

says Barreto, who is now at Oregon State University, Corvallis.

Some researchers speculate that the impact of mitochondria on evolution goes well beyond spurring faster mutation in the nucleus. Burton, for example, thinks that mismatches between nuclear and mtDNA can help isolate populations, possibly setting them on a path toward diverging into two different species. When he mated copepods from separate tidepools, whose mitochondrial and nuclear genomes had been coevolving along different trajectories, he found that the offspring of the mismatched parents were less viable, a first step in reproductive isolation.

Auburn's Hill suggests that some species may even alert prospective mates to the health of their mitochondria, driving sexual selection. In 2013, he proposed that variations in the redness of male finches, a trait well known to be under sexual selection, may reflect differences in mitochondrial function due to genomic incompatibility. At the meeting, he reported circumstantial evidence: In the finches, the enzyme that makes red pigment may concentrate in the mitochondria, possibly to produce the pigment inside the organelle. He thinks that the redness of the feathers is a signal of mitochondrial fitness and hence the compatibility of the birds' mitochondrial and nuclear genomes.

Testing the idea by gauging genomic compatibility in male finches of different rednesses is difficult. But working with Burton, Hill has found that in copepods, which also produce a red pigment, color and compatibility do vary together.

A possible connection between mitochondria and sexual selection "is a provocative and exciting idea," Sloan says. But David Rand, an evolutionary biologist at Brown University, is skeptical that the interplay between mitochondrial and nuclear DNA has as broad an influence on evolution as others suggest. The evidence "is not in line with the enthusiasm out there," he says.

The enthusiasts, however, are going further. In the September 2015 issue of *Bioessays*, Havird and Damian Dowling and Matthew Hall from Monash University, Clayton, in Australia, proposed the biggest role yet for genomic incompatibility: spurring the evolution of sex. The trio argued that the mixing and matching of genomes that takes place during sexual reproduction might help nuclear genes keep pace with the rapidly accumulating changes in an mtDNA. For all these reasons, Sloan says, how eukaryotes deal with the genomic mismatch at the heart of the cell is "one of the coolest and most important biological questions out there." ■

ANIMAL BEHAVIOR

Wild bird comes when honey hunters call for help

Honeyguides understand specific human signal

By Elizabeth Pennisi

Of all the relationships between people and wild animals, few are more heartwarming than that of African honey hunters and a starling-sized bird called the greater honeyguide. Flitting and calling, the bird leads the way to a bee nest and feasts on the wax left after the hunters have raided it. A study on p. 387 now shows that this mutualistic relationship is even tighter than it seemed, with the bird recognizing and responding to specific calls from its human partners.

The work, by evolutionary biologist Claire Spottiswoode and her collaborators, "is the first to provide clear and direct evidence that honeyguides respond to specialized human signals ... and that the birds associate those signals with potential benefits," says John Thompson, an evolutionary biologist at the University of California, Santa Cruz. "The honeyguide literally understands what

the human is saying," adds Stuart West, an evolutionary biologist at the University of Oxford in the United Kingdom. "It suggests that the honeyguide and human behavior have coevolved in response to each other."

Spottiswoode, who is at the University of Cambridge in the United Kingdom and the University of Cape Town in South Africa, first became fascinated with honeyguides at age 11. She had heard a talk by Kenyan ornithologist Hussein Isack, who had followed honey hunters and found that the birds really do lead people to honey. In the new work, she teamed up with Keith and Colleen Begg, conservation biologists who work at the Niassa National Reserve in Mozambique. They began by quantifying Isack's discovery, showing that when guided by the bird, Yao honey hunters in Mozambique find nests 75% of the time.

The trio went on to study how the honeyguide responds to people. The Yao summon the bird with a "trill-grunt" call—one that is reserved for attracting honeyguides, according to 20 hunters Spottiswoode interviewed. In 72 trials, the team played back one of three sounds—the hunter's usual trill-grunt, a ring-necked dove's song, or an unrelated Yao call—and tracked the birds' responses. They were "elegantly simple controlled experiments," West says.

In response to the proper call, the birds guided 66% of the time, and 81% of those forays led to a nest. Guiding occurred half as often or less in response to other calls, and nest finding was much less likely, the team reports. The pattern makes evolutionary sense: By saving their efforts for calls that indicate a willing human partner, the birds run a better chance of ending up with a bonanza of tasty beeswax.

Brian Wood, an anthropologist at Yale University who has studied honey hunters, says the Hadza, a

hunter-gatherer group in Tanzania, summon honeyguides with a different signal, a melodious whistle. He expects that the Tanzanian birds, too, discriminate the call from other sounds and respond specifically to it.

It's unclear how young birds learn to recognize the hunters' calls, given another peculiarity of honeyguide behavior: Like cuckoos, they lay their eggs in the nests of other species, which means that young honeyguides don't have an opportunity to learn from their biological parents. There may be little time left to solve this and other puzzles, as age-old lifestyles like honey hunting vanish. "The historical connections between humans and wild animals are becoming altered at unprecedented rates," Thompson says, and "the possibility of studying these kinds of relationships in any historically meaningful way are decreasing quickly." ■



A Yao honey hunter with a feathered friend.

