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Quantification of Internal Trunk Decay in Urban Trees using Ground Penetrating Radar (TRU™): A Case Study in Colombo, Sri Lanka**Alahendra, S.N.*, Chandrathilake, G.G.T.***Department of Forestry and Environmental Science, Faculty of Applied Sciences,
University of Sri Jayewardenepura, Nugegoda, Sri Lanka***sandunialahendra516@gmail.com***Abstract**

Internal trunk decay is one of the least visible defects influencing the structural stability of urban trees, particularly in tropical urban environments such as Colombo, where trees frequently experience compacted soils, dense infrastructure, and mechanical injuries. Conventional Visual Tree Risk Assessment (VTRA) often fails to reveal internal structural conditions, creating uncertainty in estimating true failure risk. To address this gap, this study employed Ground Penetrating Radar (GPR) using the Tree Radar Unit (TRU™) to detect and quantify internal trunk decay in urban trees at two selected locations: Viharamahadevi park and Keppetipola road. Thirty trees (15 per site) previously categorized into low-, moderate-, and high-risk groups using VTRA were scanned circumferentially at breast height (1.3 m). Radar data were processed in TreeWin Pro to generate cross-sectional images, and decay zones were quantified using ImageJ to calculate proportions of advanced (hollow), incipient, and near-surface decay relative to total trunk area. At Viharamahadevi park, 8 of 15 trees exhibited internal decay ranging from 0.67% to 51.72%, while at Keppetipola road, 9 of 15 trees showed decay ranging from 1.13% to 78.60%. All low-risk trees showed no detectable decay, whereas moderate- and high-risk trees displayed varying degrees of internal deterioration. Although decay was more prevalent in trees with higher VTRA categories, the presence of decay did not consistently correspond to elevated failure risk, highlighting the need for a multi-parameter approach. Decay percentages were interpreted in relation to structural integrity thresholds whereas 25%, 50%, 75%, 100% decay were identified as mild, moderate, severe and extreme risk-causing conditions. This study being the first application of TRU™ in Sri Lanka, demonstrates its potential for non-destructive decay detection under tropical field conditions. However, the limitations of GPR technology must be acknowledged, including high equipment cost, the need for trained and experienced operators and sensitivity to moisture content that can influence radar signal interpretation. To overcome these constraints, the accuracy of the machine can be compared and validated with other diagnostic tools. During the study, the TRU machine used was validated with real cross sections of trees to produce a more holistic and reliable assessment. The findings further emphasize practical implications for urban tree management, including improved prioritization of high-risk trees, optimized monitoring schedules, and stronger support for evidence-based municipal policies aimed at proactive tree risk mitigation and long-term urban forest sustainability.

Keywords: *Urban trees, Ground penetrating radar, Tree radar unit, Internal decay, Risk assessment*