Study of rodent family tree puts brakes on commonly held understanding of evolution

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Rodents can tell us a lot about the way species evolve after they move into new areas, according to a new and exceptionally broad study conducted in part by Florida State University biological science Professor Scott J. Steppan.

The study of the evolutionary history of rodents calls into doubt a generally held understanding that when a species colonizes a new region, such as a continent, evolution leads to a dramatic increase in the number and variety of species.

"Biological diversification, or adaptive radiation, is generally thought to be the major explanation for diversification across all of life," said Scott J. Steppan, a Florida State University professor of biological science. "One of the most fundamental questions in biology is why some groups of plants and animals have lots of species and others do not. To address this question, we developed the most comprehensive DNA-based family tree of the most evolutionally successful group of mammals—the muroid rodents."

In the study, "Ecological Opportunity and Incumbency in the Diversification of Repeated Continental Colonizations by Muroid Rodents," published in the journal *Systematic Biology*, Steppan, John J. Schenk of Tulane University and Kevin C. Rowe of Victoria Museum, Australia, used the phylogeny, or evolutionary family tree, of these rodents to test whether the adaptive radiation model of biological diversification actually is as common as presumed.

In one of the most complex studies of the question in any group of organisms, the researchers demonstrated that muroids have colonized continents at least 28 times. Muroids include most of the species used in biomedical research, such as mice, rats, hamsters and gerbils.

When a species first colonizes a new area with no close competitors, biologists would expect the rate at which new species are created to increase rapidly. Then, adaptation into new niches should make the descendent species very different from one another. Finally, as niches fill up, these first two processes should slow down.

"In this study, we discovered that contrary to expectations, colonizing even entire continents does not generally lead to a rapid adaptive radiation, thus calling into question this model as a general explanation about the diversity of life on Earth," Steppan said.

The researchers did find that there is a weak general effect of first colonizers suppressing diversity among later colonizers, and that there is one clear exception to the general pattern. The first colonization of South America by muroid rodents between 7 million and 10 million years ago did lead to one of the great radiations in mammals—with more than 320 species—that fits the model well.

In addition to the most commonly known species of rodents, muroids also include an enormous number of more specialized and lesser-known species, from the kangaroo-like hopping mice of Australia to the giant-maned rat of East Africa, which is the only poisonous rodent. With 300 species included in the study, it is the largest such single study conducted in mammals and one of the largest ever in animals.

"Our study, which includes this muroid family tree, is significant because it firmly establishes the evolutionary history of this most diverse mammal group," Steppan said. "It also provides the new standard phylogenetic framework for future studies comparing different rodent species, whether wild species or those used for biomedical research."

In studies ranging from the process of aging to the effects of diet on heart disease or cancer susceptibility, it is important for biomedical researchers to compare multiple species of rodents and consider their evolutionary relationships, according to Steppan. This allows researchers to determine which aspects of rodent biology are related to unique adaptations and which features or results are more generally applicable to humans.

Provided by Florida State University

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