# Searching for a silver bullet: Measuring biodiversity to inform species conservation

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(Phys.org)—Ecologists in the University of Georgia Odum School of Ecology have found that evolutionary diversity can be an effective method for identifying hotspots of mammal biodiversity. In a paper published Oct. 17 in the journal *Proceedings of the Royal Society B*, they report that evolutionary diversity can be an effective proxy for both the sheer number of species as well as their characteristics and ecological roles. Their findings could help conservation organizations better protect threatened species across the globe.

There are several measures of biodiversity, including species richness—the number of species in a given area—and evolutionary diversity—how closely related the species in an area are to one another. A third measure, trait diversity, or the variation in biological and ecological characteristics across an area's species, is less commonly used but is potentially the most important in terms of conservation.

"Trait diversity is a key element when we think about biodiversity in terms of ecosystem resilience against perturbation or the stability of the system against sudden lethal events," said Shan Huang, a doctoral student in the Odum School and the study's lead author. "But trait diversity is very difficult to quantify at a scale that's meaningful for conservation prioritizing."

Decisions about which areas to conserve to protect threatened species typically have been based on species richness alone. Huang and her coauthors John Gittleman, dean of the Odum School, and Patrick

Stephens, an assistant research scientist, wanted to determine whether there was any agreement between species richness, evolutionary diversity and trait diversity and, if so, whether one of the measures could serve as a good representative of all three—or, as Huang described it, a "silver bullet."

"That would make it a whole lot easier and cheaper and more straightforward to make decisions about where to conserve," Gittleman said.

The team first had to decide how to measure trait diversity in a meaningful way for conservation purposes. The most common method is known as trait variance, a straightforward mathematical measure of traits within communities.

"Imagine a community of mammals that consists of just two species—mouse and elephant," Stephens said. "If you just measure the difference between their body sizes, for instance, you could conclude that this was a very diverse community."

The researchers weren't satisfied that trait variance provided enough useful information about the roles species play in an ecosystem, so Stephens developed a new way of measuring trait diversity, calling it trait bin filling. A trait bin represents an order of magnitude of a particular trait.

"For example, body mass in terrestrial mammals spans eight orders of magnitude, from a mouse or a shrew being the smallest to an elephant being the largest," he said. "There are all sorts of things in the middle—deer, dogs, humans, etc. To tie it back to conservation, if you have two animal species that differ by an order of magnitude in body mass, you know they're doing very different things from each other ecologically."

Huang agreed. "Trait variance is not a very intuitive way to look at site biodiversity. But if you know how many bins are filled, it essentially tells you how many types of animals you have. It's very straightforward and easy to quantify."

Working with enormous databases—PanTHERIA, an online global compendium of biological and ecological information about all known living mammal species, and the IUCN mammal species database, which was initiated by their Global Mammal Assessment and includes all known mammals' geographic range and threat status—Huang and her colleagues analyzed and compared species richness, evolutionary diversity and trait diversity of terrestrial mammal communities across the world.

"Our ideal hypothesis was that all the measures would agree," Gittleman said. "Of course, ecology and conservation never work as cleanly as that."

The team found that while species richness and evolutionary diversity correlate very well, agreement with trait diversity depended upon whether it was measured in terms of variance or bin filling. In general, evolutionary diversity did a better job of predicting trait variance and roughly as well as species richness at predicting bin filling.

"The main point is that evolutionary diversity could be a reliable representative of biodiversity," Huang said. "In some cases, it's as good as species richness, in some cases better. Also, because it's based on molecular data, it's the measure of biodiversity that correlates with genetic diversity, so it's a meaningful surrogate."

There are practical reasons why this is good news for those interested in conserving threatened species. "With new molecular techniques, it's much easier, faster and cheaper to come up with an evolutionary tree

than going out and counting species in the field," Gittleman said. "This is a sort of shortcut."

Huang cautioned that the correlation was stronger for some traits than others. "This might imply that the diversity of some traits is more influenced by contemporary ecological interactions and environmental conditions than by evolutionary history," she said, adding that further exploration was warranted.

"In terms of next steps, we need to know for which areas and species there is disagreement or incongruence," said Gittleman. "That may tell us about the biology and ecology of species distributions or something about the different levels of threat. And it may say something about the process of extinction itself."

**More information:** rspb.royalsocietypublishing.or … .1098/rspb.2012.1981

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