Smithsonian Institution News

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Smithsonian Researchers Show Major Role of Bats in Plant Protection

Researchers at the Smithsonian Tropical Research Institute report that bats significantly reduce insect abundance and damage on plants. In a lowland tropical rainforest in Panama, bats can consume roughly twice as many plant-eating insects as do birds. This landmark study in the journal Science is the first to compare the ability of bats and birds to protect plants via insect predation in a natural forest ecosystem.

A previous study by the authors suggested that bats were underestimated predators of plant eating insects, based on video recordings of feeding events.

In the current study, Smithsonian short-term fellow Margareta Kalka, and co-authors Elisabeth Kalko, institute staff scientist and professor at the Institute of Experimental Ecology at the University of Ulm, and Smithsonian postdoctoral fellow Adam Smith, separated the insect-control effects of bats and birds by placing netting enclosures over five common tropical plant species only at night or only by day. Uncovered control plants accessed by both bats and birds lost merely 4.3 percent of their leaf area to insect herbivores. When only birds were excluded, plants lost 7.2 percent of their leaf area. When only bats were excluded, plants lost a striking 13.3 percent of their leaf area, demonstrating that in the tropical forest understory bats can be more effective pest control agents than birds.

Caterpillars, katydids, beetles and other insects devour tropical plant leaves. Plants directly defend themselves by producing tough leaves and toxic chemicals. Phyllis Coley, STRI research associate and University of Utah professor, who has documented tropical plant defenses for many years, considers this study to be a major contribution: "The role of insect predators, such as birds and bats, is key to plant survival. However, the magnitude of this "top-down" pest control is still not well understood."

Previously, researchers estimating the top-down effects of birds on herbivory excluded large insect-eaters by placing netting enclosures over entire plants, leaving the nets in place around the clock. By doing so, they quantified the combined effect of birds and bats but attributed it merely to birds.

"Most researchers are outside in the daylight, when they can see birds actively hunting insects. Bats, however, hunt insects at night, which is inherently more secretive and harder to observe," said Sunshine Van Bael, a Smithsonian researcher involved in earlier exclosure projects.

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Kalka speculates that the documented greater effect of bats as insect predators in Panama could be attributed to the absence of migratory birds in the area during the study period. This explanation is supported by a similar study presented by researchers from the University of Michigan in the same issue of Science. There, the authors report a seasonal shift in top-down effects of bats and birds on herbivory of shade-grown coffee plants in Mexico. Birds are more important insect predators in the dry season, when migratory birds are present, but are less important than bats in the rainy season, when migrants are absent.

It is clear from both studies that bats play an extremely important role in the food chain in the tropics and probably in temperate areas as well. Bats should be considered in both conservation planning and in management strategies for agricultural areas.

The Smithsonian Tropical Research Institute, headquartered in Panama City, Panama, is a unit of the Smithsonian Institution. The Institute furthers the understanding of tropical nature and its importance to human welfare, trains students to conduct research in the tropics and promotes conservation by increasing public awareness of the beauty and importance of tropical ecosystems.

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