A literature review of the Tropical Dry Evergreen Forest

Introduction

The Tropical Dry Evergreen Forest (TDEF) was named by Champion and Seth[5] as one of the seven groups of tropical forests in India, and defined as where 'hard leaved evergreen trees predominate with some deciduous emergents, often dense, but usually under 20 m high'. Its occurrence was also more loosely defined as relating to summer rainfall, as tropical wet evergreen forest occurs where rainfall in May-June exceeds 200 mm, tropical deciduous where it is over 100 mm, and TDEF where it is low and irregular[4]. However, the very existence of such a forest type was disputed by Meher-Homji[10] who claimed that the community was physiognomically and floristically barely different from the thorn forest of south India. Further, he maintained that the very name, 'Tropical Dry Evergreen Forest', was a misnomer since the climate is not tropical but dissymetric, the region is not particularly dry, almost 50% of the constituent species are deciduous, and the formation is only extant as thickets, not forests. Meher-Homji concluded that rather than the TDEF, the vegetation of the Coromandel coastal region should be defined as part of the larger *Albizia amara* community, typified by scrub woodland or thickets, which extends from Hyderabad in the north to Dharwar in the west along the eastern side of the Western Ghats down to the southern tip of India[9]. In contrast, the TDEF is defined as extending in a narrow coastal strip from Vishakhapatnam in the north to Ramanathapuram in the south[4]. Meher-Homji's claims were not answered in the published literature, and so the naming and separate classification of this forest type was never confirmed. For the purposes of this review and for convenience, the name 'tropical dry evergreen forest' as described by Champion and Seth[5] will be used.

Climate

The climate pattern of the area of the TDEF has been cited by many authors as significant in determining the form of the vegetation [11, 3, 9]. The area is distinctive in having a dissymmetric rainfall regime with the rainy season being centred in October-November rather than in the middle of the year[4] - over 50% of the annual rainfall can fall in these two months. The average rainfall in October to January is 2.5 times that of June to September, even though the number of rainy days is not much greater (21 compared to 28)[11]. The dry season is then limited to 6 months, from January to June, instead of the longer period experienced further inland[3]. Blasco and Legris[3] stressed the importance of the dryness of the climate and the winter rains in determining the vegetation of the region. Meher-Homji[10] disagreed, saying that the rainfall regime is more important than the winter rains, and stressing the importance of the dew that falls between September and April.

The climate is also distinguished by its inconstancy – rainfall varies in intensity, amount, and distribution both within and between years. The number of rainy days in October and November, for example, varies between 2 and 21, while some years may have high rainfall but also an extended dry season. The intensity of the rain can reach 100 mm in a day[3]. Such inconsistency in the rainfall pattern will inevitably have effects on the vegetation of the region since it must be able to survive with months or years of relative drought, and also times of intense heavy rain.

There are some contrasts in the annual rainfall figures reported in the literature. Meher-Homji[10] states the annual rainfall of the TDEF area ranges between 1000 – 1500 mm, yet in 1973 he describes the rainfall range of the *Albizia amara* community as between 600 – 1300 mm. The mean rainfall for Marrakanum between 1971 and 1991 was reported as 1254 mm by Visalakshi[16]. In Point Calimere, further south, Balasubramanian and Bole[1] recorded an average over 6 years of 544-948 mm, yet the same authors in 1992 wrote that rainfall in Point Calimere ranges from 1000 – 1500

mm[2]. In view of these differences, a precise rainfall range for the TDEF cannot be deduced, but an approximate range could be described as 1000- 1500 mm. Climate data from various sources is summarised in Table 1.

Source	Site and period	Annual rainfall	No.rainy days	Mean temp	Mean max temp	Mean min temp
Marlange & Meher-Homji 1965	Pondicherry (1914 – 1960)	1256 mm	52	28°C	30.8°C	25.1°C
Marlange & Meher-Homji 1965	Cuddalore (1891 – 1940)	1383 mm	55	28°C	31.7°C	24.2°C
Parthasarathy & Karthikeyan 1997	Cuddalore (1971 – 1995)	1258 mm	58	-	-	-
Sebastine & Ellis 1967	Point Calimere	1250 – 1400 mm	-	-	-	-
Visalakshi 1995	Pondicherry (1971 – 1991)	1254 mm	-	-	-	-
Blasco & Legris 1972	General	1300 mm	-	-	31.5°C	24°C
Balasubraniam & Bole 1992	Point Calimere (1980 – 1984)	1000 – 1500 mm	-	-	33.3°C	26.1°C
Balasubraniam & Bole 1992	Point Calimere (1983 – 1988)	544 – 948 mm	-	-	35.7°C	21.8°C

Table 1. Climate data from different TDEF areas

Soil

The soils and geology of the region have been described in some detail, again mostly by Meher-Homji in the 1970's. More specific descriptions have been made of Point Calimere and Marrakanum[3], while some basic laboratory analyses were reported from some of the temple groves[13, 14].

Meher-Homji[11] divided the Pondicherry area into 4 geographical zones based on their soil types. The coastal zone is composed of new and old dunes, including a saline area with clayey soils near the Marrakanum creek. There are two plateaus, Pondicherry and Thiruvakkarai, which are formed from the Cuddalore sandstone and consist of a red ferrallitic sandy loamy soil. The third zone is the Plain of Valudavur which is situated below the plateaus. It continues eastwards and westwards below the Cuddalore sandstone. Finally there is the alluvial zone which contains the majority of the area.

The natural vegetation is mostly found on the less fertile red ferrallitic soil[10, 11], as the other soil types (the black clayey and alluvial) are mostly under cultivation[12]. However, there are some temple groves that have survived on the richer soils (eg. Puthupet is on alluvial sandy loam[16]).

Soil data from four sites are presented in Table 2. The contrast between Puthupet and Marrakanum, and the two Cuddalore sites is striking. Both Kulanthaikuppam and Thirumanikuzhi are noticeably acidic, whereas Puthupet and Marrakanum are neutral-alkaline. The amounts of carbon, nitrogen and phosphorus found in Puthupet are also much less than the Cuddalore groves. Phosphorus in particular is two orders of magnitude less in Puthupet than in Kulanthaikuppam, with Thirumanikuzhi in between. Such a difference would be expected to be reflected in the vegetation. But this is not examined in the papers, nor is the low level of nutrients found at Puthupet. However, it appears that species richness and diversity in Puthupet is not much lower than in the Cuddalore groves, as might be expected from these soil data.

	Source	*Description*	*WHC (%)*	*pH*	*Org. C (%)*	*Total N (%)*	*Total P ($\mu g\ g^{-1}$)*
General- red soil[1]	Marlange & Meher-Homji 1965	Red-reddish brown sandy loam	fair	5-7	-	+	-
General - black soil	Marlange & Meher-Homji 1965	Black or dark heavy clay	very good	8.5-9.5	-	<	-
General - coastal alluvial soil	Marlange & Meher-Homji 1965	Brown or reddish brown, sandy to loamy clay.	fair	6-7	-	<>	-
Kulanthai-kuppam	Parthasarathy & Karthikeyan 1997	Red ferruginous, some greyish sandy, some alluvial deposits	36.33	5	2.33	0.399	1016
Thirumani-kuzhi	Parthasarathy & Karthikeyan 1997	Uniform alluvium over Cuddalore sandstone	28.65	5.8	2.03	0.226	405
Puthupet	Parthasarathy & Sethi 1997	Alluvial sandy loam	29.4	6.9 – 8.0	0.98	0.19	13.4
Marrakanum	Visalakshi 1995	Red ferrallitic	32.9	6.9 – 8.0	-	-	-

Table 2. Soil data from four TDEF sites

WHC = Water Holding Capacity + = fully supplied with the particular nutrient
< = lacking in the nutrient <> = some portions well-supplied, others not

Species richness

Blasco and Legris (1972) reported that in the whole region there are approximately 500 dicotyledonous species, including aquatic, mangrove and terrestrial species, and that in any given regional area it can be expected to find a maximum of 200-300 dicotyledonous species. Meher-Homji (1974) however claimed there was a total of only 266 species in the TDEF region.. The number of species found in three forests in various studies can be seen in Table 2. Comparison between the different sites is hindered by the use of different criteria in the studies (eg. dicotelydons, woody species,etc.)

Site	**Point Calimere**	**Point Calimere**	**Point Calimere**	**Kuzhanthai-kuppam**	**Thirumani-kuzhi**	**Puthupet**
Area	2400 ha	2400 ha	2400 ha	1.2 ha	1.6 ha	14 ha
No. of species	200 dicots	317 flowering plants	239 dicots	54 (woody species ≥ 10 cm gbh, two sites combined)		51 (woody species ⩾ 10 cm gbh)
Source	Blasco & Legris 1972	Balasubramaniam & Bole 1993	Hussain *et al.* 1985	Parthasarathy & Karthikeyan 1997	Parthasarathy & Karthikeyan 1997	Parthasarathy & Sethi 1997

Table 3. Number of species found in three TDEF forests

Species composition

i) The evergreen component

Table 4 shows the most common species found in three different studies at five TDEF sites. Of the five sites recorded, Kuzhanthaikuppam, Thirumanikuzhi and Puthupet are temple groves, Marrakanum is a degraded reserve forest and Point Calimere is a coastal reserve forest consisting of a mix of forest and scrub areas. The forest in temple groves is generally regarded as being the best indicator of the original state of the TDEF, since the groves are less disturbed than the reserve forests and are mainly on more representative soils of the region. With this in mind it is noticeable in Table

4 that in all sites apart from Marrakanum, the most common species are evergreen. In Puthupet *Drypetes sepiaria* (an evergreen tree) accounts for 54% of the basal area, while *Memecylon umbellatum* (an evergreen shrub or tree) accounts for 22%, and deciduous or brevi-deciduous species only contribute 10% of the total species composition[16]. In Kuzhanthaikuppam the most common species are *Pterospermum canescens* (a brevi-deciduous canopy tree), *M. umbellatum* and *Garcinia spicata* (a large evergreen tree), and these account for 21%, 15% and 11% of the plot basal area respectively [13]. In Thirumanikuzhi *D. sepiaria, P. canescens* and *Lepisanthes tetraphylla* (a large evergreen tree) account for 34%, 26% and 19% of the plot basal area respectively[13]. In these two groves, out of 54 woody species of ⩾10 cm gbh, only 3 were deciduous[13]. In Point Calimere *Manilkara hexandra* was described as the 'most characteristic species'[3] and as the 'dominant evergreen tree'[6]. Also in Point Calimere, only 3% of the vegetation recorded was deciduous, compared to 61% evergreen[6] (or 60%, according to a different source[2]). Data such as these would therefore suggest that the title of 'evergreen forest' is indeed justified. *Albizia amara*, the characteristic species of Meher-Homji's proposed community, is only mentioned as a significant species in Marrakanum, which is a highly degraded scrub jungle as opposed to the denser forest vegetation of the temple groves.

Kuzhanthaikuppam[1]	**Thirumanikuzhi[1]**	**Point Calimere (upper canopy)[2]**	**Marrakanum[3]**	**Puthupet[3]**
Memecylon umbellatum	*Tricalysia sphaerocarpa*	*Manilkara hexandra*	*Albizia amara*	*Psydrax dicoccos*
Tricalysia sphaerocarpa	*Lepisanthes tetraphylla*	*Cassia fistula*	*Dalbergia paniculata*	*Carissa spinarum*
Diospyros ebenum	*Atalantia monophylla*	*Azadirachta indica*	*Garcinia spicata*	*Drypetes sepiaria*
Pterospermum canescens	*Drypetes sepiaria*	*Pongamia pinnata*	*Pterospermum canescens*	*Garcinia spicata*
Garcinia spicata	*Pleiospermum alatum*	*Syzygium cumini*	*Syzygium cumini*	*Memecylon umbellatum*
Combretum ovalifolium	*Combretum ovalifolium*	*Lepisanthes tetraphylla*		*Pterospermum canescens*

Table 4. Main species recorded in three TDEF sites
[1] – Parthasarathy and Karthikeyan 1997; [2] – Hussain et al. 1985; [3] – Visalakshi 1995

A peculiarity of the TDEF flora appears to be the variety of forms in which one species can be found. For example, *Memecylon umbellatum* may be found as a multi-stemmed shrub barely reaching 2 m in height, yet in another site it may be clearly a tree, with a twisted bole and a canopy 6 m high. This has no doubt contributed to the inconsistencies found in the literature with regard to defining species as trees or shrubs. For example, Balasubramaniam and Bole (1993) call *Memecylon umbellatum, Diospyros ferrea* and *Drypetes sepiaria* all trees, whereas most authors call these species shrubs. *Manilkara hexandra* is referred to as a shrub by Blasco and Legris (1972), although Hussain *et al*. (1985) call it a tree. Blasco and Legris (1972) also commented how *Psydrax dicoccos, Ixora pavetta* and *Murraya paniculata* are sometimes found emerging 2 – 3 m above the canopy and sometimes found as 50 cm dwarf shrubs beneath the canopy. All the species referred to as having this characteristic of variable form are evergreen. One hypothesis may be therefore that this represents an adaptation to environmental conditions which vary greatly throughout the TDEF range (for example soil, climate, competition and disturbance).

ii) The deciduous component

The deciduous element of the forest type appears to be found in the thorny pioneer vegetation and the emergent canopy trees. In areas typified by clumped vegetation pioneers are found between and at the entrance to the thickets – species such as *Dichrostachys cinerea, Securinega leucopyrus, Carissa spinarum* and *Gmelina asiatica*[3]. These are typically thorny shrubs, although at the thicket edges there may also be scrambling, straggling or climbing shrubs such as *Hugonia mystax* or *Capparis zeylanica*[3]. Such species are unable to persist in the shaded forest understorey, although forest species such as *Manilkara hexandra, Drypetes sepiaria and Pleurostylia opposita* can regenerate beneath their canopy[6]. The thicket itself may be 2-3 m high with a few small trees emerging from it[3]. The Reserve Forest at Marrakanum is typical of this kind of vegetation. In this area the Leguminosae are an important component of the vegetation. They frequently dominate the vegetation above the evergreen shrub layer and give the appearance in the dry season of a discontinuous and leafless arborescent stratum[7].Where the vegetation is highly disturbed and subject to more anthropogenic pressure (particularly grazing domestic animals and lopping for firewood) the thorny species become more dominant. The environment remains more favourable to pioneer vegetation and the natural progression to a more closed and taller forest is obstructed. Thus the result is also a movement towards more deciduous vegetation, as the pioneer species tend to be more deciduous than the species of the primary forest. A visitor to these areas may well presume that the vegetation type exists predominantly as scrubby thickets surrounded by thorny deciduous shrubs.

In the denser arborescent vegetation of temple groves such as Kuzhanthaikuppam and Thirumanikuzhi thorny species account for only 10% of the species composition[13].Likewise only 10% of the speices in Puthupet temple grove were deciduous or brevi-deciduous[14]. Clearly in these environment where the forest is established and there is generally a shaded understorey, the deciduous thorny pioneer elements cannot establish. Some thorny species are however present as part of the mature forest matrix, such as *Atalantia monophylla* and *Pamburus missionis.*

Other deciduous species are present as emergent canopy trees in the primary forest matrix. In Puthupet, Marrakanum and Point Calimere the tallest emergent trees were all deciduous. In Puthupet these were *Pongamia pinnata, Azadirachta indica and Lannea coromandelica*[16]; in Marrakanum *Syzygium cumini, Dalbergia paniculata amd Pterospermum canescens*[16]; in Point Calimere *Syzygiium cumini*, *Lannea coromandelica* and *Pithecellobium dulce*[6]. As emergent trees these individuals would be subject to even harsher environmental conditions than the trees comprising the main forest canopy – the wind would be greater, and transpiration rates much higher, for example. It is therefore possible that the ecological niche of the emergent canopy tree is more suitably filled by deciduous species which can tolerate the drying atmosphere of the upper canopy better than the evergreen species.

Some species that are typical of the inland dry deciduous forest are found in some abundance close to the coast at Marrakanum (eg. *Cleistanthus collinus, Calycopteris floribunda, Combretum ovalifolium*). This area is far from any dry deciduous forest, which raises the question of whether such elements of the flora are relics of an old deciduous flora, introduced from the current deciduous area inland, or simply are also part of the TDEF flora. The answer to this question is as yet unknown[3].

Forest structure

The structure of the TDEF varies considerably with environmental conditions and the extent of human interference in the forest. There appears to be a correlation between the physiognomy of the vegetation and the density of human settlement. For example, near Murkal where human population density is low there is continuous forest cover, but near Mysore it exists only as low scattered shrubs[12].

The TDEF, where it exists as a forest, is typically of low stature, with the upper canopy generally not exceeding 10 m [3]. In Puthupet the average tree height was 8 m[14] while in Thirumanikuzhi it was 10 m and in Kuzhanthaikuppam, 6 m[13]. The typically low height of the common trees seems to have resulted in disagreements among authors as to which species are trees and which are shrubs.

Table 5 shows the distribution of life forms according to four different authors, in three different sites. Although the three authors who describe the same site (Point Calimere) differ considerably, the contrast with the other authors (describing the two temple groves Kuzhanthaikuppam and Thirumanikuzhi) is far more striking. The disparity may arise because Parthasarathy and Karthikeyan (1997) do not include any shrubs or herbs, and therefore cover everything in only two categories.

	Point Calimere	**Point Calimere**	**Point Calimere**	**KK and TM ***
Arborescent species	10%	17%	17%	63%
Shrubs/ subshrubs	22%	30%	22%	-
Climbing species	17%		8%	37%
Herbaceous species	50%	-	53%	-
Source	Blasco & Legris 1972	Balasubramaniam & Bole 1992	Hussain *et al.* 1985	Parthasarathy & Karthikeyan 1997

Table 5. Distribution of Life Forms in different TDEF sites
*= Kuzhanthaikuppam and Thirumanikuzhi

Flora distribution

There is similar disagreement on the matter of endemic species of the TDEF. Meher-Homji (1974) stated that there were only 6 species that were present in the TDEF and not in the inland thorn forest (and this was a major argument towards the inclusion of the TDEF with the *Albizia amara* community). These six are: *Manilkara hexandra, Memecylon umbellatum, Drypetes sepiaria, Pterospermum canescens, Carmona retusa, Garcinia spicata*. Of these six species, *M. hexandra* is found in other parts of India as a much larger tree than it ever appears in this region; some believe *M. umbellatum* to be a variety of *Memecylon edule* from the Western Ghats; and *D. sepiaria, P canescens* and *G. spicata* were present in Meher-Homji's study only in very low numbers (2 out of 46 quadrats). Therefore, most species are common to the TDEF and also to the interior thorn forest. Blasco and Legris (1972), however, stated that there were 'about 50' species endemic to the 'eastern floristic province, Carnatic sector'. This number was derived from other papers quoted in their review. However, the same authors in another 1972 paper stated that there were no endemics in this vegetation formation.[7] No other paper discusses endemic species so it is difficult to conclude anything from these results. It may be observed however that Meher-Homji's conclusions were reached from fieldwork that did not access the many temple groves of the TDEF area, in which the actual TDEF formation is best preserved.
Two contrasting descriptions of the distribution of the TDEF flora exist in the literature, and are summarised in Table 6.

	Blasco & Legris 1972	Meher-Homji 1974
Pantropical	21%	6%
Asian	20%	-
Indian subcontinent	18%	45.5% (17.7% South Indian, 27.8% Indian)
Afro-Asian	14%	12.7%
Afro-Asian-Australian	7%	4.1%
Asian-Australian	-	7%
Indo-Malayan	-	17.3%
Endemic	3.5% (7 species, of which 4 are endemic to S. India)	17.7% endemic to South India
Introduced species	10%	-

Table 6. Summary of the floristic distribution of the TDEF flora, according to two different authors

The difference between the two distribution descriptions is too large to explain by any means other than the two authors using totally different criteria for the various categories. Meher-Homji (1974) does not describe how the origin of the different species was found. Blasco and Legris (1972) appear to have drawn on several sources (Sebastine 1967, Marlange and Meher-Homji 1965) as well as their own data for their description. However, the disparity is so great that little can be inferred from either source.

Species' adaptations

Within the entire flora that can be described for the TDEF region, there are clearly species adapted to a variety of niches. Some have already been discussed, such as the thorny pioneers and the deciduous emergent trees. Others, with broad or narrow niches, are listed here:

- *Eugenia bracteata, Ixora pavetta, Manilkara hexandra,* and *Sapindus emarginatus* are typical of salty seashore conditions, according to a study at Point Calimere[14].
- *Albizia amara* is an acidophilous species, never seen on the more alkaline calcium-rich black clayey soil[8]
- *Memecylon umbellatum* is almost always found on lateritic soils. Until recently (when it changed to Memecylaceae) it was in the Melastomataceae family which are often Aluminium accumulators.
- *Diospyros ferrea, Dichrostachys cinerea* and *Salvadora persica* have been suggested as forming the transition between evergreen and deciduous regions[6]

When taking the flora as a whole it can be observed that there is a strong convergence of forms, as most evergreen species are bushy, sclerophyllous, with thin twisted stems[3]. Such a convergence would most likely be in response to the prevailing environmental conditions of the area.

Phenology

The flowering formations of TDEF species are complex and irregular. Both vegetative growth and flowering are spread over the whole year despite the long and hot dry season.
Some species flower throughout the year, such as *Gmelina asiatica, Carissa spinarum*; others have two peak flowering seasons (*Manilkara hexandra, Scutia myrtina*); or even flower several times during the year (*Murraya paniculata*). Some flower in the dry season (*Sapindus emarginatus, Lepisanthes tetraphylla*) while some do in the rainy season (*Strychnos minor*)[3,6]. Thus the

determinism of flowering is complex and unknown. Flowering periods vary from year to year, and even within the same year and same species, indicating a wide ecological plasticity in the flora[3].

The main fruiting season extends from November to March[6]. The number of fruiting plants in Point Calimere increased from September-October, peaking in February-March. The lowest number of fruiting individuals was in June[1]. Thus the fruiting season is concentrated during the rainy season and at the beginning of the dry season. It can also be correlated with bird migrations, as the peak of the frugivore migration is also in March[1]. However, there are some species with fleshy fruits which fruit for an extended period – according to one author, 6 - 8 months in the year, eg. *Benkara malabarica, Carissa spinarum*)[6]. Such species included 11 trees (eg. *Manilkara hexandra, Walsura trifoliata, Lannea coromandelica*), 6 shrubs and 6 climbers[1].

Balasubramaniam and Bole (1993) identified three fruiting patterns:

i. Summer and pre-monsoon fruiting
   - April to August.
   - 9 trees, 2 shrubs, 2 climbers
   - three sub-types – (1) Ripe March – June.
     Eg. *Ixora pavetta, Drypetes sepiaria*
     (2) Ripe May – September
     Eg. *Walsura trifoliata, Lannea coromandelica*
     (3) Ripe only in summer
     Eg. *Lepisanthes tetraphylla, Ochna obtusata*

ii. Monsoon and post-monsoon fruiting
   - Mostly starting in Septmeber and continuing through to March, but some confined only to monsoon
   - 11 trees, 15 shrubs, 11 climbers
   - Eg. *Glycosmis mauritana, Syzigium cumini, Psydrax dicoccos*

iii. Year-round fruiting
   - Some in every month, some not in every month but in every season of the year
   - 7 trees, 6 shrubs, 1 climber
   - Eg. *Pleurostylia opposita, Olax scandens, Salacia chinensis*

Little data is available on pollination or fruit dispersal. One study of seed dispersal by mammals in Point Calimere however found 59 plant species dispersed by animals, and 10 species which were only dispersed by animals[2]. The animals responsible for dispersal were bonnet macaque, civet cat,fruit bat, jackal and spotted deer[2].

Equally, there is barely any available information on new leaf formation of TDEF species, whether of the deciduous or the evergreen component. The one study which mentions this states that new leaf formation is high in Sepetmber and October[6] – i.e. after the first winter rains. All the non-evergreen species were observed to put new leaves after the first few showers of the monsoon[6].

Conclusion

Of the literature on the TDEF published to date, most studies focus on one site or at most two. Many have been written about Point Calimere and Marrakanum with only three papers focussing on the vegetation of the temple groves, which contain arguably the best remaining example of the TDEF type. For these sites it is therefore possible to describe in some detail the vegetation and structure of the forest, including in many cases the soil and geological conditions. However it is difficult to obtain an overall picture of the TDEF, since the literature provides rather snapshots at different locations. For the conservation of this dwindling forest type a priority must be to broaden the picture so that a clear image of the nature of the TDEF, its variations and the threats to its survival can emerge.

List of references

[1] Balasubramanian, P. and Bole, P. V. (1993) Fruiting phenology and seasonality in tropical dry evergreen forest in Pt. Calimere wildlife sanctuary. *J. Bombay Nat. Hist. Soc*. 90: 163-178

[2] Balasubramanian, P. and Bole, P. V. (1992?) Seed dispersal by mammals at Point Calimere Wildlife sanctuary, Tamil Nadu. *J. Bombay Nat. Hist. Soc*. 90: 33-44

[3] Blasco, F. and Legris, P. (1972) Dry Evergreen forest of Point Calimere and Marakanum. *J. Bombay Nat. Hist. Soc*. 70(2) 279-294

[4] Puri, G. S., Gupta, R. K., Meher-Homji, V. M., Puri, S. (1989) *Forest Ecology (2nd Edn)* Oxford and IBH Publishing Co.Ltd., New Delhi pp. 297-312

[5] Champion, H. G. and Seth, V. K. (1968) A *Revised Survey of the Forest Types of India*. Government of India

[6] Hussain, S.A., Sugathan, R., Balasubramanian, P. (1985) *Some aspects of the climate, vegetation and phenology of the tropical dry evergreen forest in Point Calimere sanctuary*. 'Studies on the movement and population structure of Indian avifauna', Bombay Natural History Society

[7] Legris, P.and Blasco, F. (1972) Biology of the Dry Evergreen Forests of South India. In V. puri, Y. S. Murty, P. K. Gupta, D. Banerjee (ed.s) *Biology of Land Plants* pp. 341-343. Sarita Prakashan, Meerut.

[8] Marlange, M. and Meher-Homji, V. M. (1965) Phytosociological studies in the Pondicherry region. *J. Indian Botanical Soc*. 44(2):167-182

[9] Meher-Homji, V.M. (1973) A phytosociological study of the Albizia amara Boiv. community of India. *Phytocoenologia* 1(1): 114-129

[10] Meher-Homji, V. M. (1974) On the origin of the tropical dry evergreen forest of south India. *Int. J. Ecol. Environ. Sci*. 1:19-39

[11] Meher-Homji, V. M. (1976) *Phytogeography of Pondicherry region*. Symposium on Advancement of Ecology (1-9) at Muzaffarnagar December 8-10, 1976. Eds. Agarwal, V. P. and Sharma, V. K.

[12] Meher-Homji, V. M. (1977) Vegetation-climate parallelism along Pondicherry-Mysore-Murkal transect, South India. *Phytocoenologia* 4(2): 206-217

[13] Parthasarathy, N., Karthikeyan, R (1997) Plant biodiversity and conservation of two tropical dry evergreen forests on the Coromandel coast, south India. *Biodiversity and conservatio*n 6 (1063-1083)

[14] Parthasarathy, N., Sethi, P (1997) Tree and liana species diversity and population structure in a tropical dry evergreen forest in south India. *Tropical Ecology* 38(1):19-30

[15] Sebastine, K. M. and Ellis, J. L. (1967) A contribution to the vascular flora of Vedharanyam and Talaignayar Reserve Forests, Tanjore District, Madras State. *Bull. Bot. Surv. India* 9(1-4):190-200

[16] Visalakshi, N (1995) Vegetation analysis of two tropical dry evergreen forests in Southern India. *Tropical Ecology* 36(1):117-127

Gemma Hunneyball
June 2003