

Landscape Genetics Offers New Insights

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Genetics and geography help inform species conservation.

On the way to Quepos, Costa Rica, perfectly aligned rows of palm oil trees unfurl along the roadside. Sandwiched between the palm oil plantations are hotels and restaurants catering to tourists. The combined forces of agribusiness and tourism threaten to push the local squirrel monkey (*Saimiri oerstedii citrinellus*)—known as the *mono titi*—into extinction.

The fast progress and falling cost of DNA-sequencing technologies have made it possible for researchers to study hard-to-track animals such as the *mono titi* at an unprecedented level of detail. It has been clear for years that human land use is hitting the monkeys hard. Now, a new study combines genetic analyses with habitat mapping to offer greater insight into which parts of the mixed-up landscape act as barriers for troops of *mono titi* on the move.

This work is part of a new wave in conservation research: landscape genetics, the study of wildlife populations in the context of complex, shifting, real-world landscapes. It is a step beyond traditional population models in which the role of individual animals' movements is often glossed over. Landscape genetics studies are yielding new insights into potential conservation solutions for beetles, frogs, lizards, birds, and mammals in human-dominated landscapes around the world. Improved DNA extraction techniques allow the recovery of DNA

from bits of tissue that animals leave behind in hair, feces, and even pond water, giving researchers the opportunity to sample large numbers of individuals without capturing or disturbing them.

Combined genetic and geographic information can reveal how populations of a threatened species interacted before modern human impacts and thus offers clues as to how best to help the animals survive into the future. "There's a problem of shifting baselines in conservation," explains ecologist Clinton Epps, of Oregon State University. "We look at a landscape after it's already experienced intense change, and it's hard to know what was going on before. That's one of the things genetic data can tell us."

Plantations pose a threat to squirrel monkeys

In the case of the *mono titi*, estimates show that the monkey's numbers have dropped sharply since the 1970s, a time that also saw a massive increase in the rate of Costa Rica's deforestation. The *mono titi* never had a large range: They are the last descendants of an ancient migration of squirrel monkeys out of South America. A small population hanging on in scattered fragments of habitat, the endearing *mono titi* has become an icon of humanmade threats to biodiversity and of grassroots efforts to reverse the tide of extinction.



The Central American squirrel monkey, or mono titi, is threatened by the loss of forest habitat. Narrow strips of native trees and shrubs could restore the connections among now-isolated groups. Photograph: Christina Craft, Titi Conservation Alliance.

Mary Blair, an ecologist at Columbia University, in New York, based her study on feces collected from the resting sites of 14 different groups of *mono titi*. DNA extracted from the droppings yielded data on 233 individual monkeys, including detailed information on long-term movements and family relationships—impossible to obtain from simple observations in the field. Using microsatellite markers