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Martha Muñoz Uncovers the Drivers and Dampers of Biodiversity

The Yale biologist says that organisms' behavior, physiology, and morphology engage in a const "evolutionary dance."

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ABOVE: © Christopher Beauchamp Photogr

Raised in Flushing, New York, Martha Muñoz fed her love of nature at the Bronx Zoo, the Queens Botanical Garden, and the American Museum of Natural History. "I was, on a regular basis, flabbergasted by the diversity of life," she says. As a teenager, the first-generation Cuban-American planned to become a wildlife veterinarian, but that changed when Muñoz started her undergraduate degree at Boston University in 2003 and took a biology course with Chris Schneider. On day one, Schneider lectured on the Cambrian explosion, and Muñoz says she remembers being "emotionally moved, physically to te She knew she wanted to answer the big questions that evolutionary biologists were asking.

After earning her undergraduate degree in 2007, Muñoz won a Fulbright scholarship to study population genetic using the collections at the National Museum of Natural History of Spain in Madrid. A year later, she began study lizards as a graduate student in the lab of Jonathan Losos at Harvard University. Losos, Muñoz recalls, encouraged her to "find the thing that spun [her] spurs," which she discovered was learning how organisms interact with their environment to increase their evolutionary fitness.

During a research trip to the Dominican Republic, Muñoz noted that anole lizards there behaved differently depending on their ecological niches. Lizards closer to sea level clung to relatively cool tree trunks throughout th day, while lizards living two kilometers up in the mountains only emerged when the sun was high to warm themselves on sun-soaked rocks. In turn, populations of the high-altitude lizards adapted skull and limb shapes better suited to splaying out on boulders. Yet, even though the animals' behaviors and morphologies had changed better suit their environment, they still had similar physiologies to tolerate heat, she found (*Am Nat*, 191:E15–E26, 2018).

> **Behavior, morphology, and physiology are constantly in a delicate evolutionary dance, no part removed from the other.**
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> —Martha Muñoz

Muñoz finished her PhD in 2014, and then joined Craig Moritz at the Australian National University in Canberra a postdoc to study heat tolerance in some of Australia's rainforest lizards. The lizards with low heat tolerance hide away in the shade at midday, while those with high tolerance bask in the sun during that time. Surprisingly, the lizards have swapped their sunning behaviors repeatedly over evolutionary time; once-sun-loving species' heat

tolerance dipped predictably as, over generations, they hid in the shade, while former shade-lovers' tolerance increased after their ancestors repeatedly sunned themselves at midday, Muñoz found (*Evolution*, 70:253–49, 2016

"Behavior, morphology, and physiology are constantly in a delicate evolutionary dance, no part removed from th other," Muñoz explains.

After working in Moritz's lab, Muñoz joined Sheila Patek at Duke University for a second postdoc and began studying the evolution of animal biomechanics, and in 2017, she established her own lab at Virginia Tech. There, launched a study on *Anolis* lizards descended from animals that had washed ashore on the Caribbean islands from mainland Latin America. The island lizards evolve quickly to occupy distinct ecological niches, such as the canop tree trunks, or bushes, which scientists assumed meant island organisms evolved faster than their mainland counterparts. But Muñoz found that this trend isn't uniform across all traits. Populations of the island lizards don evolve physiologically to regulate their temperature because individuals don't have to contend with many predat so they simply step out into the sun when they get a bit cold. Mainland lizards, on the other hand, must spend the days in hiding, and have rapidly adapted changes in heat tolerance over evolutionary time (*Evolution*, 73:1241–52, 2019).

Earlier this year, Muñoz moved to Yale University, where she says she hopes her research will reveal more about t core laws of evolution. "We're still in a major discovery phase . . . stitching together how it all works." Moritz suspe she will be successful. Muñoz is adept at using fieldwork to shape her research questions and is propelled by her "intellectual vitality," he says. "I expect great things."

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