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Cover: Mauve Stinger *Pelagia noctiluca* by Swaathi Na. Medium used is soft pastels and gelly roll.

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ARTICLE

Plant species diversity in the riparian forests of the Moyar River in southern India

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Abstract: Riparian forests are among the most rapidly disappearing vegetation types throughout the world. River Moyar cascades through gorges and links the Western Ghats with the southernmost segments of the Eastern Ghats. Considering the relatively well-preserved state of the Moyar riparian vegetation and being amongst the least explored forests in southern India, an assessment of angiosperm diversity was undertaken. The study used an array of belt transects along and perpendicular to the river course so that the entire elevation gradient of the gallery could be covered. A total of 172 species representing 126 genera belonging to 47 families, including 100 monotypic genera and 17 monotypic families, were recorded from both the transects in the study area. 131 woody angiosperm species representing 100 genera in 41 families were recorded along the river. The perpendicular gallery transects recorded 111 woody angiosperm species representing 86 genera in 36 families. Thirteen monotypic families were found in both transects, and 70 species were found in both transects. The dominant families with the maximum species were Fabaceae, Rubiaceae and Phyllanthaceae. Shannon diversity index ranged between 2.0 to 3.27 along the river transects and 1.51 to 2.67 along the galleries. The study concludes that Moyar riparian zone merits high conservation value as it supports significant species diversity, including red-listed species and habitat-specific plants, and functions as a vital wildlife corridor in the landscape.

Keywords: Angiosperm diversity, flora, gallery, Nilgiris, riparian vegetation, Tamil Nadu, Western Ghats.

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Competing interests: The authors declare no competing interests.

Author details: Muthu Karthick Nagarajan is pursuing his PhD and works largely in the landscape of Western Ghats on various aspects like riparian forests and invasive alien species. Avantika Bhaskar, project manager (R&D) is a researcher working on various aspects of ecological conservation in Tamil Nadu.

Author contributions: NMK did the floristic assessments and data analyses, and AB wrote the manuscript.

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INTRODUCTION

Riparian forests are among the most rapidly-disappearing vegetation community types, largely owing to direct human actions and the indirect effects of modifying river courses for navigation and building of dams (Kauffman et al. 1997). Riparian forests are directly adjacent to rivers and streams, including active floodplains and nearby terraces (Naiman et al. 2001), and their vegetation interacts with terrestrial as well as aquatic ecosystems (Nilsson et al. 1994). Riparian communities are structurally and compositionally diverse, and vary from patchy forests with dense moss in cold regions, to deciduous trees and shrubs in floodplains, to well-developed forests with distinct plant zonation in the deltas (Nilsson & Svedmark 2002). The riparian zone is inhabited by specialist plants that are resilient to frequent disturbances like flooding, sedimentation, abrasion, breakage, etc. (Naiman et al. 1993). Riparian vegetation performs various ecological functions, such as providing food, organic matter, shelter and habitat, regulating stream water temperature, filtering sediments and nutrients, dissipating stream energy, preventing erosion and regulating the flow of litter from the forest floor into the stream (Gregory et al. 1991; Naiman & Decamps 1997; Naiman et al. 2001; Bowler et al. 2012; Jackson et al. 2015).

Rivers in India have historically seen the flourishing of human cultures, and in recent times they have been dammed and transformed considerably, with major consequences for riparian vegetation. While riparian vegetation structure is fairly similar along free-flowing rivers, it varies along regulated rivers due to changing water level conditions (Nilsson et al. 1997). High rates of disturbances make the riparian zone susceptible to invasions by alien species that are generally early seral species (Richardson et al. 2007). Studies have shown that riparian plant community structure is related to land use, and areas adjacent to agricultural and urban stretches have been found to have high invasive species cover and richness, respectively (Meek et al. 2010; Méndez-Toribio et al. 2014).

Our study is focused on the river Moyar that flows eastwards from the Western Ghats, a global biodiversity hotspot (Myers et al. 2000). River Moyar originates in the higher elevation zones of Nilgiri Biosphere Reserve, the first UNESCO recognized biosphere reserve in India. The riparian vegetation of the Moyar River is heterogeneous, and is undergoing gradual degradation owing to the construction of hydroelectric projects, pollution from factory effluents, local tourism pressure, widespread agriculture and excessive use of pesticides. An integrated conservation plan that includes participatory micro-plans has been made for the entire course of the river. As one of the first steps of this plan, we explored the riparian vegetation and enumerated the angiosperm species. The preliminary results of the study are presented in the sections below.

STUDY AREA AND METHODS

The Moyar River originates (11.5143^{0}N 76.5353^{0}E) in the upper reaches of the Niligiri Biosphere Reserve and meanders about 90 km through the Mudumalai and Sathyamangalam Tiger Reserves before joining Bhavani River at Bhavanisagar reservoir (11.4760^{0}N; 77.0553^{0}E). Pykara and Sigur are the major streams that feed the Moyar River. To the south, a few smaller streams like Kukkulthorai, Kedrahalla, and Kahanhalla drain into the river (Sukumar 1989; Lannerstad & Molden 2009) (Figure 1). Moyar River is also important, as it is a part of the larger Cauvery River basin.

Moyar River is known for its rich biodiversity, especially the large threatened animals such as Asian Elephants, Gaurs, feral water buffalos, Bengal Tigers, Marsh Crocodiles, Indian Rock Pythons, and vultures. The riparian vegetation sustains a small nesting colony of the 'Critically Endangered' Indian White-rumped Vulture. Around 90 species of fish have been reported from this river (Sukumar 1989; CEPF Project Report 2012), which contributes enormously to both fisheries in the state of Tamil Nadu and also local subsistence fishing throughout its length. The total study area falls under the protected area network of India. The Tamil Nadu Forest Department gave permission to carry out this research in the landscape.

The 90 km long Moyar River was sampled (during the period 2010–2011, spanning the wet and dry seasons) for angiosperm species richness and diversity using 20 transects, each of 4 km in length, along the river course (longitudinal transects). To capture the variations in species composition caused by the gallery (Yang et al. 2011), 24 supplementary or perpendicular transects (1 km each) were laid such that they cut across the lateral slopes. The supplementary transects were perpendicular to the river course transects. The width of the belt along transects was limited to five metres on either side. The elevation of the study area ranged 267–947 m.

Woody plants were identified and enumerated within the belts. Woody plants with girth at breast height (GBH) of more than one centimetre were enumerated. Plants

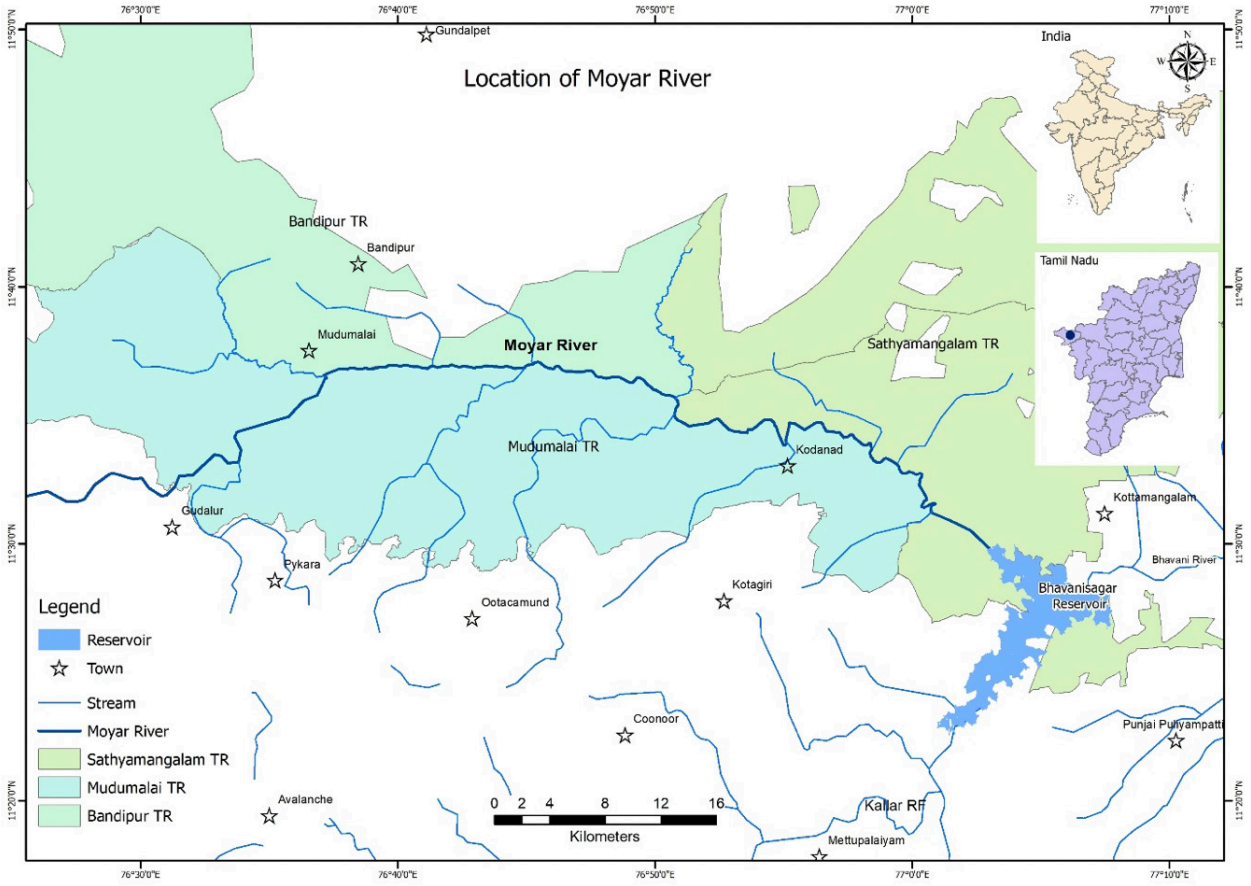

Figure 1. Map of the study area along the Moyar River in Tamil Nadu, India.

were identified using available guides, Floras and with the help of reference photographs. Hand-held lenses and measuring scales were used in the field and lab for plant identification. Some flowers from tall trees were observed and identified with the help of binoculars. In cases where field identification was not possible, voucher specimens were collected, preserved and identified using standard references such as Bentham & Hooker (1862–1883), Gamble & Fischer (1915–1936), and Mathew (1983). Nomenclature and classification were adopted from the Angiosperm Phylogeny Group IV system (Stevens 2001). Nomenclatural information was verified with online portals such as Tropicos (http://www.tropicos.org/), Plants of the World Online (POWO 2022), International Plant Names Index (IPNI 2022), and World Flora Online (WFO 2022). The nomenclature and distribution information were further verified using Flowering Plants of Tamil Nadu: A Compendium (Narasimhan & Irwin 2021). The erstwhile traditionally recognized families of Caesalpinaceae and Mimosaceae were reduced to the subfamily level and included under the family Fabaceae with the recent phylogenetic analyses by the Legume Phylogeny Working Group (LPWG 2017).

Vegetation classification was done using 'Map of the Nilgiri Biosphere Reserve (1/100,000): land use and vegetation' (Prabhakar & Pascal 1996) and 'A Revised Survey of Forest Types of India' (Champion & Seth 1968). The extent of each vegetation type in the study area was visually interpreted using Google Earth software. The woody angiosperm species were classified based on their life form into trees, shrubs and lianas.

Diversity was calculated using Shannon's diversity index (Shannon & Weaver 1949), and Pielou's index was used to determine evenness in the community (Pielou 1966).

RESULTS

River Moyar flows from west to east. Following is the vegetation types from its origin to towards the reservoir; Southern Moist Mixed Deciduous Forests (3B/C2), Dry Savannah Forests (5/DS3), Southern Dry Mixed

Deciduous Forests (5A/C3), and Southern Thorn Scrub Forests (6A/DS1). The forest types are classified based on Champion & Seth (1968).

From the East to west, the vegetation along the Moyar River course, according to Champion & Seth (1968), is composed of Southern Thorn Scrub Forests (6A/DS1), Southern Dry Mixed Deciduous Forests (5A/C3), Dry Savannah Forests (5/DS3), Southern Moist Mixed Deciduous Forests (3B/C2) vegetation, Southern Tropical Riverine Forest (5/B1) and Tropical Riparian Fringing Forests (4E/RS1).

The manual visual interpretation of the study area in Google Earth software reveals that vegetation of the Moyar River valley is heterogeneous and largely composed of riparian (32%), scrub (25%), deciduous (14%), plantation (13%), savanna (11%), and infested (5%) vegetation (Figure 2). Based on the dominance of certain species, the riparian vegetation of the Moyar River could be broadly classified into three types, namely *Terminalia–Pongamia–Syzygium* type, *Prosopis*-infested type, and *Bamboo–Mangifera* type (Images 1–3).

Life-form composition of angiosperm species was trees (78.6%), shrubs (15.3%), and lianas (6.1%) along the river-bank, and correspondingly, 73%, 24.3% and 2.7%, along the perpendicular transects, suggesting an overall dominance of trees. A higher percentage of shrubs was however observed in the galleries.

When analyzing the family richness, it was found that there are no significant differences in families representing different species in both types of transects, suggesting the dominance of few families in both zones (Figure 3). The families dominating the river course transects included Fabaceae (20 species and 16 genera), Phyllanthaceae (nine species and seven genera) and Rubiaceae (nine species and nine genera). In comparison, the perpendicular gallery transects were dominated by Fabaceae (21 species and 18 genera) Rubiaceae (eight species and eight genera), and Malvaceae (six species and three genera) families. Fabaceae has been the dominant family in Tamil Nadu state and it includes four clades, viz., Caesalpinioideae (including Mimosoid group), Cercidoideae, Detarioideae, and Faboideae (Narasimhan & Irwin 2021).

A total of 172 species representing 126 genera belonging to 47 families, including 100 monotypic genera and 17 monotypic families, were recorded from all the transects in the entire study area (Table 1); 131 woody species representing 100 genera belonging to 41 families, including 82 monotypic genera and 13 monotypic families, were enumerated in the longitudinal transects along the river course. Additionally, 111 species representing 86 genera belonging to 36 families, including 68 monotypic genera and 13 monotypic families, were recorded in the perpendicular gallery transects. Seventy species were found in both the transects, dominated by Fabaceae with 10 genera and 12 species alone. In the case of riverine vegetation, the Shannon diversity index ranged 2.0–3.27 and evenness (Pielou-index) was of the order of 0.59–0.85; whereas, in perpendicular gallery transects, the diversity was 1.5–2.67 with an evenness of 0.53–0.86. This data indicates that the riparian zone was more diverse. However, the variations in the number of species between the two communities were not very different.

Species like *Filicium decipiens* (Wight & Arn.) Thwaites, *Homonoia riparia* Lour., *Salix tetrasperma* Roxb., *Vitex leucoxylon* L.f., and *Walsura trifoliolata* (A.Juss.) Harms were predominantly riparian. Dominant tree species found along the river-course transects included *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn., *Pongamia pinnata* (L.) Pierre and *Syzygium cumini* (L.) Skeels, *Diospyros malabarica* (Desr.) Kostel., while *Catunaregam spinosa* (Thunb.) Tirveng., *Albizia amara* (Roxb.) Boivin, *Prosopis juliflora* (Sw.) DC. and *Cordia monoica* Roxb. were the common trees observed in the perpendicular gallery transects (Photographs of

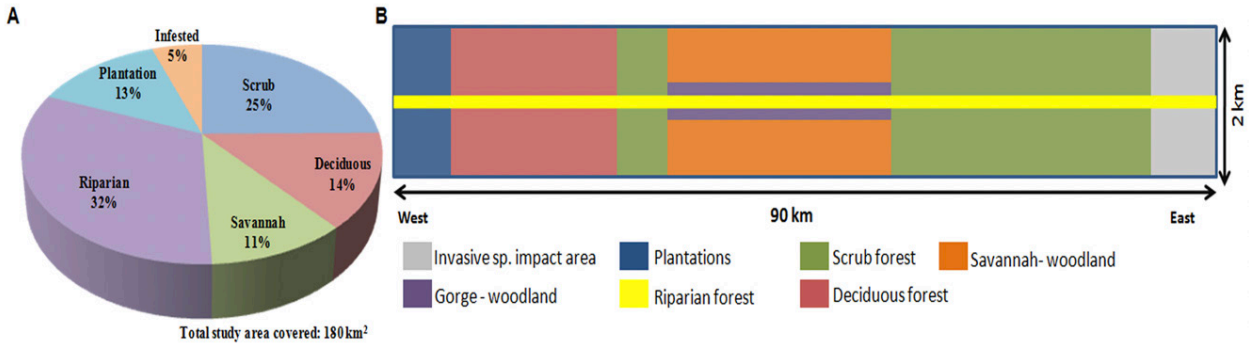

Figure 2. A—Vegetation composition along Moyar River | B—Schematic diagram showing the distribution of vegetation along Moyar River.

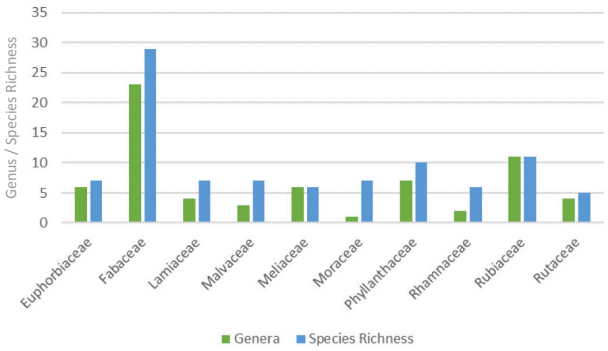

Figure 3. Dominant families along Moyar River.

a few representative species are shown in Images 4–6). Seventy-two species in both communities are categorised as 'Least Concern', while seven species are assigned with 'Vulnerable' status in the IUCN global Red List data (IUCN 2022). *Pterocarpus marsupium* Roxb. and *Swietenia mahagoni* (L.) Jacq. are the 'Near Threatened' species found in both the transects (http://www.iucnredlist.org) (Table 1). The taxa observed in both transects included 160 indigenous species and 12 non-native woody plant species.

Non-native species found in the riparian zone included *Bixa orellana* L., *Delonix regia* (Bojer ex Hook.) Raf., *Jatropha curcas* L., *Ricinus communis* L., and *Senna didymobotrya* (Fresen.) H.S.Irwin & Barneby. The predominant invasive species commonly observed here were *Chromolaena odorata* (L.) R.M.King & H.Rob., *Lantana camara* L., *Opuntia monocantha* Haw., *Prosopis juliflora*, and *Senna spectabilis* (DC.) H.S.Irwin & Barneby.

DISCUSSION

Riparian vegetation studies conducted earlier along the Chalakudy River (Bachan 2003), the Pamba River (Paul & George 2010) and the Benin River (Natta 2003), revealed Euphorbiaceae (including Phyllanthaceae), Fabaceae and Rubiaceae as the dominant families, as in this study. The dominance of these families along the rivers has been attributed to the thriving of these species in flooded and highly humid regions and improved adaptation of legume trees to waterlogged conditions owing to symbiotic nitrogen-fixing organisms (Koponen et al. 2004; Bognounou et al. 2009; Sambaré et al. 2011).

The high value of woody species richness, similar to the present study, has been previously reported in many riparian forests (Pither & Kellman 2002; Suzuki et al. 2002; Ward et al. 2002; Natta 2003; Tiegs et al. 2005; Sambaré et al. 2011). The Shannon diversity index of angiosperms in riparian forests along the Cauvery River basin has been reported to be 2.7±0.51 (Sunil et al. 2010). It ranged 1.0–2.95 in the case of the Meenachil River basin, Kerala, southern India (Vincy et al. 2015). The diversity index of angiosperms in Moyar is comparable to those of the riverine forests in Indonesia (Richter 2000), the southeastern United States (Burton et al. 2005), and Burkina Faso (Sambaré et al. 2011). The observed heterogeneity in vegetation along the gallery can be attributed to variations in geomorphology, soil drainage, moisture availability and light conditions (Gregory et al. 1991).

The long history of human interference has made the riparian zone a corridor for invasion and spread of

Image 1. Riparian habitat in the lower elevation (*Terminalia-Pongamia-Diospyros* zone). © Muthu Karthick.

Image 2. Riparian habitat in the upper elevation (*Bamboo-Mangifera* zone). © Muthu Karthick.

Image 3. Riparian habitat showing the *Prosopis*-infested zone. © Muthu Karthick.

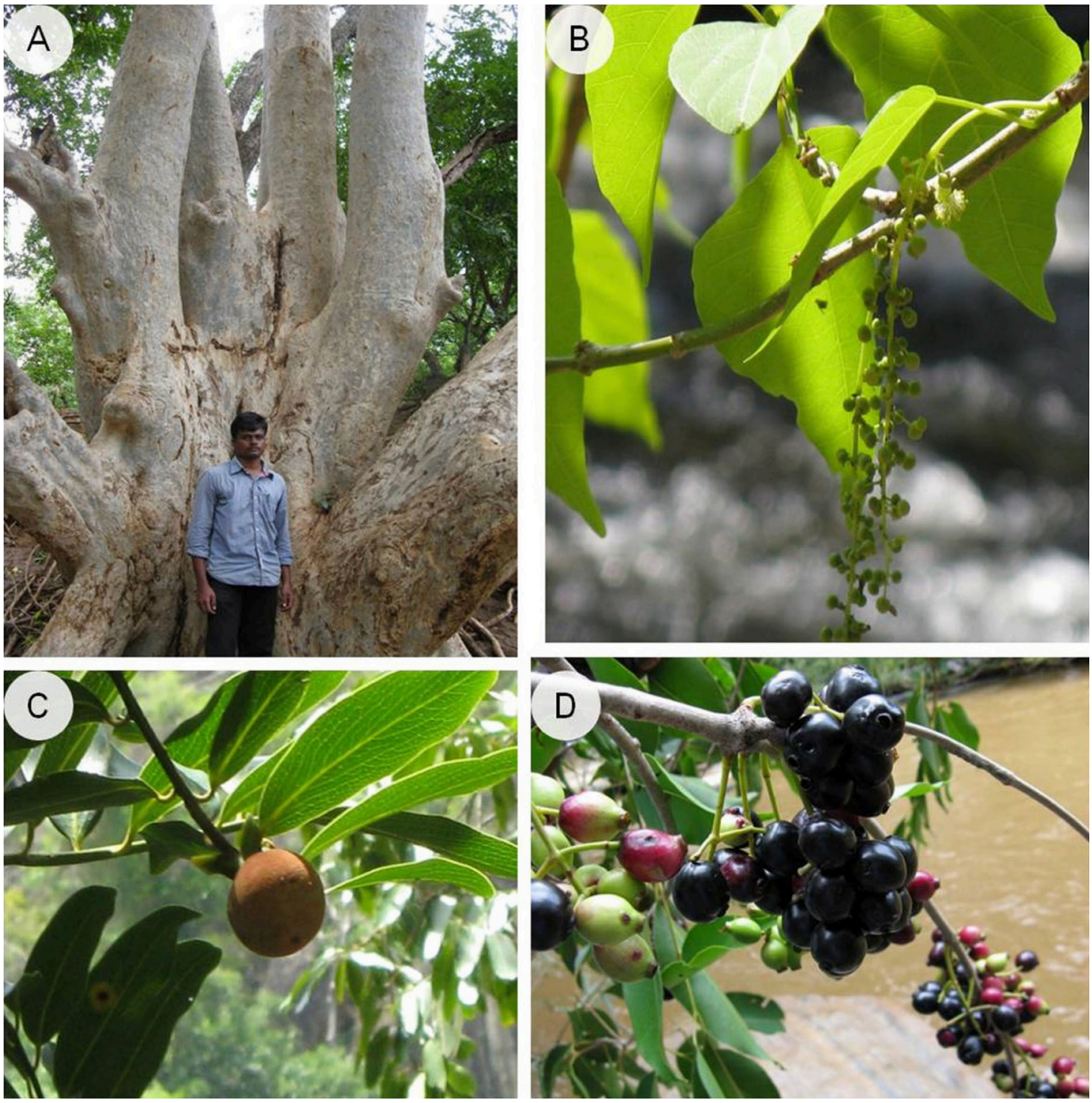

Image 4. Dominant trees of the gallery vegetation along the Moyar River: A—*Terminalia arjuna* (Combretaceae) | B—*Mallotus nudiflorus* (Euphorbiaceae) | C—*Diospyros malabarica* (Ebenaceae) | D—*Syzygium cumini* (Myrtaceae). © Muthu Karthick & Chenna Krishnan.

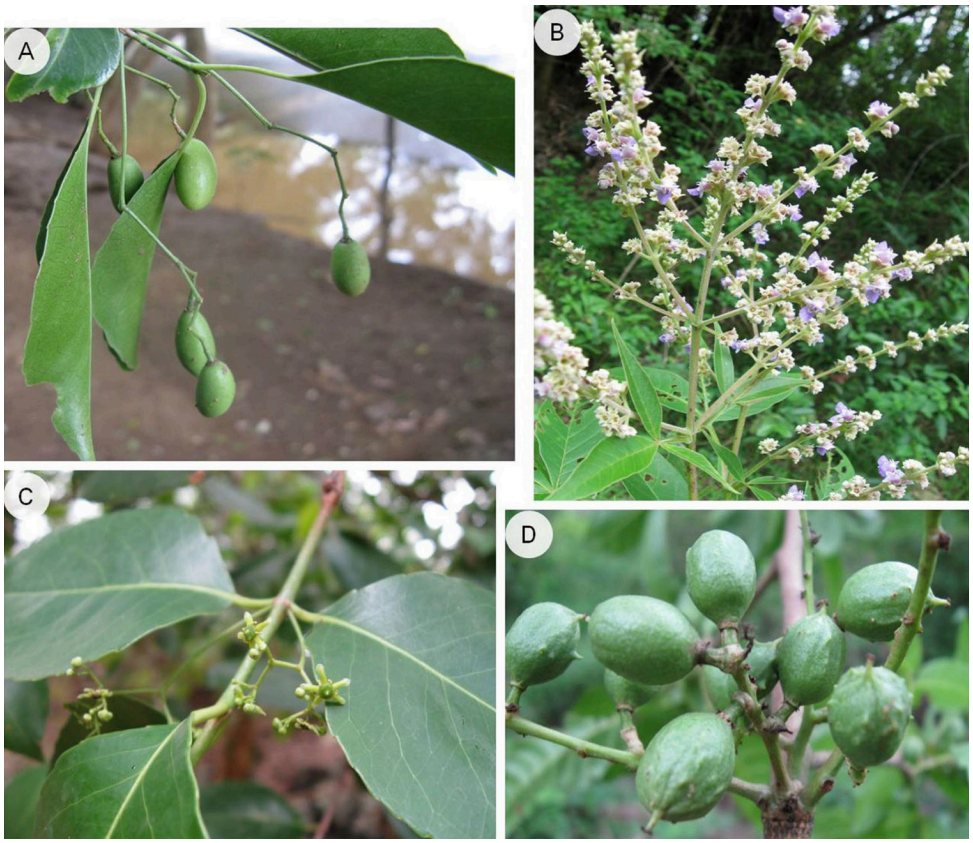

Image 5. Common trees in the upper elevation regions of the Moyar River system: A—*Pleurostylia opposita* (Celastraceae) | B—*Vitex altissima* (Lamiaceae) | C—*Elaeodendron glaucum* (Celastraceae) | D—*Schleichera oleosa* (Sapindaceae). © Muthu Karthick.

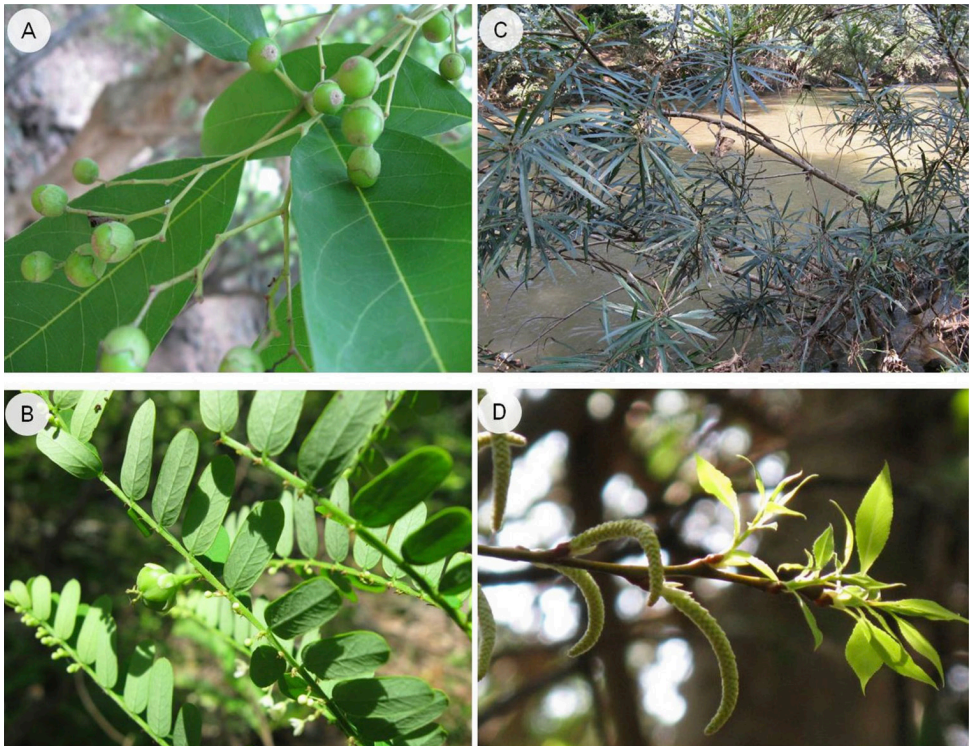

Image 6. Strict riparian species of the Moyar River system: A—*Vitex leucoxylon* (Lamiaceae) | B—*Homonoia riparia* (Euphorbiaceae) | C—*Phyllanthus racemosus* (Phyllanthaceae) | D—*Salix tetrasperma* (Salicaceae). © Muthu Karthick.

Table 1. Woody species recorded in the longitudinal (LT) and perpendicular transects (PT) along the Moyar River.

	Family	Species	Habit	Origin	IUCN Status	Voucher no.	LT	PT
1	Acanthaceae	*Strobilanthes cordifolia* (Vahl) J.R.I.Wood	Shrub	I	NE	CET 555		Y
2	Anacardiaceae	*Lannea coromandelica* (Houtt.) Merr.	Tree	I	LC	#		Y
3	Anacardiaceae	*Mangifera indica* L.	Tree	I	DD	#	Y	Y
4	Anacardiaceae	*Searsia mysorensis* (G.Don) Moffett	Shrub	I	NE	#		Y
5	Anacardiaceae	*Spondias pinnata* (L.f.) Kurz	Tree	I	NE	#	Y	
6	Apocynaceae	*Carissa carandas* L.	Shrub	I	NE	#	Y	Y
7	Apocynaceae	*Carissa spinarum* L.	Shrub	I	LC	#		Y
8	Apocynaceae	*Rauvolfia verticillata* (Lour.) Baill.	Shrub	I	NE	CET 552		Y
9	Apocynaceae	*Wrightia arborea* (Dennst.) Mabb.	Tree	I	LC	CET 512	Y	
10	Apocynaceae	*Wrightia tinctoria* (Roxb.) R.Br.	Tree	I	NE	#	Y	Y
11	Asteraceae	*Orbivestus cinerascens* (Sch.Bip.) H.Rob.	Shrub	I	NE	CET 554		Y
12	Bignoniaceae	*Dolichandrone arcuata* (Wight) C.B.Clarke	Tree	I	NE	CET 533	Y	Y
13	Bignoniaceae	*Dolichandrone atrovirens* (Roth) K.Schum.	Tree	I	NE	#	Y	Y
14	Bignoniaceae	*Dolichandrone falcata* (Wall.ex DC.) Seem.	Tree	I	NE	CET 551	Y	Y
15	Bignoniaceae	*Radermachera xylocarpa* (Roxb.) K.Schum.	Tree	I	NE	#	Y	
16	Bignoniaceae	*Stereospermum colais* (Buch.-Ham. ex Dillwyn) Mabb.	Tree	I	NE	CET 513	Y	Y
17	Bixaceae	*Bixa orellana* L.	Tree	TAm	LC	#	Y	
18	Boraginaceae	*Cordia macleodii* (Griff.) Hook.f. & Thoms.	Tree	I	NE	CET 567		Y
19	Boraginaceae	*Cordia monoica* Roxb.	Tree	I	LC	#	Y	Y
20	Boraginaceae	*Cordia obliqua* Willd.	Tree	I	NE	#	Y	
21	Burseraceae	*Boswellia serrata* Roxb.	Tree	I	NE	#		Y
22	Burseraceae	*Commiphora caudata* (Wight & Arn.) Engl.	Tree	I	NE	#	Y	Y
23	Burseraceae	*Garuga pinnata* Roxb.	Tree	I	NE	CET 560	Y	Y
24	Cactaceae	*Opuntia monocantha* Haw.	Shrub	TAm	NE	#		Y
25	Cannabaceae	*Celtis timorensis* Span.	Tree	I	LC	CET 511	Y	Y
26	Cannabaceae	*Trema orientalis* (L.) Blume	Tree	I	LC	#	Y	
27	Capparaceae	*Capparis brevispina* DC.	Shrub	I	NE	CET 556		Y
28	Capparaceae	*Capparis divaricata* Lam.	Tree	I	NE	CET 559		Y
29	Capparaceae	*Capparis sepiaria* L.	Shrub	I	LC	#		Y
30	Caprifoliaceae	*Viburnum punctatum* Buch.-Ham. ex D.Don	Liane	I	NE	CET 516	Y	
31	Celastraceae	*Elaeodendron glaucum* (Rottb.) Pers.	Tree	I	NE	CET 558	Y	Y
32	Celastraceae	*Gymnosporia heyneana* (Roth) M.A.Lawson	Shrub	I	NE	#	Y	Y
33	Celastraceae	*Pleurostylia opposita* (Wall.) Alston	Tree	I	LC	CET 517	Y	
34	Combretaceae	*Combretum ovalifolium* Roxb.	Liane	I	NE	CET 536	Y	
35	Combretaceae	*Terminalia anogeissiana* Gere & Boatwr.	Tree	I	NE	#	Y	Y
36	Combretaceae	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Tree	I	NE	#	Y	Y
37	Combretaceae	*Terminalia bellirica* (Gaertn.) Roxb.	Tree	I	LC	#	Y	Y
38	Combretaceae	*Terminalia elliptica* Willd.	Tree	I	NE	CET 562	Y	Y
39	Cornaceae	*Alangium salviifolium* (L.f.) Wangerin	Tree	I	LC	CET 583	Y	
40	Dipterocarpaceae	*Shorea roxburghii* G.Don.	Tree	I	VU	#	Y	
41	Ebenaceae	*Diospyros ferrea* (Willd.) Bakh.	Tree	I	NE	CET 572	Y	Y
42	Ebenaceae	*Diospyros malabarica* (Desr.) Kostel.	Tree	I	NE	CET 588	Y	
43	Ebenaceae	*Diospyros montana* Roxb.	Tree	I	NE	#	Y	Y
44	Erythroxylaceae	*Erythroxylum monogynum* Roxb.	Tree	I	NE	CET 522	Y	Y
45	Euphorbiaceae	*Euphorbia antiquorum* L.	Tree	I	LC	#		Y
46	Euphorbiaceae	*Givotia moluccana* (L.) Sreem.	Tree	I	NE	#	Y	Y

	Family	Species	Habit	Origin	IUCN Status	Voucher no.	LT	PT
47	Euphorbiaceae	*Homonoia riparia* Lour.	Shrub	I	LC	CET 571	Y	Y
48	Euphorbiaceae	*Jatropha curcas* L.	Shrub	TAm	NE	#	Y	
49	Euphorbiaceae	*Jatropha gossypiifolia* L.	Shrub	I	LC	#		Y
50	Euphorbiaceae	*Mallotus nudiflorus* (L.) Kulju & Welzen	Tree	I	LC	CET 521	Y	
51	Euphorbiaceae	*Ricinus communis* L.	Shrub	TAm	NE	#	Y	
52	Fabaceae	*Albizia amara* (Roxb.) Boivin	Tree	I	LC	#	Y	Y
53	Fabaceae	*Albizia lebbeck* (L.) Benth.	Tree	I	LC	#	Y	Y
54	Fabaceae	*Bauhinia racemosa* Lam.	Tree	I	NE	CET 520	Y	Y
55	Fabaceae	*Brachypterum scandens* (Roxb.) Miq.	Liane	I	NE	#	Y	Y
56	Fabaceae	*Butea monosperma* (Lam.) Kuntze	Tree	I	LC	#		Y
57	Fabaceae	*Cassia fistula* L.	Tree	I	LC	#	Y	Y
58	Fabaceae	*Dalbergia lanceolaria* subsp. *paniculata* (Roxb.) Thoth.	Tree	I	NE	#	Y	Y
59	Fabaceae	*Dalbergia latifolia* Roxb.	Tree	I	VU	CET 504	Y	Y
60	Fabaceae	*Delonix regia* (Bojer ex Hook.) Raf.	Tree	M	LC	#	Y	
61	Fabaceae	*Dichrostachys cinerea* (L.) Wight & Arn.	Tree	I	LC	#		Y
62	Fabaceae	*Entada rheedei* Spreng.	Liane	I	NE	CET 527	Y	
63	Fabaceae	*Erythrina variegata* L.	Tree	I	LC	#	Y	
64	Fabaceae	*Hardwickia binata* Roxb.	Tree	I	LC	#		Y
65	Fabaceae	*Mundulea sericea* (Willd.) A.Chev.	Tree	I	LC	CET 573		Y
66	Fabaceae	*Pongamia pinnata* (L.) Pierre	Tree	I	LC	#	Y	Y
67	Fabaceae	*Prosopis juliflora* (Sw.) DC.	Tree	TAm	NE	#	Y	Y
68	Fabaceae	*Pterocarpus marsupium* Roxb.	Tree	I	NT	#		Y
69	Fabaceae	*Pterolobium hexapetalum* (Roth.) Santapau & Wagh	Liane	I	NE	#	Y	
70	Fabaceae	*Samanea saman* (Jacq.) Merr.	Tree	TAm	LC	#	Y	
71	Fabaceae	*Senegalia chundra* (Roxb. ex Rottler) Maslin	Tree	I	NE	#		Y
72	Fabaceae	*Senegalia pennata* (L.) Maslin.	Liane	I	LC	#	Y	
73	Fabaceae	*Senna didymobotrya* (Fresen.) H.S.Irwin & Barneby	Shrub	I	LC	#	Y	
74	Fabaceae	*Senna occidentalis* (L.) Link	Shrub	TAm	LC	#	Y	
75	Fabaceae	*Senna spectabilis* (DC.) H.S.Irwin & Barneby	Tree	TAm	LC	CET 515	Y	Y
76	Fabaceae	*Sophora velutina* Lindl.	Shrub	I	NE	CET 576		Y
77	Fabaceae	*Spatholobus purpureus* Benth. ex Baker	Liane	I	NE	CET 580		Y
78	Fabaceae	*Tamarindus indica* L.	Tree	M	LC	#	Y	Y
79	Fabaceae	*Vachellia leucophloea* (Roxb.) Maslin, Seigler & Ebinger	Tree	I	LC	CET 532	Y	Y
80	Fabaceae	*Vachellia planifrons* (Wight & Arn.) Ragup., Seigler, Ebinger & Maslin	Tree	I	NE	#		Y
81	Hernandiaceae	*Gyrocarpus americanus* Jacq.	Tree	I	LC	#	Y	Y
82	Lamiaceae	*Gmelina arborea* Roxb. ex Sm.	Tree	I	LC	#		Y
83	Lamiaceae	*Gmelina asiatica* L.	Shrub	I	LC	#		Y
84	Lamiaceae	*Premna mollissima* Roth	Tree	I	NE	CET 592	Y	Y
85	Lamiaceae	*Premna tomentosa* Willd.	Tree	I	LC	#		Y
86	Lamiaceae	*Tectona grandis* L.f.	Tree	I	NE	#	Y	Y
87	Lamiaceae	*Vitex altissima* L.f.	Tree	I	NE	CET 541	Y	
88	Lamiaceae	*Vitex leucoxylon* L.f.	Tree	I	LC	CET 542	Y	
89	Loganiaceae	*Strychnos nux-vomica* L.	Tree	I	NE	#	Y	Y
90	Loganiaceae	*Strychnos potatorum* L.f	Tree	I	NE	CET 525	Y	Y
91	Lythraceae	*Lagerstroemia microcarpa* Wight	Tree	I	NE	CET 586	Y	Y
92	Lythraceae	*Lagerstroemia parviflora* Roxb.	Tree	I	LC	#		Y

	Family	Species	Habit	Origin	IUCN Status	Voucher no.	LT	PT
93	Lythraceae	*Lawsonia inermis* L.	Shrub	I	LC	#	Y	
94	Malvaceae	*Bombax ceiba* L.	Tree	I	LC	CET 557		Y
95	Malvaceae	*Grewia hirsuta* Vahl	Shrub	I	LC	CET 595	Y	Y
96	Malvaceae	*Grewia orbiculata* Rottler	Shrub	I	NE	#		Y
97	Malvaceae	*Grewia orientalis* L.	Shrub	I	NE	CET 543		Y
98	Malvaceae	*Grewia serrulata* DC.	Tree	I	NE	#	Y	
99	Malvaceae	*Grewia tiliifolia* Vahl	Tree	I	NE	#	Y	Y
100	Malvaceae	*Helicteres isora* L.	Shrub	I	NE	#	Y	Y
101	Melastomataceae	*Memecylon grande* Retz.	Tree	I	VU	CET 526	Y	
102	Melastomataceae	*Memecylon umbellatum* Burm.f.	Tree	I	NE	#	Y	
103	Meliaceae	*Aglaia elaeagnoidea* (A.Juss.) Benth.	Tree	I	LC	CET 505	Y	
104	Meliaceae	*Azadirachta indica* A.Juss.	Tree	IC	LC	#	Y	Y
105	Meliaceae	*Cipadessa baccifera* (Roxb. ex Roth) Miq.	Tree	I	LC	#	Y	Y
106	Meliaceae	*Soymida febrifuga* (Roxb.) A.Juss.	Tree	I	NE	CET 581		Y
107	Meliaceae	*Swietenia mahagoni* (L.) Jacq.	Tree	I	NT	#	Y	
108	Meliaceae	*Walsura trifoliolata* (A.Juss.) Harms	Tree	I	NE	#	Y	
109	Moraceae	*Ficus benghalensis* L.	Tree	I	NE	#	Y	
110	Moraceae	*Ficus benjamina* L.	Tree	I	LC	#	Y	Y
111	Moraceae	*Ficus hispida* L.f.	Tree	I	LC	#	Y	
112	Moraceae	*Ficus microcarpa* L.f.	Tree	I	LC	CET 506	Y	Y
113	Moraceae	*Ficus mollis* Vahl	Tree	I	NE	#	Y	Y
114	Moraceae	*Ficus racemosa* L.	Tree	I	LC	#	Y	
115	Moraceae	*Ficus tsjakela* Burm.f.	Tree	I	NE	CET 529	Y	
116	Moringaceae	*Moringa concanensis* Nimmo ex Dalzell & A.Gibson	Tree	I	NE	CET 537	Y	Y
117	Myrtaceae	*Psidium guajava* L.	Tree	I	LC	#	Y	
118	Myrtaceae	*Syzygium cumini* (L.) Skeels	Tree	I	LC	#	Y	Y
119	Myrtaceae	*Syzygium grande* (Wight) Walp.	Tree	I	NE	#	Y	
120	Olacaceae	*Olax scandens* Roxb.	Liane	I	NE	CET 509	Y	
121	Olacaceae	*Olea dioica* Roxb.	Tree	I	NE	#	Y	
122	Pandanaceae	*Pandanus odorifer* (Forssk.) Kuntze	Shrub	I	LC	#	Y	
123	Phyllanthaceae	*Aporosa acuminata* Thwaites	Tree	I	NE	CET 503	Y	
124	Phyllanthaceae	*Bischofia javanica* Blume	Tree	I	LC	#	Y	
125	Phyllanthaceae	*Breynia vitis-idaea* (Burm.f.) C.E.C.Fisch.	Shrub	I	LC	CET 502	Y	
126	Phyllanthaceae	*Bridelia retusa* (L.) A.Juss.	Tree	I	LC	CET 577	Y	Y
127	Phyllanthaceae	*Flueggea leucopyrus* Willd.	Shrub	I	LC	#		Y
128	Phyllanthaceae	*Glochidion zeylanicum* (Gaertn.) A.Juss.	Tree	I	LC	CET 501	Y	
129	Phyllanthaceae	*Phyllanthus emblica* L.	Tree	I	LC	CET 535	Y	Y
130	Phyllanthaceae	*Phyllanthus indofischeri* Bennet	Tree	I	VU	CET 534	Y	
131	Phyllanthaceae	*Phyllanthus racemosus* L.f.	Tree	I	NE	#	Y	
132	Phyllanthaceae	*Phyllanthus reticulatus* Poir.	Shrub	I	LC	#	Y	
133	Poaceae	*Bambusa bambos* (L.) Voss	Tree	I	NE	#	Y	Y
134	Poaceae	*Dendrocalamus strictus* (Roxb.) Nees	Shrub	I	NE	#	Y	Y
135	Primulaceae	*Ardisia solanacea* Roxb.	Tree	I	NE	CET 508	Y	
136	Putranjivaceae	*Putranjiva roxburghii* Wall.	Tree	I	LC	#	Y	
137	Rhamnaceae	*Scutia myrtina* (Burm. f.) Kurz	Shrub	I	LC	CET 524		Y
138	Rhamnaceae	*Ziziphus glabrata* B.Heyne ex Roth	Tree	I	NE	#	Y	
139	Rhamnaceae	*Ziziphus mauritiana* Lam.	Tree	I	LC	#	Y	Y

	Family	Species	Habit	Origin	IUCN Status	Voucher no.	LT	PT
140	Rhamnaceae	*Ziziphus oenopolia* (L.) Mill.	Liane	I	LC	#	Y	Y
141	Rhamnaceae	*Ziziphus rugosa* Lam.	Tree	I	NE	#		Y
142	Rhamnaceae	*Ziziphus xylopyrus* (Retz.) Willd.	Tree	I	NE	#	Y	Y
143	Rubiaceae	*Canthium coromandelicum* (Burm.f.) Alston	Shrub	I	NE	CET 530	Y	
144	Rubiaceae	*Catunaregam spinosa* (Thunb.) Tirveng.	Tree	I	LC	#	Y	Y
145	Rubiaceae	*Coffea wightiana* Wall. ex Wight & Arn.	Shrub	I	LC	CET 538	Y	Y
146	Rubiaceae	*Deccania pubescens* var. *candolleana* (Wight & Arn.) Tirveng.	Tree	I	NE	CET 589		Y
147	Rubiaceae	*Ixora pavetta* Andrews	Tree	I	NE	#	Y	Y
148	Rubiaceae	*Mitragyna parvifolia* (Roxb.) Korth.	Tree	I	NE	#	Y	Y
149	Rubiaceae	*Morinda coreia* Buch.-Ham.	Tree	I	NE	#	Y	
150	Rubiaceae	*Pavetta indica* L.	Shrub	I	NE	#	Y	Y
151	Rubiaceae	*Psydrax dicoccos* Gaertn.	Tree	I	VU	#	Y	Y
152	Rubiaceae	*Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre	Tree	I	NE	#		Y
153	Rubiaceae	*Wendlandia thyrsoidea* (Schult.) Steud.	Shrub	I	NE	#	Y	
154	Rutaceae	*Atalantia monophylla* (L.) DC.	Tree	I	NE	#	Y	Y
155	Rutaceae	*Chloroxylon swietenia* DC.	Tree	I	VU	#	Y	Y
156	Rutaceae	*Glycosmis mauritiana* (Lam.) Tanaka	Shrub	I	LC	#	Y	
157	Rutaceae	*Glycosmis pentaphylla* (Retz.) DC.	Shrub	I	LC	#		Y
158	Rutaceae	*Pleiospermium alatum* (Wall. ex Wight & Arn.) Swingle	Tree	I	NE	CET 531	Y	Y
159	Salicaceae	*Flacourtia ramontchi* L'Hér.	Tree	I	NE	CET 523	Y	
160	Salicaceae	*Salix tetrasperma* Roxb.	Tree	I	LC	#	Y	
161	Salvadoraceae	*Salvadora persica* L.	Tree	I	LC	CET 519	Y	Y
162	Santalaceae	*Santalum album* L.	Tree	I	VU	#		Y
163	Sapindaceae	*Dodonaea viscosa* Jacq.	Shrub	I	LC	#		Y
164	Sapindaceae	*Filicium decipiens* (Wight & Arn.) Thwaites	Tree	I	LC	CET 510	Y	
165	Sapindaceae	*Sapindus emarginatus* Vahl	Tree	I	NE	#	Y	Y
166	Sapindaceae	*Schleichera oleosa* (Lour.) Oken	Tree	I	LC	#	Y	Y
167	Sapotaceae	*Madhuca longifolia* (J.Koenig ex L.) J.F.Macbr.	Tree	I	NE	CET 540	Y	Y
168	Sapotaceae	*Mimusops elengi* L.	Tree	I	LC	#	Y	
169	Simaroubaceae	*Ailanthus excelsa* Roxb.	Tree	I	NE	#	Y	
170	Solanaceae	*Solanum pubescens* Willd.	Shrub	I	NE	#		Y
171	Verbenaceae	*Lantana camara* L.	Shrub	TAm	NE	#	Y	
172	Verbenaceae	*Lantana indica* Roxb.	Shrub	I	NE	CET 596		Y

DD—Data Deficient | NE—Not Evaluated | LC—Least Concern | NT—Near Threatened | VU—Vulnerable | I—Indigenous | M—Madagascar | TAm—Tropical America | IC—Indo-China | LT—longitudinal transect | PT— perpendicular transect | Y—present| #—specimen not collected

invasive species (Johansson et al. 1996; Hood & Naiman 2000; Tockner & Stanford 2002). Many non-native and invasive species were observed along Moyar River which can be a potential threat to the riparian forest in the future. Succession is usually fast in riparian zones but is often slowed by invasive species. Invasive species also alter watershed hydrology and riparian ecology (Richardson et al. 2007). For instance, the invasion of *Tamarix ramosissima* Ledeb. in North America caused an increase in channel roughness and trapping of sediments, eventually narrowing the streams (Zavaleta 2000).

Riparian vegetation along the Moyar River remains intact in some stretches, and needs to be preserved as it supports high biodiversity. This forest serves as a habitat and corridor for many wildlife, especially threatened species such as Asian Elephants, tigers, otters, vultures, and over a hundred species of birds. However, the areas that have been extensively invaded by alien species such as *Prosopis juliflora* and *Senna spectabilis* need to

be restored using the scientific approach. Studies have shown that the loss of riparian vegetation can have far-reaching effects on the ecosystem as they support high biodiversity (Sabo et al. 2005).

Moyar riparian vegetation is gradually degrading due to many factors. The river is dammed at the Bhavanisagar reservoir, where it is joined by river Bhavani, in addition to the upstream hydroelectric projects causing degradation. The construction of dams affects seed dispersal and alters the extent and composition of riparian communities (Jansson et al. 2000). Other anthropogenic activities such as cultivation, logging, grazing, water extraction and recreation also negatively impact riparian vegetation. In southern India, fragmentation and agro-forestry plantations have been found to alter riparian species composition in Cauvery and Chalakudy River basins (Bachan 2003; Sunil et al. 2011). Alteration of riparian forests can result in changes in the intensity of sunlight, nutrient availability, increased soil deposition, eutrophication, lowering of the water table and modification of both terrestrial and aquatic habitats (Decamps et al. 1988; Dudgeon 2000; Jansson et al. 2000; Aguiar et al. 2009; Wootton 2012; Kamp et al. 2013). Loss of riparian forests has also been reported to result in declines in bird species richness and diversity in the area (Arizmendi et al. 2008; Villaseñor-Gomez 2008).

Riparian vegetation characteristics reveal the water and habitat quality, and can be used to restore riparian habitats (Stockan et al. 2012). The present riparian vegetation analysis can also support water and landscape planning by involving the local community in restoration and conservation efforts. Moyar riparian zone merits high conservation value as it is a vital wildlife corridor, sustains Red Listed and important medicinal plants, and is under increasing anthropogenic pressure.

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