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Research Article

DISJUNCT DISTRIBUTION OF FIVE ENDEMIC PLANTS FROM THE TROPICAL DRY EVERGREEN FOREST OF TAMILNADU, INDIA

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ABSTRACT
The botanical survey was carried out in Hillocks, Reserve Forest, Sacred Groves and Unclassified Vegetations of Tropical Dry Evergreen Forest from three Coromandel Coastal districts of Tamilnadu *viz*. Chengalpet, Cuddalore, Villupuram and Union Territory of Pondicherry. This article deals with 5 endemic and evergreen arborous species such as *Derris ovalifolia*, *Gardenia latifolia*, *Manilkara roxburghiana*, *Pterospermum xylocarpum* and *Tricalysia sphaerocarpa* and their disjunct nature of distribution across the state by crosscutting district wise with respect to soil, climate and elevation. Their population status and the conservation measures are also discussed.

Keywords: *Disjunct Distribution, Tropical Dry Evergreen Forest, Coromandel Coast, Tamilnadu, Ecology*

INTRODUCTION
Linnaeus was one of the first, to notice the relationship in the flora of the two continents during 1750. In the 18th century, Thunberg and Castialioni independently drew attention to the baffling pattern of certain plants that were common to East Asia and Eastern USA. However, Van Steens (1934) stated that no species is homogeneously distributed throughout the area where it occupies. According to Carlquist (1967) the two disjunctive areas are climatically and ecologically analogous. Axelrod (1970), Thorne (1973) and Smith (1973) studied disjunctions between tropical countries prior to mid tertiary period of plants between tropical Africa, America and Asia. The disjunctions are not confined to the higher plants only but also abound in lichens, mosses, liver-worts and ferns.

In India, Clarke (1898) studied Indo-Malayan species, notably Dipterocarpaceae, Ericaceae (*Rhododendron*, *Gaultheria*) and *Podocarpus*; Seshagiri Rao *et al.,* (1961) had studied the distribution of some useful tree species among India, Burma, Malaysia and Sri Lanka and occurrence of certain Himalayan taxa on the hills of South India and Ceylon, such as *Rhododendron*, *Mahonia* and *Gaultheria* is other curious disjunctions. The long discontinuity in distribution of *Acacia planifrons* that occurs in northern part of Ceylon, South India (Tamilnadu and Karnataka) and Gujarat (Meher-Homji 1970); *Capparis decidua* in Rajasthan, North Gujarat, Deccan and reappears in the extreme south-eastern part of Peninsula (Meher-Homji 1974); *Albizia amara* in southern part of peninsula and disappears over the black soils of Deccan and patchy distribution of *Hardwickia binata* in Peninsular India (Meher-Homji 1974) is a puzzle.

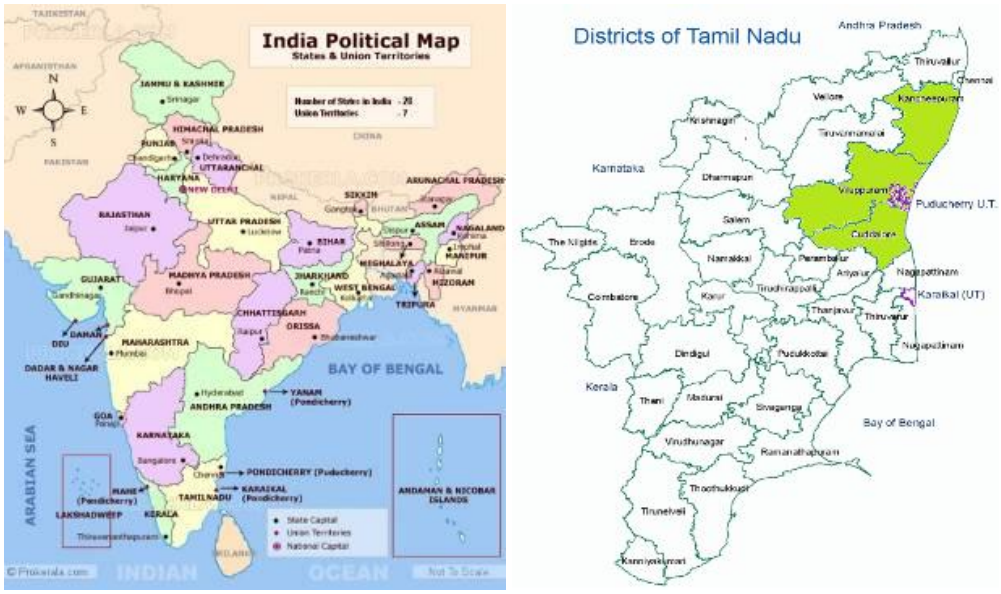
This study aims to explore the disjunct nature of distribution with respect to soil and climate; present population status and the conservation measures of 5 evergreen arbores species from the Tropical Dry Evergreen Forest (TDEF), Coromandel Coast of Tamilandu. Owing to this Chengalpet, Villupuram, Cuddalore districts of Tamilnadu and Union Territory of Pondicherry were selected for the filed survey.

METHODS
Botanical enumeration was made regularly with an interval of four months to each and every site (three times in a year). During the survey species enumeration, recording flowering and fruiting period, collection of voucher samples were done systematically and the prepared herbarium sheets deposited in AURO Herbarium for future reference. Based on the published sources (Nair and Henry1983; Henry *et al.,* 1987; Henry *et al.,* 1989) the distribution map (district wise) was prepared by using orange colour for the existing districts and extended distribution has shaded with green colour. All the species are provided

with phenology, global and regional distribution, district wise distribution map, plant part photos and notes if any for easy understanding.

Study Area

The botanical enumeration was carried out in Hillocks (HL), Reserve Forest (RF), Sacred Groves (SG) and Unclassified Vegetations (UV) during 2006 to 2013 from three coastal districts of Tamilnadu *viz*. Chengalpet, Cuddalore, Villupuram district and Union Territory of Pondicherry (Map 1). The terrain is generally plain with eruption of hillocks in Chengalpet district and sand stone plateau in Cuddalore district with four major rivers running through the districts and finally reaching the Bay of Bengal. Generally, the soil along the east coast is sandy loam or red ferralitic sometimes covered with alluvial deposits. It becomes clayey in the interiors (Meher-Homji 1974; 1986). The sandy coastal plains extend up to 40-60 km (Mani 1974). Major parts of the study area (Map 1) lies on Cuddalore sandstone formations of Meiocene period. It is overlaid by a thin layer of soil, pebbles and amorphous gravels.



Map 1: India political map with Tamilnadu state enlarged, three districts studied are shaded with green colour

Climate

A typical maritime tropical climate with a dissymmetric rainfall regime prevails in the study area. The weather is generally humid and hot for most part of the year with only minor variations. North-East monsoon constitute the principal rainy season accounting 60-80 % of the total rain fall and south-west monsoon contributes 20 %. The mean annual rainfall during 1990-2010 periods was 1428 mm with mean rainy days of 57.5 per year. The minimum temperature was 17.7 °C in January and the maximum was 40.5 °C in May. The average relative humidity is 74 %. The weather is generally cool during December-February and the late nights are dewy. Dry weather prevails during March-June. Wind speed ranges from 5.0 km/hour in June-July and 9 km/hour in August-September but not during the cyclonic days.

Enumeration

Derris ovalifolia (Wight & Arn.) Benth. in Miq. Pl. Jungh.1: 252. 1852 exparteet Journ. Linn. Soc. 4 (Suppl.): 115. 1860; Baker in Hook.f. F. Brit. Ind. 2: 247. 1878; Sanjappa, Legumes Ind. 147. 1992. *Pongamia ovalifolia* Wight & Arn. Fl. Pen. Ind. Or. 1: 262. 1834; Wight Ic. Pl. Or. t. 328. 1840. LUGUMINACEAE (FABOIDEAE)

Climbers. Leaves 13-19 cm long; leaflets ovate-oblong, 2.5-6.3 x 1.5-3.7 cm, obtuse to emarginate; petiolules 4-6 mm. Racemes axillary, 10-16 cm long. Mostly on leafless branches, rachis geminate with 3-4 flowers at nodes. Calyx widely campanulate, 2-3 mm, 5-toothed.Corolla bright red; vexillum ovato-

orbicular, 6-7 mm, margin ciliate; keels shorter than wings. Staminal sheath 6 mm long.Pistil 7 mm long. Ovary puberulous, non-stipitate; ovules 2-4.Pods narrowly oblong. 3.0-5.2 x 1.0-1.2 cm, strap shaped, distinctly winged on the dorsal suture; seeds 1-2, oblong, brown, 8.0- x 3.5 mm, testa wrinkled.
Phenology: Flower: April; Fruit: May-August.
Distribution: Peninsular India; a rare and threatened plant which in all probability has become extinct (Thoth., Fasc. Fl. India 8: 25. 1982). In Tamilnadu: Tiruchirappalli (Matthew 1996), Villupuram and Pondicherry (Balachandran and Gastmans 1997). Chingelpet, Cuddalore and Tirunelveli (personal observation) are additions from this study.

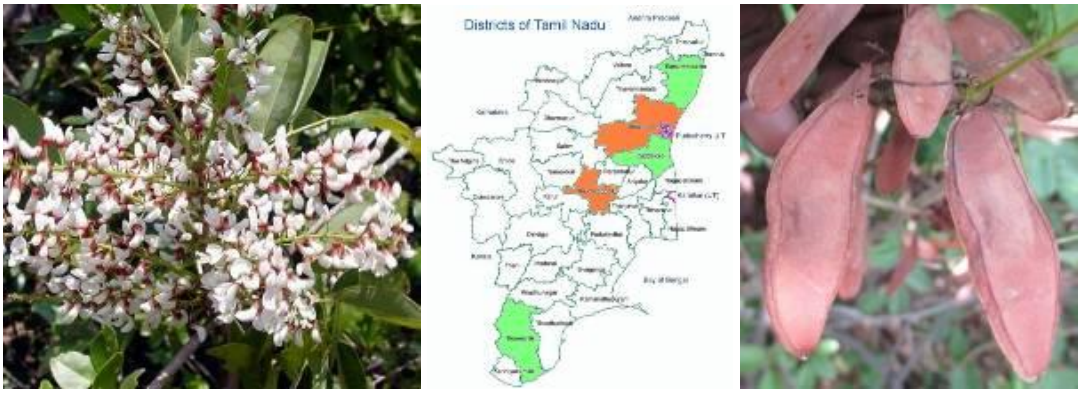


Figure 1: *Derris ovalifolia* flowering branch, distribution map and ripe fruits

Specimen examined: Cuddalore District: Sedapalayam Pudur, 25.06.2003, *WFG & NB* 8680 (fruit); Thondamanatham, 25.06.2003, *WFG & NB* 8674. Kanchepuram District: Vilangadu, 01.08.2003, W*FG & NB* 8855 (veg.); Tottacheri R.F. 10 m, 08.04.2003 *NB* 8328 (flower); 16.04.2002, *JDH & WFG* 3517 (flower); 02.05.2001, *JDH & WFG* 3210 (flower); 12.04.2000, *JDH, NB, PB & WFG* 3015 (flower); Panaiyur, 5m, 02.05.2001, *JDH & WFG* 3208 (fruit). Villupuram District: Aranya, 30 m, 19.08.2003, *WFG & NB* 8979 (fruit); Ousteri Lake, 30 m, 11.06.1996, *WFG & NB* 5591(fruit), 5593 (fruit), 5587 (fruit); 18.05.1996, *WFG, TDR & NB* 5582 (fruit); Oorani, 23.04.96, *WFG, TDR & NB* 5573 (fl) & 5572 (fr); Puthupet, 18.05.1996, *WFG, TDR & NB* 5584 (fr); 05.04.1994, WFG 5001.
Note: Though this plant shows the distribution extended to other districts, the ideal specimens whose GBH more than 30 cm have found only in and around the type locality, Pondicherry. The records from the threat assessment workshop for this plant held at Auroville during 2002 shows that it is found in alluvial soil, sandy loam and red ferralitic of coastal plains and hill slopes, distribution range approximately 2000 km^2, area of occupancy ± 400 km^2, population with 3 generation, % of decline > 80 and the number of mature individuals around 300.
Gardenia latifolia Aiton, Hort. Kew. 1: 294. 1789; Roxb. Pl. Coromandel t. 134. 1800 & Fl. Ind. 2: 552. 1824; Wight & Arn. Prodr. fl. Ind. Orient. 395. 1834; Wight, Icon. Pl. Ind. Orient t. 759.1844; Hook.f. Fl. Brit. India 3: 116. 1880; Gamble, Fl. Madras 2: 619 (436).1921; Matthew. Fl Tamilnadu Carnatic vol 3(2): 705. 1983. *G. enneandra* J. Koenig ex Wight & Arn. Prodr.fl. Ind. Orient. 394. 1834; Wight, Icon pl. Ind. Orient. T. 574. 1842. RUBIACEAE
Tamil: Kaatumarikalam, Kalkottai, Kumbi
Densely foliaceous shrub or tree to 10 (12) m. Leaves broadly elliptic, 12-25 x 8-14 cm, lateral nerves 16-24 pairs, occasionally bullate in nerve axills, nervules regular, parallel, acute-attenuate at base, acute at apex, margin entire, glabrous. Calyx tubular-campanulate, tube to 1 cm; lobes 7(9), lanceolate, 2 cm, acuminate. Corolla 7 cm across, white; tube 3 cm, pubescent without; lobes 7(9), exserted, 1.7 cm. Berry globose 4.5 cm across. With a crown of calyx; seeds rugose.
Phenology: Leaf fall: January; Flower: February-April; Fruit: Throughout the year.
Distribution: Throughout India (Hook.f. *l.c*). In Tamilnadu: Coimbatore, Nilgiri, Tirunelveli. Tiruvannamalai, Virudunagar. Kancheepuram and Villupuram is an addition from the study.

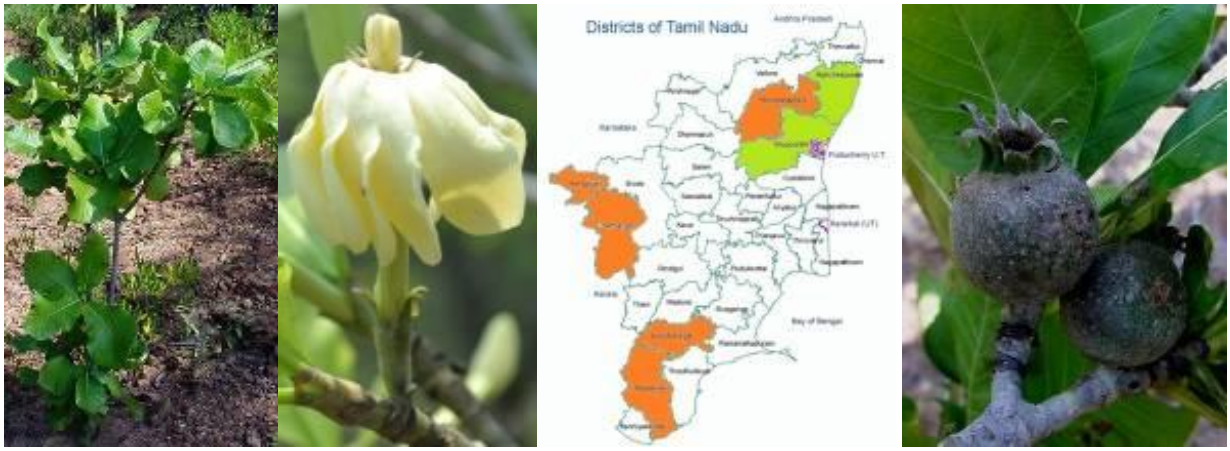


Figure 2: *Gardenia latifolia* habit, flower, distribution map and young fruit

Specimen examined: Kanchepuram District: Gudulur R.F., 35 m, 20.11. 2002, *WFG & NB* 3979 (flower & fruit); Kollattanallur, 120 m, 07.08.2002, *WFG* 3729 (fruit); Vilangadu, Madurantakam, 08.07.1998, *PB & WFG* F 6702 (fruit); 19.11.97. *PB & WFG* 2704 (fruit). Villupuram District: Pakkam malai R.F. (Personal observation).

Note: Generally it is recorded only on the hills, dry deciduous region, between 400-900 m in full sun. This is the first time record from the coastal and plain areas. Though it is found all over India, the distribution is very fragile in Tamilnadu state. Intensive filed survey needs to be done to assess the population strength and the habitat.

Manilkara roxburghiana (Wight) Dubard in Ann. Inst. Bot.-Geol. Colon. Marseille III, 3: 10, 1915; Fl. Tamilnadu 2: 64, 1987. *Mimusops roxburghiana* Wight, Ic. t. 1588. 1850; Hook.f. Fl. Birt. India 3: 548. 1882; Gamble, Fl. Madras 2: 766 (538). 1921. SAPOTACEAE

Tamil: Kanupala

Large evergreen tree, up to 10 m high. Latex milky. Leaves clustered at apex, elliptic oblong to oblanceolate, 4-9 x 2.5-4.5 cm, coriaceous, base acute, apex obtusely retuse to emarginate. Flowers large, the corolla .4 in long; staminodes long, lanceolate, fimbriate, glabrous; leaves elliptic, obtuse or emarginate, up to 2.5 in. long, 1.5 in. broad; Berris depressed globose - ellipsoid, c 1.5 cm across. Seed 1.

Phenology: Flower: March-April; Fruit: April-May.

Distribution: Peninsular India (Deccan and Carnatic) up to 1500 m. In Tamilnadu: Coimbatore, Kanniyakumari, Nilgiri and Tirunelveli. Tiruvannamalai (Vijayasankar *et al.*, 2012) and Villupuram are recent additions.

Figure 3: *Manilkara roxburghiana* flowering branch, distribution map and young fruits

Specimen examined: Vilupuram District: Pakkamalai R.F., Gangavaram, 370 m, 22.07.1998, *PB & WFG* F6725 (flower); 02.10.2013, *NB* 12809 (flower).

Note: This evergreen species is recorded only on the dry hilly areas. The earlier record is from the foot hills of Western Ghats; however the present field survey shows from the isolated hills of Eastern Ghats. It is the replacement of the *Manilkara hexandra* which is common along the plains. The regeneration and population status is not known; however the seeds of both the species were extensively collected and raised seedlings which are used as root stock for crafting of Zapota plant. Based on the gap found between the distribution sites have to be considered as very crucial for the assessment, conservation and management.

Pterospermum xylocarpum (Gaertner) Santapau & Wagh, Bull. Bot. Surv. India 5: 108. 1963; Matthew, Ill. Fl. Tamilnadu Carnatic t. 81. 1982 & Fl. Tamilnadu Carnatic vol 3(1): 150. 1983. *P. heyneanum* Wallich ex Wight & Arn. Prodr. fl. Ind. Orient. 69. 1834; Wight Icon. Pl. Ind. Orietn. t. 489. 1841; Hook.f. Fl. Brit. India 1: 369. 1874; Gamble, Fl. Madras 1: 108 (77). 1915. STERCULIACEAE

Tamil: Masapoondi, Masippuluvai

Tree to 10(20) m; branchlets warty, apically rusty-tomentose. Leaves dark green above, rusty below; juvenile ones much larger, rhomboidal with deeply incised margins, oblong-obovate, 7-18 x 4-13 cm, thick coriaceous, obscurely nerved, apex acuminate. Flowers 8-10 cm across; sepals 5, oblong, or spathulate; petals 5 white, turning yellow on fading, oblanceolate, 6x1 cm; stamens 15, staminodes linear. Capsule woody, pyriform, to 7x3.5 cm, narrow at both ends, rusty; seeds winged, brown.

Phenology: Flowers: November-January. Fruits: January-April.

Distribution: Peninsular India, drier hills (Hook.f. *l.c.*). In Tamilnadu: Coimbatore, Cuddalore, Kanchepuram, Salem, Tiruchi, Tirunelveli, Tiruvannamalai, Vellore and Villupuram.

Figure 4: *Pterospermum xylocarpum* flower, distribution map and young fruit

Specimen examined: Cuddalore District: S.Pudur, 12.11.2004, *WFG & NB* 11171 (flower); 05.02.2003, *WFG & NB* 4975 (flower & fruit); Kulanthaikuppam, 10 m, 19.03.2003, *WFG & NB* 8260 (fruit); 26.11.1997 *NB, PB & WFG* F 6009 (flower). Kanchepuram District: Kollathanallur, 60 m, 14.01.1998, *JDH, PB & WFG* F 6384 (flower). Villupuram district: Pachaiamman kovil R.F., 170 m, 29.012003, *WFG & NB* 4952 (flower); Gingee, 150 m, 10.02.2006, *WFG & NB* 12360 (in fruit); 30.12.1997, *JDH, PB & WFG* F 6164 (fruit); Marakkanam, 10 m, 12.02.97 *JDH, PB & WFG* F 10066 (fruit).

Note: This plant usually found on the hills, (300) 400-900 m on the slopes, forest border or along stream banks in shallow ravines. The occurrence of this species is very rare from the districts studied and found only on the red soil. Based on the assessment workshop in TDEF less than 250 mature individuals are recorded within the range of 9000 km^2. The percentage of seed germination is high in nurseries condition whereas in the filed the regeneration is very static. Regarding this an intensive population study is to be done by swiftly.

Tricalysia sphaerocarpa (Dalz.) Gamble, Fl. Pres. Madras.2: 620 (437). 1921. *Discospermum spaherocarpum* Dalz. In Hooker's J. Bot. Kew Gard. Misc. 2: 257. 1850. *Diplospora sphaerocarpa* (Dalz.) Bedd. For. Man. Bot. 134/3. 1872 excl. syn.; Hook.f. Fl. Brit. India 3: 123. 1880. RUBIACEAE
A small tree, with smooth leaves and very small flowers; flowers minute, fascicled; calyx lobes oblong-orbicular corolla lobes orbicular; stamens sessile; berry globose, up to 0.6 in. in diam., the seed flat, smooth, much compressed, with membranous partitions between; leaves elliptic or lanceolate, obtusely acute, smooth, the main nerves about 6-8 pairs, not prominent, nor the reticulation.
Phenology: Flowers: March-April; Fruits: May-August.
Distribution: Peninsular India (Tamilnadu), Endemic. In Tamilnadu: Tirunelveli (Gamble 1921). Cuddalore (Kadamban 1998) and Villupuram are the two recent additions.

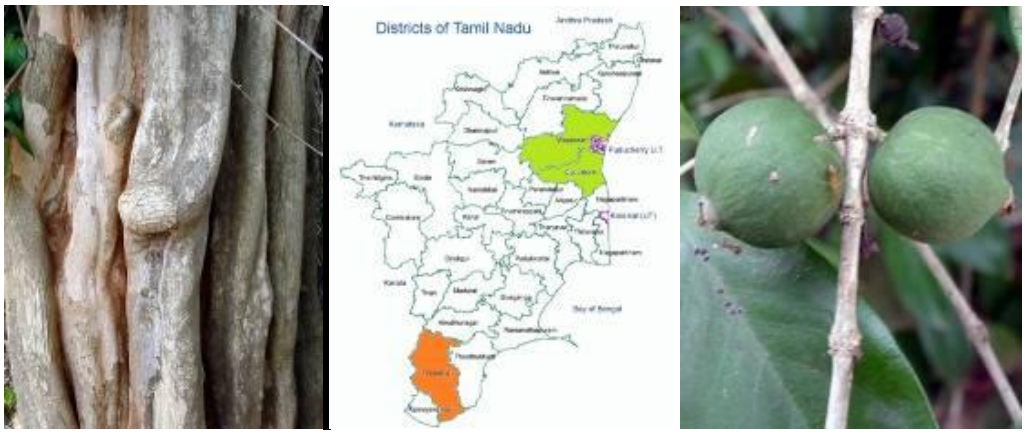


Figure 5: *Tricalysia sphaerocarpa* fluted tree trunk, distribution map and matured fruits

Specimen examined: Cuddalore District: S.Pudur, 09.07.2003, *NB* 8704 (fruit); Pudur, 35 m, 17.07.2002, *WFG* 3656 (flower); Konjikuppam, 100 m, 08.03.2000, *JDH, NB, PB & WFG* F7921 & F7906 (flower); T.Pudhupalayam, 10 m, 22.09.1999, *PB & WFG* F7200 (fruit); Kulanthaikuppam, 11.06.1997, *NB, PB & WFG* F5899 (flower) & F5900 (fruit); Suriyanpet 15 m, 02.04.1997, *JDH, PB & WFG* 0417 (flower) & 0418 (fruit). Villupuram District: Marakkanam RF, 10 m, 19.03.97, *JDH, PB & WFG* F10076 (flower).
Note: This plant has considered as rare and economically important species (Henry *et al.*, 1987). It has recently found in 7 sacred groves with red soils of Cuddalore districts and Kurumbarm R.F. from Villupuram District. It occurred after a very wide gap with Tirunelveli district (type locality), southern tip of Western Ghats. In the rapid assessment of TDEF the area of occupancy is around 10 km^2 and the number of mature individuals about 500 and the percentage of decline more than 50, because this wood is extensively used for making comb. Based on the information available this species might be considered as 'vulnerable'.

DISCUSSION

The mother earth accommodates all living organisms with no restrictions, while each species (either plants or animals or any lower group of organisms) have their own perambulation in their distribution. The distribution belongs to a region, across the country, between the neighboring countries, among the bio-geographic regions and between the continents or worldwide. In India, *Albizia amara*, *Hardwickia binata* and *Acacia planifrons* are very unique in their distribution. They are neither soil specific nor respond to climate and elevational differences. In this study, 5 endemic species are studied, in which *Derris ovalifolia, Manilkara roxburghiana, Pterospermum xylocarpum* and *Tricalysia sphaerocarpa* are endemic to Peninsular India where as *Gardenia latifolia* spread across the country. Except *Pterospermum xylocarpum*, the remaining four species shows extended distribution. However the taxon sheets from the threat assessment workshop held during 2002 at Auroville for the TDEF species shows negative results. These 5 plants have not soil and habitat specific where as it has elevational limitations *i.e*, occurs from

seal level to 800 m ASL. Interestingly all the species have recorded in Tirunelvli district of Tamilnadu which intend to say that the coverage of TDEF stated by Champion and Seth (1968) from the Vishakhapatnam, Andhra Pradesh at North and foot hills of Tirunelvel, Tamilnadu at south, has proved. While the disjunct nature of distribution and the fragile ecology of each and every species and the forest type is questioned, near future. These endemic species needs to be studied further extensively and unique conservation models to be developed to link the passage between the disjunctions.

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