Effects of lowering diameter cutting limit on understorey vegetation, litter and root biomass in tropical forest

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Abstract A study to investigate the effect of lowering diameter cutting limit from 60 cm (DCL_{60}) to 45 cm (DCL_{45}) on understorey vegetation, litter and root biomass was conducted in Deramakot forest reserve, Sandakan, Sabah. The experimental design consisted of five replicates for each treatment (DCL_{45}, DCL_{60}, and undisturbed forest as the Control). In each replicate of 30 m x 5 m (0.015 ha), there were four sub-plots each measuring 1 m x 1 m. All trees less than 5 cm diameter and 1.5 m tall were clipped from each sub-plot, oven-dried and weighted. Non-woody vegetation was also collected from these plots. Above-ground forest litters were collected from two 0.5 m x 0.5 m plots within each 1 m x 1 m plot (8 samples from each replicate). Litters were separated into fine (to a depth of 0-5 cm from surface ground), coarse (0-5 cm diameter, <50 cm in length) and necromass (>5 cm diameter). Below-ground root biomass was sampled from soil cores of 5 cm diameter to a depth of 30 cm, and separated into fine (<2mm) and coarse roots (>2 mm). The results showed that mean total understorey vegetation in DCL_{45}, DCL_{60}, and Control plots were 704 ± 168 (SE) kg ha^{-1}, 533 ± 32 kg ha^{-1}, and 526 ± 99 kg ha^{-1}, respectively, and not significantly different (F=0.778, p=0.481, N=15, ANOVA). The concentration of understorey biomass in the DCL_{45} plot was twice higher than that found in DCL_{60} and Control but comprised mainly of non-woody vegetation. Total litter biomass in the study area was much higher compared with understorey vegetation and root biomass (DCL_{45}=18,679 ± 2,405 kg ha^{-1}, DCL_{60}=18,660 ± 2,881 kg ha^{-1}, Control=16,527 ± 1,947 kg ha^{-1}). The difference in litter biomass between treatments was not significant (F=0.257, p=0.778, N=15, ANOVA) although necromass concentration had a greater influence on this outcome (p=0.049). Below-ground root biomass amounted to 7 ± 0.38 kg ha^{-1}, 9 ± 1.25 kg ha^{-1} and 11 ± 2.7 kg ha^{-1}, respectively, and was not significantly different (Chi^2=0.536, p=0.765, N=15, Kruskal-Wallis). Lowering diameter cutting limit to 45 cm had no significant effect on the total concentration of the three biomass pools in the study area. However, it changed the composition of understorey vegetation to a greater proportion of non-woody vegetation such as grass, shrubs and bamboo abundance. The silvicultural implication from this was the need to restore and carry out vine cutting operations to improve low regeneration stock. Ground litter had increased drastically as a result of the transfer of canopy biomass to ground biomass from logging. However, reducing diameter cutting limit to 45 cm did not significantly increase ground litters but this preliminary conclusion could be confounded by the accumulation of debris on the forest floor prior to logging by natural events. The apparent ease of collecting forest litter made it a potential indicator for assessing the impact of logging in primary or re-log forest. Conversely, this study had shown that lowering diameter cutting limit had reduced total below-ground root biomass associated with a higher disturbance of ground vegetation and soils. Although it is possible to draw general conclusion from this study, a complete analysis of the effect of lowering diameter cutting limit should include all trees ranging from 1 to 40 cm DBH as they alone accounted for 90% of the total biomass pool in forest. Further considerations should also include an appreciation of the biological rotation age (i.e. when mean annual increment starts to decline) of dipterocarp forest, and a valuation of the multi-benefits provided by forests.

Keywords Forest biomass, diameter cutting limits, understorey vegetation, forest litter, root biomass