Large mammal species live harder, die out faster

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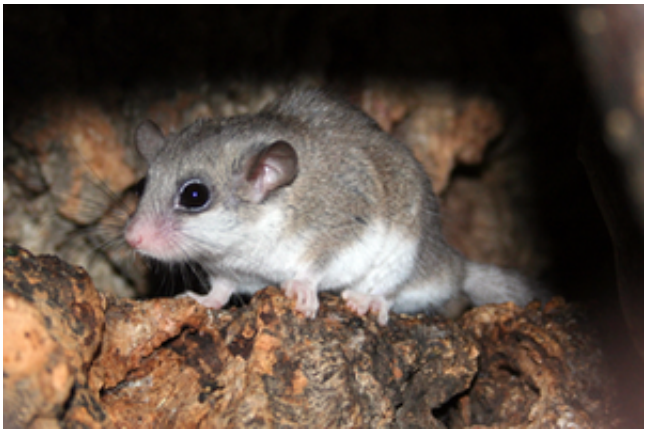

Researchers have discovered that small mammals, such as those similar to this dormouse, tend to survive longer as a species, while larger mammals tend to die out and/or evolve faster. Image: H. Osadnik.

Throughout Earth's history, species have come and gone, being replaced by new ones that are better able to cope with life's challenges. But some species last longer than others, while others may die out sooner or evolve more quickly.

Recently, a team of researchers from Finland, Norway and the US has found that larger mammals seem to evolve more quickly than smaller ones – but the reason isn't body size, per se. Rather, the scientists found that some smaller mammals have the ability to hibernate, burrow or hide in other shelters. In doing so, they effectively sleep through harsh

environmental changes.

Larger mammals, on the other hand, must endure the hard times when there's little food or extreme weather. Their large size constrains them from digging burrows or lowering their metabolic rates for extended time periods. In a sense, larger mammals face the elements head-on like a fearless adventurer who might not make it through alive, and is forever changed by the experience.

The finding – which is based on analysis of a large Neogene Old World fossil dataset – is somewhat surprising. On an individual level, large mammals tend to live significantly longer than smaller ones. For example, elephants can live up to 70 years, while shrews are lucky to reach two. Because of their faster generation times, small mammals should evolve faster, and small mammal species and genera should appear and go extinct faster – but this is not the case.

"We believe the greatest significance of our work is showing that, contrary to expectation, small mammals do not evolve faster than large mammals, and that some of them actually evolve much slower," Nils Stenseth, zoology professor at the University of Oslo, told *PhysOrg.com*. "The greatest potential significance is in the SLOH [sleep-or-hide] hypothesis – specifically in its implication that removing part of the environmental pressure slows down evolution quite dramatically."

Previous studies – some focusing on tropical mammals – have had mixed results on size-based evolution rates for fossil mammals, with some finding the opposite pattern and some finding no difference. One possible explanation is that large mammals in tropical climates don't face such harsh environmental conditions, and so they may last longer and evolve more slowly. Further, smaller mammals in tropical areas may suffer from the increased competition, leading to more rapid turnover rates for them.

But overall, small mammals' ability to hibernate or enter a state of torpor seems to give them the largest benefit for prolonging their species duration. As the researchers found, 41 of 67 (61 percent) extinct small mammal genera had some kind of hibernation ability, while only 15 of 50 (30 percent) extinct large mammal genera did. And the small mammals that didn't hibernate had relatively faster evolution rates, as they were forced to cope with the elements.

The longest living genera in the study were a mole, two gliding squirrels, and two dormice, which lasted about 16 million years, and all had the ability to burrow or hibernate. The tapir was the only large mammal that evolved at a slow rate more akin to the smaller mammals. Most large mammals that didn't hibernate evolved into a new species or went extinct in just a few million years.

The shortest duration in the researchers' data was one million years. However, Stenseth noted that the truly short-lived creatures are invisible in the fossil record. He also explained that short-lived and long-lived mammals both have their own advantages and disadvantages.

"The most diverse and abundant groups, such as the mouse-like (muroid) rodents, have high origination and extinction rates," he said. "But slow evolvers like dormice are successful in their own way, and clearly very good at what they are doing."

In light of the current climate crisis, this study may help scientists predict which kinds of species are more vulnerable to climatic fluctuations, the authors explain.

"There has been a steady loss of large mammals in recent times, and this trend is likely to continue," said Mikael Fortelius, geology professor at the University of Helsinki and a co-author of the paper. "We are currently extending our PNAS study to include living mammals and hope

to be able to present our results soon."

More information: Liow, Lee Hsiang;, Fortelius, Mikael; Bingham, Ella; Lintulaakso, Kari; Mannila, Heikki; Flynn, Larry; and Stenseth, Nils Chr. "Higher origination and extinction rates in larger mammals." *Proceedings of the National Academy of Sciences.* April 22, 2008, vol. 105, no. 16, 6097-6102.