EVOLUTION

For Island Lizards, History Repeats Itself

It is one of evolutionary biologists' favorite thought experiments: If one could start with similar organisms in similar environments, would evolution repeat itself to produce the same results?

Some biologists say no. They think that even though organisms follow the rules of natural selection, historical accidents play a large role in their ultimate fate—who wins and who goes extinct. In this view, we live in the age of mammals in part because a comet or asteroid happened to wipe out the dinosaurs. But other scientists have held that natural selection is powerful enough to shape organisms to similar ends, no matter what the vagaries of history. Now a natural version of this experiment suggests that selection is stronger than chance—at least some of the time.

On page 2115, evolutionary ecologist Jonathan Losos of Washington University in St. Louis and his colleagues report that anole lizards on four different islands independently evolved into strikingly similar creatures. Although examples of convergent evolution, such as wings on bats and birds, are well known, "what's remarkable here is the degree of similarity that has evolved on all four of the islands," says Douglas Futuyma of the State University of New York, Stony Brook. Many evolutionary biologists welcome the finding. "People have been arguing this for a long time, and I think the case is finally solved," says evolutionary ecologist Dolph Schluter at the University of British Columbia.

Dozens of species of anole lizards thrive on the islands of the Greater Antilles—Cuba, Hispaniola, Jamaica, and Puerto Rico—and these relatively isolated island ecosystems offer a good place to test theories of evolution. "It's the natural equivalent of a replicated experiment," says Futuyma.

In the 1970s, evolutionary biologist Ernest Williams of Harvard University was the first to notice that lizards from different islands living in similar environments also look similar. Anoles that live in the tops of trees, for example, have large toe pads and short legs, while anoles that live on the ground have long, strong hindlegs. Williams divided the dozens of species into six "ecomorphs" and theorized that these forms had arisen independently on each island, but he had little genetic data to back his claim.

Losos and his colleagues from Washington University, the National Museum of Natural History in Washington, D.C., and the Institute of Ecology and Systematics in Havana, Cuba, have now tested Williams's ideas. To establish that the ecomorphs are distinct groups, the team measured six characteristics that are linked to habitat, including mass, size of toe pads, and length of body, tail, and legs, in about a dozen lizards from each of 46 species. Williams's ecomorphs held up—each lizard species was indeed most like those living in an identical habitat on other islands.

K. DE QUEIROZ/SMITHSONIAN INSTITUTION

J. LOSOS/WASH. UNIV.

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Déjà vu. Twig-dwelling lizards from Hispaniola *(right)* and Cuba *(below)* independently evolved short legs and tails; ground dwellers from Hispaniola *(lower right)* and Cuba *(lower left)* separately acquired long legs and tails.

Next, the team analyzed mitochondrial DNA from 55 species to determine the relationships among the lizards. They found that members of the same ecomorphs on different islands are only distantly related, while species from the same island are closely related. They conclude that although the original lizard immigrants were likely different for each island, similar evolutionary pressures shaped them into similar ecomorphs. "There are certain ways a lizard can make a living on these islands," Losos says. "In this case, the power of natural selection is so strong that it overwhelms any differences between the islands and what has gone on there before," or what lizard began the process. In Cuba, for instance, so-called trunk-crown dwellers seem to have arrived first, while twig-dwellers were the first to inhabit Jamaica. "It's incredible," says Schluter. "It's almost as though you start from different beginnings and end up in the same place."

But not everyone is completely convinced. While she praises the work, evolutionary biologist Joan Roughgarden* of Stanford University notes that in the Lesser Antilles, which stretch from Puerto Rico to Venezuela, the lizards have evolved several alternative ways of dividing their territory.

Futuyma also points out that the natural experiment didn't produce exactly the same results on every island. Two ecomorphs are missing from Jamaica and one from Puerto Rico. Losos does not deny that chance still has a heavy hand. But, says Schluter, it seems that at least in some cases "history can repeat itself over and over."

–Gretchen Vogel

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OPTOELECTRONICS

Double Helix Doubles as Engineer

A marriage of optics and electronics could produce a new generation of computers many times faster than today's. But like many unions, this one is threatened by some serious incompatibilities. Many of the best lasers, detectors, light modulators, and other optical devices are made from semiconductors such as gallium arsenide and indium phosphide, whereas conventional electronic devices are made of silicon. As a result, the two kinds of devices have to be made separately, then mated. Although integrating one or two devices is relatively easy, assembling hundreds, thousands, or millions into a single array would defeat conventional "pick-and-place" technology.

Now, a team of researchers at the University of California, San Diego (UCSD), and Nanotronics Inc., also in San Diego, has come up with a novel way to create these hybrid devices. Like so much of the mating game, it involves DNA, which in this case serves as a selective glue for sticking the devices to the surface of the chip. Described at a meeting of the International Society for Optical Engineering early this year in San Jose, California, the work has intrigued experts in the field. Electrical engineer Joseph Talghader at the University of Minnesota, Minneapolis, for example, calls it "an exciting technique and one that merits a great deal of future work."

A strategy developed by Talghader and others was actually the starting point for the San Diego team, which is led by UCSD's Sadik Esener. In the earlier technique, known as fluidic self-assembly, the optical devices are fabricated as geometric shapes ("pegs") that can then slot into similarly shaped "holes" etched in the silicon substrate. The pegs are suspended in a liquid and spilled out over the substrate, with luck sliding into the right hole and sticking there thanks to weak van der Waals forces.