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INSIDE JEB

Long shanks make jumping easier in mice

A female Longshanks mouse standing on a force plate. Photo credit: Madison Bradley-Cronkwright.

Whether an animal is just going about its daily business or escaping from predators, moving can take quite a bit of energy. So, some animals have adopted jumping as a way of making themselves more energy efficient or more difficult to catch. Whatever their reason, animals that frequently jump around have one thing in common: longer leg bones. However, studying jumping animals such as kangaroos and small primates is difficult given their size and scarcity. But, what if you could 'engineer' your own study organism that would be small and easy to work with, but also have longer leg bones than other, similarly sized animals? In 2010, Campbell Rolian's research group at the Unviersity of Calgary, Canada, did just that, selectively breeding mice to have longer tibias. Now, the 'Longshanks' mice have tibias that are 15% longer than those of normal mice. But do these long-limbed mice jump better as well? Madison Bradley-Cronkwright of Duke University, USA, along with Sarah Moore, Lily Hou, Susanne Cote and Campbell Rolian at the University of Calgary set out to discover the answer.

Six years after the colony was founded, Bradley-Cronkwright and colleagues began the difficult task of training some of the mice to jump onto a platform. It took over 30 training sessions but, eventually, each mouse earned its peanut butter reward. First, the team wanted to see how high the Longshanks mice voluntarily jumped onto the platform. They found that the Longshanks mice preferred to jump ∼4.5 cm higher than normal mice. But do their longer legs make it any easier for them to leap?

Next, the team had the Longshanks mice jump from a force plate – a device that measures the amount of pressure that is being pushed down upon it – onto platforms that were 6, 10 or 14 cm high and video recorded their leaps. They found that the Longshanks mice didn't push off from the ground as hard as normal mice, suggesting that they weren't using as much energy to propel themselves upward. But providing more force isn't the only way to jump high. You can also increase the amount of time your feet stay in contact with the ground – which is exactly what the Longshanks mice did. 'Longer limbs give you more distance and time to accelerate over; much like having a longer runway helps a plane to take off,' explains Bradley-Cronkwright. The researchers suggest that this is caused by the longer leg bones in the Longshanks mice. But better jumping could also be the result of having bigger muscles.

So, Bradley-Cronkwright and colleagues measured the size of the gastrocnemius (calf) muscles of the Longshanks mice using CT scanning. While all of the Longshanks mice had longer calf muscles, one group also had calf muscles with a bigger cross-sectional area, suggesting that their muscles are more powerful. When the researchers investigated this group further, they found that their feet stayed in contact with the ground only slightly longer when jumping than did those of the normal mice, but not long enough to make them better jumpers. This means that both groups of Longshanks mice developed their own solutions for better jumping that are related to how long their limbs are: one group relied on jumping technique while the other used technique and larger muscles to power their leap. In the same way that bats, birds and insects all fly, but do so in different ways, evolution has once again come up with multiple solutions to the same problem. The team has given biologists a new tool for exploring how evolution can affect animals and shows that long limbs alone can make jumping a little easier.

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