Caribbean castaway lizards put evolutionary theory to the test

To adapt, average hind-leg length of later generations decreased

BY BRIAN VASTAG

When Hurricane Frances swept through the Caribbean in 2004, it wiped out populations of little anole lizards living on seven tiny islands in the Bahamas.

Instead of mourning the loss, Harvard University biologist Jonathan Losos spied an opportunity: He could, for the first time, test a controversial 70-year-old idea in evolutionary biology.

What might happen, Losos wondered, if he dropped pairs of anole lizards, castaway-like, onto each island?

Would they simply go extinct?

Or could the reptilian couples launch — or found — new colonies that would diverge in appearance, taking the first steps on the long road toward becoming different species?

The lizards, it turned out, thrived. After two years, one island sheltered 40 lizards descended from the first couple.

More intriguingly, within just a few generations, the back legs of the lizards on all seven islands began to shrink.

Shorter legs provide more agility for the lizards as they navigate the shrunken shrubbery on the tiny islands, and agile lizards can catch more insects and more easily dodge hungry birds.

Losos had, in fact, seen this rapid adaptation before. He and his colleagues have been dropping lizards onto tiny islands in the Caribbean since the late 1980s, watching their hind legs shrink to match the small branches on the tiny vegetation.

"Back then it was kind of big news that species could adapt very quickly," Losos said. "Now we realize this is very common."

But the new experiments, published online Feb. 2 by the journal Science, suggest that the randomness of the founder effect — how a population's genetic variation is affected by the founding individuals — can also play a big role in how species adapt to new surroundings.

Since proposed by biologist Ernst Mayr in the 1940s, the importance of such an effect in generating new species has been widely debated among biologists.

"Mayr believed, in most cases, speciation involved movement of a few individuals into an isolated area, followed by a genetic revolution," said Theodore Garland, an evolutionary biologist at the University of California at Riverside. But, he added, because of a lack of experimental evidence, in recent years the founder effect has fallen on hard times.

"The problem," said Losos, "is you can't observe the founder effect in nature. It's almost unheard of to actually see it happen."

So Losos turned the spits of sand into evolutionary test tubes. The castaway lizards finally put the idea to a real-world test.

Because Losos and his colleagues had randomly plucked each pair of founder lizards from a larger island, some, by chance, had longer back legs than others.

This chance, or randomness, carried through the five or six generations of lizards the team measured through 2009.

"We think it plays a role in how islands get colonized, and this was a rare opportunity to see it happen and follow it over time," said Jason Kolbe, a University of Rhode Island biologist who helped run the study.

Five years after the experiment began, the average length of the lizards' hind legs had decreased on all seven islands. But the islands that were founded by long-legged lizards at the beginning still had the longest-legged lizards at the end.

"If you had relatively long hind limbs at the beginning, you had them at the end," Kolbe said. "That's the signature of the founder effect."

Doctors see the founder effect in isolated populations of people, such as the Amish and the Dutch Afrikaners in South Africa, as rare genetic diseases carried by the community's founders spread and become more common in subsequent generations. But no one argues that those groups are on their way to becoming new species. For one thing, the groups would have to be isolated for hundreds or thousands of generations. For another, the genetic diseases are maladaptive — they hinder survival.

The populations of lizards did not have enough time to diverge into separate species, either. "It's too early" to say whether they will, Kolbe said. But the study provides the first experimental demonstration that founder effects can persist in the wild, he said.

Another hurricane, Irene, blew through the region last August. Losos said the team will soon see whether the lizards survived. He's hoping for a specific outcome: a greatly reduced population of lizards on each island. That would create a second founder effect. Mayr and others say that it's repeated squeezing and winnowing of a population that drives the development of new species.

"That's the outcome I'm cheering for," Losos said. "Absolutely. We're going back out in May."

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Shorter legs provide anole lizards with greater agility as they navigate the shrunken shrubbery on selected tiny islands in the Bahamas. Agile lizards can catch more insects and more easily dodge hungry birds.

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