# How do native Hawaiian birds survive in a fragmented forest?

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The hybrid "ApaIwi" offspring of an Apapane father and I'iwi mother.

(PhysOrg.com) -- When humans cohabit with Mother Nature, they tend to leave footprints behind. They fragment the natural forest landscape into patches of trees and other vegetation separated by the diverse products of their labors—agriculture, residential development, industry. Even well-intentioned efforts at forest management can wind up fragmenting otherwise contiguous forests. Because many wildlife species evolved in large blocks of contiguous forest, they can be harmed when human activities break up landscapes into a patchwork of smaller isolated pieces of habitat.

Sometimes Mother Nature causes fragmentation herself. When volcanoes erupt on forested hillsides, for example, lava flows divide the forest into patches of trees separated by lava rock. On the Big Island of Hawaii, lava flows have created more than 300 isolated forest fragments. Native Hawaiians call these patches of forest kipukas.

David Flaspohler, a professor in the School of Forest Resources and Environmental Science at Michigan Technological University, went to Hawaii this year to help find out how the birds that live in the kipukas manage to survive. He is part of a multi-disciplinary team of scientists from Stanford University, the University of Maryland, the Carnegie Institution for Science, the US Forest Service Institute for Pacific Islands Forestry and Michigan Tech. They were funded by the National Science Foundation (NSF) to study the effects of Hawaii's kipukas on the creatures that inhabit them. The five-year $1.2 million study will continue through 2015.

Formed by lava flows through the forests on the slopes of Mauna Loa in the 1850s, the kipukas range from ¼ acre to 150 acres in a remote, protected area where mankind's footprint is minimal. Kipukas are home to native vegetation, insects, rare birds and rats introduced by man. This relatively simple forest ecosystem presents an ideal living laboratory that allows scientists to study the interactions and adaptations of the creatures that call the forest fragments home. "Most fragmentation studies look at species response to fragmentation over a few to maybe ten years," Flaspohler explains. "Here we can examine the ecological legacy of a century and a half of fragmentation; that is extraordinary."

A conservation biologist, Flaspohler's research focuses on how organisms interact with their environment, particularly ecosystems altered by human activity and species that are most sensitive to such changes. The effect of forest fragmentation on the imperiled songbirds that live in the kipukas is one of Flaspohler's particular interests.

In a paper published last year in the journal *Biological Conservation*, Flaspohler and co-authors observed that the smaller kipukas were dominated by native birds, while the larger contiguous forests contained a higher proportion of non-native bird species. "This is precisely the opposite pattern one finds in most temperate mainland forests, where exotic birds are favored by fragmentation," he says.

In 34 kipukas on the slopes of the Mauna Loa volcano—one of the world's most active volcanoes—Flaspohler and Jessie Knowlton, a postdoctoral research fellow in his lab at Michigan Tech, are studying the songbirds known as Hawaiian Honeycreepers. Thought to be decendents of a single species of finch that reached Hawaii hundreds of thousands of years ago, the honeycreepers are found only on the islands of Hawaii. Since Polynesian and then European colonization of Hawaii, 24 of the 44 known species of honeycreeper have gone extinct, and 9 of the remaining 20 are on the federal Endangered Species List.

Some of the birds went extinct after the Polynesians arrived in Hawaii during the first millennium. More disappeared after a century of accelerated forest clearing and agriculture that followed the arrival of Europeans, Today, one third of all US endangered birds are Hawaiian species, even though Hawaii accounts for just one tenth of 1 per cent of the US land area.

The lava flows that have fragmented Hawaiian forests for millions of years presumably posed little danger to large widespread bird populations. However, as native birds have become rarer and increasingly restricted to smaller areas, volcanic eruptions have posed a threat. Still, some native birds have adapted and thrived in spite of these dynamic changes. Flaspohler and Knowlton want to find out what gave these species an edge and how forests can be managed to help others remain part of the natural heritage of Hawaii and the US.

Using delicate nylon mist nets designed especially for humane live capture and release of birds, the biologists gently capture the honeycreepers and band them. Each bird gets a uniquely colored combination of ankle bands so the scientists can identify them later. They have already banded more than 800 birds.

One of the factors the scientists are studying in the kipukas is the impact of black rats. Not natives of Hawaii, the rats probably arrived on ships centuries ago. The tree-climbing rodents have become the most significant predator of birds and their eggs in the kipukas. Rats also eat insects, directly competing with birds for food.

Rats are being trapped and removed from half of the kipukas. The scientists will then compare the survival rate and abundance of the honeycreepers and the success of their nests in rat-infested kipukas with those that are virtually rat-free.

As they study how the honeycreepers survive—or don't—Flaspohler and Knowlton are uncovering surprises too. "We found the first ever hybrid between two species of honeycreepers, the Apapane and the I'iwi," Flaspohler reports. One has an long curved orange beak and feathers with jet-black wings; the other sports a shorter black beak and scarlet feathers, with black and white mottled wings. The offspring of this mixed marriage was mostly orange, with a black beak and a flicker of the other parent's black and white feathers under its black wings. DNA tests proved it was a hybrid. This extraordinary bird was the product of mating of a male apapane with a female iiwi, the first-ever hybridization within this famiy.

Successful mating between two closely related species like Black-capped and Boreal Chickadees would not be a great surprise, given their similarities, says Flaspohler. However, the Apapane and I'iwi are not even in the same genus, only the same family. The fact that a male

Apapane was able to convince a female I'iwi to mate with it and produce viable offspring suggests more than that this male was a extraordinary suitor. “It gives us new insights into the evolutionary history of this unusual and imperiled group of birds,” he explains. “It could mean that these two species diverged more recently than we thought.”

Flaspohler hopes his research on the honeycreepers in the kipukas of Hawaii will teach us how to maintain biodiversity there and elsewhere in the face of increasing habitat fragmentation. “Hawaii can tell us how birds cope and evolve and persist, and these insights can inform our understanding of how birds cope with habitat change in other parts of the world,” he says. “This may help prevent more endangered species from becoming extinct.”

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