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Journal of Threatened Taxa

Open Access

10.11609/jott.2025.17.11.27787-28010
www.threatenedtaxa.org

26 November 2025 (Online & Print)
17(11): 27787–28010
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

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continued on the back inside cover

Cover: A male Scarlet Skimmer perching on vegetation by the banks of a waterbody. Ink and watercolour illustration by Anandita Pascal.

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 November 2025 | 17(11): 27954–27959
ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)
https://doi.org/10.11609/jott.10140.17.11.27954-27959
#10140 | Received 06 September 2025 | Final received 15 October2025 | Finally accepted 04 November 2025
COMMUNICATION
OPEN ACCESS

Conservation significance of Yelakundli Sacred Grove: a relic population of the endemic dipterocarp *Vateria indica* L.

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Abstract: Yelakundli Sacred Grove, a 4 ha evergreen forest patch in Shivamogga District, Karnataka State, India, harbours a rare and exceptionally large population of the endemic dipterocarp tree *Vateria indica*. A single transect revealed 122 mature individuals of this species, whereas it was virtually absent outside the grove. The grove's unique characteristics, including 100% evergreenness, 87% tree endemism, and a thick leaf litter layer, support the dominance of *Vateria indica* and other climax tree species, such as *Mesua ferrea*. The absence of fire and the non-removal of leaf litter have contributed to the grove's ecological integrity. In contrast, intensive litter collection and forest fires in other forest patches have altered soil properties, impaired seedling establishment, and shifted species composition. Yelakundli sacred grove's conservation significance lies in its role as a biodiversity heritage site, providing a window into the evolutionary history of tropical forests. Its protection by the local community, driven by cultural and religious beliefs, has ensured the persistence of this relic population, highlighting the importance of community-driven conservation efforts.

Keywords: Biodiversity heritage site, community-driven conservation, evergreen forest, flowering plant, sacred grove, Western Ghats.

Kannada: ಯೆಲಕುಂದ್ಲಿ ದೇವರಕಾಡು, ಕರ್ನಾಟಕದ ಶಿವಮೊಗ್ಗ ಜಿಲ್ಲೆಯಲ್ಲಿರುವ ೪ ಹೆಕ್ಟೇರ್ ವಿಸ್ತೀರ್ಣದ ಹರಿದ್ವರ್ಣ ಕಾಡು. ಇಲ್ಲಿ ಅಪರೂಪದ ಸ್ಥಳೀಯ ಡಿಪ್ಟೆರೋಕಾರ್ಪ್ ಪ್ರಭೇದದ ವೆಟೇರಿಯಾ ಇಂಡಿಕಾ (ಸಾಲ್ಮೂಪ) ಮರಗಳನ್ನು ಅತ್ಯಧಿಕ ಸಂಖ್ಯೆಯಲ್ಲಿ ಹೊಂದಿದೆ. ಒಂದೇ ಟ್ರಾನ್ಸೆಕ್ಟ್‌ನಲ್ಲಿ ಈ ಜಾತಿಯ ೧೨೨ ವೆಟೇರಿಯಾ ಇಂಡಿಕಾ ಮರಗಳು ದಾಖಲು ಮಾಡಲಾಗಿದ್ದು, ದೇವರಕಾಡಿನ ಹೊರಗೆ ಈ ಮರಗಳು ಬಹುತೇಕ ಕಾಣಸಿಗುವುದಿಲ್ಲ . ಈ ದೇವರಕಾಡಿನ ವಿಶಿಷ್ಟ ಲಕ್ಷಣಗಳಾದ 100% ಹರಿದ್ವರ್ಣ ಕಾಡು, 87% ಸ್ಥಳೀಯ ಜಾತೀಯ ಮರಗಳು, ಮತ್ತು ಮಣ್ಣಿನಲ್ಲಿ ಹೆರಳವಾಗಿ ಸಿಗುವ ದರಗೆಲೆಗಳ ಪದರು ವೆಟೇರಿಯಾ ಇಂಡಿಕಾ ಮತ್ತು ಮೆಸುವಾ ಫೆರಿಯಾ (ನಾಗಕೇಸರಿ) ಮುಂತಾದ ಮರ ಪ್ರಭೇದಗಳ ಹೆಚ್ಚಿನ ಸಂಖ್ಯೆಗೆ ಕಾರಣವಾಗಿದೆ. ಕಾಡಿನಲ್ಲಿ ಬೆಂಕಿಯ ಅನುಪಸ್ಥಿತಿ ಮತ್ತು ದರಗೆಲೆಗಳ ಸಂಗ್ರಹಣೆಯಿಲ್ಲದಿರುವುದು ದೇವರಕಾಡಿನ ಪರಿಸರ ಸಮಕೋಲನವನ್ನು ಕಾಯ್ದುಕೊಳ್ಳಲು ಸಹಾಯಮಾಡಿದೆ. ಇತರೆ ಕಾಡು ಪ್ರದೇಶಗಳಲ್ಲಿ, ದರಗೆಲೆಗಳ ತೀವ್ರ ಸಂಗ್ರಹಣೆ ಮತ್ತು ಕಾಡಾಗ್ನಿಗಳ ಪರಿಣಾಮವಾಗಿ ಮಣ್ಣಿನ ಗುಣಲಕ್ಷಣಗಳು ಬದಲಾಗಿದ್ದು, ಮರಗಳ ಬೀಜಪುನರುತ್ಪಾದನೆ ಅಸ್ಥಿರಗೊಂಡಿದೆ ಮತ್ತು ಗಿಡಗಳ ಪ್ರಭೇದ ಸಂಯೋಜನೆ ಬದಲಾಗಿದೆ. ಯೆಲಕುಂದ್ಲಿ ದೇವರಕಾಡು ಜೀವ ವೈವಿಧ್ಯ ಪರಂಪರೆ ತಾಣವಾಗಿದ್ದು, ಉಷ್ಣವಲಯದ ಕಾಡುಗಳ ವಿಕಾಸನದ ಇತಿಹಾಸ ಪರಂಪರೆಯನ್ನು ಅರಿಯುವಲ್ಲಿ ಸಹಾಯಕವಾಗಿದೆ. ಸ್ಥಳೀಯ ಜನ ಸಮುದಾಯದ ಧಾರ್ಮಿಕ ಹಾಗು ಸಾಂಸ್ಕೃತಿಕ ನಂಬಿಕೆಗಳಿಂದಾಗಿ, ಈ ಅಪರೂಪದ ವೆಟೇರಿಯಾ ಇಂಡಿಕಾ ಮರಗಳ ಹರಿದ್ವರ್ಣ ಕಾಡು ಇಂದಿಗೂ ಉಳಿದುಕೊಂಡಿರುವುದು ವಿಶೇಷವಾಗಿದೆ.

Editor: A.J. Solomon Raju, Andhra University, Visakhapatnam, India.

Date of publication: 26 November 2025 (online & print)

Citation: Rao, G.R. (2025). Conservation significance of Yelakundli Sacred Grove: a relic population of the endemic dipterocarp *Vateria indica* L.. *Journal of Threatened Taxa* 17(11): 27954–27959. https://doi.org/10.11609/jott.10140.17.11.27954-27959

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Funding: None.

Competing interests: The author declares no competing interests.

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Acknowledgements: I extend my heartfelt gratitude to the people of Yelakundli Sacred Grove for sharing their valuable insights and knowledge. I also appreciate the assistance provided by the officers and forest officials from the Karnataka Forest Department. I am deeply indebted to Dr. T.V. Ramachandra and Dr. M.D. Subash Chandran, CES, IISc, for their unwavering support and encouragement. I also thank Mr. Vishnu D and Mr. Srikanth Naik for their technical and field assistance. Special thanks are due to Dr. Chetan Nag, deputy director, CUBEC, JAIN (Deemed-to-be-University), for his timely help and valuable suggestions. I also appreciate the various forms of assistance provided by Ph.D. scholars, Mr. Gagan Kini, Mr. Ganesh N, and Ms. D Bindu Madhavi from CUBEC, JAIN (Deemed-to-be-University). Finally, I am grateful to the anonymous reviewers for their insightful comments and suggestions.

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INTRODUCTION

Western Ghats represent one of the best non-equatorial tropical forests and are also considered one of the 36 biodiversity hotspots of the world (Nayar 1996; Myers et al. 2000; Conservation International 2025). These ancient landscapes have nurtured the evolution of several primitive plant families, notably Myristicaceae and Dipterocarpaceae, with the latter forming the dominant canopy component of primary lowland forests (Meijer 1973). The discovery of fossilized ambers (a hardened resin) of dipterocarp origin from the Cambay shale of Gujarat in Western India indicates the antiquity of the family to be over 50 million years ago (Rust et al. 2010). Yelakundli Sacred Grove (Yelakundli SG) of Sagara Taluk, Karnataka, is one such dipterocarp forest patch dominated by the endemic tree *Vateria indica* L., surrounded by paddy fields and other human landscapes. How did such an ancient forest patch survive despite climatic adversities and human disturbances? The answer lies in the genesis of sacred groves. Sacred groves are segments of landscape containing trees and other forms of life and geographical features that are delimited and protected by human societies, believing that preserving such a patch of vegetation in a relatively undisturbed state is necessary for expressing one's relation to nature. So, these remain as isolated patches of forests in the midst of agricultural landscapes (Hughes & Chandran 1998). It is one such sacred grove that escaped human pressures due to its sanctity. Gadgil & Berkes (1991) attributed the traditional practice of most human societies in providing complete protection to certain biological communities by setting aside refugia to a variety of regulatory measures that have been an integral part of the utilization of biological resources. This has kept alive the protection of primaeval relic forest patches as sacred groves. Despite their size limitations, these fragments conserve local biodiversity and offer important ecological services (Ray & Ramachandra 2010). This study investigates the structure and floristic composition of the Yelakundli SG, with a focus on understanding its conservation through the role of community-driven management, rooted in cultural reverence and its significance as a living relic of evolutionary antiquity.

Study area

This study was conducted in the Yelakundli Sacred Grove (SG), located in Sagara Taluk, Shivamogga District of Karnataka State (Figure 1). The grove is situated within evergreen-to-semi-evergreen forest matrix, surrounded by human-modified landscapes comprising paddy fields and Areca plantations. The Yelakundli SG is a 4-ha evergreen climax forest, harbouring several deities and small sacred places, with Rachamma Devi being the primary worshipped deity (Image 1).

MATERIALS AND METHODS

Due to strict regulations and restricted access set by the local people community, a transect-based approach was employed to study the Yelakundli Sacred Grove. The work was done barefoot within the grove's boundaries, adhering to local customs. A single belt transect (2,000 m^2, 180 m long) was established, comprising five quadrats (20 x 20 m each), following Chandran et al. (2010) (Figure 2). In each tree quadrat, trees with >30 cm GBH and lianas >10 cm GBH were enumerated. Tree height, climbers, and epiphytes were also recorded. Shrubs (GBH <30 cm, height >1 m) were counted in two 5 x 5 m quadrats within each tree quadrat. Herb plots (1 x 1 m) were established within each shrub quadrat to study herbs and woody seedlings.

Data analysis included calculating Shannon-Wiener's diversity index, Simpson dominance (Ludwig & Reynolds 1988), and importance value indices (IVI) for each tree species (Curtis & McIntosh 1951). Basal area per ha was calculated to understand the dominant species in the tree layer. Evergreeness and endemism percentage of the tree layer were calculated following Mesta & Hegde (2018), along with girth class distribution of the dominant tree, *Vateria indica*. Local people and priests were interviewed to gather information on the sacred grove's history, conservation, and community involvement.

RESULTS

Vegetation structure and composition

A total of 187 plant species, representing 52 families, were recorded across the tree, shrub, and herb layers during the survey. There were 122 individuals of *Vateria indica* (Dipterocarpaceae) recorded in a single transect within the tree layer, indicating a near-monodominant forest composition. Other notable tree species present in the transect included *Mesua ferrea, Saraca asoca, Holigarna arnottiana, Artocarpus hirsutus,* and *Knema attenuata*. Importance value indices (IVI) revealed *Vateria indica* as the dominant species (IVI = 209), followed by *M. ferrea* (IVI = 30.86) and *S. asoca* (IVI = 19.58) (Table 1). The Shannon diversity index was low (H' = 0.6) and Simpson dominance index was high (D = 0.71) indicating

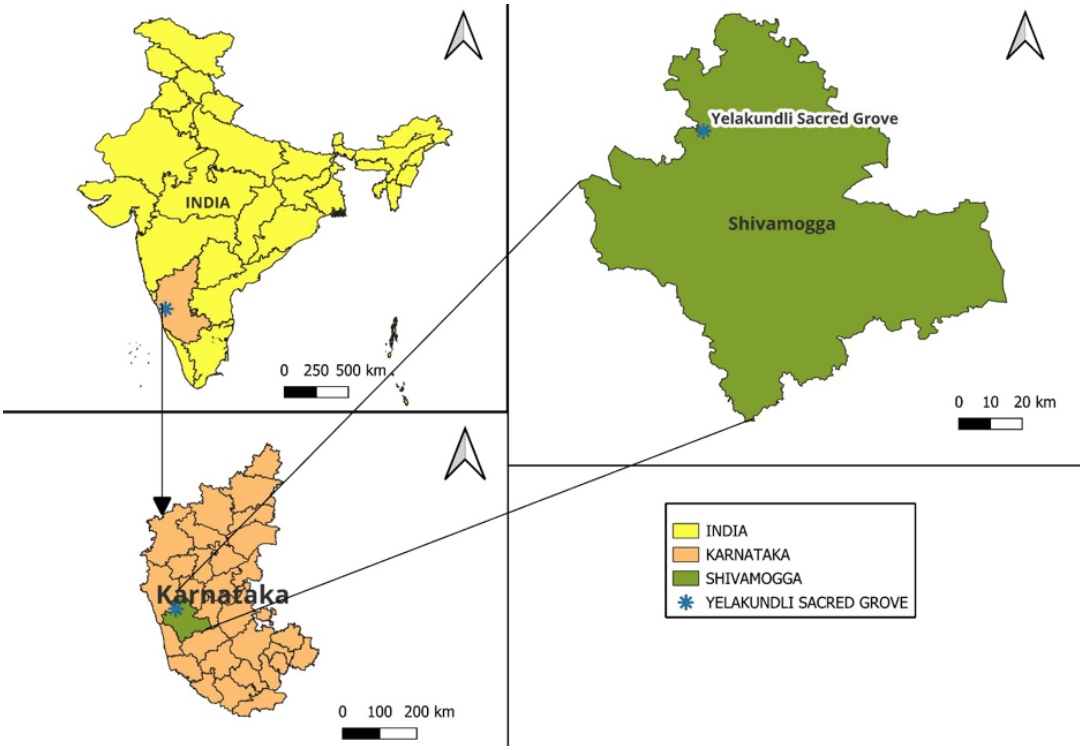

Figure 1. Map of Yelakundli Sacred Grove, Sagara Taluk, Shivamogga District, Karnataka State.

Table 1. IVI of seven tree species (tree layer) in the Yelakundli Sacred Grove.

Species	IVI
Vateria indica	209.01
Mesua ferrea	30.86
Saraca asoca	19.58
Artocarpus hirsutus	14.13
Knema attenuata	9.05
Caryota urens	8.69
Holigarna arnottiana	8.69

the overwhelming dominance of *V. indica*.

The forest exhibited 100% evergreenness, with a remarkably high level (87%) of tree endemism (Figure 3). Transect analysis of the tree layer revealed a basal area of 86.9 m^2/ha, primarily attributed to the massive individuals of *V. indica*, which averaged 17 m in height. Other tree species, such as *A. hirsutus* and *K. attenuata* were represented by a few individuals. Girth class distribution analysis of *V. indica* revealed a healthy population structure with individuals ranging 30 cm to over 100 cm GBH, and some trees exceeding 300 cm GBH (Figure 4). In the shrub layer, *V. indica* exhibited the highest number of saplings (148), followed by *M. ferrea* (51), *Syzygium stocksii* (19), and others. Similarly, in the herb layer, *V. indica* had the highest number of individuals (119), followed by *Lagenandra ovata* (81), *Combretum latifolium* (52), and others.

DISCUSSION

The Yelakundli SG is distinguished by a rare and exceptionally large population of the endemic dipterocarp *V. indica*. Within a single transect, 122 mature individuals of this species were recorded, whereas outside the grove, *V. indica* was virtually absent. This species represents one of the important relic species along with other endangered dipterocarps such as *Dipterocarpus indicus* (Chandran et. al. 2010). Other important trees include *M. ferrea, S. asoca, H. arnottiana,* and *A. hirsutus* , also form some of the important elements of the evergreen forest (Image 2). As the forest area has shrunk to just a few ha the diversity was very low with nearly mono-dominant dipterocarp *V. indica* in overwhelming numbers and just six other tree species sparingly occurring (Table 1). This healthy population of *V. indica* was seen in tree, shrub, and herb layers. The sacred grove was also 100% evergreen climax forest with highest level of tree endemism (87%). One of the important factors contributing to this is the

Image 1. A glimpse into the sacred grove: A—a dense canopy of lofty *Vateria indica* trees | B—the revered deity Rachamma inside the sacred grove, Yelakundli, Sagara Taluk, Shivamogga District, Karnataka State | C—sacred grove entrance view. © G. Ramachandra Rao.

presence of heavy leaf litter, which were not collected by the local people. They informed that even a single dry leaf or fallen twig was never collected or taken out from the sacred grove. The leaf litter layer is itself nearly 0.6 m (2 ft.) thick making ideal nursery grounds for large seeded climax trees such as *V. indica* and *M. ferrea*. The absence of fire promotes the luxuriant regeneration of large-seeded evergreen species. In contrast, many other forest patches, including sacred groves practice intensive litter collection for agricultural use, which significantly alters soil structure. Studies have shown that litter removal increases soil bulk density and reduces surface-soil carbon and nitrogen content, thereby impairing seedling establishment and nutrient cycling (Chandran et al. 2010; Ito et al. 2014). When compounded by forest fires, these disturbances further degrade soil properties, volatilize essential nutrients, and kill microbial communities, leading to a shift in species composition toward smaller-seeded, fire-tolerant, and often deciduous taxa (Elakiya et al. 2023). Such changes undermine the ecological integrity and resilience of evergreen forest fragments.

Yelakundli SG as a biodiversity heritage site

The Yelakundli SG, dedicated to the mother goddess 'Rachamma', stands as a rare and remarkable remnant of tropical forest heritage (Figure 2B). Its continued existence owes much to the unwavering protection offered by the local village community. Other deities seen include Chowdamma and Rameshwar. Outside the SG, a deity by the name Anegundi Bhutappa was also worshipped during the commencement of early monsoon rains. These gods and bhutas with rigorous religious sanctity have played a pivotal role in maintenance and survival of this ancient primary patch. *Vateria indica* trees, being lofty emergent primary forest species, have large sized fruits and seeds. Seeds dispersal can only be feasible by wild animals and large birds such as Hornbills. In Yelakundli SG the forest size is very less to support larger wild animals and hence are totally absent. Absence of larger dispersal agents and soil having heavy leaf litter with moisture, supported trees such as *V. indica* and *M. ferrea* which have dominated the sacred grove over the years. Other evergreen trees might have slowly got locally extinct from the area due to small grove size. But the very presence of primary tree species, *V. indica*, and *M. ferrea* in this hostile area indicates the past grandeur these areas might have had. What is now seen is just a chunk of that bygone history of tropical luxuriance. Studies indicate

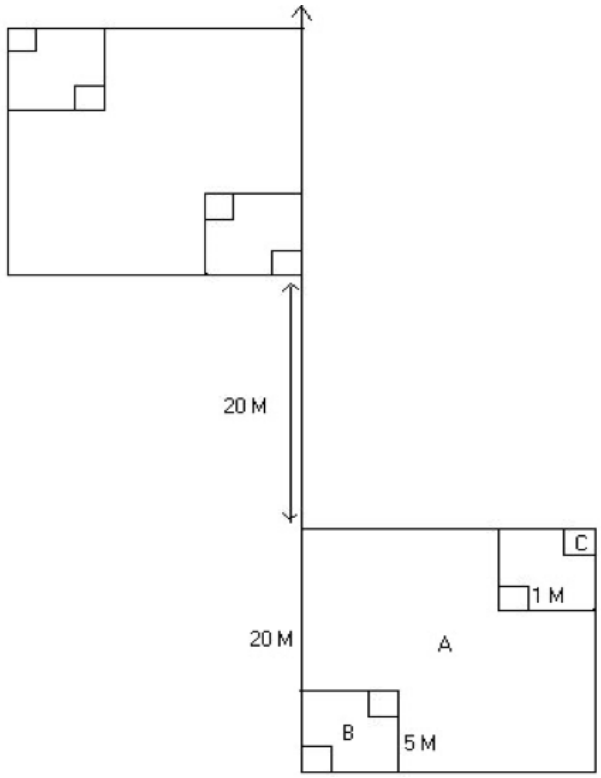

Figure 2. Schematic representation of the modified belt transect design, illustrating two of the five quadrats (20 x 20 m each): A—tree quadrat (20 x 20 m) | B—shrub plot (10 x 10 m) | C—herb plot (5 x 5 m), used for vegetation sampling and analysis.

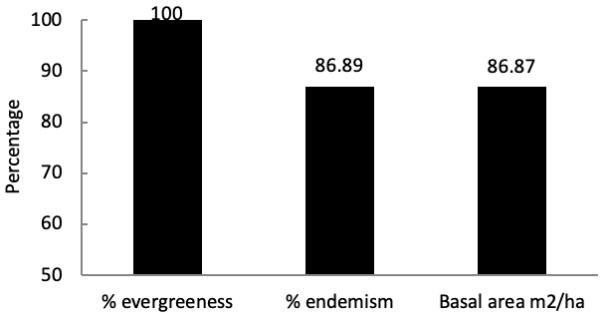

Figure 3. Ecological characteristics of Yelakundli sacred grove: A—percentage evergreenness | B—percentage endemism | C—basal area per ha.

that natural populations of *V. indica* are rare in the central Western Ghats, occurring only in undisturbed primary forest patches or well-preserved sacred groves (Chandran et al. 2010; Gunaga et al. 2015) and more frequent in southern Western Ghats (Jose & Binoy 2018; Singh et al. 2022). Therefore, Yelakundli SG with all its evolutionary significance and cultural importance highly qualifies to be declared as biodiversity heritage site. These are some of the areas where the missing links of tropical forest evolution are discovered, which would have been highly impossible if it had not been protected with such rigorous austerity.

CONCLUSIONS

The Yelakundli SG represents a unique relic of evergreen forest dominated by the endemic dipterocarp *V. indica*. Its near-monodominant structure, high endemism and evergreenness underscore both its evolutionary antiquity and its role as a living museum of Dipterocarpaceae heritage. Community-driven protection rooted in sacred grove traditions has safeguarded this fragment against litter removal, fire and land conversion. This fosters seedling establishment for large-seeded climax species. This culturally enforced refuge illustrates how traditional

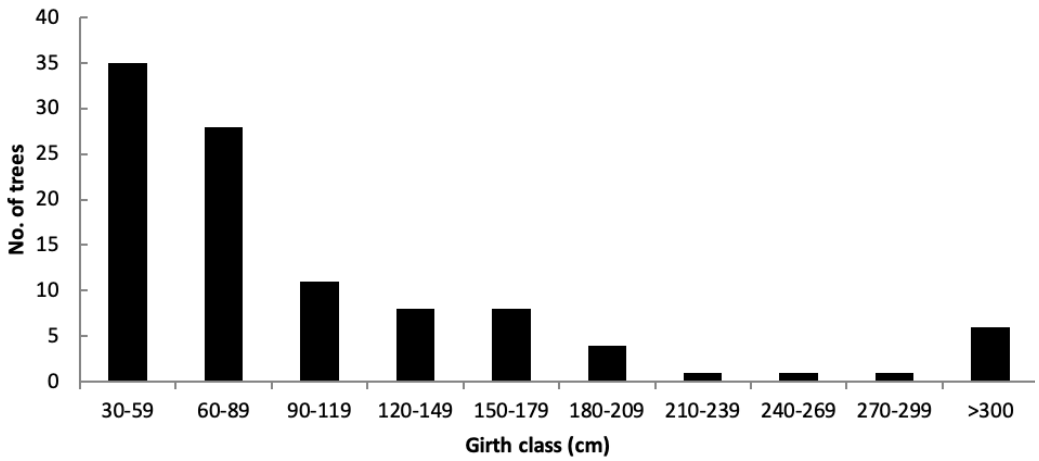

Figure 4. Girth class distribution of the endemic dipterocarp *Vateria indica* in Yelakundli Sacred Grove: a transect-based analysis revealing the population structure and size-class distribution.

Image 2. Important trees of Yelakundli Sacred Grove: A—*Knema attenuata* | B—*Saraca asoca* | C—*Mesua ferrea* | D—*Vateria indica*. © G. Ramachandra Rao.

ecological knowledge can sustain primeval forest even within intensively modified agricultural landscapes.

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NAAS rating (India) 5.64

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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

November 2025 | Vol. 17 | No. 11 | Pages: 27787–28010
Date of Publication: 26 November 2025 (Online & Print)
DOI: 10.11609/jott.2025.17.11.27787-28010

Publisher & Host

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