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# Forest Fragmentation Hits Insectivorous Birds Hard

Cagan H. Sekercioglu
*Center for Conservation Biology, Department of Biological Sciences, Stanford University, Stanford, CA 94305-5020*

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Habitats around the world, especially in the tropics, are being fragmented at a rapid rate, causing a tremendous loss of biodiversity[1]. For example, 12% of the approximately 10,000 bird species are threatened with extinction in the next 10 to 100 years, and another 8% are near-threatened[2]. This loss of species is likely to result in the collapse of significant ecosystem processes and free ecosystem services to people[3], such as pest control by insectivorous birds. Tropical forest insectivorous birds, such as antbirds, woodcreepers, and wrens, present a good example of an important, species-rich group of small, noncharismatic organisms who do not get much public attention, but whose demise may have significant negative ecological and financial consequences. They are among the species most likely to go extinct as a result of forest fragmentation[4] and their loss may result in insect pest outbreaks in tropical forests and surrounding agricultural areas. Finding out the causes of the disappearance of understory insectivores may help explain the disappearance of the other small, short-lived, and specialized bird species that comprise the majority (65%) of threatened bird species in the world[5].

In a recent study of the factors behind the disappearance of insectivorous birds in Costa Rican forest fragments reported in the *Proceedings of the National Academy of Sciences*[6], we provide evidence that interfragment dispersal, rather than food limitation, may be the most critical factor for the persistence of understory insectivorous birds in forest fragments. As in previous studies[4,7], small forest fragments had significantly lower insectivore species diversity and abundance than more extensive forest. However, our initial hypothesis — that the decline of insectivorous birds in forest fragments is caused by an impoverished invertebrate prey base — was not supported by invertebrate counts and examination of bird diet samples. Instead, the inability of understory insectivores to use the nonforest matrix surrounding the fragments seemed to be the main reason for their decline.

Email: cagan@stanford.edu

Few studies have examined tropical bird communities along with their food resources[8,9] and studies on the effects of forest fragmentation on understory insectivorous birds through changes in prey availability have been few and limited to the temperate zone[10,11]. Ours is the first study to investigate the effects of forest fragmentation on a bird community, along with bird diet and prey availability. In the two temperate forest studies[10,11], increased invertebrate abundance in larger forest fragments was positively correlated with the reproductive performance of the two understory insectivorous bird species studied. Karr and Brawn[8], on the other hand, could not find a clear relationship between the abundances of understory arthropods and understory insectivorous birds in Panama. They concluded that the habitat associations of these birds were not solely food-resource mediated, and that a combination of factors, such as microclimate, predation, and food availability, determine the habitat associations of bird species and guilds.

Our results are consistent with the findings of Karr and Brawn[8]. Invertebrate prey abundance, biomass, and composition, both in habitats (106,082 invertebrates sampled) and in bird diet (735 diet samples obtained nonlethally with the use of antimony potassium tartarate) were not significantly different between small forest fragments and the more extensive Las Cruces forest. However, the sampling of over 2,300 birds with mist nets revealed that the abundance and species richness of understory insectivorous birds were significantly lower in small fragments. Abundance and species richness of birds in other guilds, such as granivores, nectarivores, and omnivores, did not differ or were greater in small fragments. The limited dispersal capabilities of understory insectivores[4,12] may be the most important reason behind their sensitivity to fragmentation. Insectivorous birds were significantly underrepresented in the nonforest matrix surrounding our forest fragments. The opposite was true for other guilds, such as granivores, nectarivores, and omnivores. Therefore, we concluded that weak dispersal across nonforest habitats, not limited prey availability, is the main reason behind the disappearance of many insectivorous species from forest fragments around Las Cruces.

Tropical understory insectivorous birds and many other species that are not good at dispersing through nonforest habitats are more likely to go extinct in forest fragments as a result of increased nest predation and demographic stochasticity[13]. Even though tropical forest fragments may have high overall bird diversity, as observed in many studies including ours, some groups will be far more susceptible to extinction than others. Consequently, we need to investigate the effects of fragmentation on a group-by-group basis and not just rely on overall biodiversity. Facilitating animal dispersal across agricultural tropical countryside by planting vegetation corridors between forest fragments and by improving agricultural practices (such as emphasizing shade coffee over sun coffee) will promote the conservation of biodiversity in this extensive but often-neglected habitat. The preservation of the biodiversity of ecologically significant groups, such as insectivorous birds, will ensure the continuity of their contribution to ecosystem processes and services, such as control of insect pests. Insect outbreaks in forests and surrounding agricultural areas are likely if no insectivorous birds remain in forest fragments. This will have significant negative ecological and financial consequences for local people, not to mention the intrinsic, priceless value of the biodiversity that is being lost.

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## BIOSKETCH

**Cagan H. Sekercioglu** is a 4th year Ph.D. student in the Department of Biological Sciences at Stanford University and a member of the Research staff, Stanford University Center for Conservation Biology. Mr. Sekercioglu received B.A. degrees in Biology (magna cum laude) and Anthropology (magna cum laude) from Harvard University. He is a member of the American Ornithologists Union, Ecological Society of America, Sigma Xi Scientific Research Society, The Explorers Club, and The Society for Conservation Biology. He was elected one of the top 100 scientists of Turkey in 2001 by Aktuel magazine, and has been awarded Sigma Xi Grants-in-aid of Research (1996, 1999), Stanford University Bing Research Award (1999, 2000), and the Walter Loewenstern doctoral fellowship (1998-2002). Mr. Sekercioglu's research focuses on the causes and consequences of bird extinctions around the world. He investigates ecological factors that make it more likely that certain bird groups, such as tropical understory insectivores, will go extinct. He also assesses how these extinctions will affect bird-mediated ecosystem processes and services, such as pollination, seed dispersal, and control of insect outbreaks. He hopes to find better ways to increase the contribution of ecotourism, especially birdwatching, to community-based conservation in the tropics and improve the role of the private sector in the conservation of biodiversity to prevent extinctions and consequent collapses of critical ecosystem processes.