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Assessment of Forest Health in the Horton Plains National Park in Relation to Possible Forest Dieback and Recovery

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Abstract

Dieback of the upper montane forest in the Horton Plains (HNP) has been reported since 1970s. While some visual patches of dieback are observed, there have been limited systematic assessments on the underlying status of the forest, especially in areas which do not show widespread tree death. Here, our objective was to quantify the current health status of the forest in HNP via a comprehensive tree-level assessment scheme. For this purpose, we developed a 'dieback index (DBI)' based on visual assessment of, (a) percentage of defoliation and (b) presence of abnormalities (disease symptoms, physical damage, yellowing etc.) in the foliage canopy plus (c) the extent of stem damage in each individual tree of DBH $\geq$ 5 cm in 24 sampling plots (25 m $\times$ 25 m) within four main plots of 3750 m², distributed equally on eastern and western slopes of HNP. Based on defoliation and leaf abnormalities, the health status of the foliage canopy of each tree was ranked from 1 (healthy) to 6 (dead). Similarly, health status of each tree stem was ranked on a 1 (<10% of surface area below 1.5 m height damaged) to 6 (>75% damaged) scale. For each tree, a combined rank on a 1-6 scale was given based on the combination of leaf and stem ranks. A dieback score for each tree was given based on the combined rank as: rank 1-0%; 2-20%; 3-40%; 4-60%; 5-80% and 6-100%. Finally, a dieback index (DBI) for each 25 m $\times$ 25 m plot was computed as the sum of dieback scores of its trees weighed by the fraction of trees within each combined rank. A vegetation survey during August-October 2023 showed that plot-wise DBI, which could range from 0 (healthy) to 100 (dead), varied significantly ($p<0.001$) among the four main plots. The two main plots on the eastern slope of HNP showed significantly ($p<0.05$) higher mean DBI (51.40 and 45.43) than the two plots on the western slope (35.57 and 37.91). At the plot level, DBI varied from 28.82 to 54.40 and showed a significant ($p<0.05$) negative linear relationship with canopy leaf area index as measured by hemispherical photography in each plot. Canopy openness, measured as the visible sky fraction of each hemispheric image, showed a significant ($p<0.05$) positive linear relationship with DBI. These relationships validated DBI as a measure of health status of the forest, which can be used in future assessments of forest health and dieback status at HNP.

Keywords: *Horton Plains, Dieback index, Forest health, Leaf area index*