hutchinson, J. R. (2008). The movements of limb segments and joints during locomotion in African and Asian elephants. *J. Exp. Biol.* **211**, 2735-2751.

WHAT RUSTLING INSECTS GIVE AWAY

Foraging in the dark is challenging, but not when you're equipped with echolocation. Plucking insects from the open air is simple for bats. But it's much trickier hunting at the forest edge. Detecting an insect amongst the barrage of reflections from the surroundings seems almost impossible. So how do echolocating bats locate tasty treats on the forest floor? Björn Siemers from the Max Plank Institute of Ornithology explains that some bats tune their acute hearing to the tiny rustling sounds made by insects.

But how much of an effect does the material that an insect is clambering over have on the tell-tale sound it makes? And what could an approaching bat learn about its victim from its rustling? Siemers and his students, Holger Goerlitz and Stefan Greif, decided to measure sound volumes as insects scuttled across various natural surfaces to see how the landscape affects their acoustic trail (p. 2799).

Starting out in Germany, Siemers and Greif decided to measure the sounds made by insects as they wandered over three different surfaces; a beech forest floor, a freshly mown meadow and newly ploughed earth. But the team needed to make their sensitive recordings in a completely silent environment, so they excavated 50 cm square chunks of each surface and transported them back to a soundproof room in the University of Tübingen to record the noises made by wandering carabid beetles. Equipped with exquisitely sensitive recording equipment, Greif waited patiently for the beetles to go about their everyday business, recording their tiny footsteps as they walked over each surface when dry and damp.

Analysing the recordings, Siemers found that the beetles were much nosier ambling through the beech leaf litter than the meadow or bare earth. And when he compared the sound generated by the dry surfaces with that from the same surfaces when damp, the volume doubled across all surfaces. The team also found that the rustling became significantly louder as the beetles walked faster.

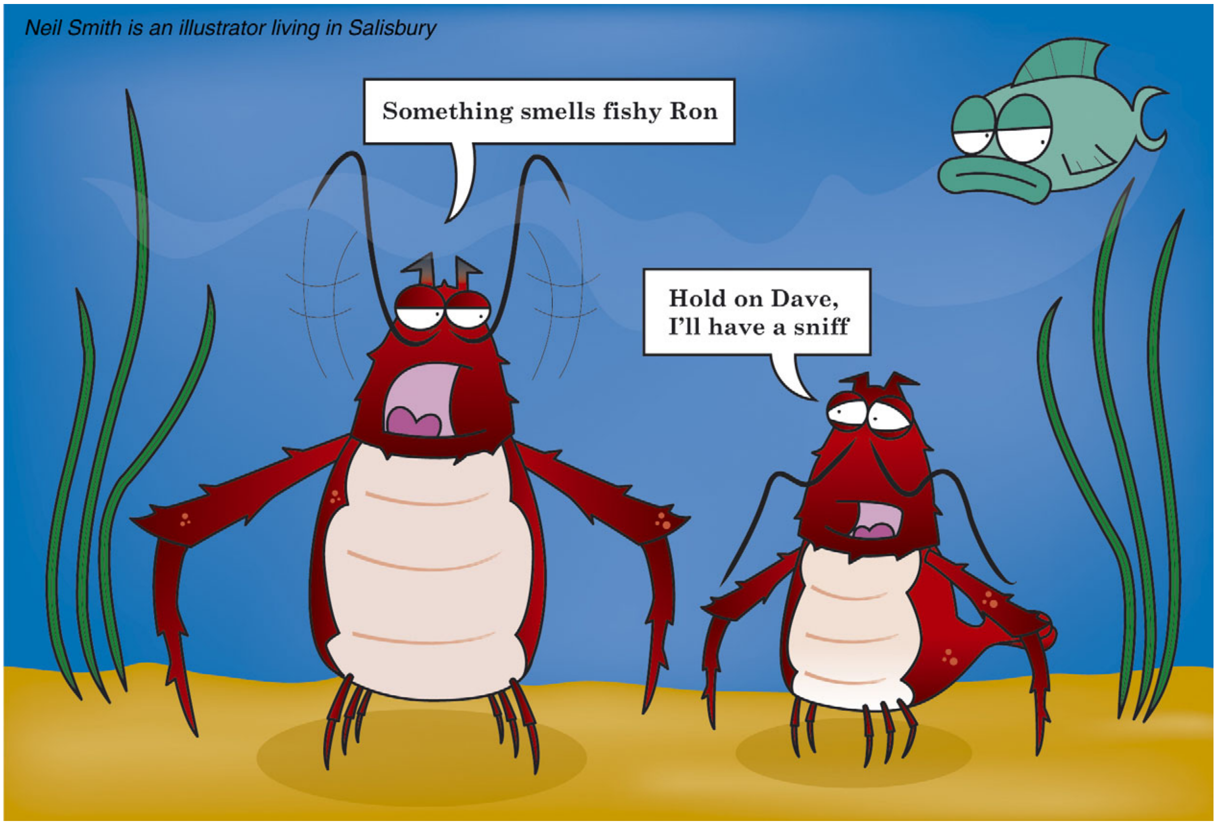
But what effect did the beetles' size have on their rustling volumes? Siemers needed to find insects with a wide range of sizes and knew that the Madagascan rainforest is home to some of the most diverse populations of insects on the planet. Collecting beetles and cockroaches ranging in size from a few tens of milligrams up to 10 g, Siemers and Goerlitz recorded the sounds generated by the animals as they walked across dry leaf litter, bark or sand and found that the larger beetles made louder rustling noises. Also, the volume increase was more significant for larger creatures on noisy leaf litter than sand, with relatively small increases in the insects' size generating significantly larger sound volumes.

So what does all this mean for a ravenous bat hunting for a snack? Siemers explains that given the way sounds fade as you move further from their source, a beetle clambering over dry leaf litter could be heard eight times further away than another ambling over dry soil. He also suspects that an approaching bat could distinguish between a millipede and a six-legged beetle, but probably couldn't differentiate between a spider and a beetle. And if the bat knew a little about the nature of the surface beneath the insect, it might even be able to estimate its size, all crucial information for helping a bat to decide whether it's worth snatching that snack.

10.1242/jeb.023374

Goerlitz, H. R., Greif, S. and Siemers, B. M. (2008). Cues for acoustic detection of prey: insect rustling sounds and the influence of walking substrate. *J. Exp. Biol.* **211**, 2799-2806.

SPINY LOBSTERS SNIFF BY FLICKING



When spiny lobsters sniff out the lay of the land, they wave their scent-sensitive antennules through odour plumes that waft their way. According to Mimi Koehl from the University of California, Berkeley, spiny lobsters 'sniff' by rapidly flicking their antennules downwards before slowly lifting the antennule up. But how do the flicking movements affect the way that odour molecules get picked up by scent receptors on the antennules' aesthetascs? Koehl, Matthew Reidenbach and Nicole George built a large scale model of an antennule from clay, complete with aesthetascs and guard hairs made from Pyrex©. Next the team reproduced the antennule's flicking movements in slow motion in a tank filled with mineral oil, while visualising the fluid flows around the Pyrex© aesthetascs with a plane of laser light (p. 2849).

According to Koehl, the fluid flowed rapidly through the hair and aesthetasc network as the antennule swept downward, completely replacing the fluid in contact with the scent-sensitive aesthetascs. Then the fluid remained trapped by the guard hairs and aesthetascs as the model antennule slowly returned to its starting point. Knowing that a return 'flick' could take as long as 0.5 s, Koehl and her team calculated that this would be long enough for 25% of the odour molecules trapped in the fluid to diffuse through to the aesthetascs' scent receptors, allowing the lobsters to take a good sniff at any scent that drifted by.

10.1242/jeb.023382

Reidenbach, M. A., George, N. and Koehl, M. A. R. (2008). Antennule morphology and flicking kinematics facilitate odor sampling by the spiny lobster, *Panulirus argus*. *J. Exp. Biol.* **211**, 2849-2858.

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