

Extinctions, loss of habitat harm evolutionary diversity

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These are protoaceae plants *banksia menziesii* (firewood banksia) in Australia.
Credit: Photo by H. Morlon

A mathematically driven evolutionary snapshot of woody plants in four similar climates around the world has given scientists a fresh perspective on genetic diversity and threats posed by both extinctions and loss of habitat.

The message from the study, appearing online ahead of publication in [Ecology Letters](#), says lead author H  l  ne Morlon, is that evolutionary diversity -- the millions of years of evolutionary innovations contained in present-day species -- is more sensitive to extinctions or loss of habitat than long thought. And that, she adds, means conservation efforts really need to take into consideration how species are evolutionarily related.

"We are all interested in preserving biodiversity," said Morlon, a French scientist formerly with the University of Oregon's Center for Ecology and Evolutionary Biology as a postdoctoral researcher and now at the University of California, Berkeley. "This means trying to preserve the most species we can, but remembering that all species are not equal. None of us want to make choices on which species to preserve, but if we have to, we might be interested in preserving the species that are the most unique in evolutionary history. There are also other characteristics of species to consider, of course. Biodiversity is simply too complex to be summarized by a single number -- be it species richness or phylogenetic diversity."

Since conservation efforts take place within specific geographical or geopolitical areas, Morlon said: "It is important to understand how biodiversity is distributed spatially." To consider that, the researchers focused on plant species living within defined areas in Mediterranean-type regions around the world -- Australia, California, Chile and South Africa.



These are proteaceae plants, commonly known as laurel protea or laurel-leaf protea, in South Africa. Credit: Photo by H. Morlon

For 538 plant species, which covered 254 genera and 71 families, researchers built an evolutionary tree tracing them back to their common ancestor. They then applied mathematical approaches that considered the increase of evolutionary diversity with the size of geographic areas, as well as the decay of evolutionary similarity with the geographic separation between various communities.

The newly described approach -- one of the first to mathematically compute spatial diversity patterns involving phylogenetic relationships -- is based on realistic ancestry trees. There is a general belief that only a small amount of evolutionary diversity is being lost when [extinction](#) occurs. This would be true if the terminal branches of phylogenetic trees were short, said Morlon. But phylogenetic trees typically have long terminal branches; the impact of extinction on phylogenetic diversity is huge.

"When you think about species, you usually think of, say, those in the Northwest, and they are not present in South Africa," she said. "When people have thought about preserving the tree of life, not preserving only species but also all this evolutionary history, they have tended to think at a global scale. If you consider a branch of the tree of life that is present in the Northwest and also in South- Africa, you can lose one while the other remains to preserve diversity on the planet. These connections are important to make, but it is important to preserve phylogenetic diversity at regional scales, not only the global scale."

"The tools that conservationists use to preserve species at regional scales are not well adapted for preserving phylogenetic diversity," said Morlon, who is also on the faculty of Ecole Polytechnique in France. "This paper gives some clues on how to preserve that diversity."

"The beauty of Helene's work is that she has truly brought together ideas from ecology and evolution," said co-author Jessica Green, a UO

biologist in the Center for Ecology and Evolutionary Biology (CEEB) and the Santa Fe Institute. "If you open any ecology textbook a central theme is island biogeography, which was developed by Robert MacArthur and E. O. Wilson to explain why larger islands have more species on them than smaller islands. Helene has brought evolution front and center to this classic field of study. I anticipate that her ideas about how [evolutionary history](#) increases with increasing habitat area will land in the next generation of science textbooks."

Provided by University of Oregon

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