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Functional Analysis of Microbial Extracellular Enzymes in Soils from Rain Forest and Oil Palm Plantations in Pasoh, Malaysia

Deforestation is a major threat to lowland tropical rain forests in Southeast Asia, as forests are being cut down at an alarming rate for commercial logging and expansion of oil palm plantations for the production of palm oil. Removal of old-growth, tropical rain forest alters the physical and chemical characteristics of soil, but few studies have examined the effects of anthropogenic disturbances on soil microbial communities. Since soil microbes are responsible for cycling the majority of plant-derived nutrients through the ecosystem, changes to microbial communities could have major implications for global C, N, and P cycles. To examine the effects of deforestation and conversion of forests to oil palm plantations in Southeast Asia, we studied soil microbial communities in and around the Pasoh Forest Reserve in Malaysia. At Pasoh, there is a mosaic of primary forest, regenerating forest that was logged in the 1950s, and oil palm plantations that have been in cultivation for 25 years. To measure microbial function, we collected samples from three plots (20 m x 20 m) per forest type and used extracellular enzyme assays to measure the activity of microorganisms in soil. The activity of extracellular enzymes, which are secreted by soil microbes during decomposition, represents the biological potential for nutrient cycling. Across the three forest types, we separated each soil sample into three horizons: litter (organic horizon), 0-10 cm, and 10-20 cm. For each horizon from each sample, we assayed three enzymes involved in the cycling of C, N, and P from plant material: β-glucosidase (BG) which targets cellulose, N-acetylglucosaminidase (NAG) which targets chitin, and acid phosphatase (AP) which targets nucleic acids and phospholipids. NAG activity levels were highest in primary forest soils, ($p < 0.05$). Regenerating forest soil had the highest BG and AP activity levels of the three forest types, ($p < 0.05$), whereas oil palm soils had the lowest enzyme activity for NAG and AP enzymes, ($p < 0.05$). Together, these results imply that conversion of primary forest to oil palm plantation has negative consequences for nutrient cycling, whereas forest that has been logged and allowed to regenerate can recover some of its ecosystem functioning over time.