

Endemic and threatened flora recorded in *Acacia auriculiformis* plantations of Kerala, India

Prasanna Rajamanickam, Subramani S P, Kunhikannan C*

ICFRE-Institute of Forest Genetics and Tree Breeding, Coimbatore, Tamil Nadu, India

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Abstract

Phytodiversity surveys were conducted across 32 *Acacia auriculiformis* plantations of varying age classes within 12 forest divisions of the state in order to understand the plant wealth of the plantations. The survey documented 40 endemic plant species occurring within plantations indicating substantial native species recruitment under the *Acacia* stands. Among these, 17 species are listed under threatened categories of the IUCN Red List, including four Endangered, nine Vulnerable and four Near Threatened taxa. Although *A. auriculiformis* is an exotic and invasive species targeted for removal, the presence of endemic and threatened flora within certain plantations highlights their interim conservation value. The study emphasizes that the phased removal of *Acacia* plantations should be implemented using site-specific and strategic approaches, prioritizing the conservation of endemic and threatened species during restoration.

Keywords: Endemic flora, threatened species, *Acacia auriculiformis* plantations, phytodiversity, conservation management

Introduction

In Kerala, monoculture plantations of *A. auriculiformis* were extensively established by the Kerala Forest Department from the 1960s onwards due to the Social Forestry Scheme by the World Bank, particularly on degraded forest lands, lateritic plateaus, hill slopes and former low-productivity plantations (Jayaraman & Rajan, 1991) [5]. According to records of the Kerala Forest Department, monoculture plantations of *Acacia auriculiformis* were established at 369 sites across the state between 1964 to 2017. After the introduction of the Kerala Forestry Project in 1998, many low-yielding eucalyptus plantations were removed and replaced mainly with *Acacia* species (KFD Working Plan, 2004^[6]–2014). Although these plantations initially contributed to soil stabilisation and increased tree cover, long-term ecological studies have raised concerns regarding their impacts on native biodiversity. Dense canopy cover, heavy litter accumulation, altered soil nutrient dynamics and aggressive regeneration have been shown to suppress native species recruitment and modify natural successional, with the species exhibiting invasive nature in Kerala (Parrotta, 1999; Drisya *et al.*, 2023) [7, 8].

The state's eco-restoration policies emphasise the gradual removal of exotic monocultures and their conversion into near-native vegetation, with the objective of restoring ecosystem functions, enhancing native biodiversity and

improving landscape resilience (Kerala Forest Department, 2021) [9]. Evaluating the biodiversity potential of plantation forests is therefore important, especially in biodiversity hotspots such as the Western Ghats (Phillips *et al.*, 2017; Tudge *et al.*, 2023) [10, 11]. However, effective implementation of this transition requires a clear understanding of existing vegetation composition within plantations, particularly the presence of endemic and threatened plant species. Therefore, the present study documents the occurrence of endemic and IUCN-listed threatened flora within *A. auriculiformis* plantations across Kerala, providing critical insights for developing site-specific and biodiversity-sensitive strategies for phasing out of plantation and forest restoration.

Materials and Method

The present study was conducted across 12 forest divisions representing three major zones, namely northern, central, and southern Kerala. A total of 32 *A. auriculiformis* plantations were surveyed to enable comparison and assessment of native species occurrence within plantation landscapes. Northern Kerala: Kannur, Kasargode, and Wayanad South Forest Divisions, Central Kerala: Thrissur, Chalakudy, Malayattoor, Mannarkkad, Palakkad, and Nenmara Forest Divisions, Southern Kerala: Ranni, Thenmala, and Tiruvananthapuram Forest Division.

Table 1: Details of *Acacia auriculiformis* plantations surveyed in Kerala

Forest Division	Forest Range	Name of Plantation & extent	Plantation	GPS
Kannur	Thaliparamba	Padiyoor- 19.36 Ha	1	11°59'24.7"N 75°37'50.67"E
	Thaliparamba	Kunnathur -11 Ha	2	12°04'44.0"N 75°37'58.09"E
	Kottiyoor	Kurisumala Bit 1 and 2 - 34.75 Ha	3	12°01'12.3"N 75°46'21.90"E
Kasargod	Kasaragod	Olathukaya (Karadukka)- 23 Ha	4	12°28'56.1"N 75°08'33.0"E
	Kasaragod	Manjakkal (Kuttimunda Kanakamajil)- 10.81 Ha	5	12°29'08.8"N 75°08'38.1"E
	Kasaragod	Pandi (Palakochi) - 10 Ha	6	12°30'14.6"N 75°07'01.6"E
Wayanad	Kalpetta	Idiyam vayal- 46.42	7	11°36'50.2"N 76°00'30.6"E
	Meppady	Lakkidi- 10 Ha	8	11°31'25.5"N 76°01'03.0"E
	Kalpetta	Pookode- 21.5 Ha	9	11°32'10.4"N 76°01'01.7"E
Thrissur	Machad	Chepilakode - 63.3 Ha	10	10°38'50.1"N 76°17'26.5"E
	Machad	Elanadu- 20 Ha	11	10°36'17.3"N 76°23'49.3"E

	Wadakkanchery	Wadakkanchery Bit 1 &2- 73.7 Ha	12	10°39'00.5"N 76°13'16.5"E
Chalakudy	Vellikulangara	Areshwaram Chattilapadam- 10.1 Ha	13	10°22'26.0"N 76°20'16.7"E
	Pariyaram	Kunnankuzhy (Kannattupadam)- 15 Ha	14	10°18'07.9"N 76°25'43.0"E
	Palappilly	Vattakottayi- 21.4Ha	15	10°27'05.7"N 76°20'14.4"E
Malayattoor	Kodanad	Kottapara Kolankatu muzhi Bit VI- 233 Ha	16	10°08'19.0"N 76°38'03.1"E
	Kalady	Karakkad- 41.9 Ha	17	12°32'07.6"N 75°08'15.0"E
	Kodanad	Mekkapala- 21.16 Ha	18	10°07'10.3"N 76°34'32.8"E
Mannarkkad	Mannarkkad	Tathengalam- 10.56	19	11°02'31.2"N 76°27'19.6"E
Palakkad	Walayar	Palamara-68.7 Ha	20	10°48'08.0"N 76°42'53.3"E
	Olavakkode	Aatupathy- Vattapara -17.5 Ha	21	10°49'04.3"N 76°42'24.5"E
	Walayar	Paanampalli- 10 Ha	22	10°47'17.4"N 76°46'12.2"E
Nenmara	Alathur	Manthittu- muringamalai -16 Ha	23	10°41'57.4"N 76°30'43.9"E
	Alathur	Poothamalai - 33.4 Ha	24	10°45'41.5"N 76°28'49.8"E
Ranni	Ranni	Kulanjithodu - 39.41 Ha	25	9°21'07.6"N 76°47'37.1"E
	Vadasserikkara	Adukuzhy -12.04 Ha	26	9°22'18.3"N 76°54'52.3"E
Thenmala	Aryankavu	Kochuthalapara- 21.9 Ha	27	8°56'57.3"N 77°08'45.7"E
	Aryankavu	Bedford- 14 Ha	28	8°57'18.4"N 77°07'19.1"E
	Thenmala	Villumala 16.38 Ha	29	9°00'14.4"N 77°08'26.7"E
Thiruvananthapuram	Paruthipally	Bonacaud 24.53 Ha	30	8°41'32.7"N 77°09'12.8"E
	Paruthipally	Kuttapara 54.71 Ha	31	8°37'42.1"N 77°07'54.6"E
	Kuzhathupuzha	Anapetty -19.8 Ha	32	8°39'22.2"N 77°04'03.0"E

Plantations containing mixed planted species such as *Eucalyptus spp.*, *Swietenia macrophylla*, *Ailanthus triphysa*, *Hevea brasiliensis*, *Camellia sinensis*, and *Coffea arabica* were intentionally excluded to strengthen the data that ensured the recorded floristic composition reflected natural colonisation and regeneration within monoculture *A. auriculiformis* stands alone.

Species identification was performed using regional floras and taxonomic revisions, and nomenclature was standardised following Plants of the World Online (POWO, 2024) [17]. Endemic status was determined based on information from *Flora of the Western Ghats*, *Flora of Kerala* and the India Biodiversity Portal. Conservation status was assigned according to the IUCN Red List of Threatened Species.

Result

A taxonomic inventory was undertaken to examine the ability of these plantations to support native, endemic, and threatened Western Ghats flora. The findings demonstrate that despite being exotic monocultures, many *Acacia auriculiformis* stands harbour a significant assemblage of Western Ghats endemics, including several taxa listed under threatened IUCN categories and those with restricted distributions as recognised by Plants of the World Online (POWO), India Biodiversity Portal (IBP), floras, and regional taxonomic monographs.

As a result, a total of 40 endemic taxa belonging to 23 families were documented in the surveyed plantations. Many of these species are strict Western Ghats endemics and are listed below in Table 2.

Table 2: Endemic Plant species recorded in different *Acacia auriculiformis* plantations of Kerala

Sl. No.	Botanical Name	Family	Plantation / Forest code	Region of Endemism
1	<i>Actinodaphne bourdillonii</i> Gamble	Lauraceae	3	Southern Western Ghats
2	<i>Actinodaphne lawsonii</i> Gamble	Lauraceae	8	Western Ghats
3	<i>Ancistrocladus heyneanus</i> Wall. ex J. Graham	Ancistrocladaceae	27	Western Ghats
4	<i>Aporosa cardiosperma</i> (Gaertn.) Merr.	Phyllanthaceae	1	Peninsular India
5	<i>Baccaurea courtallensis</i> (Wight) Müll.Arg.	Phyllanthaceae	30	Southern Western Ghats
6	<i>Cinnamomum malabatum</i> (Burm.f.) J. Presl	Lauraceae	31	Western Ghats
7	<i>Connarus sclerocarpus</i> Planch.	Connaraceae	30	Western Ghats
8	<i>Cullenia exarillata</i> A. Rich.	Malvaceae	27	Southern Western Ghats
9	<i>Dalbergia malabarica</i> Thoth.	Fabaceae	14	Western Ghats
10	<i>Dysoxylum malabaricum</i> Bedd. ex C.DC.	Meliaceae	26	Western Ghats
11	<i>Ecbolium ligustrinum</i> var. <i>aryankavensis</i>	Acanthaceae	28	Western Ghats (Aryankavu)
12	<i>Gluta travancorica</i> Bedd.	Anacardiaceae	30	Southern Western Ghats
13	<i>Gordonia obtusa</i> Wall. ex Wight & Arn.	Theaceae	30	Western Ghats
14	<i>Holigarna arnottiana</i> Hook.f.	Anacardiaceae	26,32	Western Ghats
15	<i>Hopea parviflora</i> Bedd.	Dipterocarpaceae	27	Western Ghats
16	<i>Hopea racophloea</i> (Thwaites) P.S. Ashton	Dipterocarpaceae	30	Southern Western Ghats
17	<i>Hugonia belli</i> Forman	Linaceae	2	Southern Western Ghats
18	<i>Humboldtia brunonis</i> Wall.	Fabaceae	27	Southern Western Ghats
19	<i>Kunstleria keralensis</i> (Baker) P.C. Tam	Fabaceae	15	Southern Western Ghats
20	<i>Lagerstroemia microcarpa</i> Wight	Lythraceae	4, 6, 12, 25, 26	Western Ghats
21	<i>Lepidagathis keralensis</i> Madhus. & N.P. Singh	Acanthaceae	5	Southern Western Ghats
22	<i>Meiogyne pannosa</i> (Dalzell) Heusden	Annonaceae	13, 14, 33	Western Ghats
23	<i>Memecylon malabaricum</i> (C.B. Clarke) Cogn.	Melastomataceae	30	Western Ghats
24	<i>Mitragyna tubulosa</i> (Arn.) Korth.	Rubiaceae	2	Western Ghats & Peninsular India
25	<i>Monoon fragrans</i> (Dalzell) B. Xue & R.M.K. Saunders	Annonaceae	2	Western Ghats

26	<i>Naregamia alata</i> Wight & Arn.	Meliaceae	4, 5, 6, 13, 16, 17, 19, 22	Peninsular India
27	<i>Strobilanthes ciliatus</i> Nees	Acanthaceae	14	Western Ghats
28	<i>Palaquium ellipticum</i> (Dalzell) Baill.	Sapotaceae	30	Western Ghats (South & Central)
29	<i>Psychotria flavida</i> Zipp. ex Miq.	Rubiaceae	13, 32	Western Ghats
30	<i>Pterospermum rubiginosum</i> Wight & Arn.	Malvaceae	29	Western Ghats
31	<i>Selaginella keralensis</i> Fraser-Jenk.	Selaginellaceae	27	Southern Western Ghats
32	<i>Sonerila rheedii</i> Wall. ex Wight & Arn.	Melastomataceae	9	Southern Western Ghats
33	<i>Syzygium laetum</i> (Buch. -Ham.) Gandhi	Myrtaceae	3, 13, 14	Western Ghats
34	<i>Syzygium mundagam</i> (Bourd.) Chithra	Myrtaceae	30	Western Ghats
35	<i>Tabernaemontana alternifolia</i> L.	Apocynaceae	2, 5, 6, 8, 9, 11, 12, 13, 14, 15, 17, 18, 29, 20, 21, 23, 24, 25, 26, 28, 29, 31, 32	Peninsular India
36	<i>Terminalia paniculata</i> Roth	Combretaceae	19	South India
37	<i>Uvaria narum</i> (Dunal) Wall. ex Wight & Arn.	Annonaceae	3,4	Peninsular India
38	<i>Vateria indica</i> L.	Dipterocarpaceae	4, 30	Western Ghats
39	<i>Xanthophyllum flavescens</i> Roxb.	Polygalaceae	2,30	Western Ghats

Plants documented in the study area that are recognised as threatened under the IUCN Red List, encompassing species classified as Endangered, Vulnerable and Near Threatened were listed in Table 3. The presence of such taxa within

plantations demonstrates the conservation value of the plants in the plantations. The species which are presently under the IUCN categories were only considered in this article

Table 3: Threatened flora recorded in the *Acacia auriculiformis* plantations

Endangered (EN)		
Sl. No.	Botanical Name	Family
1	<i>Dysoxylum malabaricum</i> Bedd. ex C.DC.	Meliaceae
2	<i>Hopea racophloea</i> (Thwaites) P.S. Ashton	Dipterocarpaceae
3	<i>Humboldtia brunonis</i> Wall.	Fabaceae
4	<i>Selaginella keralensis</i> Fraser-Jenk.	Selaginellaceae
Vulnerable (VU)		
Sl. No.	Botanical Name	Family
2	<i>Actinodaphne lawsonii</i> Gamble	Lauraceae
3	<i>Aporosa cardiosperma</i> (Gaertn.) Merr.	Phyllanthaceae
4	<i>Baccaurea courtallensis</i> (Wight) Müll.Arg.	Phyllanthaceae
5	<i>Dalbergia malabarica</i> Thoth.	Fabaceae
6	<i>Gluta travancorica</i> Bedd.	Anacardiaceae
7	<i>Hugonia belli</i> Forman	Linaceae
8	<i>Palaquium ellipticum</i> (Dalzell) Baill.	Sapotaceae
9	<i>Vateria indica</i> L.	Dipterocarpaceae
Near Threatened		
Sl. No.	Botanical Name	Family
1	<i>Actinodaphne bourdillonii</i> Gamble	Lauraceae
2	<i>Cullenia exarillata</i> A.Rich.	Malvaceae
3	<i>Hopea parviflora</i> Bedd.	Dipterocarpaceae
4	<i>Meiogyne pannosa</i> (Dalzell) Heusden	Annonaceae

Discussion

This study shows that *Acacia auriculiformis* plantations in Kerala, though established as exotic monocultures on degraded forest lands, now support a notable diversity of native plants, including several Western Ghats endemics and species of conservation importance. A total of 40 endemic taxa and 17 IUCN-listed threatened species were recorded from 32 plantations surveyed across 12 forest divisions. Many of these species such as *Cullenia exarillata*, *Hopea racophloea*, *Selaginella keralensis* and *Dysoxylum malabaricum* are restricted to the Western Ghats and possess narrow ecological ranges.

Kunnathur plantation supported endemic flora with species such as *Xanthophyllum flavescens*, *Hugonia belli*, *Mitragyna tubulosa* and *Monoon fragrans*. In Kasaragod, Olathukaya–Karadukka, Manjakkal and Pandi plantations

recorded Peninsular Indian and Southern Western Ghats endemics including *Lagerstroemia microcarpa*, *Naregamia alata* and *Lepidagathis keralensis*. In central Kerala, Chepilakode, Elanadu and Wadakkanchery plantations, along with Malayattoor, supported endemic representation of *Lagerstroemia microcarpa* and *Naregamia alata*, while Chalakudy plantations harboured endemic flora such as *Syzygium laetum*, *Strobilanthes ciliatus*, *Kunstleria keralensis* and *Dalbergia malabarica*. The Thenmala–Aryankavu plantations exhibited high endemism richness, harbouring species such as *Hopea parviflora*, *Selaginella keralensis* and *Ecbolium ligustrinum* var. *aryankavense*. *Tabernaemontana alternifolia* and *Naregamia alata* were reported from most of the plantations and adjacent natural vegetation as pioneer species. *Meiogyne pannosa* was recorded from plantations as well as forest fringes.

Strobilanthes ciliatus, being endemic to the Western Ghats, was found to be widespread in the Kunnankuzhy plantation. *Ecbolium ligustrinum* var. *aryankavense* was also recorded as dense populations in the Bedford plantation of the Thenmala Range.

Based on the current IUCN status, four species were categorized as Endangered (EN), nine as Vulnerable (VU), and four as Near Threatened (NT) among the endemic flora recorded during the study. Across the surveyed sites, forest patches adjoining the plantations harboured Endangered species such as *Hopea racophloea*, *Selaginella keralensis*

and *Humboldtia brunonis*, together with Vulnerable taxa including *Vateria indica*, *Palaquium ellipticum*, *Dysoxylum malabaricum*, *Actinodaphne bourdillonii*, *Gluta travancorica*, *Dalbergia malabarica*, *Aporosa cardiosperma*, *Baccaurea courtallensis* and *Hugonia belli*. In addition, Near Threatened species such as *Hopea parviflora*, *Cullenia exarillata* and *Meiogyne pannosa* were frequently recorded within nearby forest patches. Species under the Near Threatened category, including *Actinodaphne bourdillonii* and *Meiogyne pannosa*, were also reported from within the plantation stands.



Hugonia belli



Humboldtia brunonis



Mitragyna tubulosa



Lepidagathis keralensis



Uvaria narum



Baccaurea courtallensis



Psychotria flavida



Ecbolium ligustrinum var. *aryankavense*

Plant 1: Endemic flora recorded during the study



Meigyne pannosa - NT



Ixora malabarica - VU



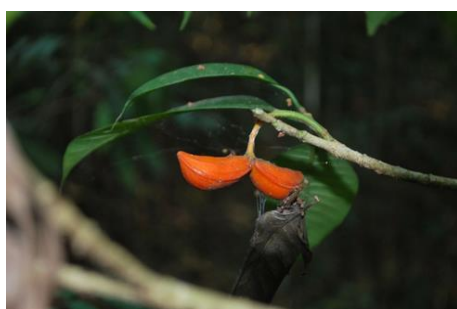
Strobilanthus ciliatus - VU



Actinodaphne bourdillonii - VU



Pterospermum acerifolium - NT



Tabernaemontana alternifolia – NT



Humboldtia brunonis - EN

Plant 2: Threatened flora as per IUCN recorded during the study

Conclusion

The present study clearly demonstrates that *Acacia auriculiformis* plantations, support a considerable number of endemic and IUCN-listed plant species, highlighting their underestimated role in regional biodiversity conservation. The occurrence of these threatened and endemic taxa within plantation landscapes and the nearby forest indicates that the undisturbed plantations can function as secondary habitats and facilitate native species persistence and regeneration, particularly when located close to evergreen and semi-evergreen forests. These findings underscore the need for a cautious and biodiversity-sensitive approach during the phased removal or conversion of *Acacia* plantations to near

native forest, wherein naturally regenerated endemic and IUCN-listed species should be identified, retained and actively protected. Incorporating such species into site-specific conservation and restoration strategies would help enhance floristic richness, maintain ecological continuity, and contribute meaningfully to Western Ghats biodiversity conservation goals. Therefore, plantation blocks that show high levels of native regeneration and endemism should be prioritised in conservation planning. Such areas must be managed carefully during any conversion or afforestation programme, ensuring that transitions to near-natural forests are gradual, ecologically sensitive, and designed to retain and enhance existing native biodiversity.

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