ScienceWatch – Evolution in Action: Adaptive Anoles

"The evidence for evolutionary change surprised me; the pace at which the change was happening surprised me even more." – Y. Stuart

Charles Darwin thought that evolution is a slow process taking millions of years. But modern genetics has shown that mutations, which are responsible for evolution, can spread in a population over just a few generations. So why shouldn't evolutionary changes occur quickly too? Now a study published in the October 24, 2014 issue of *Science* provides a clear example of rapid evolutionary change.

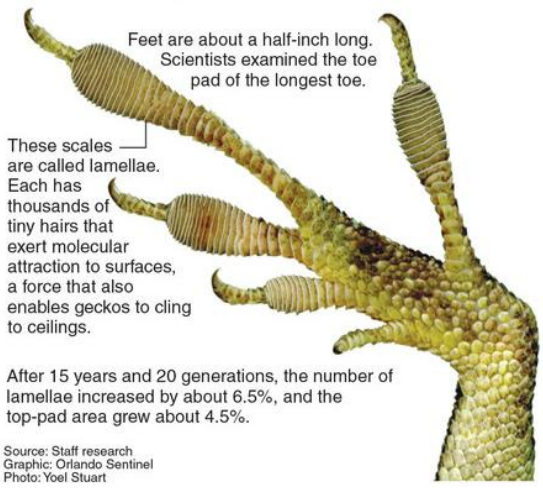
The research team headed by Yoel Stuart University of Texas, Austin, TX, and Todd Campbell, University of Tampa, Tampa, FL, looked at what happens when two closely related species of arboreal lizards that do not interbreed, the Carolina or green anole (*Anolis carolinensis*)—native to the southwestern U.S., and the brown anole (*Anolis sagrei*)—native to Cuba and the Bahamas, occupy the same space. An important tenet of biology states that no two species can occupy the same niche* at the same time. If they do, then either one species will outcompete the other or one (or both) will change in some way to decrease competition for the same resources. Such a change is called *character displacement*.

The study began in 1995 when Campbell saw that where brown anoles had invaded Carolina anole territory due to human releases, the Carolina anole lost some habitat. The Carolina anole normally occupies its home tree from ground to crown. But when both anoles were present the Carolina anole became relegated to the upper, thinner branches of the tree.

No one knew exactly why this happened and Campbell realized he could design a doctoral thesis study to find out. He chose six small artificial islands just off the Florida coast, which contained only resident Carolina anoles. He measured the height at which the lizards were usually perched and did the same after introducing (with federal permission) the brown anole to three of the six islands. After just three months, perch heights for the resident Carolina anoles on the "invaded" islands increased significantly and remained so throughout the four years he did the study. Perch heights on the islands without brown anoles did not change.

In 2009 Stuart came on the scene and suggested they go back for another look. The scientists predicted that the Carolina anoles would develop a character change (*i.e.*, character displacement); namely, they would grow larger toepads in order to better grasp the narrower, smoother branches they now had to deal with. Over a two year period they measured the toepad size on the longest toe of the Carolina anoles on the two sets of islands. They also counted the lamellae, grooves on the toe that allow for better gripping.

They found that after only 15 years the Carolina anoles living on the invaded islands had toepads that were 4.5% larger and the number of lamellae had increased by 6.5% —important changes that took only 20 anole generations!



These changes could have been caused by harder gripping of the thinner, smoother branches. Such a change, like muscle building, is known as *phenotypic plasticity*. It is not genetically based and does not result in evolution. To show that phenotypic plasticity was not occurring, the team took gravid female Carolina anoles off invaded and non-invaded islands and raised their offspring under identical outdoor conditions without any brown anoles. They found that the Carolina anole offspring from the invaded islands retained the larger toepads, indicating that the change was indeed genetically based and not a result of building up their toepads simply by harder gripping.

"This elegant study adds to a growing body of evidence that evolutionary changes can occur very rapidly, on time scales that we once regarded as far too brief for significant adaptation," said Rick Shine an evolutionary ecologist not involved in the study.

Darwin would be pleasantly surprised.

Saul Scheinbach

*In biology *niche* not only refers to the area where an organism lives, but also its role or function in an ecosystem. This includes how it interacts with all other species in the ecosystem.