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Cover: Pseudo-flying animals and wind-dependent seed & spore dispersers – made with digital painting in Krita. © Melito Prinson Pinto

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COMMUNICATION

An inventory of endemic and near endemic angiosperm flora of Biligiri Rangaswamy Temple Tiger Reserve, peninsular India

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Abstract: The Biligiri Rangaswamy Temple (BRT) Tiger Reserve is a biodiverse region of peninsular India that harbors a significant number of endemic and near-endemic angiosperm species. The present documentation reveals a total of 211 endemic taxa conserved in this reserve. Analysis show that the endemic flora is dominated by Western Ghats (57%) elements, followed by Eastern and Western Ghats elements (28%), peninsular endemic elements (9%), and Indian elements (6%). The present study reports two endemic species of Western Ghats *Syzygium densiflorum* (Myrtaceae) and *Meineckia longipes* (Phyllanthaceae) as new distribution records for Karnataka state. The family Orchidaceae harbors the maximum endemic taxa. A majority of endemic taxa are confined to the evergreen forest of the reserve, hence these forests need special attention for conservation.

Keywords: Biligirirangan hills, BRT, diversity, conservation, documentation, Eastern Ghats, evergreen forest, Karnataka, priority, Western Ghats.

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Competing interests: The author declares no competing interests.

Author details: J. Jayanthi, scientist-E, Botanical Survey of India, has been studying the flora of protected areas for the last 15 years. She has completed the angiosperm flora of Great Indian Bustard Wildlife Sanctuary (Maharashtra), Biligiri Rangaswamy Temple Tiger Reserve (Karnataka) and Campbell Bay National Park, Great Nicobar (Andaman & Nicobar Islands).

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INTRODUCTION

Survey and documentation are basic aspects of biodiversity conservation. Cataloguing the species of a particular area can provide baseline data that enable conservation efforts to be effectively targeted (Brummitt et al. 2021). Endemic species help to determine priorities for conservation owing to their limited distribution ranges and vulnerability to disturbance (Morrone 2008). Endemic flora and fauna are considered to be exclusive biological capital of a region or nation (Nayar 1996). The presence of endemic plant species in an area is often considered a measure of stability, allowing prioritization of sites for conservation (Myers et al. 2000).

Peninsular India is bounded by the Western and Eastern Ghats. The Western Ghats comprises of about 7,400 angiosperm species, of which 5,588 are native. Among the native species, 2,253 are endemic, of which 1,273 species are exclusively endemic to the Western Ghats (Nayar et al. 2014), recognized as a global biodiversity hotspot. The Eastern Ghats comprise of about 4,000 angiosperm species (Krishnamurthy et al. 2014) of which 166 are exclusively endemic (Singh et al. 2015). Although these hill ranges have been botanized for a long time and their flora are relatively well known, there are areas with rich floristic diversity that are poorly or sporadically studied, including the Biligirirangan hills.

The Biligirirangan hills are a discontinuous chain of hills running north to south in the Mysore plateau between the Western and Eastern Ghats (Figure 1). An account of the flora of North Coimbatore published by Blatter (1908) based on the notes of C.E.C. Fischer is the first available floristic documentation to include plants from Biligirirangan hills. After more than three decades Barnes (1944) published an account of these hills which included only a particular group of herbaceous plants. Kammathy et al. (1967) published a contribution towards a flora of Biligirirangan hills documenting 825 plant species. Rao & Razi (1981) while studying the flora of Mysore district also made collections from these hills. Later Ramesh (1989) studied the evergreen forests of these hills which included trees and shrubs. None of these studies have mentioned or focused about endemic plants. Therefore, the present study aims to document the endemic flora of the Biligiri Rangaswamy Temple Tiger Reserve due to its unique location often mentioned as a connecting bridge between Western Ghats and Eastern Ghats. This is the first comprehensive documentation available on the endemic flora after notification of these hill ranges as BRT Wildlife Sanctuary in 1972 and as BRT Tiger Reserve in 2011. This documentation will be helpful in conservation & monitoring of endemic species within this reserve, and also contribute to the endemic species database of the country.

MATERIALS AND METHODS

Study area

This work was carried out by the author as part of a project on the flora of BRT Tiger Reserve by the Botanical Survey of India. The BRT Tiger Reserve is situated in the Chamrajanagar district of Karnataka state and lies between 11.727 & 12.140 ^{0}N and 77.007 & 77.269 ^{0}E (Figure 1). The Tiger Reserve (TR) falls under the Kollegal, Yelandur, and Chamrajanagar taluks of the district. The TR is spread over an area of 574.82 km^2 and managed by different forest department administrative units such as Yelandur range, Kollegal range, Kyathdevaragudi range, Bylore range, and Punajur range. This Tiger Reserve also forms an important wildlife corridor which is contiguous with Malai Mahadeshwar Wildlife Sanctuary in the east, Sathyamangalam Tiger Reserve, and Mudumalai National Park in south, Bandipur & Nagarhole National Park in the west. Apart from this, it is also a part of Nilgiri Biosphere Reserve and the Mysore Elephant Reserve (MoEF&CC 2018). BRT TR is also home for the indigenous Soliga tribe.

The topography of this reserve is highly undulating with elevation ranges 600–1,825 m at Kattaribetta, the highest peak. The BRT receives rainfall from both south-west monsoons from the west coast, and retreating north-east monsoon from the east coast. Rainfall is generally greatest at higher elevations. The mean annual rainfall varies between 620 mm and 1,850 mm. Due to its meteorological and topographical variations, the landscape in BRT TR is heterogeneous with patches of shola grasslands, evergreen forests, moist deciduous forests, dry deciduous forests, scrub forests, and riparian habitats. Presence of diverse ecosystem within a small area is a characteristic feature of this reserve. The forests of BRT TR have been classified as 28.2% of scrub forests, 36.1% dry deciduous, 25% moist deciduous, and 10.7% evergreen forests including shola (Kumara et al. 2012).

Survey and Data collection

Field surveys were conducted at regular intervals every three to six months during the period 2013–2017. Field surveys were organized in different seasons and covered all habitat types in every season. Field data were noted, such as life-form, habitat, elevation, and flowering and fruiting period. Voucher specimens were collected and processed, and herbaria prepared. The

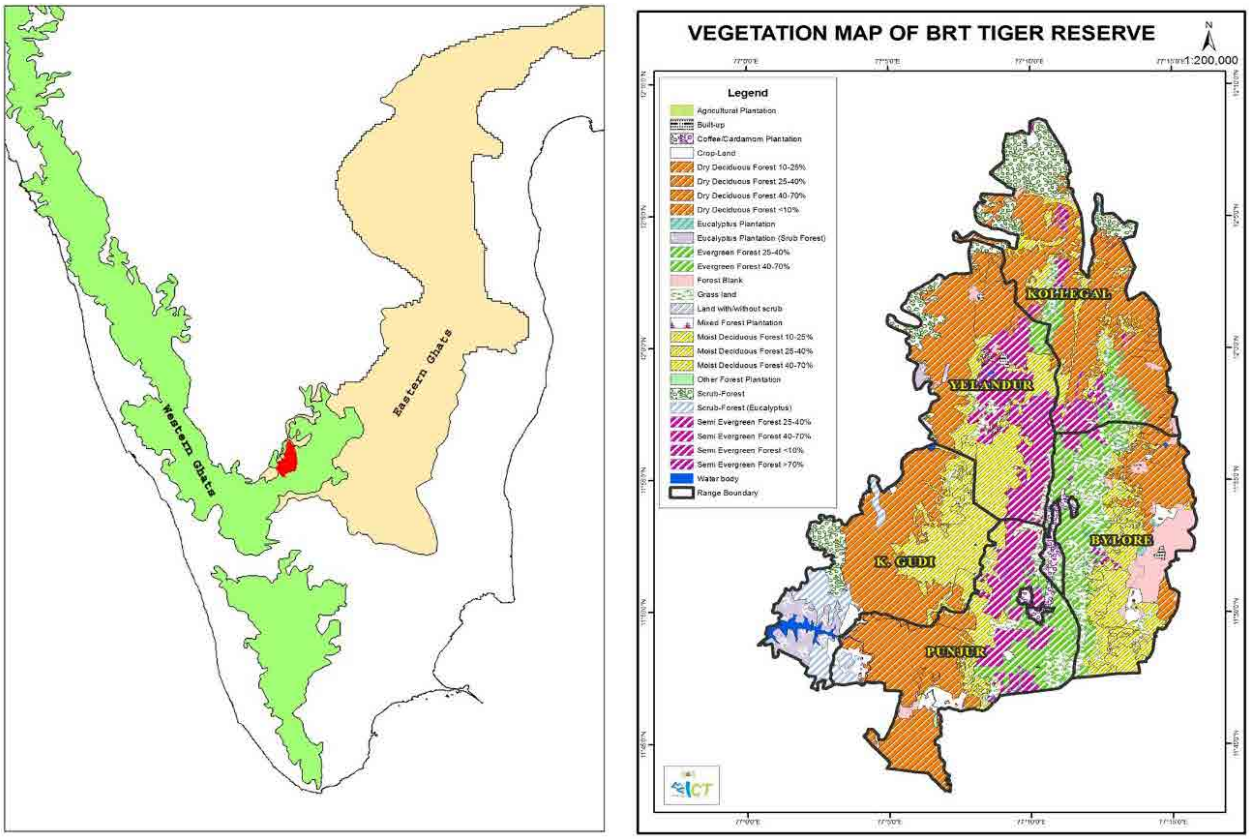

Figure 1. Location of Biligiri Rangaswamy Temple Tiger Reserve in Karnataka, peninsular India (Map source: Karnataka Forest department).

voucher specimens were accessioned and deposited in the Botanical Survey of India (BSI) herbarium. Samples were studied and identified using floras, revisions, checklists such as Blatter (1908), Gamble (1915–1936), Barnes (1944), Kammathy et al. (1967), Rao & Razi (1981), Saldanha (1976), Saldanha (1984), Saldanha (1996), Sharma et al. (1984), Ramesh (2002), Lakshminarasimhan et al. (2019) and online floras, archives, and databases such as Digital flora of Karnataka, Biodiversity Heritage Library (BHL 2022), Digital archives of Botanical Survey of India, Flora of Peninsular India, and through reference against identified herbarium specimens at Botanical Survey of India (BSI), Western Regional Centre, Pune. Apart from own collections, specimens of other collectors were also consulted in different herbaria at Mysore University herbarium, Herbarium of French Institute (HIFP), Pondicherry, University of Agriculture Sciences, Bangalore, Foundation of Revitalisation of Local Health Traditions (FRLH) herbarium, and Ashoka Trust for Research in Ecology and Environment. After identification of species, the endemic species were determined using distributional records from published national, state, district, regional floras, revisionary work, taxonomic accounts, distributional records from published research papers, herbarium reference, and online databases (Nayar 1982; Ahmedullah & Nayar 1986; Venu 2007; Karthikeyan 2009; Jalal & Jayanthi 2012; Jalal et al 2014; Nayar et al. 2014; Singh et al 2015; Jayanthi et al. 2017, 2018; Dash & Mao 2020; Mao & Dash 2020; POWO 2021; WCSP 2021; IPNI 2021; TROPICOS 2021). Species which are strictly confined within the Indian political boundary, Western Ghats, Eastern Ghats, peninsular India or BRT TR is considered as endemic (Table 1). Those species which are found only restricted to BRT TR or found only in few localities in Western Ghats are considered as narrow endemic species. The species which were earlier considered endemic but presently found extended in any one of the countries within Indian subcontinent including Sri Lanka, Bangladesh, Nepal, Pakistan or Myanmar are separately included as near endemic species (Table 2). Photographs of some of the endemic species occurring in BRT TR are provided in Images 1–6.

RESULTS AND DISCUSSION

Taxonomic distribution

The present study resulted in documentation of a total of 211 endemic taxa belonging to 125 genera under 53 families from BRT TR (Table 1). This is almost 15 % of the total flora documented from BRT TR. Of the 211 endemic taxa, 73% were dicotyledonous (154 taxa) and 27% monocotyledonous (57 taxa). The family Orchidaceae is dominant with 39 endemic species, followed by Acanthaceae (23), Rubiaceae (12), Fabaceae (11), Lamiaceae (10), and Lauraceae (10) (Figure 2). These families are also among the 10 dominant families of endemic species in Indian flora as well in the Western Ghats (Singh et al. 2015). Apart from that, about 126 near-endemic species are also documented from BRT TR (Table 2).

Geographical distribution

Among the total endemic taxa documented, 13 are found widely distributed throughout India, 19 are restricted to Peninsular region, 120 are restricted to Western Ghats and 59 are found in both Eastern Ghats (EG) & Western Ghats (WG). In totality, 57 % of the endemic taxa are dominated by WGs elements; 28% of the endemic taxa are shared by EGs & WGs endemic elements. About 9% of the endemic taxa are contributed by Peninsular elements. Only 6% of the Indian endemic taxa are found in BRT Tiger Reserve. This is depicted in Figure 3.

This geographical distribution of endemic flora shows that the BRT TR predominantly composed of Western Ghats endemic elements. About 86% of the Western Ghats endemics in the BRT TR are evergreen and shola forest species occurring in the high rainfall peaks and valleys in BRT TR. Presence of 28% of endemic species common to both Eastern Ghats and Western Ghats could be due to the proximity of BRT towards Eastern Ghats and similar habitats. These common endemic species are mostly of moist deciduous, dry deciduous, and scrub forest species.

Narrow endemics

A few endemic species are found to be confined to only BRT Tiger Reserve. For example, *Barleria morrisiana* is a point endemic species described in 1940, found only in two localities in the dry deciduous forest of BRT TR in Kyathdevaragudi range and Punajur range. Another point endemic species *Amorphophallus mysorensis* described in 1940 is known to occur only in BRT TR, in the moist deciduous forests of Punajur range. This restricted range of distribution may be due to small population of low abundance or subject to under collection and need of more surveys. Even after a lapse of over 80 years these species have so far been recollected only from BRT TR and nowhere else. Another endemic threatened orchid species, *Schoenorchis smeeana* found restricted to few localities of southern Western Ghats is found in BRT TR (Jalal et al. 2014). Another near endemic rare orchid species of southern India, *Vanilla walkerae* is rediscovered from BRT TR after a lapse of more than 100 years (Jayanthi et al. 2018). *Habenaria sahyadrica* a recently described terrestrial orchid from Kerala is also located in BRT TR in the present study (Jayanthi et al. 2017).

Distribution based on vegetation and elevation

The analysis of endemic flora based on elevation distribution in BRT TR showed that 48% (101 spp.) of endemic species are distributed above 1,400 m; 34% (71 spp.) of endemic species occur at 1,000–1,400 m, and 16% (35 spp.) at 600–1,000 m. This shows that evergreen forests which occur above 1,400 m hold most of the endemic species, especially Western Ghats elements. The mid and low elevation regions of BRT TR composed of moist deciduous forests and scrub-dry deciduous forests is dominated by the endemic elements common to WGs & EGs, Peninsular region and Indian region. About 2% (4 spp.) of the endemic species are found in all vegetation types from scrub to evergreen forests. This is depicted in Figure 4.

Life-form distribution

The endemic flora is categorized into different life forms such as trees, shrubs, lianes, climbers, epiphytes, parasitic shrubs and herbs. There are 85 herbs, 35 trees, 39 shrubs (including undershrub), 17 climbers (including herbaceous, woody climbers, lianes or scandent shrubs), 25 epiphytes, and 10 parasitic shrubs documented during the present study (Table 3). Of the total endemic flora, arborescent flora that includes trees, shrubs, lianas, epiphytes, and parasitic shrubs constitutes 50% of which 34% are tree species. The arborescent endemic flora is dominated by Orchidaceae, Rubiaceae, and Lauraceae members. Herbaceous plants contribute 50% of endemic flora which are annuals or perennials with underground bulbs or rhizomatous found during monsoon season and about 51% of them are found in evergreen and shola forests. The herbaceous endemic flora is mostly dominated by Orchidaceae and Poaceae members.

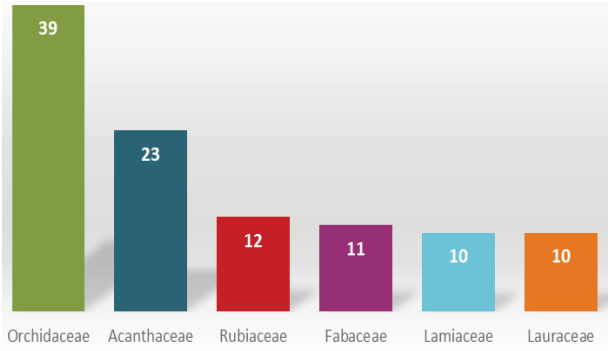

Figure 2. Dominant families of endemic taxa in Biligiri Rangaswamy Temple Tiger Reserve.

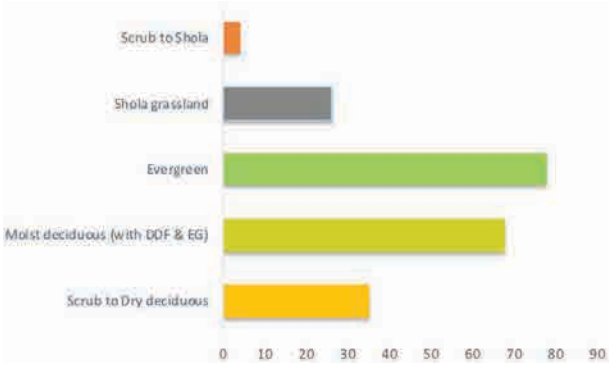

Figure 4. Representation of endemic taxa in different forest types.

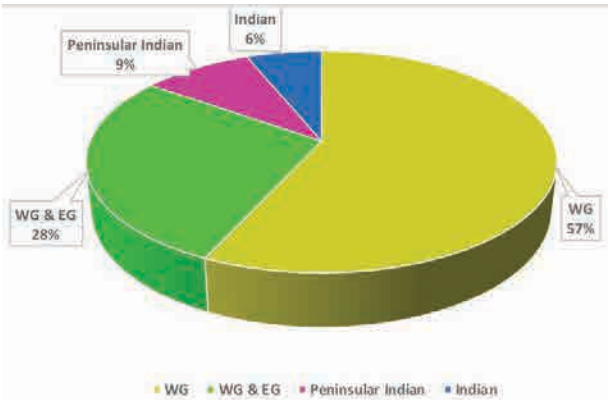

Figure 3. Distribution of endemic taxa based on geographic distribution in Biligiri Rangaswamy Temple Tiger Reserve.

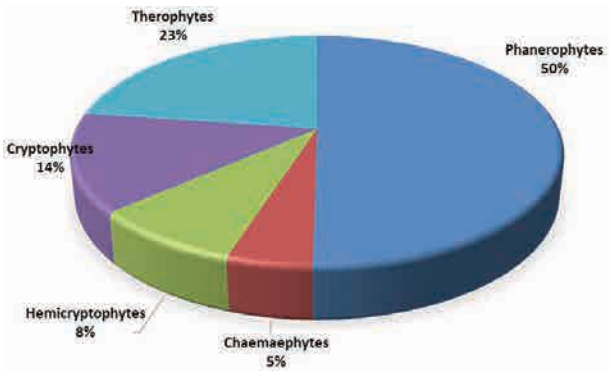

Figure 5. Representation of Raunkiaer's life-form of endemic flora in Biligiri Rangaswamy Temple Tiger Reserve.

Raunkiaer life-form

An analysis based on the Raunkiaer life form classification was also carried out for the endemic flora of BRT Tiger Reserve to determine the biological spectrum of endemic elements which reflect the phytoclimate and adaptation to ecological conditions and prevailing climate of the region. The life form categories were identified according to Raunkiaer (1934) classification. According to this classification, the plant life forms are classified into five main groups such as phanerophytes, chamaephytes, hemicryptophytes, cryptophytes, and therophytes depending on the position and degree of protection of the growth buds of other renewing organs from the ground level in relation to protection during unfavourable seasons. The Raunkiaer life form for BRT is provided in Figure 5. This shows that the endemic flora of BRT TR is dominated by phanerophytes followed by therophytes, hemicryptophytes, cryptophytes, and chamaephytes. Phanerophytes are represented by arborescent group such as trees, shrubs, scandent or woody climbers, epiphytes, and parasitic shrubs. In BRT TR about 51% of the endemic flora (102 taxa) is dominated by phanerophytes and a majority of them are found in evergreen forests. It is to be noted that only 10% of the area of BRT TR holds evergreen forests and hence evergreen forests of BRT should be a high priority conservation zone within this protected area. About 23% of the endemic flora (48 taxa) in BRT TR belongs to therophytes category which are represented by herbaceous plants mainly annuals and a majority are found occurring in shola grassland at higher elevations. Hemicryptophytes, which show reduced stem growth with the shoot apices lying close to the ground surface, are represented by 8% of the flora (18 taxa). Similarly, cryptophytes which comprises of bulbous and rhizomatous plants mainly orchids and gingers comprising about 14 % of the endemic flora (29 taxa). Hemicryptophytes and cryptophytes are mostly found in the scrub, dry deciduous forests, and shola grassland where dry climate prevails and receive moisture only during monsoon period. Only 5% of the endemic flora (10 taxa) belongs to chamaephytes, short stemmed plants that occurs in dry forests or dry habitats. Dominance of phanerophytes over other denotes that BRT TR is

Table 1. List of endemic taxa in the Biligiri Rangaswamy Temple Tiger Reserve.

	Family	Plant Name	Habit	Flowers	Forest type	Voucher no.
1	Acanthaceae	**Andrographis affinis** Nees	US	September–December	MDF	R.S. Rao 73646
2	Acanthaceae	**Andrographis lineata** Nees	H	June–December	MDF-EGF	Barnes 1944
3	Acanthaceae	**Andrographis neesiana** Wight	H	June	MDF-EGF	Barnes 1944
4	Acanthaceae	**Andrographis serpyllifolia** (Rottler ex Vahl) Wight	H	July	SF-DDF	JJ 194419
5	Acanthaceae	**Asystasia crispata** Benth.	H	March, June–July	MDF-EGF	JJ 194622, JJ 195745
6	Acanthaceae	**Asystasia dalzelliana** Santapau	H	March	MDF	JJ 207003
7	Acanthaceae	**Barleria cuspidata** F.Heyne ex Nees	US	November	SF	JJ 197207
8	Acanthaceae	**Barleria gibsonii** Dalzell	US	September–October	MDF	R.S. Rao 73639
9	Acanthaceae	**Barleria involucrata** var. **elata** (Dalzell) C.B.Clarke	S	September–December	SHEG	Barnes 1944
10	Acanthaceae	**Barleria lawii** T.Anderson	US	September	DDF	JJ 202928
11	Acanthaceae	**Barleria montana** Herb.Madr. ex Nees	US	September	DDF	JJ 194659, JJ 195774, JJ 202863, JJ 202866, JJ 203434
12	Acanthaceae	**Barleria morrisiana** E.Barnes & C.E.C.Fisch.	US	September	DDF	JJ 195731, JJ 203435
13	Acanthaceae	**Barleria prattensis** Santapau	US	October–December	DDF	JJ 194685, JJ 206516
14	Acanthaceae	**Dicliptera cuneata** Nees	US	December	MDF	JJ 203533
15	Acanthaceae	**Justicia micrantha** Wall. ex C.B.Clarke (*Justicia neesii* Ramamoorthy)	H	July–September–December	SF,MDF,EGF	JJ 194417, JJ 203534, JJ 203419
16	Acanthaceae	**Lepidagathis cristata** Willd.	H	November	DDF	JJ 195794
17	Acanthaceae	**Nicoteba nilgherrensis** (Nees) Lindau [*Justicia nilgherrensis* (Nees) Wight ex C.B.Clarke]	H	May–June	SHG	Barnes 1944, Kammathy 1967
18	Acanthaceae	**Strobilanthes barbata** Nees [*Nilgirianthus barbatus* (Nees) Bremek.]	S	October	EGF	JJ 194715
19	Acanthaceae	**Strobilanthes foliosa** (Wight) T.Anderson [*Nilgirianthus foliosus* (Wight) Bremek.]	S	September–October	SHEG	Barnes 1944, Kammathy 1967
20	Acanthaceae	**Strobilanthes lurida** Wight	S	December–April	SHEG	Barnes 1944, Kammathy 1967
21	Acanthaceae	**Strobilanthes meeboldii** Craib [*Nilgirianthus meeboldii* (Craib) Bremek.]	S	March	MDF	JJ 207002
22	Acanthaceae	**Strobilanthes neilgherrensis** Bedd. [*Nilgirianthus neilgherrensis* (Bedd.) Bremek.]	S	September–March	EGF	JJ 197459, JJ 203431
23	Acanthaceae	**Strobilanthes pulneyensis** C.B.Clarke [*Xenacanthus pulneyensis* (C.B.Clarke) Bremek.]	S	September	SHEG	Barnes 1944, Kammathy 1967
24	Amaranthaceae	**Indobanalia thyrsiflora** (Moq.) A.N.Henry & B.Roy. [*Banalia thyrsiflora* Moq.]	H	May	MDF-EGF	Barnes 1944, Kammathy 1967
25	Amaryllidaceae	**Pancratium parvum** Dalzell	H	May–June	SHG	A.S. Rao 79911
26	Annonaceae	**Miliusa nilagirica** Bedd.	T	December–January	EGF	JJ 207025
27	Annonaceae	**Miliusa wightiana** Hook.f. & Thomson	T	December	EGF	JJ 206504
28	Apiaceae	**Pimpinella candolleana** Wight & Arn.	H	September	MDF	R.S.Rao 73537
29	Apiaceae	**Pimpinella wallichiana** (Miq.) Gandhi	H	September–October	MDF-EGF	JJ 194714
30	Apiaceae	**Tetrataenium rigens** (Wall. ex DC.) Manden. [*Heracleum candolleanum* (Wight & Arn.) Gamble]	H	September	MDF	Kammathy 1967
31	Apocynaceae	**Ceropegia hirsuta** Wight & Arn.	C	September	MDF	JJ 203441
32	Apocynaceae	**Ceropegia attenuata** Hook.	C	September	SHG	R.S.Rao 73808
33	Apocynaceae	**Ceropegia fimbriifera** Bedd.	H	June	MDF	Barnes 1944, Kammathy 1967

	Family	Plant Name	Habit	Flowers	Forest type	Voucher no.
34	Apocynaceae	**Ceropegia pusilla** Wight &Arn.	H	May–September	SHG	Barnes 1944, Kammathy 1967
35	Apocynaceae	**Decalepis hamiltonii** Wight &Arn.	WC	December–March	SF-DDF	JJ 207046
36	Apocynaceae	**Heterostemma beddomei** (Hook.f.) Swarupan. & Mangaly (*Oianthus beddomei* Hook.f.)	WC	February–March	MDF	R.S. Rao 73745
37	Apocynaceae	**Hoya wightii** Hook.f.	E	May	EGF-SHEG	Barnes 1944, Kammathy 1967
38	Apocynaceae	**Vincetoxicum capparidifolium** (Wight & Arn.) Kuntze (*Tylophora capparidifolia* Wight & Arn.)	CS	May	EGF	Barnes 1944
39	Araceae	**Amorphophallus mysorensis** E.Barnes & C.E.C.Fisch. var. **mysorensis**	H	June	MDF	R.H.Beddome No.2159A
40	Araceae	**Arisaema peltatum** C.E.C.Fisch.	H	May–October	SHEG	Barnes 1944, Kammathy 1967
41	Araliaceae	**Heptapleurum capitatum** (Wight &Arn.) Seem. [*Schefflera capitata* (Wight & Arn.) Harms]	S	May–June	EGF	JJ 195717
42	Arecaceae	**Calamus gamblei** Becc.	CS	December–January	EGF	JJ 207060
43	Asparagaceae	**Chlorophytum indicum** (Willd. ex Schult. & Schult.f.) Dress	H	September	DDF	JJ 202877
44	Asparagaceae	**Chlorophytum malabaricum** Baker	H	September	MDF	R.S. Rao 73618
45	Asteraceae	**Anaphalis lawii** Gamble	H	September	SHG	JJ 202970
46	Asteraceae	**Blumea belangeriana** DC.	H	June, December	SHG	JJ 195759, JJ 203547
47	Asteraceae	**Cyanthillium albicans** (DC.) H.Rob. (*Vernonia albicans* DC.)	H	December	DDF	JJ 203566
48	Asteraceae	**Cyanthillium conyzoides** (DC.) H.Rob. (*Vernonia conyzoides* DC.)	H	August–September	SF-DDF	JJ 202872
49	Asteraceae	**Emilia ramulosa** Gamble	H	May–September	DDF	R.S. 73810
50	Asteraceae	**Leucoblepharis subsessilis** Arn. (*Blepharispermum subsessile* DC.)	H	June	MDF	Barnes 1944, Kammathy 1967
51	Asteraceae	**Senecio edgeworthii** Hook.f.	H	August–September	SHG	Barnes 1944, Kammathy 1967
52	Balsaminaceae	**Impatiens balsamina** var. **micrantha** Hook.f.	H	September	SHEG	JJ 202983
53	Balsaminaceae	**Impatiens cuspidata** Wight & Arn. subsp. **cuspidata**	H	May	SHEG	Kammathy 79925
54	Balsaminaceae	**Impatiens fruticosa** Lesch. ex DC.	H	September	SHEG	Barnes 1971
55	Balsaminaceae	**Impatiens goughii** Wight	H	September	SHEG	Barnes 1969
56	Balsaminaceae	**Impatiens scapiflora** B.Heyne ex Wall.	H	September	SHEG	Barnes 1944, Kammathy 1967
57	Bignoniaceae	**Radermachera xylocarpa** (Roxb.) Roxb. ex K.Schum.	T	May–June	MDF	JJ 195990
58	Boraginaceae	**Cordia domestica** Roth	T	May	MDF	JJ 195998
59	Boraginaceae	**Cordia macleodii** (Griff.) Hook.f. & Thomson	T	July	DDF	JJ 194603
60	Boraginaceae	**Cynoglossum meeboldii** Brand	H	April–September	MDF	A.S. Rao 79816
61	Burseraceae	**Boswellia serrata** Roxb.	T	September–March	DDF	A.S. Rao 80115
62	Capparaceae	**Capparis grandiflora** Wall. ex Hook.f. & Thomson	SS	March, July– October	SF	JJ 194509, JJ 195935, JJ 197420
63	Combretaceae	**Terminalia paniculata** B.Heyne ex Roth	T	July	SF,DDF, MDF	JJ 194463, JJ 194552
64	Commelinaceae	**Cyanotis tuberosa** (Roxb.) Schult. &Schult.f.	H	July–October	SF-SHG	JJ 194443, JJ 194575, JJ 194735, JJ 202918
65	Convolvulaceae	**Argyreia cuneata** (Willd.) Ker Gawl.	S	July	SF,DDF, SHG	JJ 194429, JJ 194506
66	Convolvulaceae	**Argyreia sericea** Dalzell & A.Gibson	CS	July–October	SF-EGF	JJ 194466, JJ 195936, JJ 202881, JJ 202936
67	Convolvulaceae	**Argyreia nellygherya** Choisy	C	June	DDF	Barnes 1944
68	Convolvulaceae	**Argyreia pilosa** Wight &Arn.	CS	September–October	DDF	R.S. Rao 73652
69	Crassulaceae	**Kalanchoe bhidei** T.Cooke	H	December	DDF	JJ 203561

	Family	Plant Name	Habit	Flowers	Forest type	Voucher no.
70	Crassulaceae	**Kalanchoe olivacea** Dalzell	H	March	SHG	JJ 207042
71	Cyperaceae	**Cyperus diaphanus** var. **gracilescens** (Kük.) H.O.Saxena [*Pycreus diaphanus* var. *gracilescens* (Kük.) S.S.Hooper]	H	October	SHG	JJ 194784
72	Dilleniaceae	**Dillenia bracteata** Wight	T	April–August	EGF	JJ 207032
73	Elaeocarpaceae	**Elaeocarpus munroi** (Wight) Mast.	T	February–March	EGF	JJ 197456
74	Eriocaulaceae	**Eriocaulon leucomelas** Steud.	H	December	SHG	JJ 206546
75	Eriocaulaceae	**Eriocaulon margaretae** Fyson	H	April	SHG	A.S. Rao 80401
76	Euphorbiaceae	**Epiprinus mallotiformis** (Müll.Arg.) Croizat	T	October–December	EGF	B.R. Ramesh 1320
77	Euphorbiaceae	**Euphorbia notoptera** Boiss.	H	December	DDF	JJ 203562
78	Fabaceae	**Alysicarpus hamosus** Edgew.	H	December	SHG	JJ 203548
79	Fabaceae	**Alysicarpus racemosus** Benth. [*Desmodiastrum racemosum* var. *rotundifolium* A.Pramanik & Thoth.]	H	December	MDF	JJ 206522
80	Fabaceae	**Alysicarpus roxburghianus** Thoth. & Pramanik	H	December	DDF	JJ 203558
81	Fabaceae	**Crotalaria paniculata** Willd.	US	September–November	SF-DDF	JJ 195770, JJ 202933
82	Fabaceae	**Crotalaria pusilla** Roxb. ex Roth	H	October	SF	JJ 195927
83	Fabaceae	**Dalbergia malabarica** Prain	CS	March	EG	JJ 207069
84	Fabaceae	**Flemingia nilgheriensis** (Benth. ex Baker f.) Wight ex T.Cooke	H	September	SHG	Barnes 1944, Kammathy 1967
85	Fabaceae	**Smithia gracilis** Benth.	H	December	SHG	Barnes 1944, Kammathy 1967
86	Fabaceae	**Vigna vexillata** var. **wightii** (Benth. ex Bedd.) Babu & S.K.Sharma (*Vigna wightii* Benth. ex Bedd.)	C	April	MDF	A.S. Rao 79776, A.S.Rao 80157
87	Fabaceae	**Senna montana** (B.Heyne ex Roth) V.Singh	S	September	SF	JJ 203495
88	Fabaceae	**Tephrosia calophylla** Bedd.	US	June–July	SF	JJ 194636
89	Gentianaceae	**Lomatogonium minus** (Griseb.) Fernald [*Swertia minor* (Griseb.) Knobl.]	H	September	SHG	JJ 203480
90	Gentianaceae	**Swertia corymbosa** (Griseb.) Fielding & Gardner	H	December	SHG	JJ 206508
91	Gentianaceae	**Swertia trichotoma** Wight ex C.B.Clarke	H	October–December	SHG	Barnes 1944, Kammathy 1967
92	Gesneriaceae	**Aeschynanthus perrottetii** A.DC.	E	September–October	SHEG	JJ 194721, JJ 203417
93	Gesneriaceae	**Henckelia incana** (Vahl) Spreng. (*Didymocarpus tomentosus* Wight)	H	October–December	SHEG	R.S. Rao 73794
94	Haloragaceae	**Myriophyllum intermedium** DC.	H	February–March	MDF	Barnes 1944, Kammathy 1967
95	Lamiaceae	**Coleus dysophylloides** (Benth.) A.J.Paton (*Anisochilus dysophylloides* Benth.)	US	September–December	EF	Barnes 1944, Kammathy 1967
96	Lamiaceae	**Isodon nilgherricus** (Benth.) H.Hara (*Plectranthus nilgherricus* Benth.)	H	December	EF	Barnes 1944, Kammathy 1967
97	Lamiaceae	**Leucas eriostoma** Hook.f.	US	March	SHG	JJ 207072
98	Lamiaceae	**Leucas hirta** (B.Heyne ex Roth) Spreng.	H	July	SF	JJ 194407
99	Lamiaceae	**Leucas montana** (Roth) Spreng.	US	April–September	DDF-EGF	R.S. Rao 73783, A.S. Rao 79938
100	Lamiaceae	**Leucas prostrata** (Hook.f.) Gamble	H	April	EGF	Barnes 1944, Kammathy 1967
101	Lamiaceae	**Leucas pubescens** Benth.	H	April–June	MDF	A.S. Rao 79774
102	Lamiaceae	**Pogostemon mollis** Benth.	H	October–December	SHEG	JJ 194727, 203550
103	Lamiaceae	**Scutellaria colebrookeana** Wall. ex Benth.	H	December	SHEG	Barnes 1944, Kammathy 1967
104	Lamiaceae	**Scutellaria wightiana** Benth.	H	March	EGF	JJ 197445
105	Lauraceae	**Actinodaphne bourdillonii** Gamble	T	December	EGF	JJ 206538

	Family	Plant Name	Habit	Flowers	Forest type	Voucher no.
106	Lauraceae	**Actinodaphne lawsonii** Gamble	T	December	EGF	B.R. Ramesh 1434A
107	Lauraceae	**Beilschmiedia wightii** (Nees) Benth. ex Hook.f.	T	December–March	SHEG	JJ 206544
108	Lauraceae	**Cinnamomum travancoricum** Gamble	T	January–June	EGF	A.S. Rao, 79935
109	Lauraceae	**Cinnamomum wightii** Meisn.	T	March	EGF	JJ 207024
110	Lauraceae	**Cryptocarya beddomei** Gamble	T	March	EGF	JJ 207028
111	Lauraceae	**Litsea floribunda** (Blume) Gamble	T	March–October	SHEG	JJ 207097
112	Lauraceae	**Litsea stocksii** (Meisn.) Hook.f.	T	March	SHEG	JJ 207099
113	Lauraceae	**Litsea wightiana** (Nees) Wall. ex Hook.f.	T	March–September	SHEG	JJ 203407, JJ 207100
114	Lauraceae	**Phoebe wightii** Meisn.	T	March	EGF	JJ 197458, JJ 207029
115	Loranthaceae	**Dendrophthoe memecylifolia** (Wight & Arn.) Danser	PS	October	EGF	JJ 194746
116	Loranthaceae	**Helicanthes elastica** (Desr.) Danser	PS	December–March	MDF-EGF	JJ 203532, JJ 207071
117	Loranthaceae	**Helixanthera intermedia** (Wight) Danser	PS	July	EGF	JJ 194540
118	Loranthaceae	**Helixanthera obtusata** (Wall. ex Wight & Arn.) Danser	PS	March–May	EGF	JJ 195716, JJ 207027
119	Loranthaceae	**Helixanthera wallichiana** (Schult. &Schult.f.) Danser	PS	September	EGF	JJ 203452
120	Loranthaceae	**Macrosolen trigonus** (Wight & Arn.) Tiegh. [*Dendrophthoe trigona* (Wight & Arn.) Danser ex Santapau]	PS	October	SF-DDF	JJ 195940
121	Loranthaceae	**Taxillus heyneanus** (Schult. &Schult.f.) Danser	PS	July	DDF	JJ 194578
122	Loranthaceae	**Taxillus recurvus** (Wall. ex DC.) Tiegh.	PS	April–May, December	MDF-EGF	JJ 195988, JJ 206593
123	Malvaceae	**Grewia orbiculata** Rottler	T	June–July	DDF	JJ 195732, JJ 194639
124	Malvaceae	**Microcos heterotricha** (Mast.) Burret (*Grewia heterotricha* Mast.)	SS	October	DDF	JJ 195929
125	Melastomataceae	**Memecylon lushingtonii** Gamble	S	May–June	SF	JJ 195723
126	Melastomataceae	**Memecylon talbotianum** D.Brandis	T	March	EGF	JJ 207015, JJ 207076
127	Melastomataceae	**Osbeckia brachystemon** Naudin (*Osbeckia cupularis* D.Don ex Wight & Arn.)	H	September	SHG	JJ 203420
128	Melastomataceae	**Osbeckia leschenaultiana** DC.	H	September	SHG	Saldanha 1996
129	Meliaceae	**Naregamia alata** Wight &Arn.	US	March	EGF	JJ 207094
130	Musaceae	**Ensete superbum** (Roxb.) Cheesman	H	June–September	EGF	Barnes 1944
131	Myrtaceae	**Syzygium densiflorum** Wall. ex Wight &Arn.	T	December–March	SHEG	JJ 206543, JJ 207041
132	Myrtaceae	**Syzygium malabaricum** (Bedd.) Gamble	T	April	MDF	JJ 202852
133	Oleaceae	**Ligustrum gamblei** Ramamoorthy (*Ligustrum minii* Raizada)	T	May–June	MDF-EGF	JJ 195753
134	Orchidaceae	**Anoectochilus elatus** Lindl.	H	October	EGF	JJ 195959
135	Orchidaceae	**Bulbophyllum fimbriatum** (Lindl.) Rchb.f. (*Cirrhopetalum fimbriatum* Lindl.)	E	March–April	EGF	JJ 197448
136	Orchidaceae	**Bulbophyllum fusco-purpureum** Wight	E	March–April	EGF-SHEG	JJ 197450
137	Orchidaceae	**Bulbophyllum kaitiense** Rchb.f.	E	June–October	EGF	R.R. Rao 1039
138	Orchidaceae	**Bulbophyllum proudlockii** (King & Pantl.) J.J.Sm. (*Cirrhopetalum proudlockii* King & Pantl.)	E	April	EGF	A.S. Rao 79899
139	Orchidaceae	**Coelogyne nervosa** A.Rich.	E	August	SHEG	JJ 195769
140	Orchidaceae	**Crepidium intermedium** (A. Rich.) Sushil K. Singh, Agrawala & Jalal (*Microstylis stocksii* Hook.f.) [*Malaxis intermedia* (A.Rich.) Seidenf.]	H	June–September	SHG	Barnes 1944, Kammathy 1967
141	Orchidaceae	**Dendrobium aqueum** Lindl.	E	September–October	SHEG	JJ 207149
142	Orchidaceae	**Dendrobium nanum** Hook.f.	E	September–October	SHEG	JJ 207139

	Family	Plant Name	Habit	Flowers	Forest type	Voucher no.
143	Orchidaceae	**Dendrobium nodosum** Dalzell [*Flickingeria nodosa* (Dalzell) Seidenf.]	E	September	SHEG	JJ 202978
144	Orchidaceae	**Eria exilis** Hook.f.	E	August–September	SHEG	JJ 202964
145	Orchidaceae	**Eria filiformis** (Wight) Rchb.f. [*Porpax filiformis* (Wight) Schuit., Y.P.Ng & H.A.Pedersen] [*Eria dalzellii* (Hook. ex Dalzell) Lindl.]	E	July	EGF	JJ 207130
146	Orchidaceae	**Eria microchilos** (Dalzell) Lindl.	E	October	SHEG	JJ 194739
147	Orchidaceae	**Eria mysorensis** Lindl.	E	August–September	EGF	JJ 202976
148	Orchidaceae	**Eria nana** A.Rich. [*Porpax nana* (A.Rich.) Schuit., Y.P.Ng & H.A.Pedersen]	E	September	SHEG	R.S. Rao 73721, R.S. Rao 73770
149	Orchidaceae	**Eria pauciflora** Wight [*Cylindrolobus pauciflorus* (Wight) Schuit., Y.P.Ng & H.A.Pedersen]	E	September	EGF	Barnes 1944, Kammathy 1967
150	Orchidaceae	**Eria polystachya** A.Rich [*Pinalia polystachya* (A.Rich.) Kuntze]	E	September	EGF	Barnes 1944, Kammathy 1967
151	Orchidaceae	**Eria pseudocalvicaulis** Blatt.	E	August–September	EGF	JJ 203499
152	Orchidaceae	**Eria reticosa** Wight	E	June–July	SHEG	B.R.Ramesh 1490
153	Orchidaceae	**Eulophia pratensis** Lindl. (*Eulophia ramentacea* Wight)	H	December	SHG	Barnes 1944, Kammathy 1967
154	Orchidaceae	**Gastrochilus flabelliformis** (Blatt. & McCann) C.J.Saldanha	E	March	EGF-SHEG	JJ 207138
155	Orchidaceae	**Habenaria brachyphylla** (Lindl.) Aitch.	H	August–September	MDF	JJ 207148
156	Orchidaceae	**Habenaria elliptica** Wight	H	September		R.S. Rao, 73789
157	Orchidaceae	**Habenaria elwesii** Hook.f.	H	August–September	SHG	JJ 207140
158	Orchidaceae	**Habenaria foliosa** A.Rich.	H	September	EGF	JJ 203500
159	Orchidaceae	**Habenaria heyneana** Lindl.	H	September	SHG	JJ 203482
160	Orchidaceae	**Habenaria hollandiana** Santapau	H	September	MDF	R.S. Rao, 73746
161	Orchidaceae	**Habenaria longicornu** Lindl.	H	September	MDF	JJ 203440
162	Orchidaceae	**Habenaria multicaudata** Sedgw.	H	September-October	EGF	JJ 207135
163	Orchidaceae	**Habenaria ovalifolia** Wight	H	September-October	MDF	JJ 195934
164	Orchidaceae	**Habenaria rariflora** A.Rich.	H	September	SHG	R.S. Rao 73788
165	Orchidaceae	**Habenaria sahyadrica** K.M.P.Kumar, Nirmesh, V.B.Sreek. & Kumar	H	December	EGF	JJ 206559
166	Orchidaceae	**Liparis platyphylla** Ridl.	H	September	MDF	Barnes 1944, Kammathy 1967
167	Orchidaceae	**Oberonia chandrasekharanii** V.J.Nair, V.S.Ramach. & R.Ansari	E	September–December	EGF	JJ 202977
168	Orchidaceae	**Oberonia verticillata** Wight	E	September	EGF	Barnes 1944
169	Orchidaceae	**Peristylus stocksii** (Hook.f.) Kraenzl.	E	September	SHG	Barnes 1944
170	Orchidaceae	**Plectoglossa perrottetiana** (A. Rich.) K.Prasad & Venu (*Habenaria perrottetiana* A.Rich.)	H	September	SHG	R.S. Rao, 73786, R.R. Rao 3402
171	Orchidaceae	**Schoenorchis jerdoniana** (Wight) Garay	E	September–June	EGF	Barnes 1944
172	Orchidaceae	**Schoenorchis smeeana** (Rchb.f.) Jalal, Jayanthi & Schuit. [*Schoenorchis latifolia* (C.E.C.Fisch.) C.J.Saldanha] (*Rhynchostylis latifolia*C.E.C.Fisch.) [*Xenikophyton smeeanum* (Rchb.f.) Garay]	E	October–June	EGF-SHEG	JJ 195738, JJ 195943
173	Phyllanthaceae	**Glochidion hohenackeri** (Müll.Arg.) Bedd. var. **hohenackeri** [*Glochidion fagifolium* (Müll.Arg.) Miq. ex Bedd.]	T	April	EGF	A.S.Rao, 79969
174	Phyllanthaceae	**Glochidion hohenackeri** var. **johnstonei** (Hook.f.) Chakrab. & M.Gangop.	T	July	EGF	JJ 194536

	Family	Plant Name	Habit	Flowers	Forest type	Voucher no.
175	Phyllanthaceae	**Meineckia longipes** (Wight) G.L.Webster	S	September–December	EGF	JJ 203456, JJ 206525
176	Phyllanthaceae	**Phyllanthus indofischeri** Bennet	T	March–April	DDF	JJ 197484
177	Phyllanthaceae	**Phyllanthus narayanswamyii** Gamble	US	December	SHEG	JJ 206540
178	Piperaceae	**Piper hookeri** Miq.	CS	July	EGF	JJ 194542
179	Piperaceae	**Piper schmidtii** Hook.f.	CS	April	SHEG	A.S. Rao 79970, A.S. Rao 79977
180	Pittosporaceae	**Pittosporum dasycaulon** Miq.	T	May–June	EGF	JJ 196000
181	Pittosporaceae	**Pittosporum neelgherrense** Wight & Arn.	T	December–February	EGF	R.R. Rao 1805
182	Poaceae	**Aristida stocksii** (Hook.f.) Domin	H	October	SF	JJ 195906
183	Poaceae	**Arthraxon villosus** C.E.C.Fisch.	H	December	EGF	JJ 206567
184	Poaceae	**Capillipedium filiculme** (Hook.f.) Stapf	H	December	SHG	JJ 203556
185	Poaceae	**Isachne setosa** C.E.C.Fisch.	H	October	SHG	JJ 194771
186	Poaceae	**Oropetium roxburghianum** (Schult.) S.M.Phillips	H	December	SHG	JJ 206570
187	Ranunculaceae	**Clematis wightiana** Wall. ex Wight &Arn.	WC	December–February	EGF-SHEG	Kammathy 1967
188	Ranunculaceae	**Ranunculus subpinnatus** Wight &Arn.	H	May	SHG	Blatter 1908
189	Ranunculaceae	**Thalictrum dalzellii** Hook.	H	July–September	SHG	Barnes 1944
190	Rosaceae	**Rubus kasthuriae** Gandhi	CS	May–June	SHEG	Kammathy 1967
191	Rubiaceae	**Gardenia gummifera** L.f.	T	March	DDF	JJ 197403
192	Rubiaceae	**Ixora elongata** B.Heyne ex G.Don	T	May–October	EGF	JJ 194741, JJ 195962
193	Rubiaceae	**Lasianthus coffeoides** Fyson	S	May	EGF	Barnes 1944, Kammathy 1967
194	Rubiaceae	**Mussaenda glabrata** (Hook.f.) Hutch. ex Gamble	S	September	MDF	R.S.Rao, 32944
195	Rubiaceae	**Ophiorrhiza hirsutula** Wight ex Hook.f.		April	EGF	A.S.Rao, 79851
196	Rubiaceae	**Pavetta breviflora** DC.	S	April	SHEG	JJ 202844
197	Rubiaceae	**Pavetta crassicaulis** Bremek.	S	April	EGF	A.S.Rao, 79853
198	Rubiaceae	**Psychotria bisulcata** Wight & Arn.	S	June	SHEG	Barnes 1944
199	Rubiaceae	**Psychotria flavida** Talbot	S	December	SHEG	JJ 206514
200	Rubiaceae	**Psychotria octosulcata** Talbot	S	March	EGF	JJ 207034
201	Rubiaceae	**Psychotria truncata** Wall.	S	March	EGF	JJ 207073
202	Rubiaceae	**Wendlandia thyrsoidea** (Roth) Steud.	T	March	MDF-SHEG	JJ 197279
203	Rutaceae	**Atalantia wightii** Yu.Tanaka	S	March	EGF	JJ 207078
204	Salicaceae	**Flacourtia montana** J.Graham	T	March	MDF-EGF	JJ 197276
205	Santalaceae	**Viscum angulatum** B.Heyne ex DC.	PS	October	SF	JJ 194656
206	Santalaceae	**Viscum subracemosum** Sanjai & N.P.Balakr.	PS	December	SF	JJ 206518
207	Sapindaceae	**Allophylus rheedei** (Wight) Radlk.	T	April	MDF	A.S. Rao 79777
208	Sapotaceae	**Isonandra perrottetiana** A.DC.	T	March	SHEG	JJ 207040, JJ 207077
209	Vitaceae	**Tetrastigma sulcatum** (M.A.Lawson) Gamble	CS	March	MDF	JJ 207005
210	Zingiberaceae	**Curcuma pseudomontana** J.Graham	H	May	EGF	JJ 195953
211	Zingiberaceae	**Zingiber cernuum** Dalzell	H	September	MDF	JJ 202952

C—Climbers | E—Epiphytes | H—Herbs | PS—Parasitic shrubs | S—Shrubs | SS—Scandent shrubs | T—Trees | US—Undershrubs | WC—Woody climbers | SF—Scrub forest | DDF—Dry deciduous forest | MDF—Moist deciduous forest | EGF—Evergreen forest | SHEG—Shola evergreen forest | SHG—Shola grassland.

Table 2. List of near endemic species in the study area Biligiri Rangaswamy Temple Tiger Reserve.

	Family	Plant Name	Habit	Flowering	Voucher no.	Distribution
1	Acanthaceae	**Andrographis alata** (Vahl) Nees	H	March–April	JJ 197483	India, Sri Lanka
2	Acanthaceae	**Asystasia chelonoides** Nees	H	August–September	JJ 202935	India, Sri Lanka
3	Acanthaceae	**Barleria buxifolia** L.	US	December	JJ 206526	India, Sri Lanka
4	Acanthaceae	**Barleria courtallica** Nees	US	March	JJ 197468	India, Sri Lanka
5	Acanthaceae	**Barleria mysorensis** Roth	US	July	JJ 194481	India, Sri Lanka
6	Acanthaceae	**Strobilanthes heyneana** Nees [*Nilgirianthus heyneanus* (Nees) Bremek.]	S	October–December	JJ 206588, JJ 194693	India, Sri Lanka
7	Acanthaceae	**Strobilanthes kunthiana** (Nees) T.Anderson ex Benth. (*Phlebophyllum kunthianum* Nees)	S	December	JJ 203476	India, Myanmar
8	Acanthaceae	**Strobilanthes cordifolia** (Vahl) J.R.I.Wood [*Phlebophyllum spicatum* (Roth) Bremek.]	S	December	JJ 206587	India, Sri Lanka
9	Acanthaceae	**Barleria involucrata** Nees var. **involucrata**	S	September–December	Barnes 1944	India, Sri Lanka
10	Acanthaceae	**Justicia vahliana** Schult. (*Justicia vahlii* Roth)	H	October–December	R.S. Rao 73539	India, Bangladesh, Pakistan
11	Acanthaceae	**Ruellia beddomei** C.B.Clarke	H	September	Barnes 1944	India, Nepal
12	Amaryllidaceae	**Pancratium triflorum** Roxb.	H	October	JJ 207129	India, Bangladesh
13	Anacardiaceae	**Buchanania axillaris** (Desr.) Ramamoorthy	T	November–December	JJ 206597	India, Sri Lanka
14	Annonaceae	**Uvaria narum** (Dunal) Blume	CS	May	JJ 195964	India, Sri Lanka
15	Apiaceae	**Bupleurum ramosissimum** Wight &Arn. (*Bupleurum virgatum* Wight & Arn.)	H	May	Barnes 1944, Kammathy1967	India, Sri Lanka
16	Apocynaceae	**Ceropegia candelabrum** L.	C	September–October	JJ 195933, JJ 202993	India, Sri Lanka
17	Apocynaceae	**Secamone emetica** (Retz.) R.Br. ex Sm.	CS	December–February–March	JJ 202811, JJ 203505, JJ 203510, JJ 207064	India, Sri Lanka
18	Apocynaceae	**Hoya pauciflora** Wight	E	May–June	JJ 195739	India, Sri Lanka
19	Apocynaceae	**Cynanchum tunicatum** (Retz.) Alston	C	December	Barnes 1944	India, Sri Lanka
20	Araceae	**Arisaema barnesii** C.E.C.Fisch.	H	May–October	Barnes 1944	India, Sri Lanka
21	Araceae	**Lagenandra ovata** (L.) Thwaites	H	June	Barnes 1944	India, Sri Lanka
22	Araliaceae	**Heptapleurum stellatum** Gaertn. [*Schefflera stellata* (Gaertn.) Baill.]	CS	May–June	JJ 195987	India, Sri Lanka
23	Arecaceae	**Phoenix loureiroi** var. **pedunculata** (Griff.) Govaerts (*Phoenix humilis* Royle ex Becc. var. *pedunculata* Becc.)	T	May	JJ 195968	India, Pakistan, Nepal Bangladesh
24	Asparagaceae	**Asparagus gonoclados** Baker	H	May	Barnes 1944	India, Sri Lanka
25	Asteraceae	**Anaphalis subdecurrens** Gamble	H	October	JJ 194704	India, Sri Lanka
26	Begoniaceae	**Begonia malabarica** Lam.	H	May–June	R.S. 73708	India, Sri Lanka
27	Burseraceae	**Commiphora caudata** (Wight & Arn.) Engl.	T	December	JJ 206596	India, Sri Lanka
28	Capparaceae	**Capparis divaricata** Lam.	S	October–March	JJ 194650, JJ 197419	India, Sri Lanka
29	Celastraceae	**Elaeodendron glaucum** (Rottb.) Pers. [*Cassine glauca* (Rottb.) Kuntze]	T	September–December	JJ 194630, JJ 197413, JJ 206580	India, Sri Lanka
30	Celastraceae	**Elaeodendron glaucum** (Rottb.) Pers.	T	March, July, December	JJ 194630, JJ 197413, JJ 206580	India, Sri Lanka
31	Celastraceae	**Elaeodendron paniculatum** Wight & Arn.	T	March	JJ 207091	India, Sri Lanka
32	Celastraceae	**Euonymus dichotomus** B.Heyne ex Wall.	T	March–May	Barnes 1944, Kammathy 1967	India, Sri Lanka
33	Combretaceae	**Combretum albidum** G.Don [*Combretum ovalifolium* Roxb. ex G.Don]	SS	March–May	JJ 195971, JJ 197281, JJ 207044	India, Sri Lanka

	Family	Plant Name	Habit	Flowering	Voucher no.	Distribution
34	Combretaceae	**Terminalia anogeissiana** Gere & Boatwr.	T	March–September	JJ 194404	Indian subcontinent
35	Commelinaceae	**Cyanotis villosa** (Spreng.) Schult. & Schult.f.	H	September–December, March	JJ 197469, JJ 203489, JJ 203581	India, Sri Lanka
36	Commelinaceae	**Commelina indehiscens** E.Barnes	H	September	R.S. 73556	India, Sri Lanka
37	Commelinaceae	**Cyanotis fasciculata** (B.Heyne ex Roth) Schult. & Schult.f.	H	September	Barnes 1944	India, Sri Lanka
38	Commelinaceae	**Cyanotis pilosa** Schult. & Schult.f.	H	September	R.S. 73589	India, Sri Lanka
39	Commelinaceae	**Murdannia esculenta** (Wall. ex C.B.Clarke) Abeyw.	H	September	R.S. 73775	India, Sri Lanka
40	Convolvulaceae	**Argyreia elliptica** (Roth) Choisy	CS	September–October	JJ 194681, JJ 202943, JJ 203560	India, Nepal, Sri Lanka
41	Daphniphyllaceae	**Daphniphyllum neilgherrense** (Wight) K.Rosenthal	T	October–December	B.R. Ramesh 1571	India, Sri Lanka
42	Dioscoreaceae	**Dioscorea tomentosa** J.Koenig ex Spreng.	C	August–September	JJ 202927	India, Bangladesh, Sri Lanka
43	Ebenaceae	**Diospyros melanoxylon** Roxb.	T	December–March	JJ 206577, JJ 207090	India, Sri Lanka
44	Eriocaulaceae	**Eriocaulon thwaitesii** Körn.	H	September	JJ 203447	India, Myanmar, Sri Lanka
45	Euphorbiaceae	**Givotia moluccana** (L.) Sreem. (*Givotia rottleriformis* Griff. ex Wight)	T	May–June, September	JJ 195734, JJ 202992	India, Sri Lanka
46	Euphorbiaceae	**Glochidion candolleanum** (Wight &Arn.) Chakrab. & M.Gangop. (*Glochidion arboreum* Wight)	T	September	R.S. 73829	India, Sri Lanka
47	Fabaceae	**Cajanus rugosus** (Wight &Arn.) Maesen (*Atylosia rugosa* Wight &Arn.)	CS	December	JJ 206510	India, Sri Lanka
48	Fabaceae	**Cajanus albicans** (Wight &Arn.) Maesen	C	November	JJ 195775, JJ 197242	India, Sri Lanka
49	Fabaceae	**Crotalaria scabrella** Wight &Arn.	H	March	JJ 207057	India, Sri Lanka
50	Fabaceae	**Dichrostachys cinerea** (L.) Wight & Arn. subsp. **cinerea**	S	March	JJ 202807	India, Sri Lanka
51	Fabaceae	**Hardwickia binata** Roxb.	T	December	JJ 203504	India, Bangladesh
52	Fabaceae	**Smithia bigemina** Dalzell	H	September–December	JJ 206511, JJ 206554	India, Pakistan
53	Fabaceae	**Tephrosia tinctoria** (L.) Pers.	US	October	JJ 194753	India, Sri Lanka
54	Fabaceae	**Dalbergia sissoides** Graham ex Wight & Arn.	T	March–April	JJ 197270, JJ 207085	India, Java
55	Gesneriaceae	**Rhynchoglossum notonianum** (Wall.) B.L.Burtt	H	May & December	Barnes 1944	India, Sri Lanka
56	Hypericaceae	**Hypericum mysurense** Wall. ex Wight & Arn.	S	May–October	JJ 194749, JJ 195984	India, Sri Lanka
57	Lamiaceae	**Endostemon viscosus** (Roth) M.R.Ashby	US	July–October	JJ 194516, JJ 194571, JJ 195911, JJ 202958	India, Sri Lanka
58	Lamiaceae	**Gomphostemma heyneanum** Wall. ex Benth.	US	August–September	JJ 202920	India, Vietnam
59	Lamiaceae	**Coleus divaricatus** A.J.Paton (*Anisochilus paniculatus* Benth.)	H	April	A.S. Rao 80069	India, Sri Lanka
60	Lamiaceae	**Coleus malabaricus** Benth.	H	December	Barnes 1944	India, Sri Lanka
61	Lauraceae	**Cinnamomum sulphuratum** Nees	T	March–June	JJ 195707, JJ 207061	India, Myanmar
62	Liliaceae	**Lilium wallichianum** var. **neilgherrense** (Wight) H.Hara	H	October	JJ 194747, JJ 202979	India, Nepal
63	Loranthaceae	**Helixanthera hookeriana** (Wight &Arn.) Danser	PS	March	JJ 207108	India, Sri Lanka
64	Loranthaceae	**Taxillus courtallensis** (Gamble) Danser	PS	December	JJ 203507	India, Sri Lanka
65	Loranthaceae	**Dendrophthoe neelgherrensis** (Wight &Arn.) Tiegh.	PS	September	Barnes 1944	India, Sri Lanka
66	Magnoliaceae	**Magnolia nilagirica** (Zenker) Figlar	T	March	JJ 197466	India, Sri Lanka

	Family	Plant Name	Habit	Flowering	Voucher no.	Distribution
67	Malvaceae	**Byttneria herbacea** Roxb.	H	July–September	JJ 194570, JJ 202867	India, Bangladesh
68	Malvaceae	**Eriolaena hookeriana** Wight &Arn.	T	September	JJ 203438	India, Sri Lanka
69	Molluginaceae	**Trigastrotheca pentaphylla** (L.) Thulin (*Mollugo pentaphylla* L.)	H	July	JJ 194628	India, Sri Lanka
70	Moraceae	**Dorstenia indica** Wight	H	September	Barnes 1944	India, Sri Lanka
71	Myristicaceae	**Myristica dactyloides** Gaertn.	T	May–June, December	JJ 195718, JJ 206502	India, Bangladesh
72	Oleaceae	**Jasminum angustifolium** (L.) Willd.	CS	July	JJ 194484, JJ 194515	India, Sri Lanka
73	Oleaceae	**Jasminum ritchiei** C.B.Clarke	CS	December	JJ 203506	India, Bhutan
74	Oleaceae	**Ligustrum robustum** subsp. **perrottetii** (A.DC.) de Juana	T	May–June	JJ 195973	India, Laccadive islands
75	Oleaceae	**Jasminum brevilobum** DC.	CS	September	Barnes 1944	India, Vietnam
76	Orchidaceae	**Aerides ringens** (Lindl.) C.E.C.Fisch.	E	July	JJ 194449, JJ 194547	India, Sri Lanka
77	Orchidaceae	**Coelogyne breviscapa** Lindl.	E	March–April	JJ 197478	India, Sri Lanka
78	Orchidaceae	**Coelogyne odoratissima** Lindl.	E	March–April	JJ 197479	India, Sri Lanka
79	Orchidaceae	**Crepidium versicolor** (Lindl.) Sushil K.Singh, Agrawala & Jalal [*Malaxis versicolor* (Lindl.) Sant. & Kapadia]	H	October	JJ 194748	India, Sri Lanka
80	Orchidaceae	**Diplocentrum recurvum** Lindl.	E	May–June	JJ 195767, JJ 195952	India, Sri Lanka
81	Orchidaceae	**Gastrochilus acaulis** (Lindl.) Kuntze [*Saccolabium pulchellum* (Wight) C.E.C.Fisch.]	E	March	JJ 207105	India, Sri Lanka
82	Orchidaceae	**Habenaria longicorniculata** J.Graham	H	September–October	JJ 194732, JJ 202967	India, Sri Lanka
83	Orchidaceae	**Habenaria roxburghii** Nicolson	H	July–September	JJ 194441, JJ 202957	India, Sri Lanka
84	Orchidaceae	**Luisia tenuifolia** Blume	E	July	JJ 194546	India, Sri Lanka
85	Orchidaceae	**Oberonia brunoniana** Wight	E	December	JJ 206598	India, Bangladesh
86	Orchidaceae	**Papilionanthe cylindrica** (Lindl.) Seidenf. (*Aerides cylindrica* Lindl.)	E	March–June	JJ 195706, JJ 197449	India, Sri Lanka
87	Orchidaceae	**Trichoglottis tenera** (Lindl.) Rchb.f.	E	March	JJ 197480	India, Sri Lanka
88	Orchidaceae	**Vanilla walkerae** Wight	C	March–December	JJ 207115	India, Sri Lanka
89	Orchidaceae	**Dendrobium jerdonianum** Wight (*Dendrobium nutans* Lindl.)	E	April–May	Barnes 1944	India, Sri Lanka
90	Orchidaceae	**Habenaria barbata** Wight ex Hook.f.	H	September	Barnes 1944	India, Sri Lanka
91	Orchidaceae	**Liparis atropurpurea** Lindl.	H	September	Barnes 1944	India, Sri Lanka
92	Orchidaceae	**Peristylus spiralis** A.Rich.	H	September	Barnes 1944	India, Sri Lanka
93	Orobanchaceae	**Parasopubia delphiniifolia** (L.) H.-P.Hofm. & Eb.Fisch.	H	October	JJ 195928	India, Sri Lanka
94	Orobanchaceae	**Pedicularis zeylanica** Benth.	H	September	Barnes 1944	India, Sri Lanka
95	Phyllanthaceae	**Glochidion bourdillonii** Gamble	T	February–March	A.S. Rao 80036	India, Bhutan
96	Phyllanthaceae	**Phyllanthus rheedei** Wight	H	July–September	JJ 194430	India, Sri Lanka
97	Poaceae	**Cyrtococcum deccanense** Bor	H	August–September	JJ 202908	India, Sri Lanka
98	Poaceae	**Pseudanthistiria umbellata** (Hack.) Hook.f.	H	December	JJ 206557	India, Sri Lanka
99	Poaceae	**Themeda cymbaria** Hack.	H	March–April	JJ 202846	India, Sri Lanka
100	Poaceae	**Tripogon jacquemontii** Stapf	H	December	JJ 206551	India, Bangladesh
101	Poaceae	**Themeda cymbaria** Hack.	H	September	R.S. Rao 73572	India, Sri Lanka
102	Poaceae	**Tripogon jacquemontii** Stapf	H	April–May	A.S. Rao 80409	India, Bangladesh
103	Primulaceae	**Myrsine wightiana** Wall. ex A.DC. [*Rapanea wightiana* (Wall. ex A.DC.) Mez]	T	May-June	JJ 195710	India, Sri Lanka
104	Ranunculaceae	**Ranunculus wallichianus** Wight & Arn.	H	May	Barnes 1944, Kammathy 1967	India, Sri Lanka
105	Rosaceae	**Rubus fairholmianus** Gardner	CS	March	JJ 207070	India, Sri Lanka

	Family	Plant Name	Habit	Flowering	Voucher no.	Distribution
106	Rubiaceae	**Benkara malabarica** (Lam.) Tirveng.	S	March–September	JJ 194510, JJ 195724, JJ 202808, JJ 202810, JJ 202812, JJ 202937	India, Sri Lanka
107	Rubiaceae	**Gardenia latifolia** Aiton	T	March	JJ 197485	India, Bangladesh
108	Rubiaceae	**Meyna laxiflora** Robyns	T	May–July	JJ 194476, JJ 195945, JJ 197287	India, Bangladesh
109	Rubiaceae	**Mussaenda glabrata** (Hook.f.) Hutch. ex Gamble	S	July	JJ 194548	India, Bangladesh
110	Rubiaceae	**Neanotis monosperma** (Wight & Arn.) W.H.Lewis	H	September	JJ 203457	India, Sri Lanka
111	Rubiaceae	**Psychotria nilgherensis** (Kuntze) Govaerts & Chakrab. [*Psychotria elongata* (Wight) Hook.f.]	S	May–June, September	JJ 195741	India, Sri Lanka
112	Rubiaceae	**Psychotria nigra** (Gaertn.) Alston	S	March	JJ 207038	India, Sri Lanka
113	Rubiaceae	**Ixora pavetta** Andrews	S	July	JJ 194633	India, Bangladesh, Sri Lanka
114	Rubiaceae	**Ixora notoniana** Wall. ex G.Don	S	May	Barnes 1944	India, Sri Lanka
115	Rutaceae	**Chloroxylon swietenia** DC.	T	March–June	JJ 195764, JJ 197404	India, Sri Lanka
116	Rutaceae	**Clausena indica** (Dalzell) Oliv.	T	March–July, December	JJ 194625, JJ 206568, JJ 207079	India, Sri Lanka
117	Rutaceae	**Pleiospermium alatum** (Wall. ex Wight & Arn.) Swingle	T	March–April	JJ 197422	India, Sri Lanka
118	Rutaceae	**Pamburus missionis** (Wall. ex Wight) Swingle	T	March–July	A.S. Rao 80398	India, Sri Lanka
119	Salicaceae	**Casearia thwaitesii** Briq.	T	May	JJ 195712	India, Sri Lanka
120	Salicaceae	**Scolopia crenata** (Wight &Arn.) Clos	T	July	JJ 194522	India, Sri Lanka
121	Santalaceae	**Viscum capitellatum** Sm.	PS	September	R.S. Rao 73760	India, Sri Lanka
122	Sapotaceae	**Madhuca longifolia** var. **latifolia** (Roxb.) A.Chev.	T	March	JJ 203513, JJ 207043	India, Bangladesh
123	Tiliaceae	**Grewia bracteata** B.Heyne ex Roth (*Grewia wightiana* J.R. Drumm.)	T	May	Kammathy 1967	India, Sri Lanka
124	Vitaceae	**Ampelocissus indica** (L.) Planch.	CS	December	JJ 206562	India, Sri Lanka
125	Vitaceae	**Ampelocissus araneosa** (Dalzell) Gamble	CS	July–September	Kammathy 1967	India, Thailand
126	Zingiberaceae	**Meistera acuminata** (Thwaites) Skornick. &M.F.Newman (*Amomum muricatum* Bedd.)	H	May	A.S. Rao 79979	India, Sri Lanka

C—Climbers | E—Epiphytes | H—Herbs | PS—Parasitic shrubs | S—Shrubs | SS—Scandent shrubs | T—Trees | US—Undershrubs | WC—Woody climbers.

predominantly a tropical forest. As, plant life form is the growth form that represents adaptation to specific ecological conditions that reflects climatic adaptability as well as vegetation of that area.

New records for Karnataka

The present study also resulted in documentation of two endemic species of Western Ghats *Syzygium densiflorum* Wall. ex Wight & Arn. (Myrtaceae) and *Meineckia longipes* (Wight) G.L.Webster (Phyllanthaceae) as new distributional records to Karnataka state. *Syzygium densiflorum* and *Meineckia longipes* were so far known to occur in Kerala and Tamil Nadu, and this present report shows their extended distribution to Karnataka.

Threats and Conservation

The endemic flora of BRT TR is vulnerable to anthropogenic pressure and also impacted by other factors. Within its boundary the tiger reserve includes a popular ancient temple 'Biligiri Rangaswamy Temple', coffee plantations in the core zone, settlements of indigenous people 'Soligas', state highways, and ecoresorts of tourism department. The main threats are in the form of invasive alien species, forest fires, and plantations. A study by Barve et al. (2005) revealed that

Table 3. Representation of life-form of endemic flora in Biligiri Rangaswamy Temple Tiger Reserve.

Life form	No. of endemic taxa	Percentage
Trees	35	17%
Shrubs & Under shrubs	39	20%
Herbaceous climbers/ Woody climbers/ Liane/ Scandent shrubs	17	9%
Herbs	85	40%
Epiphytes	25	12%
Parasitic shrubs	10	5%
Total	**211**	**100%**

human induced threats within and around the sanctuary appear to have significantly affected the vegetation composition and structure resulting in thinning of forests. The core area of BRT TR is relatively vulnerable due to the presence of coffee plantations located and also due to the presence of high human densities in the zone. The invasion by weeds such as *Lantana camara* L. and *Chromolaena odorata* (L.) R.M.King & H.Rob. in the dry deciduous to moist deciduous forests is of major concern (Murali & Siddappa 2001). Likewise, presence of another invasive alien weed *Ageratina adenophora* (Spreng.) R.M.King & H.Rob. in the evergreen forests and shola forests causes severe damage to the community composition, species diversity and abundance of native flora including endemic through its allelopathic effects. It is of great concern that majority of the endemic species are concentrated in the evergreen forests necessary steps may be taken to mitigate the effects of invasive weeds and to maintain the health of ecosystem.

Some of the endemic species such as *Andrographis serpyllifolia* and *Lepidagathis cristata* are mostly found growing in the dry deciduous forest and scrub forest areas along the forest borders in the open areas in mud roadsides and sandy-gravely soil along the metal roadsides inside BRT TR. Road expansion or reconstruction of roads will result in dumping and excavation of soils nearby areas which will trample the endemic plants growing along the roadsides. Another threat to the endemic species is the forest fires. Some of the areas in BRT TR especially the dry deciduous forest areas are prone to forest fires. An elegant narrow endemic species, *Barleria morrisiana* is threatened due to this. Similarly, the cultivated trees planted amidst the coffee plantations and other wild trees along the coffee plantations are laden with many endemic orchids. If the trees are removed by natural or unnatural means it will also wipe out the epiphytic species growing along with them.

Recently, in 2018 the Government of India has notified an area to an extent varying from 0.50 km to 6 km from the boundary of BRT TR as an ecosensitive zone. This zone covers a total area of 262.43 sq. km. around the sanctuary. Apart from this, the Forest department has undertaken periodical removal of invasive species such as *Lantana camara*. This should be also expanded to eradication of other major species like *Ageratina adenophora* and *Chromolaena odorata*. Training of local communities, forest department and coffee plantation staff and personnel should be given to identify endemic species for recovery and rehabilitation.

CONCLUSION

The BRT TR is a home to diverse endemic flora that are predominantly Western Ghats elements and confined to the evergreen forests. Presence of 28% of the endemic flora common to Western Ghats and Eastern Ghats elements supports the identification of a unique biogeographical zone which acts as a bridge between the Western and Eastern Ghats. Orchidaceae is the dominant family among the endemic flora of BRT TR, and one of the dominant families of endemic flora of the Western Ghats. The evergreen forests, while comprising only 10% of the total area of BRT TR, shelters a maximum diversity of endemic flora which are vulnerable due to the rapid spread of invasive species. Hence additional focused conservation measures are required for conservation of evergreen forests within BRT TR.

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Image 1. Endemic species occurring in Biligiri Rangaswamy Temple Tiger Reserve: A—*Andrographis serpyllifolia* | B—*Asystasia crispata* | C—*Asystasia dalzelliana* | D—*Barleria cuspidata* | E—*Barleria lawii* | F—*Barleria montana* | G—*Barleria morrisiana* | H—*Justicia micrantha* | I—*Lepidagathis cristata* | J—*Strobilanthes barbata* | K—*Strobilanthes meeboldii* | L—*Strobilanthes neilgherrensis*. © J. Jayanthi.

Image 2. Endemic species occurring in Biligiri Rangaswamy Temple Tiger Reserve: A—*Pimpinella wallichiana* | B—*Ceropegia hirsuta* | C—*Heptapleurum capitatum* | D—*Calamus gamblei* | E—*Chlorophytum indicum* | F—*Impatiens balsamina* var | *micrantha*. G—*Radermachera xylocarpa* | H—*Cordia macleodii* | I—*Capparis grandiflora* | J—*Terminalia paniculata* | K—*Cyanotis tuberosa* | L—*Argyreia cuneata*.

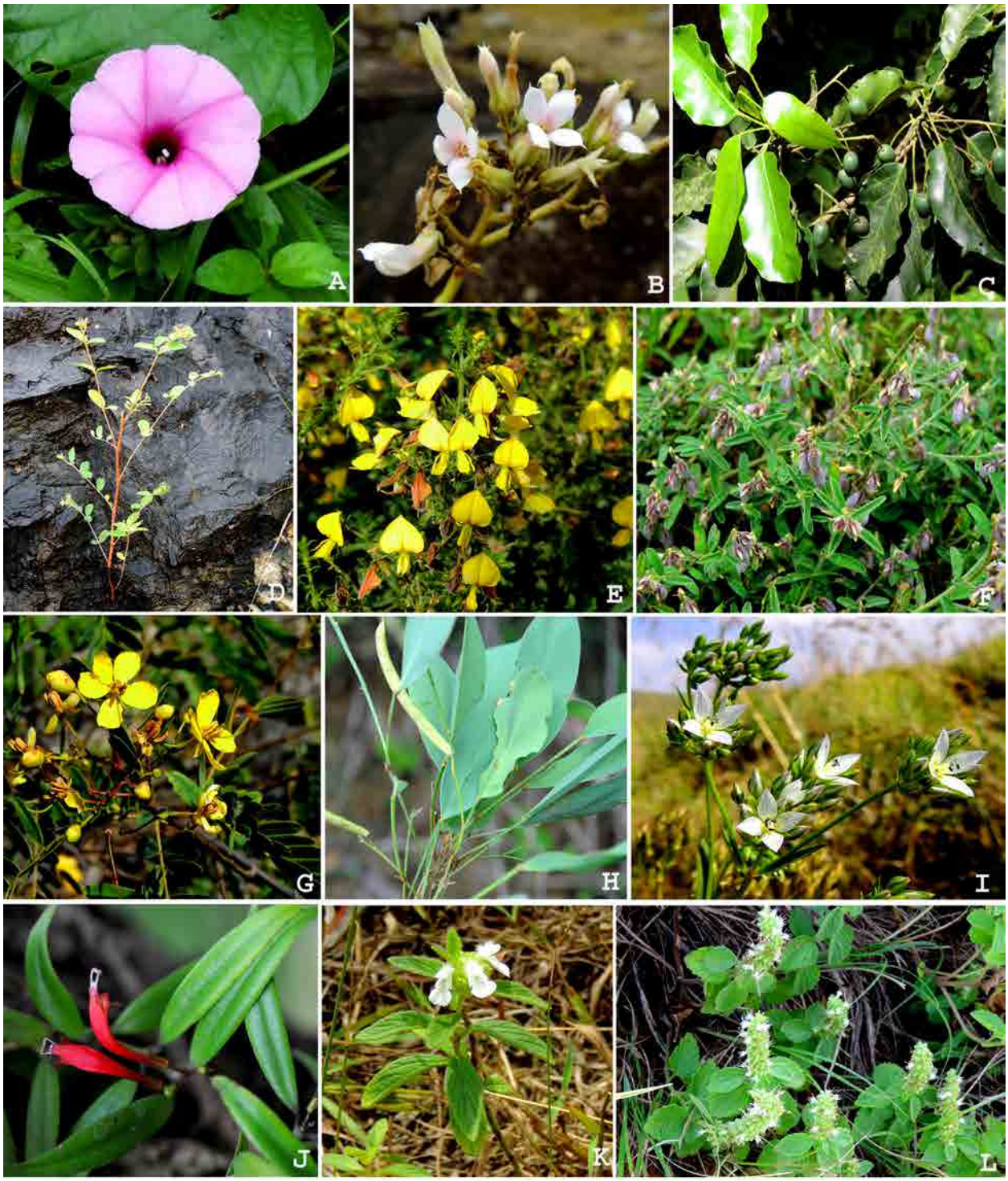

Image 3. Endemic species occurring in Biligiri Rangaswamy Temple Tiger Reserve: A—*Argyreia sericea* | B—*Kalanchoe olivacea* | C—*Elaeocarpus munroi* | D— *Euphorbia notoptera* | E—*Crotalaria paniculata* | F—*Crotalaria pusilla* | G—*Senna montana* | H—*Tephrosia calophylla* | I—*Swertia corymbosa* | J—*Aeschynanthus perrottetii* | K—*Leucas eriostoma* | L—*Pogostemon mollis*. © J. Jayanthi.

Image 4. Endemic species occurring in Biligiri Rangaswamy Temple Tiger Reserve: A—*Scutellaria wightiana* | B—*Actinodaphne bourdillonii* | C—*Beilschmiedia wightii* | D—*Cinnamomum wightii* | E—*Litsea floribunda* | F—*Phoebe wightii* | G—*Dendrophthoe memecylifolia* | H—*Helicanthes elastica* | I—*Helixanthera obtusata* | J—*Helixanthera wallichiana* | K—*Macrosolen trigonus* | L—*Taxillus recurvus*. © J. Jayanthi.

Image 5. Endemic species occurring in Biligiri Rangaswamy Temple Tiger Reserve: A—*Grewia orbiculata* | B—*Microcos heterotricha* | C—*Memecylon lushingtonii* | D—*Osbeckia brachystemon* | E—*Naregamia alata* | F—*Syzygium densiflorum* | G—*Syzygium malabaricum* | H—*Bulbophyllum fimbriatum* | I—*Bulbophyllum fusco-purpureum* | J—*Habenaria longicornu* | K—*Schoenorchis smeeana* | L—*Glochidion hohenackeri* var. *johnstonei*. © J. Jayanthi.

Image 6. Endemic species occurring in Biligiri Rangaswamy Temple Tiger Reserve: A—*Meineckia longipes* | B—*Phyllanthus indofischeri* | C—*Pittosporum dasycaulon* | D—*Gardenia gummifera* | E—*Ixora elongata* | F—*Pavetta breviflora* | G—*Psychotria flavida* | H—*Psychotria truncata* | I—*Wendlandia thyrsoidea* | J—*Atalantia wightii* | K—*Flacourtia montana* | L—*Isonandra perrottetiana*. © J. Jayanthi.

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