Recovery of soil microbial diversity and functions along a tropical montane forest disturbance gradient

ABSTRACT

Logging and forest conversion are occurring at alarming rates in tropical forests. These disturbances alter soil microbial community structure and functions. While direct links between changes in soil properties, such as pH and microbial community structure are well established, the indirect effects of logging and forest conversion on soil microbial community structure and functions are poorly understood. We used a space-for-time substitution to investigate the changes in soil microbial diversity and functions across a forest recovery gradient in the tropical montane forests of northern Borneo. We used surface (top 5 cm) soil to assess soil physicochemical and microbial (next-generation DNA sequencing) properties, and standardized litterbags (Tea Bag Index) to assess litter decomposition and stabilization. Our results show that bacterial and fungal diversity increases with recovery time and reaches pre-disturbance levels between 60- and 80-years post-disturbance. Litter decomposition rate constants increased linearly with increasing bacterial and fungal diversity. Litter stabilization also increased linearly with fungal diversity, but was highest at intermediate levels of bacterial diversity. Our results provide insights on the effects of forest logging and conversion on soils and highlight the tight coupling between soil microbial diversity and soil functions in tropical montane forests.