

The Joint Effects of Forest Habitat Area and Fragmentation on Dung beetles

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Abstract

Habitat loss and habitat fragmentation usually occur together, at the same time and place. However, while there is consensus that habitat loss is the preeminent threat to biodiversity, the effects of fragmentation are contentious. Some argue that habitat fragmentation is not bad for biodiversity, and even that it is good. Generally, the studies that find no harm or positive outcomes of fragmentation invariably assume that it is independent of habitat loss. However, dissociating the effects of habitat fragmentation from habitat loss is questionable because of the two are essentially coupled. Accordingly, we evaluated how forest area and fragmentation (via edge effects) influenced dung beetles per se, and through their effects on the abundance of mammals, using structural equation modeling (SEM). Dung beetles are very sensitive to forest habitat loss and fragmentation, and to changes in the abundance of mammals on which they depend for dung. Our study area was in the Tana River, Kenya, where forest fragments are depauperate of mammals except for two endemic species of monkeys. We mapped 12 forests, counted the resident monkeys, and sampled 113,959 beetles from 288 plots. Most of the 87 species of beetles were small, affirming the endemic monkeys as the main source of dung. After implementing a fully latent Structural Regression SEM, the optimal model explained a significant 26% of the variance in abundance, and 89% of diversity. The main drivers of beetle abundance were positive, direct, effects of forest area and number of monkeys, and negative edge effects. The main drivers of diversity were the direct effects of the beetle abundance, indirect effects of forest area and abundance of mammals, and indirect negative edge effects. Thus forest area, fragmentation (via edge effects) and the number of monkeys jointly influenced the abundance and diversity of the beetles directly and indirectly.

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