

Population structure and regeneration status of *Dalbergia latifolia* Roxb. (Indian rosewood) in forest areas of Karnataka, India: implications for conservation and sustainable management

S. M. Balakrishna¹, T. N. Manohara^{1,*} and H. S. Suresh²

¹Institute of Wood Science and Technology, Bengaluru 560 003, India.

²Centre for Ecological Sciences, Indian Institute of Science, Bengaluru 560 012, India.

Dalbergia latifolia Roxb. (Indian rosewood) is a valuable tropical hardwood native to South and Southeast Asia, increasingly threatened by habitat loss, overexploitation, and regeneration challenges. The present study provides a comprehensive field-based assessment of population structure, regeneration dynamics, and ecological factors across thirteen forest divisions in Karnataka, India, including Reserve Forests (RFs) and Wildlife Sanctuaries/Tiger Reserves (WLS/TRs). A total of 190 transects were surveyed, recording 1,705 individuals classified as seedlings, saplings (poles), or mature trees. The average tree density was 6.66 ± 6.51 individuals per 0.1 hectare (range: 0–34). Regeneration was mainly seed-originated, accounting for 92.5% of individuals, with minimal contribution from root suckers. Seedling (520 individuals/ha) and sapling (330 individuals/ha) densities were significantly higher in RFs compared to WLS/TRs, where regeneration was considerably limited despite the presence of mature trees. Size-class distributions in RFs showed a reverse J-shaped pattern, indicating active recruitment, whereas WLS/TRs displayed recruitment bottlenecks dominated by mature cohorts. Invasive species such as *Lantana camara* and *Chromolaena odorata* have been identified as significant barriers to regeneration, intensifying competition and increasing fire risk. Biomass and carbon stock assessments revealed significant spatial variation, with the Madikeri and Bhadra divisions contributing notably to carbon sequestration. These findings emphasise the urgent need for adaptable, site-specific management approaches, including invasive species control, fire mitigation, enrichment planting, and regeneration support, guided by ongoing ecological monitoring. The integrated methodological framework presented here offers a scalable model for assessing other endangered hardwood species, delivering essential insights to promote conservation, sustainable forest management, and global climate resilience.

Keywords: Carbon sequestration, conservation management, *Dalbergia latifolia*, invasive species, population structure, regeneration dynamics, Western Ghats.

DALBERGIA latifolia Roxb., commonly known as Indian rosewood (family Fabaceae), is among the most highly valued tropical hardwood species, primarily distributed across the Indian subcontinent and parts of Southeast Asia^{1,2}. Renowned for its fine-grained, durable timber, *D. latifolia* is extensively used in the production of high-quality furniture, musical instruments, decorative veneers, and artisanal woodcraft^{1,2}. Beyond its economic value, it plays a vital role in ecosystem health by improving soil fertility through nitrogen fixation, supporting biodiversity, and sequestering atmospheric carbon, thus helping to mitigate climate change and providing essential ecological services^{3–5}. Empirical evidence from field-based assessments highlights the significant carbon sequestration potential of *D. latifolia* in both natural forests and plantation systems. In the Tarai region of Uttarakhand, monocultures with a tree density of 880 individuals per hectare recorded a total biomass of 145.14 Mg per hectare and a carbon stock of approximately 68.94 Mg C per hectare in 7-year-old stands, with annual carbon sequestration rates reaching 7.6 Mg C per hectare per year⁴. Similarly, studies conducted in Karnataka's Rajiv Gandhi National Park reported substantial carbon storage in natural *D. latifolia* populations, closely linked to regeneration status and forest structural attributes⁵. These findings underscore the species' ecological importance within protected forest ecosystems. Despite its ecological and economic importance, *D. latifolia* faces mounting threats from habitat degradation, illegal logging, unsustainable harvesting, and insufficient natural regeneration^{1,3,5,6}. Field research in the Nilgiris has documented poor natural regeneration in disturbed forest patches⁷, while more comprehensive ecological evaluations underscore the need for continuous regeneration monitoring to maintain population viability⁸. These ongoing pressures have led to a notable decline in the species' population across its native

*For correspondence. (e-mail: tnmanohara.iwst@gmail.com)