

## **Benign effects of logging on aerial insectivorous bats in Southeast Asia revealed by remote sensing technologies**

### **ABSTRACT**

Logging is the most widespread disturbance in tropical forests, altering ecological communities and functions. However, many species can persist in logged forests, particularly where disturbance is low. Despite a growing understanding of how logging affects wildlife, there remains little information for Southeast Asia's bats—in part due to major challenges in monitoring. 2. We integrated remote sensing data from passive acoustic bat detectors with LiDAR-derived measures of forest structure from a human-modified landscape in Sabah, Borneo. Our appraisal of logging effects benefitted from a semi-automated classifier of bat calls that vastly speeds up the analysis of acoustic recording data. We recorded 105,576 bat passes from 21 phonic groups across a habitat disturbance gradient, comprising old-growth forest, repeatedly logged forest and tree plantations. 3. We show that logging pressure (as depicted by changes to habitat quality, e.g. canopy height or shape) had negligible impact on the acoustic activity of bats. However, bat activity was higher in areas with a greater extent of high-biomass forest, as well as areas with greater topographical ruggedness. Logged forest supported higher levels of activity for several common bat phonic groups compared to old-growth forest. Across the landscape, plantations supported the lowest levels of bat activity, representing a threefold decrease compared to old-growth forest, and several species were not recorded in this habitat. 4. We found different call groups demonstrated different responses to forest disturbance. Sheath-tailed bats (*Emballonura* spp.) were active across all habitat types and were the most resilient to logging. Edge/open foragers were more prevalent in highly forested and topographically rugged areas. Horseshoe and leaf-nosed bats (flutter clutter foragers) demonstrated idiosyncratic responses to logging but were consistently absent from plantations. 5. Synthesis and applications. Logged forests can provide an important refuge for many common bat species in Southeast Asia, but do not capture the full breadth of forest-specialist species. Nevertheless, logged forests provide substantially better habitat for bats than tree plantations. While aerial insectivorous bats sampled via acoustic methods are poor indicators of forest disturbance overall, several species that respond predictably to logging could be targeted for biodiversity monitoring using acoustic and capture-based methods.