Species accumulate on Earth at slower rates than in the past: study

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Computational biologists at the University of Pennsylvania say that species are still accumulating on Earth but at a slower rate than in the past.

In the study, published in the journal PLoS Biology, Penn researchers developed a novel computational approach to infer the dynamics of species diversification using the family trees of present-day species. Using nine patterns of diversification as alternative models, they examined 289 phylogenies, or evolutionary trees, representing amphibians, arthropods, birds, mammals, mollusks and flowering plants.

The study demonstrated that diversity is generally not at equilibrium. Nonetheless, speciation rates have typically decayed over time, suggesting that the diversification of species is somehow constrained, and that equilibrium may eventually be reached.

There are many competing theories for how species diversify and become extinct. Some suggest that species continually accumulate in time, always finding new ecological niches. Other theories suggest that the number of coexisting species is limited and that we will eventually have equilibrium. In other words, a species will be born only when another goes extinct.

The question that intrigued the Penn researchers was whether species diversity on Earth is in equilibrium or is still expanding. They also wondered whether the world has an invisible stop sign on species

diversity that would eventually limit the diversity on the planet.

"What we see is diversification rates that are declining but not yet to zero," said Joshua Plotkin, assistant professor in the Department of Biology in the School of Arts and Sciences at Penn. "We are not yet in equilibrium. Either there is a limit to the total species number and we haven't reached it yet, or there is no such limit. But the rates of diversification are typically falling; when we will hit zero is not yet obvious."

While it is clear that Earth has recently lost species due to human impact, this study dealt with much longer, geologic time scales. Understanding these long-term dynamics is central to our understanding of what controls present-day biodiversity across groups and regions.

Even though the study did not deal with the current anthropogenic loss of biodiversity, researchers were surprised at how little extinction they actually saw in the evolutionary trees of species. The fossil record shows that many species have gone extinct over geologic time. For example, the diversity of whales has decreased during the last ~12 million years. But extinction was rarely apparent in this analysis of evolutionary trees.

The study also shows how analyzing molecular phylogenies can shed light on patterns of speciation and extinction; future work may reconcile this approach with the fossil record.

"By taking advantage of existing data from the flood of genomic research, we hope to combine efforts with paleontologists gathering fossil data," Plotkin said.

Provided by University of Pennsylvania