

# **Correlation and persistence of hunting and logging impacts on tropical rainforest mammals**

## **Abstract**

Humans influence tropical rainforest animals directly via exploitation and indirectly via habitat disturbance. Bushmeat hunting and logging occur extensively in tropical forests and have large effects on particular species. But how they alter animal diversity across landscape scales and whether their impacts are correlated across species remain less known. We used spatially widespread measurements of mammal occurrence across Malaysian Borneo and recently developed multispecies hierarchical models to assess the species richness of medium- to large-bodied terrestrial mammals while accounting for imperfect detection of all species. Hunting was associated with 31% lower species richness. Moreover, hunting remained high even where richness was very low, highlighting that hunting pressure persisted even in chronically overhunted areas. Newly logged sites had 11% lower species richness than unlogged sites, but sites logged >10 years previously had richness levels similar to those in old-growth forest. Hunting was a more serious long-term threat than logging for 91% of primate and ungulate species. Hunting and logging impacts across species were not correlated across taxa. Negative impacts of hunting were the greatest for common mammalian species, but commonness versus rarity was not related to species-specific impacts of logging. Direct human impacts appeared highly persistent and lead to defaunation of certain areas. These impacts were particularly severe for species of ecological importance as seed dispersers and herbivores. Indirect impacts were also strong but appeared to attenuate more rapidly than previously thought. The lack of correlation between direct and indirect impacts across species highlights that multifaceted conservation strategies may be needed for mammal conservation in tropical rainforests, Earth's most biodiverse ecosystems.