How geckos cope with wet feet

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Close-up of the underside of a gecko's foot as it walks on a glass wall. Van der Waals force interactions between the finely divided setae (hairs on the toes) and the glass enables the gecko to stay in place and walk on the seemingly smooth glass. Image: Bjørn Christian Tørrissen, via Wikipedia.

Geckos are remarkable little creatures, clinging to almost any dry surface, and Alyssa Stark, from the University of Akron, USA, explains that they appear to be equally happy scampering through tropical rainforest canopies as they are in urban settings. 'A lot of work is done on geckos that looks at the very small adhesive structures on their toes to really understand how the system works at the most basic level', says Stark. She adds that the animals grip surfaces with microscopic hairs on the soles of their feet that make close enough contact to be attracted to

the surface by the minute van der Waals forces between atoms. However, she and her colleagues Timothy Sullivan and Peter Niewiarowski were curious about how the lizards cope on surfaces in their natural habitat.

Explaining that previous studies had focused on the reptiles clinging to artificial dry surfaces, Stark says 'We know they are in tropical environments that probably have a lot of rain and it's not like the geckos fall out of the trees when it's wet'. Yet, the animals do seem to have trouble getting a grip on smooth wet surfaces, sliding down wet vertical glass after a several steps even though minute patches of the animal's adhesive structures do not slip under humid conditions on moist glass. The team decided to find out how Tokay geckos with wet feet cope on wet and dry surfaces, and publish their discovery that geckos struggle to remain attached as their feet get wetter in The Journal of Experimental Biology.

But first they had to find out how well their geckos clung onto glass with dry feet. Fitting a tiny harness around the lizard's pelvis and gently lowering the animal onto a plate of smooth glass, Stark and Sullivan allowed the animal to become well attached before connecting the harness to a tiny motor and gently pull the lizard until it came unstuck. The geckos hung on tenaciously, and only came unstuck at forces of around 20N, which is about 20 times their own body weight. 'The gecko attachment system is over-designed', says Stark.

Next, the trio sprayed the glass plate with a mist of water and retested the lizards, but this time the animals had problems holding tight: the attachment force varied each time they took a step. The droplets were interfering with the lizards' attachment mechanism, but it wasn't clear how. And when the team immersed the geckos in a bath of room temperature water with a smooth glass bottom, the animals were completely unable to anchor themselves to the smooth surface. 'The toes

are superhydrophobic [water repellent]', explains Stark, who could see a silvery bubble of air around their toes, but they were unable to displace the water around their feet to make the tight van der Waals contacts that usually keep the geckos in place.

Then, the team tested the lizard's adhesive forces on the dry surface when their feet had been soaking for 90min and found that the lizards could barely hold on, detaching when they were pulled with a force roughly equalling their own weight. 'That might be the sliding behaviour that we see when the geckos climb vertically up misted glass', says Stark. So, geckos climbing on wet surfaces with damp feet are constantly on the verge of slipping and Stark adds that when the soggy lizards were faced with the misted and immersed horizontal surfaces, they slipped as soon as the rig started pulling.

Therefore geckos can walk on wet surfaces, so long as their feet are reasonably dry. However, as soon as their feet get wet, they are barely able to hang on and the team is keen to understand how long it takes geckos to recover from a drenching.

More information: Stark, A. Y., Sullivan, T. W. and Niewiarowski, P. H. (2012). The effect of surface water and wetting on gecko adhesion. *J. Exp. Biol.* 215, 3080-3086. jeb.biologists.org/content/215/17/3080.abstract

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