Ridiculously cute mouse lemurs hold key to Madagascar's past

July 18 2016

A Goodman's mouse lemur, named for study co-author Steve Goodman, was one of the species studied. The lemur's scientific name is *Microcebus lehilahytsara*--"lehilahytsara" is Malagasy for "good man," after Steve. Credit: Robert Zingg

Today, Madagascar is home to a mosaic of different habitats—a lush rainforest in the east and a dry deciduous forest in the west, separated by largely open highlands. But the island off the southeast coast of Africa hasn't always been like that—a new study published in the *Proceedings*

of the National Academy of Sciences announces that these two ecologically different portions of the island were once linked by a patchwork of forested areas. And to figure it out, the scientists analyzed the DNA of some of the cutest animals on earth—mouse lemurs.

"For a long time, scientists weren't sure how or why Madagascar's biogeography changed in very recent geological time, specifically at the key period around when humans arrived on the island a few thousand years ago. It has been proposed they heavily impacted the Central Highland forests," says Steve Goodman, MacArthur Field Biologist at The Field Museum in Chicago, who co-authored the study and has been studying Malagasy animals for thirty years. "This study shows the landscape was changing thousands of years before humans arrived."

So scientists wanted to learn about the history of Madagascar's landscape—why study mouse lemurs? The tiny primates are the perfect combination of fast-breeding, hardy, and unique to the island. "They reach reproductive maturity within a year, and that means that a lot of generations are produced very quickly," explains Goodman. "That enables us to see evolution at work faster than we would in an animal that took, say, five years to first reproduce." The lemurs, which are found only on Madagascar, live across much of the island, even forested areas that have been damaged by humans. That means that for scientists studying how the island changed over time, mouse lemurs are a jackpot. "The mouse lemurs are forest dependent—as the forest changes, they change. By studying how mouse lemurs evolved in different areas of the island, we're able to glimpse how the island itself changed and learn whether those changes were caused by humans," says Goodman.

By analyzing DNA from five different mouse lemur species, the scientists were able to tell when the different kinds of lemurs branched out from each other. "We were able to characterize tens of thousands of changes in the genomes of mouse lemurs that are now isolated and form

separate species. By analyzing these DNA changes, we were able to understand when the species diverged from each other, and by inference, identify the ecological forces that might have driven them apart," says Anne Yoder, Director of the Duke University Lemur Center and lead author on the paper.

"When we analyzed the mouse lemurs' DNA, we were able to see genetic similarities between lemur species that are closely related but today live far apart from each other. That suggests that their ancestors were able to disperse across forested habitat that no longer exists—portions of the Central Highlands that formed the bridge between the eastern and western parts of the island today," explains Goodman. Instead, the scientists believe, Madagascar was covered by a patchwork of forests, enabling the mouse lemurs to slowly disperse over tens of thousands of years between different areas. Then, once those bridges did not exist anymore, the populations became isolated.

The DNA analysis allowed the scientists to infer the timeline for the habitat changes of the Central Highlands—it happened thousands of years before humans arrived on the island. "At least at first, the changes to this region of the island were almost certainly the result of natural climate change over the past approximately 50,000 years," says Goodman.

The study also indicates that the former forested areas of the Central Highlands may have been an important zone of ecological transition between the extremes of eastern humid forests and western dry forests. This has important implications for understanding how the mid-section of the island served as a zone of dispersal for animals, such as mouse lemurs and many others. "We've learned that it's probably incorrect to talk about Madagascar's humid east and dry west like they're two completely separate habitats," says Goodman. "The eastern and western parts of the island are just different extremes on the continuum."

"Madagascar is one of the top conservation priorities in the world," says Goodman. "All of the native land mammals on Madagascar occur nowhere else in the world. This study is important because it sheds light upon the long-term life history of Madagascar, before human colonization. It helps us understand change."

More information: Geogenetic patterns in mouse lemurs (genus Microcebus) reveal the ghosts of Madagascar's forests past, www.pnas.org/cgi/doi/10.1073/pnas.1601081113

Provided by Field Museum