Tropentag, September 11-13, 2024, hybrid conference

"Exploring opportunities …
for managing natural resources and a better life for all"

Land use alters nocturnal insect communities and their contribution to coffee pollination in India's western Ghats

Rama Narayanan Harihara subramanian[1], Smitha Krishnan[2], Anand M Osuri[3]

[1] *ETH, Zurich, Switzerland*
[2] *The Alliance of Bioversity International & CIAT, India*
[3] *Nature Conservation Foundation, India*

Abstract

Land-use change is a major driver of insect declines and can disrupt insect-driven ecosystem functions and services. It is well-established that insects contribute crucially to pollinating many major crop species, and that insect-mediated crop pollination is sensitive to habitat and landscape factors. However, this understanding is largely shaped by research on diurnal pollinators and pollination, while nocturnal pollination by insects and the factors that influence it remain poorly understood for most crops. We examined nocturnal insect communities and nocturnal pollination of shade-grown robusta coffee (*Coffea canephora*) in a landscape with coffee agroforests and tropical forest remnants in the Western Ghats, India. Specifically, we compared a traditional polyculture-shade coffee agroforest and a 40+ year-old secondary tropical rainforest comprising patches of abandoned robusta coffee bushes and asked: (1) how do the abundance, diversity, and composition of nocturnal insects differ between coffee agroforest and secondary rainforest?; and (2) is coffee nocturnally pollinated, and does coffee nocturnal pollination differ between the secondary rainforest and the more intensively managed coffee agroforest? We observed nocturnal flying insects using illuminated screens (24 screen nights in each habitat) and conducted pollinator-exclusion experiments on coffee flowers – comprising day- and night-exclusion treatments, and controls – in the coffee agroforest and secondary rainforest. Nocturnal insect encounter rates were 21 % lower in the coffee agroforest than secondary rainforest, and Lepidoptera and Coleoptera genus-level compositions differed between the two habitats, but genus-level diversity was marginally lower (Lepidoptera) or substantially higher (Coleoptera) in agroforest than in rainforest. While flowers accessible to diurnal insects had the greatest pollination success in coffee agroforest (19%-24 %) and rainforest (34%-60 %), we found some evidence of nocturnal coffee pollination in the secondary rainforest, and none in agroforest. Our findings suggesting reduced abundances and altered community composition, but not diversity loss, of nocturnal insects in coffee agroforests aligns with previous findings on other taxa, and reiterate the conservation significance of traditional polyculture-shade coffee agroforests. Our study also presents preliminary empirical evidence that nocturnal insects have the potential to pollinate robusta coffee and complement and enhance diurnal pollination, but suggest that nocturnal coffee pollination is vulnerable to deforestation and land-use intensification.

Keywords: Agroforestry, Coleoptera, exclusion experiment, land-use change, Lepidoptera, plant-pollinator interactions, Robusta coffee, tropical forest

Contact Address: Rama Narayanan Harihara subramanian, ETH, Zurich, Zurich, Switzerland, e-mail: nram.efi@gmail.com