Evolution is predictable, study suggests

July 21, 2013
Courtesy of UC Davis
and World Science staff

If you could hit the reset button on evolution and start over, would basically the same species appear? Yes, according to a study of Caribbean lizards published July 19 in the journal *Science*.

Pairs of *Anolis* species from different Greater Antillean islands that have independently evolved matching morphologies, or body forms. Anoles diversifying on four islands repeatedly colonized the same adaptive peaks on a shared evolutiona landscape, resulting not just in convergence among a few species pairs, such as those shown here, but in the convergence of entire island anole faunas, researchers said. From left to right, the top row depicts giant tree crown specialists Anolis cuvieri (Puerto Rico; photo by J. Losos) and A. garmani (Jamaica); second row depicts the twig specialists A. garridoi (Cuba) and A. occultus (Puerto Rico); third row depicts trunk and ground specialists A. cybotes (Hispaniola; photo by B. Falk) and A. lineatopus (Jamaica); fourth row depicts grass specialists A. alumina (Hispaniola; photo by M. Landestoy) and A. alutaceus (Cuba). Images not otherwise marked are by L. Mahler. (Credit: Luke Mahler, UC Da-

vis)

Biologists have long debated evolution's predictability over millions of years, said Luke Mahler of the University of California, Davis, one of the researchers. For example, the late Stephen Jay Gould predicted that if you "rewound the tape" on evolution and started over, you would get a totally new outcome, as small events could snowball into large consequences.

On the other hand, there are a number of examples of species in similar habitats that evolve independently into similar-looking forms, such as the cichlid fishes of African lakes.

"It's a big question in evolutionary biology, but very hard to test," Mahler said.

Mahler found his test subjects in the Anole lizards that live on four neighboring islands—Cuba, Hispaniola (Haiti and the Dominican Republic), Jamaica and Puerto Rico. Anoles began colonizing these islands, all similar in climate and ecology, about 40 million years ago. Once there, they began to multiply, resulting in a diversity of species on each.

The researchers studied 100 of the 119 Anole lizard species from the islands, taking measurements of their bodies from wild and museum specimens and comparing them across islands.

They found a striking degree of convergence—on each island, evolution had produced a set of very similar-looking lizards occupying similar environmental niches.

The "adaptive radiations"—the way species branch out into new species—"match on all four islands," Mahler said. "With few exceptions, each species on an island has a match on the other islands."

The four islands also show similar "adaptive landscapes," the researchers found. An adaptive landscape is a fundamental concept in evolutionary biology but difficult to show in practice. Peaks on an adaptive landscape represent various combinations of features that will be favored by evolution, whereas valleys are just the opposite. Species with similar habits will tend to cluster on the same peak.

For Anole lizards, their niche might be living on tree-trunks, or among twigs high in a tree, or down in the grasses on the ground. Each calls for different adaptations, and creates a different adaptive peak. "The cool part is that we now have a way of modeling the adaptive landscape that explains this convergence," Mahler said