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Density-Dependent Variations of Vegetation Dynamics in the Horton Plains National Park as Indicators of the Possible Long-Term Impacts of Forest Dieback and Recovery

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Abstract

Forest dieback in the Horton Plains (HNP) has been documented since the 1970s. However, its impact on the current vegetation composition has not been studied. Our objective was to determine the possible impacts of forest dieback on vegetation diversity and taxonomic composition in HNP. Here, we carried out a complete vegetation census of all trees ≥ 5 cm diameter at breast height in 24 sub-plots of 25 m × 25 m within four main plots (3750 m^2 each) having six sub-plots each. Two of the main plots (A and B) were on the eastern slope of HNP towards Ohiya while the other two (C and D) were on the western slope towards 'World's End'. Tree density at the sub-plot and main plot levels varied significantly ($p(\chi^2)$ <0.0001) with main plots A and C having lower tree densities (1,363 and 1,824 ha^{-1}) than B and D (3,253 and 2,712 ha^{-1}), possibly as a long-term (over 50 years since the 1970s) consequence of dieback-related phenomena. Shannon-Wiener and Simpson diversity indices, species richness and Shannon-Wiener and Simpson evenness indices varied significantly (p<0.05) among main plots while showing negative linear relationships with tree density at the main plot level. Accordingly, all five indices were higher in the two lower-density plots (A and C) in comparison to the respective higher-density plots (B and D). We recorded 42 tree species in the overall study area, with *Syzygium revolutum* (IVI=27.97), *Symplocos bractealis* (IVI=23.08) and *Neolitsea fuscata* (IVI=20.45) being the three most-influential, based on the Importance Value Index (IVI). We identified tree species sensitive or resilient to density reduction, possibly due to dieback-related phenomena, by quantifying the plot-wise variation of IVI of each species. Accordingly, *Syzygium revolutum* and *Symplocos bractealis* showed substantial reductions in IVI due to density reduction on both slopes of HNP, which shows that they are sensitive species. In contrast, *Calophyllum walkeri* is identified as resilient as its IVI showed little variation with density reduction on both slopes. The IVI of *Neolitsea fuscata* decreased with decreased tree density on the western slope, but increased on the eastern slope, thus showing differential sensitivity to dieback-related processes, probably due to environmental variations on the two slopes. Increasing trends in species richness, evenness and diversity indices with decreased tree density indicate that processes of recovery from tree dieback are occurring via colonization and re-growth. These results reveal important underlying trends of vegetation dynamics in HNP.

Keywords: *Horton Plains, Forest dieback, IVI, Diversity, Tree density*