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Climate Change & Bats

Bats and Birds Tag-Team Help for Coffee

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Bats of the Tropics

Bats & Birds:

A potent team for coffee plantations

by Kimberly Williams-Guillén

In terms of the attention they get from scientists, birds win over bats hands – well, wings – down. Birds, beloved the world over, are the subject of countless scientific studies and lavishly illustrated field guides and the object of international ecotours throughout the world. Bat lovers, meanwhile, grow accustomed to perplexed and skeptical looks when we explain our interest in these elegant creatures.

Bats are tough to study and frequently maligned by myths and misconceptions. Our understanding of their ecology and behavior is often limited, and, not surprisingly, birds get much of the credit for the beneficial actions of bats. Consider the impact of insect-eating bats in reducing insect damage to economically important plants in tropical forests. Birds have long gotten all the recognition – and the powerful justification for conservation and protection – while the role of bats has been largely ignored.

This is partly because it is difficult to directly measure the impact of bat predation. And that difficulty is exaggerated by a common misconception that all insectivorous bats hunt by "aerial hawking," with insects spotted and tracked by echolocation, then pursued and caught in flight. Many bats are, in fact, "gleaners:" they perch in an area waiting for cues (like the sound of a katydid calling or a caterpillar munching a leaf) that reveal the location of their next meal. Then they swoop down and snatch the prey from a plant or from the ground.

COURTESY OF KIMBERLY WILLIAMS-GUILLÉN

(*Top*) Tomes' sword-nosed bat (*Lonchorhina aurita*) is a gleaner the author found mostly in forest fragments and high-shade coffee plantations. (*Above*) Head field technician Gabriel Domínguez Martínez removes a bat from a mist net.

One method used to directly measure the effects of insectivorous predators involves "exclosures" – fences or cages placed around a study plant to keep predatory animals away from it. If insects can enter the exclosure but predators cannot, the number of insect prey should increase. We can measure the predator's impact by comparing this density of insects on similar plants with and without exclosures. Several exclosure studies have shown that when birds cannot reach plants, the num-

ber of insects increases, as does insect damage to leaves.

But it turns out that all of these studies share the same weakness: the exclosures were left in place day and night, so that not only birds but also bats were excluded from the plants. Most of the studies nonetheless attribute the insect reduction primarily to – you guessed it – birds.

That shortcoming can, however, be overcome. By leaving exclosures on plants only during the day, we measure the impact of birds, while leaving them on at night lets us document the impact of bats. If we leave the exclosures in place 24 hours a day, we can learn how the two groups interact.

Field volunteers (left to right) Julie York, Aniko Zolei and Elissa Olimpi feed a nectarivorous Commissaris' nectar bat (*Glossophaga commissari s i*) diluted fruit juice before releasing it.

For the past two years, I have been working with a group of ecologists to study the biodiversity in Finca Irlanda, an organic, shade-coffee plantation in Chiapas in southern Mexico. With partial funding from BCI's North American Bat Conservation Fund, I studied bats' contribution to controlling insects on the plantation. This was part of a larger study on the effects of coffee agriculture on bats.

As with most shade-coffee plantations, where taller trees are left standing to shade the growing coffee plants, the diversity of insects and birds was almost as high in our study area as in nearby forest fragments. Bats followed suit: we identified more than 15 species of insect-eating bats, including several foliage gleaners.

(Shade-grown coffee is a traditional, sustainable approach that leaves the tropical forest largely intact by planting coffee beneath existing trees, where it thrives. Benefits, beyond simply preserving rainforest, include less soil erosion, fewer pesticides and chemical fertilizers and far more support of the region's biodiversity.)

Field assistants Gabriel Martínez and Carlos Rosas and I set up bat-versus-bird exclosures around individual coffee plants. We conducted two eight-week experiments, one in the dry season and one in the wet months.

COURTESY OF CARLOS ROSAS

A Central American yellowbat (*Rhogeessa tumida*), tagged with an aluminum wing band, takes flight after resting on Williams-Guillén's shoulder.

We monitored the insect populations on 88 coffee plants during the experiments. Each day, we set out before dawn to put exclosures over the no-bird plants. Every evening, we crisscrossed the plantation again, switching the nets to the no-bat plants. At two-week intervals, we counted *all* the insects on each plant, turning over thousands of leaves to check for bugs.

The hard work paid off and we got two important results: first, we found that gleaning bats have significant impacts on insects, and second, that healthy ecosystems need birds *and* bats.

In both wet and dry seasons, insects were most numerous when they were protected from both bats and birds. During dry months, the birds had a bigger impact on insects than bats: while there was only a 7 percent increase in insects when bats alone were excluded, the increase was 30 percent when birds were banned. This is the time of year when orioles, warblers and other migratory birds head south for the winter, so the density of insect-eating birds skyrockets, as does their consumption of insects.

The results were reversed during the wet season, when bats are more abundant and migratory birds have moved on. Birds still have a big effect, since insects increased 58 percent without bird predation. However, bats were even more important, with a whopping 84 percent increase in insects when bats were not present. Many bats reproduce in the wet season, and pregnant and lactating bats can double their normal food intake of insects as they produce milk to feed their pups.

On this coffee plantation, we find two groups of predators, one group feeding by day and the other by night. Preserving this dual-functional richness reduces insect populations and maintains that reduction year-round.

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