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DIVERSITY AND QUANTIFICATION OF TREES IN SESHACHALAM BIOSPHER RESERVE, EASTERN GHATS, INDIA

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ABSTRACT

Species diversity, density, population structure and dispersion patterns of trees species and their relation to grids disturbance (≥30 cm dbh), were inventoried in a tropical dry deciduous forest in the Seshachalam Biosphere Reserve of Southern Eastern Ghats, India. Such data are necessary for ecosystem conservation of the under-studied in Eastern Ghats. The plant resources were quantitatively assessed through 46 grids of size 6.25x 6.25 km, covering the whole terrain. The grids were stratified based on NDVI value 130 using remote sensed (IRS-1C) datasets. A belt transect of 1000×5m was randomly laid in each grid. A total of 16,338 stems (mean density 355.17 per 0.5ha) covering 222 species belongs to 144 genera and 56 plant families were recorded. The mean species richness in Seshachalam Biosphere Reserve is 34.36 ± 11.71 per 0.5 ha with a range of 8-62 species. Ten trees, Pterocarpus santalinus, Anogeissus latifolia, Syzygium alternifolium, Chloroxylon swietenia, Hardwickia binata, Terminalia pallida, Dolichandrone atrovirens, Ziziphus xylopyrus and Shorea tumbuggaia dominated the study area, collectively contributing to >50% of the total density. Species richness and stand density decreased with increasing tree girth classes. The forest stand contained a growing population, but there was considerable variation in basal area distribution between the grids. All species exhibited clumped dispersion of individuals. The non-metric multidimensional scaling (NMS) ordination, based on the species richness, diversity indices, stand density, basal area and disturbance score, organized the grids in to different clusters influenced by species richness, density and disturbance score. The study reveals the importance of conservation of these biodiversity-rich area.

Keywords: Conservation, Dispersion pattern, Eastern Ghats, Population structure and Seshachalam Biosphere Reserve.

INTRODUCTION

Tropical forests, the most complex of all the terrestrial ecosystems and major repository of biodiversity, are undergoing rapid fragmentation and degradation all over the world (Janzen, 1998). They covers 7 % of the earth's land surface, but harbors more than half of the world's species (Wilson and Peters,1988) and are currently disappearing at an overall rate of 0.8 to 2 % per year (Sagar et al. 2003). Species diversity in the tropics varies dramatically from place to place. One of the characteristic features of these forests is their high species richness, more threatened and less protected than moist and wet forests (Gerhardt and Hytteborn, 1992). Because of due to more rigorous and less predictable environment, dry forests are more vulnerable to stress especially the succession processes (Murphy and Lugo, 1986; Gentry 1992). Tropical trees are especially interesting subjects, as there is much species diversity (Condit et al. 1996; Chittibabu and Parthasarathy 2000).

Cataloguing biodiversity resources and quantitative estimation of their natural stands is need of the hour for any country in the post-CBD era. Analysis of the quantitative relationship among the plant species growing in an area reflects structural property of the community. This study is not only to describe the vegetation, but also to predict its pattern and classify it in a meaningful way (Ilorkar and Khatin, 2003). Phytosociological investigation of vegetation serves as a pre-requisite for investigating the details of primary productivity of an ecosystem. There is a dearth of such studies on tropical deciduous forests in developing countries in India. Data pertaining to inventory and monitoring of plant resources in wild habitats are essential to identify the key issues for policy and management goals in the age of intellectual property rights. Such data is vital for Environmental Impact Assessment studies.

Information on tropical plant species is needed because of its potential usefulness in understanding the relative extent of plant biodiversity across the tropics and its implication for conservation and management. In peninsular India, although a few quantitative plant biodiversity inventories are available from the forests of the Western Ghats (Parthasarathy et al., 1992; Sukumar et al., 1992; Pascal and Pelissier, 1996) and Eastern Ghats of India, (Rawat, 1997; Kaduvul & Parthasarathy, 1999; Sudhakar Reddy et al. 2007; Sahu et al. 2007). This kind of studies was poorly explored for these aspects in the southern Eastern Ghats of Andhra Pradesh, which encompasses major portions of Eastern Ghats. Hence this investigation was undertaken, to determine the extent of tree species richness, their population density and dispersion patterns in the dry deciduous forest. It is hoped that these data will be useful in conservation planning.

MATERIALS AND METHODS

STUDY AREA

Seshachalam Biosphere Reserve, also known as Tirupati-Kadapa hills are one of the major landscapes of Eastern Ghats of Southern Andhra Pradesh. These ranges lies between latitudes 13^0 30' to $14^0$11' 15" N and longitudes E 79^0 0' 30" to $79^0$30' and extended to an area of 1758 sq. km **(Figure 1**). The Seshachalam Biosphere Reserve running to North West to South East, over to a length about 80km and width ranged from 32 to 40 km in the two Rayalaseema region districts, Chittoor and Kadapa. These ranges have typical gorges and gaps due to faulting and stream erosion resulting in to discontinuous ranges. The altitude of Seshachalam Biosphere Reserve varies from 168 to 1187m above MSL. The highest hill peak is Tellaralla penta (1187m) and most of the other hill peaks are above 900m MSL.

Seshachalam Biosphere Reserve comprise world famous sacred shrines collectively called as Tirumala hills are the abode of Lord Venkateswara or Balaji. These hills are situated at 900m above MSL. The sanctum sanctorum is situated on the top of seven adjoining hills, which are believed to be an incarnation of Ananta Sesha, the serpent God. Tirumala hills cover about 365 theerthams consisting of seasonal and perennial waterfalls and springs. Talakona is the highest waterfall (270 ft tall) in the state of Andhra Pradesh.

Most of the Soils are formed of lateritic, gneissic and quartzite origin. Much of the hilly area is composed of granite complex. Usually the entire hill range has a dry climate. The higher elevation of the hill ranges is comparatively cooler than the foot hills. During summer, the climate in places like on the top of the Talakona and Tirumala is cool and pleasant. Hot season is during March and May. The monthly average minimum temperature is varied from 18^0C to 22.67^0C, the lowest in January; maximum 33.36^0C to 36.21^0C, the highest in May. With the onset of south-west monsoon, the temperature declines. In the post-monsoon period there will be a rapid fall in both day and night temperature. The study area experiences both the Southwest monsoon (June-September) and North-East monsoon (October-December). The annual rainfall varies between 569.43 and 1230.81mm. The forests of the Seshachalam can be broadly categorized into three types: dry deciduous mixed type with patches of moist deciduous forests and scrub type (Champion and Seth, 1968). Dry deciduous forests dominate in the study area. The study area encompasses two protected areas: Sri Venkateswara Wildlife Sanctuary and Sri Venkateswara National Park and large number of sacred groves.

Sampling design and measurements

The present study aims at a first ever systematic attempt towards a fine scale assessment of the tree resources of Seshachalam Biosphere Reserve based on field explorations. The tree resources were quantitatively assessed through 46 grids of size 6.25x 6.25 km, covering the whole terrain. The grids were stratified based on NDVI value 130 using remote sensed (IRS-1C) datasets. A belt transect of 1000×5m

was randomly laid in each grid. Based on heterogeneity of the terrain, these transects were split into 2-5 sub-transects. The entire tree population of ≥30cm at 1.37 meter height (dbh) within transects were enumerated and voucher specimens were collected for species confirmation and herbarium sheets were deposited in the herbarium of S. K. University.

Disturbance scores were assigned to all 46 grids based on 6 factors, namely, signs of lopping, the presence of cut stumps, soil removal, grazing, fire, and invasive weeds. The presence of various types of disturbance was assessed qualitatively; Cumulative Disturbance Index (CDI) was computed based on Boraiah et al. (2001) scored as absent (0), low (1), medium (2) and high (3) to arrive at a cumulative score of disturbance (Table 1).

Data analysis

Species diversity indices such as the Simpson index (Simpson, 1949) and Shannon index (Shannon and Weaver, 1963) were calculated. To understand a species share in the tree community, the species importance value index (as per Curtis and McIntosh, 1951) and family importance value index (based on Mori et al., 1983) were calculated. The species area curves plated as species increment with every 0.5 ha area. The relationship between forest stand structure (basal area distribution) and site disturbance score were analyzed by Spearman rank correlation (Zar, 1999). The distribution pattern of the species population is determined by calculating the abundance to frequency ratio (A/F) following Curtis and Cottam (1956). Accordingly, if the value is <0.025, the dispersion of the species is considered regular; 0.025 to 0.05 for random dispersion and >0.05 represents the contagious dispersion pattern. We examined the patterns of tree species composition in the 46 grids using non-metric multidimensional scaling (NMS) ordination. The ordination was performed based on the data of species richness, diversity indices, stem density, basal area and disturbance score, using Biodiversity pro (1997).

Results and Discussion

Tree species richness

A total of 222 tree species (≥30 cm DBH) representing 144 genera and 56 families were recorded in all the sampled units of 46 grids. Of these, 219 are angiosperms and 3 are gymnosperms: Cycas beddomei, C. circinalis and Pinus longifolius. The dominant family is Euphorbiaceae represented by 24 species, followed by Moraceae (14), Rubiaceae (12), Caesalpiniaceae (11), Mimosaceae (10), Rutaceae (9), Bignoniaceae and Ebenaceae (8 species each), Combretaceae, Cordiaceae, Fabaceae and Verbenaceae (7 species each). Sixteen families are represented by single species.

The mean species richness in Seshachalam Biosphere Reserve is 34.36 ± 11.71 per 0.5 ha with a range of 8-62 species (Table 1). The species richness is maximum in one of the grid of Talakona (57O/1SE2) followed by Tirumala area (57O/6NW4) and Pullutla Gutta (57O/5SE4). The lowest species richness (8) is recorded in Chintala cheruvu (57O/1NW3). Of the 46 grids, 9 grids were represented by more than 45 species and with 5 grids less than 20 species. The species richness trend among the grids indicates that the tree species richness varied according to the disturbance gradient in different grids.

Findings in the present study are comparable and are within the range of other studies carried out in deciduous forests of India. Kadavul and Parthasarathy (1999) and Chittibabu and Parthasarathy (2000) recorded 42-47 and 26-56 tree species per ha, respectively in deciduous forests of the Kolli and Kalrayan hills in Tamil Nadu. Sukumar et al., (1992) have reported 31 woody species from the Mudumalai tropical deciduous forests of Tamil Nadu, while Sagar et al., (2003) reported 49 tree species in dry forests of the Vindhyan hill ranges in Northern India. In tropical evergreen forests of Chandoli National Park, northern Western Ghats the species richness varied from 25 to 57 per 0.5ha (Kanade et al., 2008). Similarly 64-82 species/ha were recorded by Parthasarathy (2001) in Sengaltheri, of Western Ghats; 48-74 species in humid tropical forest in Tamil Nadu; 30-31 species in tropical dry evergreen forest of the Coramandel coast by Venkateswaran and Parthasarathy (2003) and 87 species in Sal forests of Eastern Himalayas by Umashankar (2001). Seshachalam Biosphere Reserve have a lower number of species compared with similar dry forests in Ethiopia with 113 species (Alelign et al. 2007).

The prevailing disturbance level in the forest seems to play a major role in influencing the species richness level. When species richness of all the grids was correlated with the computed cumulative disturbance scores of each grid, a significant negative trend was observed $r^2_{(45,\ 0.05)} = 0.18$ ($P<0.05$). This indicates that in Seshachalam Biosphere Reserve, the tree species richness and density declines with increased disturbance levels (**Figure 2a &b**). This feature calls for not only reduction in disturbance levels, but also to under take ecological studies so as to identify vulnerable plant taxa.

Diversity indices

Simpson index

The Simpson index of species dominance varied across the Seshachalam Biosphere Reserve. The mean±SD of Simpson index is 0.89 ± 0.05 with a range from 0.703 to 0.969 per 0.5 ha (**Table 1**). The highest value 0.969 is observed in 57O/1SW3 (Chintala cheruvu) followed by 0.965 in 57N/4SE2 (Mallalamma Temple). The high values for Simpson's index indicated high floristic richness of the forest. The lowest value in 0.703 in Ninchenala bodu (57O/1NW1). The Simpson's index in the present study (0.70 – 0.96) is towards the upper end of values reported in various dry deciduous forest of Eastern Ghats: 0.67 to 2.09 (Pitchairamu et al., 2008; Khadar Basha, 2009) and evergreen forests of Western Ghats: 0.78 to 0.95 (Elouard et al., 1997; Vasanthraj et al., 2005).

Shannon index

The Shannon index of species diversity varied across 46 grids. The mean±SD of the Shannon index is 2.86 ± 0.45 with a range from 1.56 to 3.63 per 0.5 ha (**Table 1**). The highest value 3.63 is observed in 57O/1SW3 (Chintala cheruvu) followed by 3.61 in 57N/4SE2 (Mallalamma Temple). The lowest value is 1.56 in Ninchenala bodu (57O/1NW1). The Shannon value is quite high compared to 2.20-2.62 for the forests of Kodayar in the Western Ghats of southern India (Sundarapandian and Swamy, 2000). More comparable values were reported from Nallamalais in southern Eastern Ghats of Andhra Pradesh with diversity index values of 3.96 (Khadar Basha 2009) and Kalakad Reserved Forests (3.69) in Western Ghats (Parthasarathy et al., 1992).

Species area curves

The species accumulation curve plotted between cumulative number of tree species and number of belt-transects revealed that for study site captured about 50% of species at the 3 ha scale and about 80% at 8 ha scale, and then it raised gradually with an addition of 1 to 2 species for every 0.5 ha. The species-area curve showed an increase in species until it attained an asymptote around 18.5 ha (**Figure 3)** which indicates that the sampling was sufficient and more or less representative sample was collected by this sampling method.

Tree density and stand basal area

A total of 16,338 tree individuals are enumerated from 65 transects of 46 grids (**Table 1)**. The mean± SD of the density is 355.17 ± 106.92 with a range from 63 -684 per 0.5 ha. Tellarallakuppa (57O/1SE3) has the highest stand density of 684 trees per 0.5 ha. The lowest stand density of 63 trees per 0.5 ha was recorded in 57O/6SW1 (Pandurangavari Palli). The latter is attributed to grazing and over-exploitation of fuel wood. Ranges of tree density among the grids are 63-684 trees per 0.5ha. In general it is observed that tree density varied with forest type, forest age class, tree species and size class, site history, site condition and other factors. Studies in tropical forests of other parts of the world also reveal a wide range of densities of trees (>30 cm dbh) ranging from 98 trees/ha in Panamanian equatorial insular forest (Itow, 1986) to 1720 trees/ha in Amazonian tropical rain forest (Campbell et al., 1992).

The mean±SD basal area of the study area was 9.11 ± 4.87 m^2 ha^{-1} and ranged as low as 1.29 m^2 ha^{-1} in 57O/6SW1(Pandurangavari Palli) to as high as 31.69 m^2 ha^{-1} in 57O/1NE1 (Dongabanda/Jalakona) (**Table 1).** The high annual precipitation rate and equable climate in the study area may have contributed to high tree growth rates and high tree basal area.

Species abundance

The population density of 222 tree species varied considerably across the 46 grids. Pterocarpus santalinus was the most abundant species (11.01%, 1799 stems) in the study area followed by Anogeissus latifolia (9.79%, 1600 stems), Syzygium alternifolium (5.87%, 970 stems), Chloroxylon swietenia (5.45%, 892 stems), Hardwickia binata (4.53%, 741 stems) and Terminalia pallida (2.98%, 488 stems). Whereas 22 species represents only single individual including Ailanthus excelsa, Anacardium occidentale, Bauhinia tomentosa, Capparis grandis, Cordia dichotoma, Ehretia aspera, Ficus semicordata, Kydia calycina and Wrightia arborea (**Table 2**). It is observed that the top ten abundant species have shared nearly 50% of the total density of the study area. According to Beard (1955), formation series, edaphic factors as well as annual rainfall are responsible for the difference in forest structure among various tropical dry deciduous forest formations. Sagar et al. (2003) as observed in the dry forests of Vindhyan hills, that few dominant tree species are better evolved to these dry conditions and can utilize the resources in a better way.

Species-wise tree basal area

The highest basal area (**Table 2**) is recorded for Pterocarpus santalinus (38.49 m^2ha^{-1}), followed by Mangifera indica (37.62 m^2ha^{-1}), Syzygium alternifolium (26.43 m^2ha^{-1}), Anogeissus latifolia (26.39 m^2ha^{-1}), Hardwickia binata (24.99 m^2ha^{-1}), Chloroxylon swietenia (16.65 m^2ha^{-1}), Terminalia pallida (11.39 m^2ha^{-1}), Shorea tumbuggaia (11.22 m^2ha^{-1}), Madhuca indica (8.34 m^2ha^{-1}), and Albizia amara (8.18 $m^2 ha^{-1}$). These ten species registered 50.03% of the total basal area of all the species. The lowest basal area was recorded for Kydia calycina (0.01 m^2ha^{-1}), followed by Thespesia populnea (0.01 m^2ha^{-1}), Manilkara roxburghiana (0.01m^2ha^{-1}), Diospyros peregrina (0.008 m^2ha^{-1}) and Ficus semicordata (0.007 m^2ha^{-1}).

Importance Value Index (IVI)

IVI is the most important parameter to understand the community organization in relation to the competitive ability. **Table 2** presents the IVI calculated for the tree taxa encountered in the study area. Pterocarpus santalinus is the most dominant species (IVI=22.46; occupied 7.48% of the total tree species) followed by Anogeissus latifolia (18.49; 6.16%), Syzygium alternifolium (13.19; 4.39%), Hardwickia binata (12.26; 4.08%), Chloroxylon swietenia (11.71; 3.9%), Mangifera indica (9.86; 3.28%), Terminalia pallida (6.65; 2.21%), Dolichandrone atrovirens (6.63; 2.21%), Ziziphus xylopyrus (6.57; 2.19%) and Shorea tumbuggaia (5.93; 1.97%).

The IVI values revealed that Seshachalam forests are dominated by relatively few species. It is observed that the top ten dominant tree species have shared nearly 37.93% of the total IVI values of the study area. The higher value of IVI indicates that all the available resources are being utilized by these species and left over are being trapped by another species as competitors and associates. The high IVI of a species indicated its dominance and ecological success, its good power of regeneration and greater ecological amplitude (Bhandari et al., 1999). Anogeissus latifolia showed maximum IVI value at all grids and emerged as dominant species of the dry deciduous forest ecosystem of the study area.

Family Importance Value index (FIV)

The contribution of 56 plant families towards species diversity and density varied across the sampled sites. Euphorbiaceae represented by 24 species is considered taxonomically diverse followed by Moraceae with 14 species, Rubiaceae (12), Caesalpiniaceae (11), Mimosaceae (10), Rutaceae (9), Bignoniaceae and Ebenaceae with 8 species each. Taking into consideration of FIV, Combretaceae appear more dominant than Euphorbiaceae. FIV is an independent of species richness but depends on high density of the species and its basal area (**Table 4**). Although Combretaceae is represented by 7 species, but because of its large dbh (50.83m^2ha^{-1}) and high density (2, 476 individuals) it ranked first with a high FIV of 30.43 (10.14%) followed by Fabaceae 28.48 (9.49%), Euphorbiaceae 20.70 (6.9%), Anacardiaceae 19.36 (6.45%), Caesalpiniaceae 19 (6.33%), Rubiaceae 15.3 (5.13%), Myrtaceae 14.73 (4.91%) Mimosaceae 11.88 (3.96%) and Flindersiaceae 9.88 (3.29%) Euphorbiaceae and Moraceae despite of their high species richness do not have high FIV value because of their lower density and lower basal areas. At the 1-ha scale, the family richness of different tropical forests varied greatly (Heany & Proctor 1990).

Five families Combretaceae (2476 individuals comprising 15.15%) Fabaceae (2166, 13.25%), Caesalpiniaceae and Myrtaceae (1017, 6.22% each), Rubiaceae (984, 6.02%) and Euphorbiaceae (825, 5.04%) were abundant in terms of density; totaling to 52% of the forest stand. Combretaceae, Euphorbiaceae, and Caesalpiniaceae constituted the predominant plant families by density in the near by Nallamalais forests (Khadar Basha, 2009). Melastomataceae (22%), Oleaceae (26%) and Lauraceae (28%) formed bulk of the tree population in Kolli hills, Shervarayan hills of Eastern Ghats and Kalakad forest respectively (Parthasarathy 1999). Dominant tree species in different forests are: Peltogyne gracilipes (Caesalpiniaceae) in Maraca Island, Brazil (Nascimento et al., 1997), Memecylon umbellatum (Melastomataceae) in Pudukottai, India (Mani & Parthasarathy 2005). Dipterocarpaceae is the dominant family in Malaysia (Manokaran et al., 1991; Whitmore 1984).

Structure of forest stand

Tree species richness and stem density across girth classes in the study areas decreased from the smallest to high girth trees, while the occurrence rate of species increased with girth size-class 30-59cm to > 210cm dbh (**Table 3**). Tree density and species richness consistently decreased with increasing girth class of tree species (**Figure 4).** An obvious variation in representation of tree species and the proportion of dominant species in the study area can directly be attributed to rainfall distribution and favorable edaphic conditions. The highest tree stand density and species richness of Seshachalam Biosphere Reserve were found in the girth class of 30 to 59 cm dbh and 60 to 89 cm dbh.

The contribution of lower girth class size (30-59 cm dbh) tree density among the forest stands is 80.49% and basal area covers 44.6%. The density of medium girth class size (120-149 cm dbh) covers 0.9% with a basal area of 5.39%. The high girth class size density (150-179, 180-209, and > 210cm dbh) is 0.5% with a basal area of 13.45% was recorded. All the tree species of Seshachalam Biosphere Reserve are distributed in various girth classes represent the reverse J shaped structure which indicates a good regeneration of tree species **(Figure 5)**. Khadar Basha (2009) and Rao et al. (2011) reported the reverse J shaped structure for girth class distribution of species in different parts of southern Eastern Ghats of Andhra Pradesh. Denslow (1995) correlated basal area with the rate of disturbance, and diameter distributions are commonly used to assess the disturbance effect within forest. In general, in Indian forests subjected to selective felling in the past, high density of low girthed trees and single species dominance is observed (Sagar & Singh 2005). According to Beard (1955), formation series, edaphic factors as well as annual rainfall are responsible for the difference in forest structure among various tropical dry deciduous forest formations.

Distribution pattern

The value of A/F for all the tree taxa of Seshachalm hill ranges are greater than >0.05 value which indicates that all the plant species have shown contagious or clumped type of dispersion pattern (**Table 2**). Contagious distribution is common in natural forests, as observed by Suresh Babu (2008) and Khadar Basha (2009) in southern Eastern Ghates.

NMS Ordination

The non-metric multidimensional scaling (NMS) ordination, based on the species richness, diversity indices (Shannon,and Simpson), stand density, basal area and disturbance score for the forty six grids, is showing in **Figure 6**. Based on the variables taken, the forty six grids are distinctly dispersed. The analysis revealed that the grids 57O/1SE3, 57N/4SW4, 57O/6NW4 and 57O/5SE2 were distinctly placed on the positive coordinates of the NMS axis, mainly because of high species richness, high density of four species (Pterocarpus santalinus, Anogeissus latifolia, Syzygium alternifolium and Chloroxylon swietenia) and low level of disturbance score, with moderate diversity, basal area. The grids are 57O/6SW1, 57O/1SW1, 57O/5NW4 and 57N/4SE2 placed in the left of the ordination due to the low species richness, poor representation of the former four species density and high disturbance such as biotech factors and human interference.

CONCLUSIONS

Seshachalam Biosphere Reserve, the present study area is one of significant biodiversity rich areas in Eastern Ghats of India. Seshachalam Biosphere Reserve represent a wide array of diversified habitats and provide basic livelihood for indigenous rural and tribal communities. Heavy biotic interference primarily pertaining to over-exploitation of wild plant resources is leading to alarming loss of species populations in the study area. Four year intensive and extensive study in Seshachalam Biosphere Reserve has brought interesting facts and figures to light.

The key strategies proposed for effective conservation of plant resources in Seshachalam Biosphere Reserve are : declaration of prioritized areas for conservation as ‘local hotspots’ by state forest department and ensure further protection; State Forest department should ensure sustainable harvesting of tree resources with varied economic importance especially of NTFP; focus on immediate attention on the trees identified as threatened species by the forestry sector, promoting ex situ conservation of identified threatened species of Seshachalam Biosphere Reserve; regular monitoring of tree resources of the study area to assess the structural and functional changes in the natural vegetation and factors of disturbance.

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TABLE 1: GRID-WISE QUANTITAVE VALUES AND DIVERSITY INDICES

Grid - ID	No. of species	Density trees/ 0.5ha	Basal Area (m^2ha^{-1})	Simpson Index	Shannon Index	CDI
57N/4NW2	30	383	7.903	0.802	2.364	5
57N/4SE2	50	192	6.426	0.965	3.610	6
57N/4SE4	32	398	11.131	0.940	3.062	10
57N/4SW1	35	294	11.395	0.885	2.869	7
57N/4SW2	22	449	6.578	0.897	2.668	2
57N/4SW3	29	460	6.989	0.891	2.771	4
57N/4SW4	23	558	9.882	0.857	2.456	5
57O/1NE1	35	255	31.691	0.884	2.722	7
57O/1NE2	47	406	19.974	0.933	3.116	3
57O/1NE3	23	373	5.040	0.859	2.408	4
57O/1NE4	30	305	7.705	0.878	2.627	6
57O/1NW1	13	356	9.316	0.703	1.565	5
57O/1NW2	40	385	8.699	0.958	3.419	6
57O/1NW3	8	336	9.619	0.753	1.645	10
57O/1NW4	41	368	10.092	0.913	2.940	5
57O/1SE1	49	261	7.061	0.932	3.177	4
57O/1SE2	62	412	8.185	0.841	2.951	4
57O/1SE3	38	684	12.286	0.831	2.196	3
57O/1SE4	48	350	13.197	0.927	3.169	3
57O/1SW1	26	147	5.286	0.927	2.878	10
57O/1SW3	50	315	8.797	0.969	3.637	10
57O/2NE3	37	261	5.802	0.954	3.304	8
57O/2NE4	39	404	12.093	0.945	3.207	5
57O/2SE1	34	298	5.827	0.886	2.763	4
57O/2SE2	40	483	10.037	0.929	3.075	5
57O/2SE3	33	290	5.607	0.901	2.864	6
57O/2SE4	45	303	9.516	0.918	3.149	7
57O/5NW1	30	306	4.636	0.890	2.665	11
57O/5NW2	47	330	6.451	0.941	3.250	5

57O/5NW4	19	187	4.393	0.921	2.719	9
57O/5SE1	40	461	9.196	0.914	2.886	6
57O/5SE2	45	483	13.534	0.930	3.059	5
57O/5SE4	52	351	7.991	0.946	3.377	4
57O/5SW1	36	382	7.311	0.901	2.888	4
57O/5SW2	36	438	8.404	0.880	2.675	3
57O/5SW3	17	337	5.927	0.762	1.837	9
57O/5SW4	28	347	19.636	0.946	3.091	3
57O/6NE1	26	344	5.083	0.903	2.813	9
57O/6NE2	35	306	6.521	0.930	3.118	4
57O/6NE3	22	424	6.414	0.903	2.648	8
57O/6NE4	25	357	7.242	0.826	2.381	8
57O/6NW1	28	290	11.176	0.929	2.900	9
57O/6NW2	30	336	7.223	0.841	2.521	8
57O/6NW3	36	326	10.087	0.925	3.004	5
57O/6NW4	55	544	10.579	0.952	3.497	4
57O/6SW1	15	63	1.294	0.839	2.198	12

TABLE 2: PHYTOSOCIOLOGICAL ATTRIBUTES OF TREES

S. No	Name of the Species	Family	TNI	BA	RD	RF	IVI	A/F
1	Pterocarpus santalinus L. f.	Fabaceae	1799	38.49	11.011	2.28	22.47	0.64
2	Anogeissus latifolia (Roxb.ex DC.) Wall.ex Guill. & Perr.	Combretaceae	1600	26.40	9.793	2.40	18.49	0.51
3	Syzygium alternifolium (Wight) Walp.	Myrtaceae	960	26.44	5.876	1.01	13.19	1.73
4	Chloroxylon swietenia DC.	Flindersiaceae	892	16.66	5.460	2.28	11.71	0.32
5	Hardwickia binata Roxb.	Caesalpiniaceae	741	24.99	4.535	1.77	12.27	0.43
6	Terminalia pallida Brandis	Combretaceae	488	11.39	2.987	0.95	6.65	1.00
7	Dolichandrone atrovirens (Roth) Sprague	Bignoniaceae	434	6.59	2.656	2.40	6.63	0.14
8	Ziziphus xylopyrus (Retz.) Willd.	Rhamnaceae	433	5.84	2.650	2.53	6.57	0.12
9	Shorea tumbuggaia Roxb.	Dipterocarpaceae	398	11.23	2.436	0.82	5.94	1.08
10	Buchanania axillaris (Desr.) Ramam.	Anacardiaceae	351	7.62	2.148	1.64	5.61	0.24
11	Grewia flavescens Juss.	Tiliaceae	328	4.10	2.008	1.83	4.82	0.18
12	Gardenia gummifera L.f.	Rubiaceae	320	3.76	1.959	2.09	4.94	0.14
13	Strychnos potatorum L.f.	Loganiaceae	247	4.11	1.512	1.71	4.20	0.16
14	Terminalia alata Heyne ex Roth	Combretaceae	245	6.39	1.500	1.20	4.22	0.31
15	Acacia catechu (L.f.) Willd.	Mimosaceae	214	3.25	1.310	1.14	3.22	0.30
16	Lannea coromandelica (Houtt.) Merr.	Anacardiaceae	201	5.22	1.230	1.45	3.93	0.17
17	Ochna obtusata DC. var. gamblei (King ex Brandis) Kanis	Ochnaceae	198	2.67	1.212	1.45	3.30	0.17
18	Strychnos nux-vomica L.	Loganiaceae	187	3.78	1.145	1.71	3.75	0.12
19	Albizia amara (Roxb.) Boivin	Mimosaceae	185	8.18	1.132	1.39	4.48	0.18
20	Dalbergia lanceolaria L. f.	Fabaceae	182	5.18	1.114	1.39	3.74	0.17
21	Dendrocalamus strictus (Roxb.) Nees	Poaceae	178	0.00	1.089	0.13	1.22	20.47
22	Cycas beddomei Dyer	Cycadaceae	177	0.00	1.083	0.25	1.34	5.09
23	Gardenia latifolia Ait.	Rubiaceae	158	2.47	0.967	1.33	2.88	0.16
24	Phyllanthus emblica L.	Euphorbiaceae	149	2.45	0.912	1.33	2.83	0.16
25	Wrightia tinctoria R. Br.	Apocynaceae	148	2.70	0.906	1.52	3.07	0.12
26	Boswellia serrata Roxb. ex Colebr.	Burseraceae	140	5.12	0.857	0.38	2.46	1.79
27	Ixora arborea Roxb.ex Smith	Rubiaceae	132	2.10	0.808	1.58	2.89	0.10
28	Premna tomentosa Willd.	Verbenaceae	124	2.04	0.759	1.27	2.51	0.14
29	Givotia moluccana (L.) Sreemadh.	Euphorbiaceae	122	5.77	0.747	1.08	3.20	0.19

30	Cassia fistula L.	Caesalpiniaceae	118	1.53	0.722	1.90	2.98	0.06
31	Commiphora caudata (Wight & Arn.) Engler	Burseraceae	116	5.31	0.710	1.14	3.11	0.16
32	Mangifera indica L.	Anacardiaceae	114	37.63	0.698	0.19	9.86	5.83
33	Soymida febrifuga (Roxb.) A. Juss.	Meliaceae	111	2.24	0.679	0.76	1.97	0.35
34	Morinda pubescens J.E. Smith	Rubiaceae	107	1.70	0.655	1.27	2.33	0.12
35	Erythroxylum monogynum Roxb.	Erythroxylaceae	105	1.57	0.643	1.45	2.47	0.09
36	Croton scabiosus Bedd.	Euphorbiaceae	100	1.22	0.612	0.38	1.28	1.28
37	Polyalthia cerasoides (Roxb.) Beddome	Annonaceae	100	1.47	0.612	1.01	1.97	0.18
38	Diospyros chloroxylon Roxb.	Ebenaceae	99	2.55	0.606	1.33	2.54	0.10
39	Bauhinia racemosa Lam.	Caesalpiniaceae	96	1.85	0.588	1.33	2.36	0.10
40	Diospyros melanoxylon Roxb.	Ebenaceae	94	1.64	0.575	1.52	2.49	0.08
41	Shorea roxburghii G.Don	Dipterocarpaceae	93	7.00	0.569	0.19	2.43	4.75
42	Madhuca indica J. Gmelin	Sapotaceae	92	8.35	0.563	0.89	3.44	0.22
43	Cochlospermum religiosum (L.) Alston	Cochlospermaceae	90	1.25	0.551	0.89	1.73	0.21
44	Acacia auriculiformis A. Cunn. ex. Benth.	Mimosaceae	89	1.85	0.545	0.19	1.18	4.55
45	Canthium dicoccum (Gaertner) Teijsm. & Binn.	Rubiaceae	89	1.42	0.545	1.01	1.90	0.16
46	Terminalia chebula Retz.	Combretaceae	87	2.02	0.533	0.82	1.84	0.24
47	Bridelia cinerascens Gehrm.	Euphorbiaceae	84	1.95	0.514	0.95	1.93	0.17
48	Manilkara hexandra (Roxb.) Dubard	Sapotaceae	79	1.67	0.484	0.70	1.58	0.30
49	Cleistanthus collinus (Roxb.) Hook.f.	Euphorbiaceae	78	1.13	0.477	0.19	0.94	3.99
50	Dalbergia paniculata Roxb.	Fabaceae	75	3.22	0.459	0.89	2.11	0.18
51	Alangium salvifolium (L.f.) Wangerin ssp. salvifolium	Alangiaceae	73	0.95	0.447	0.70	1.37	0.28
52	Sapindus emarginatus Vahl	Sapindaceae	72	2.83	0.441	1.08	2.19	0.11
53	Grewia damine Gaertner	Tiliaceae	69	0.91	0.422	0.57	1.21	0.39
54	Grewia tiliaefolia Vahl	Tiliaceae	67	0.88	0.410	0.82	1.44	0.18
55	Pterocarpus marsupium Roxb.	Fabaceae	64	2.01	0.392	0.95	1.82	0.13
56	Drypetes sepiaria (Wight & Arn.) Pax & Hoffm.	Euphorbiaceae	56	1.49	0.343	0.70	1.39	0.21
57	Syzygium cumini (L.) Skeels	Myrtaceae	55	3.34	0.337	0.44	1.58	0.52
58	Wendlandia tinctoria (Roxb.) DC.	Rubiaceae	54	1.45	0.331	0.32	0.99	0.99
59	Azadirachta indica A. Juss.	Meliaceae	53	1.26	0.324	0.89	1.51	0.12
60	Albizia thompsonii Brandis	Mimosaceae	51	1.11	0.312	1.08	1.65	0.08
61	Deccania pubescens (Roth) Tirveng. var. candolleana (Wight & Arn.) Tirveng.	Rubiaceae	50	1.03	0.306	0.57	1.12	0.28
62	Lagerstroemia parviflora Roxb.	Lythraceae	49	0.73	0.300	0.63	1.11	0.23
63	Holarrhena pubescens (Buch.-Ham.) Wall. ex G.Don	Apocynaceae	47	0.54	0.288	0.51	0.92	0.34
64	Atalantia monophylla (L.) Correa	Rutaceae	46	0.72	0.282	0.63	1.09	0.21
65	Macaranga peltata (Roxb.) Muell.-Arg.	Euphorbiaceae	42	1.66	0.257	0.32	0.97	0.77
66	Cassine glauca (Rottb.) Kuntze	Celastraceae	41	1.40	0.251	0.89	1.47	0.10
67	Memecylon umbellatum Burm.f.	Melastomataceae	41	0.87	0.251	0.38	0.84	0.52
68	Tamarindus indica L.	Caesalpiniaceae	40	3.91	0.245	0.57	1.75	0.23
69	Pleurostylia opposita (Wall.) Alston	Celastraceae	39	1.29	0.239	0.38	0.92	0.50
70	Haldinia cordifolia (Roxb.) Ridsd.	Rubiaceae	36	1.35	0.220	0.63	1.18	0.17
71	Albizia odoratissima (L. f.) Benth.	Mimosaceae	35	0.93	0.214	0.44	0.88	0.33
72	Gyrocarpus americanus Jacq.	Hernandiaceae	35	1.51	0.214	0.19	0.76	1.79

73	Vitex altissima L. f.	Verbenaceae	35	0.94	0.214	0.70	1.13	0.13
74	Pterospermum xylocarpum (Gaertner) Sant.& Wagh	Sterculiaceae	34	1.07	0.208	0.44	0.91	0.32
75	Vitex pinnata L.	Verbenaceae	34	1.00	0.208	0.32	0.76	0.63
76	Euphorbia antiquorum L.	Euphorbiaceae	33	1.06	0.202	0.38	0.83	0.42
77	Ximenia americana L.	Olacaceae	33	0.31	0.202	0.57	0.85	0.19
78	Semecarpus anacardium L.f.	Anacardiaceae	32	0.65	0.196	0.51	0.86	0.23
79	Naringi crenulata (Roxb.) Nicolson	Rutaceae	31	0.58	0.190	0.63	0.96	0.14
80	Bridelia airy-shawii P.J.	Euphorbiaceae	30	0.64	0.184	0.57	0.91	0.17
81	Sterculia urens Roxb.	Sterculiaceae	30	0.83	0.184	0.57	0.95	0.17
82	Terminalia bellirica (Gaertner) Roxb.	Combretaceae	30	1.57	0.184	0.51	1.06	0.22
83	Ficus mollis Vahl	Moraceae	29	3.28	0.178	0.63	1.59	0.13
84	Naringi alata (Wall. ex Wight & Arn.) Ellis	Rutaceae	28	0.46	0.171	0.38	0.66	0.36
85	Pamburus missionis (Wight) Swingle	Rutaceae	26	1.12	0.159	0.06	0.49	11.96
86	Sapium insigne (Royle) Trimen	Euphorbiaceae	26	0.76	0.159	0.44	0.78	0.24
87	Boswellia ovalifoliolata Balakr. & Henry	Burseraceae	25	1.03	0.153	0.19	0.59	1.28
88	Careya arborea Roxb.	Lecythidaceae	25	0.52	0.153	0.51	0.78	0.18
89	Chukrasia tabularis A. Juss.	Meliaceae	25	1.20	0.153	0.25	0.69	0.72
90	Grevillea pteridifolia Knight	Proteaceae	25	0.67	0.153	0.13	0.44	2.88
91	Maba buxifolia (Rottb.) A.L. Juss.	Ebenaceae	23	0.59	0.141	0.19	0.47	1.18
92	Pongamia pinnata (L.) Pierre	Fabaceae	23	1.31	0.141	0.13	0.58	2.65
93	Dalbergia latifolia Roxb.	Fabaceae	22	0.39	0.135	0.32	0.54	0.40
94	Drypetes roxburghii (Wall.) Hurusawa	Euphorbiaceae	22	0.82	0.135	0.13	0.46	2.53
95	Mitragyna parvifolia (Roxb.) Korth.	Rubiaceae	22	1.12	0.135	0.51	0.91	0.16
96	Terminalia paniculata Roth	Combretaceae	22	0.74	0.135	0.19	0.50	1.12
97	Aegle marmelos (L.) Correa	Rutaceae	21	0.30	0.129	0.32	0.52	0.39
98	Carallia brachiata (Lour.) Merr.	Rhizophoraceae	21	0.49	0.129	0.19	0.44	1.07
99	Dolichandrone falcata Seem. var. lawii (Seem) Haines	Bignoniaceae	21	0.70	0.129	0.19	0.49	1.07
100	Actinodaphne madraspatana Bedd.ex Hook.f.	Lauraceae	20	0.33	0.122	0.25	0.45	0.58
101	Grevillea robusta A.Cunn. ex R.Br.	Proteaceae	20	0.66	0.122	0.19	0.47	1.02
102	Santalum album L.	Santalaceae	20	0.16	0.122	0.38	0.54	0.26
103	Tectona grandis L. f.	Verbenaceae	20	0.34	0.122	0.25	0.46	0.58
104	Buchanania lanzan Sprengel	Anacardiaceae	18	0.30	0.110	0.19	0.37	0.92
105	Sterculia villosa Roxb. ex DC.	Sterculiaceae	18	0.43	0.110	0.06	0.27	8.28
106	Celtis philippensis Blanco	Ulmaceae	17	0.40	0.104	0.32	0.52	0.31
107	Litsea glutinosa (Lour.) C.B. Robinson	Lauraceae	16	0.32	0.098	0.19	0.36	0.82
108	Aglaia elaeagnoidea (Juss.) Benth.var. beddomei (Gamble) K.K.N. Nair	Meliaceae	15	0.49	0.092	0.13	0.34	1.73
109	Cleistanthus patulus (Roxb.) Muell.-Arg.	Euphorbiaceae	15	0.28	0.092	0.25	0.41	0.43
110	Dolichandrone falcata (Wall.ex DC.) Seem. var. falcata	Bignoniaceae	15	0.21	0.092	0.06	0.20	6.90
111	Flacourtia ramontchi L.	Flacourtiaceae	15	0.24	0.092	0.44	0.59	0.14
112	Holoptelea integrifolia (Roxb.) Planchon	Ulmaceae	15	0.71	0.092	0.32	0.58	0.28

113	Pterospermum canescens Roxb.	Sterculiaceae	15	0.37	0.092	0.13	0.31	1.73
114	Walsura trifolia (A. Juss.) Harms	Meliaceae	15	0.45	0.092	0.38	0.58	0.19
115	Bambusa arundinacea (Retz.) Roxb.	Poaceae	14	0.00	0.086	0.19	0.28	0.72
116	Suregada angustifolia (Baillon ex Muell.-Arg.) Airy Shaw	Euphorbiaceae	14	0.33	0.086	0.25	0.42	0.40
117	Dillenia indica L.	Dilleniaceae	13	0.67	0.080	0.06	0.30	5.98
118	Phyllanthus polyphyllus Willd.	Euphorbiaceae	13	0.18	0.080	0.32	0.44	0.24
119	Schleichera oleosa (Lour.) Oken	Sapindaceae	13	0.67	0.080	0.38	0.62	0.17
120	Balanites aegyptiaca (L.) Del.	Balanitaceae	12	0.13	0.073	0.06	0.17	5.52
121	Memecylon edule Roxb.	Melastomataceae	12	0.17	0.073	0.13	0.24	1.38
122	Trema orientalis (L.) Blume	Ulmaceae	12	0.31	0.073	0.19	0.34	0.61
123	Ziziphus mauritiana Lam. var. mauritiana	Rhamnaceae	12	0.49	0.073	0.06	0.25	5.52
124	Caryota urens L.	Arecaceae	11	2.83	0.067	0.19	0.93	0.56
125	Limonia acidissima L.	Rutaceae	11	0.43	0.067	0.38	0.55	0.14
126	Diospyros ebenum J.Koenig ex Retz.	Ebenaceae	10	0.42	0.061	0.19	0.35	0.51
127	Maerua apetala (Roth) Jocobs	Capparaceae	10	0.26	0.061	0.13	0.25	1.15
128	Mimusops elengi L.	Sapotaceae	10	0.30	0.061	0.25	0.39	0.29
129	Neolitsea zeylanica (Nees) Merr.	Lauraceae	10	0.15	0.061	0.13	0.22	1.15
130	Albizia lebbeck (L.) Willd.	Mimosaceae	9	0.25	0.055	0.19	0.30	0.46
131	Pittosporum napaulense (DC.) Rehder & Wilson	Pittosporaceae	9	0.21	0.055	0.19	0.29	0.46
132	Peltophorum pterocarpum (DC.) Heyne.	Caesalpiniaceae	8	0.13	0.049	0.06	0.14	3.68
133	Radermachera xylocarpa (Roxb.) Schum.	Bignoniaceae	8	0.15	0.049	0.06	0.15	3.68
134	Tabebuia rosea (Bertol.) DC.	Bignoniaceae	8	0.16	0.049	0.06	0.15	3.68
135	Alstonia scholaris (L.) R.Br.	Apocynaceae	7	0.18	0.043	0.06	0.15	3.22
136	Deccania pubescens (Roth) Tirveng. var. pubescens	Rubiaceae	7	0.16	0.043	0.13	0.21	0.81
137	Gardenia resinifera Roth	Rubiaceae	7	0.07	0.043	0.32	0.37	0.13
138	Glochidion zeylanicum (Gaertner) Juss.	Euphorbiaceae	7	0.08	0.043	0.19	0.25	0.36
139	Glochidion velutinum Wight	Euphorbiaceae	7	0.09	0.043	0.06	0.13	3.22
140	Homalium ceylanicum (Gard.) Benth.	Samydaceae	7	0.94	0.043	0.32	0.58	0.13
141	Jacaranda mimosifolia D.Don.	Bignoniaceae	7	0.32	0.043	0.06	0.18	3.22
142	Allophyllus cobbe (L.) Raeusch.	Sapindaceae	6	0.06	0.037	0.13	0.18	0.69
143	Cordia wallichii G.Don.	Cordiaceae	6	0.09	0.037	0.06	0.12	2.76
144	Dillenia pentagyna Roxb.	Dilleniaceae	6	0.19	0.037	0.13	0.21	0.69
145	Ficus amplissima Smith	Moraceae	6	0.91	0.037	0.19	0.44	0.31
146	Ficus dalhousiae Miq.	Moraceae	6	0.39	0.037	0.13	0.26	0.69
147	Vitex leucoxylon L. f.	Verbenaceae	6	0.77	0.037	0.13	0.35	0.69
148	Ziziphus glabrata Heyne ex Roth	Rhamnaceae	6	0.08	0.037	0.06	0.12	2.76
149	Alphonsea sclerocarpa Thwaites	Annonaceae	5	0.19	0.031	0.06	0.14	2.30
150	Antidesma ghaesembilla Gaertner	Euphorbiaceae	5	0.10	0.031	0.19	0.24	0.26
151	Ehretia laevis Roxb.	Cordiaceae	5	0.04	0.031	0.06	0.10	2.30
152	Glochidion tomentosum Dalz.	Euphorbiaceae	5	0.05	0.031	0.13	0.17	0.58
153	Hibiscus platanifolius (Willd.) Sweet	Malvaceae	5	0.05	0.031	0.13	0.17	0.58
154	Pinus longifolius Salisb.	Pinaceae	5	0.31	0.031	0.06	0.17	2.30
155	Bambusa vulgaris Schrader ex J.C. Wendl.	Poaceae	4	0.00	0.024	0.06	0.09	1.84

156	Cycas circinalis L.	Cycadaceae	4	0.05	0.024	0.13	0.16	0.46
157	Ficus arnottiana (Miq.) Miq.	Moraceae	4	0.32	0.024	0.19	0.29	0.20
158	Ficus rumphii Blume	Moraceae	4	0.21	0.024	0.13	0.20	0.46
159	Ficus virens Ait.	Moraceae	4	0.39	0.024	0.06	0.18	1.84
160	Mallotus philippensis (Lam.) Muell.-Arg.	Euphorbiaceae	4	0.05	0.024	0.06	0.10	1.84
161	Miliusa tomentosa (Roxb.) Sinclair	Annonaceae	4	0.05	0.024	0.06	0.10	1.84
162	Murraya paniculata (L.) Jack	Rutaceae	4	0.03	0.024	0.13	0.16	0.46
163	Schrebera swietenioides Roxb.	Oleaceae	4	0.21	0.024	0.13	0.20	0.46
164	Terminalia arjuna (Roxb.ex DC.) Wight & Arn.	Combretaceae	4	2.34	0.024	0.13	0.71	0.46
165	Annona squamosa L.	Annonaceae	3	0.02	0.018	0.06	0.09	1.38
166	Antidesma acidum Retz.	Euphorbiaceae	3	0.03	0.018	0.13	0.15	0.35
167	Bauhinia purpurea L.	Caesalpiniaceae	3	0.04	0.018	0.06	0.09	1.38
168	Borassus flabellifer L.	Arecaceae	3	0.21	0.018	0.06	0.13	1.38
169	Bridelia montana (Roxb.) Willd.	Euphorbiaceae	3	0.03	0.018	0.19	0.21	0.15
170	Cascabela thevetia (L.) Lippold	Apocynaceae	3	0.03	0.018	0.06	0.09	1.38
171	Casearia tomentosa Roxb.	Flacourtiaceae	3	0.04	0.018	0.19	0.22	0.15
172	Diospyros discolor Willd.	Ebenaceae	3	0.04	0.018	0.06	0.09	1.38
173	Euphorbia tortillis Rottler ex Ainslie	Euphorbiaceae	3	0.05	0.018	0.06	0.09	1.38
174	Ficus benghalensis L.	Moraceae	3	3.69	0.018	0.13	1.03	0.35
175	Ficus microcarpa L.f.	Moraceae	3	0.30	0.018	0.06	0.15	1.38
176	Ficus religiosa L.	Moraceae	3	0.12	0.018	0.13	0.17	0.35
177	Mallotus rhamnifolius Muell.-Arg.	Euphorbiaceae	3	0.08	0.018	0.06	0.10	1.38
178	Ochna obtusata DC. var. obtusata	Ochnaceae	3	0.03	0.018	0.13	0.15	0.35
179	Parkinsonia aculeata L.	Caesalpiniaceae	3	0.05	0.018	0.06	0.09	1.38
180	Phoenix sylvestris (L.) Roxb.	Arecaceae	3	0.19	0.018	0.06	0.13	1.38
181	Premna latifolia Roxb. var. latifolia	Verbenaceae	3	0.04	0.018	0.06	0.09	1.38
182	Prosopis chilensis (Molina) Stuntz.	Mimosaceae	3	0.15	0.018	0.06	0.12	1.38
183	Senna siamea (Lam.) Irwin & Braneby	Caesalpiniaceae	3	0.03	0.018	0.06	0.09	1.38
184	Streblus taxoides (Roth) Kurz.	Moraceae	3	0.02	0.018	0.06	0.09	1.38
185	Artocarpus heterophyllus Lam.	Moraceae	2	0.08	0.012	0.06	0.10	0.92
186	Cassia roxburghii DC.	Caesalpiniaceae	2	0.13	0.012	0.06	0.11	0.92
187	Ceriscoides turgida (Roxb.) Tirveng.	Rubiaceae	2	0.02	0.012	0.13	0.14	0.23
188	Chionanthus zeylanicaL.	Oleaceae	2	0.04	0.012	0.06	0.08	0.92
189	Cordia evolutior (C.B. Clarke) Gamble	Cordiaceae	2	0.02	0.012	0.06	0.08	0.92
190	Cordia macleodii Hook.f. & Thomson	Cordiaceae	2	0.01	0.012	0.13	0.14	0.23
191	Cyathea spinulosa Hook.	Cyathiaceae	2	0.06	0.012	0.06	0.09	0.92
192	Delonix elata (L.) Gamble	Caesalpiniaceae	2	0.11	0.012	0.06	0.10	0.92
193	Diospyros montana Roxb.	Ebenaceae	2	0.02	0.012	0.06	0.08	0.92
194	Diospyros ovalifolia Wight	Ebenaceae	2	0.02	0.012	0.06	0.08	0.92
195	Ehretia pubescens Benth.	Cordiaceae	2	0.02	0.012	0.13	0.14	0.23
196	Eucalyptus globulus Labill.	Myrtaceae	2	0.23	0.012	0.06	0.13	0.92
197	Ficus hispida L.f.	Moraceae	2	0.35	0.012	0.06	0.16	0.92
198	Murraya koenigii (L.) Sprengel	Rutaceae	2	0.01	0.012	0.13	0.14	0.23
199	Oroxylum indicum (L.) Vent.	Bignoniaceae	2	0.06	0.012	0.06	0.09	0.92
200	Stereospermum personatum (Hassk.) Chatterjee	Bignoniaceae	2	0.05	0.012	0.06	0.09	0.92
201	Acacia leucophloea (Roxb.) Willd.	Mimosaceae	1	0.07	0.006	0.06	0.09	0.46
202	Acacia nilotica (L.) Willd. ex Del. ssp. indica (Benth.) Brenan	Mimosaceae	1	0.01	0.006	0.06	0.07	0.46
203	Ailanthus excelsa Roxb.	Simaroubaceae	1	0.01	0.006	0.06	0.07	0.46
204	Anacardium occidentale L.	Anacardiaceae	1	0.02	0.006	0.06	0.08	0.46

205	Bauhinia tomentosa L.	Caesalpiniaceae	1	0.01	0.006	0.06	0.07	0.46
206	Bombax ceiba L.	Bombacaceae	1	0.04	0.006	0.06	0.08	0.46
207	Capparis grandis L.f.	Capparaceae	1	0.02	0.006	0.06	0.07	0.46
208	Ceiba pentandra (L.) Gaertener	Bombacaceae	1	0.01	0.006	0.06	0.07	0.46
209	Cordia dichotoma Forst. f.	Cordiaceae	1	0.02	0.006	0.06	0.07	0.46
210	Dalbergia sissoo Roxb.	Fabaceae	1	0.01	0.006	0.06	0.07	0.46
211	Diospyros peregrina (Gaertner) Guerke	Ebenaceae	1	0.01	0.006	0.06	0.07	0.46
212	Ehretia aspera Willd.	Cordiaceae	1	0.02	0.006	0.06	0.07	0.46
213	Ficus semicordata	Moraceae	1	0.01	0.006	0.06	0.07	0.46
214	Glycosmis pentaphylla (Retz.) DC.	Rutaceae	1	0.02	0.006	0.06	0.07	0.46
215	Gmelina arborea Roxb.	Verbenaceae	1	0.01	0.006	0.06	0.07	0.46
216	Jatropha curcas L.	Euphorbiaceae	1	0.01	0.006	0.06	0.07	0.46
217	Kydia calycina Roxb.	Malvaceae	1	0.01	0.006	0.06	0.07	0.46
218	Manilkara roxburghiana (Wight) Dubard	Sapotaceae	1	0.01	0.006	0.06	0.07	0.46
219	Pithecellobium dulce (Roxb.) Benth.	Mimosaceae	1	0.01	0.006	0.06	0.07	0.46
220	Streblus asper Lour.	Moraceae	1	0.01	0.006	0.06	0.07	0.46
221	Thespesia populnea (L.) Soland ex Corr.	Malvaceae	1	0.01	0.006	0.06	0.07	0.46
222	Wrightia arborea (Dennst.) Mabb.	Apocynaceae	1	0.01	0.006	0.06	0.07	0.46

TABLE 3: FAMILY IMPORTANCE VALUE INDEX (FIV) BASED ON TREE SPECIES RICHNESS

S. No.	Family	Species richness	TNI	BA	RDIV	RD	RDOM	FIV
1	Combretaceae	7	2476	50.834	3.153	15.155	12.126	30.434
2	Fabaceae	7	2166	50.611	3.153	13.257	12.072	28.483
3	Euphorbiaceae	24	825	20.300	10.811	5.050	4.842	20.703
4	Anacardiaceae	6	717	51.435	2.703	4.389	12.269	19.360
5	Caesalpiniaceae	11	1017	32.796	4.955	6.225	7.823	19.002
6	Rubiaceae	12	984	16.653	5.405	6.023	3.972	15.400
7	Myrtaceae	3	1017	30.003	1.351	6.225	7.157	14.733
8	Mimosaceae	10	589	15.822	4.505	3.605	3.774	11.884
9	Flindersiaceae	1	892	16.658	0.450	5.460	3.974	9.884
10	Moraceae	14	71	10.082	6.306	0.435	2.405	9.146
11	Bignoniaceae	8	497	8.242	3.604	3.042	1.966	8.612
12	Dipterocarpaceae	2	491	18.223	0.901	3.005	4.347	8.253
13	Ebenaceae	8	234	5.287	3.604	1.432	1.261	6.297
14	Rutaceae	9	170	3.671	4.054	1.041	0.876	5.970
15	Burseraceae	3	281	11.456	1.351	1.720	2.733	5.804
16	Verbenaceae	7	223	5.145	3.153	1.365	1.227	5.745
17	Rhamnaceae	3	451	6.407	1.351	2.760	1.528	5.640
18	Tiliaceae	3	464	5.887	1.351	2.840	1.404	5.595
19	Loganiaceae	2	434	7.894	0.901	2.656	1.883	5.440
20	Sapotaceae	4	182	10.325	1.802	1.114	2.463	5.379
	Sub-Total	144	14181	377.73	64.86	86.79	90.10	241.76
	Remaining 36 families	**78**	**2157**	**41.500**	**35.130**	**13.200**	**9.890**	**58.230**
	Grand Total	**222**	**16338**	**419.23**	**100**	**100**	**100**	**300**

TABLE 4: GIRTH-CLASS-WISE TREE SPECIES RICHNESS, STEM DENSITY AND OCCURRENCE RATE OF SPECIES

Girth class	Species Richness	Number of Individuals	Species occurrence rate (Species richness /Stem density)
30-59	213	13151	0.02
60-89	152	2438	0.06
90-119	93	518	0.18
120-149	41	148	0.28
150-179	17	27	0.63
180-209	8	11	0.73
>210 dbh	10	45	0.22

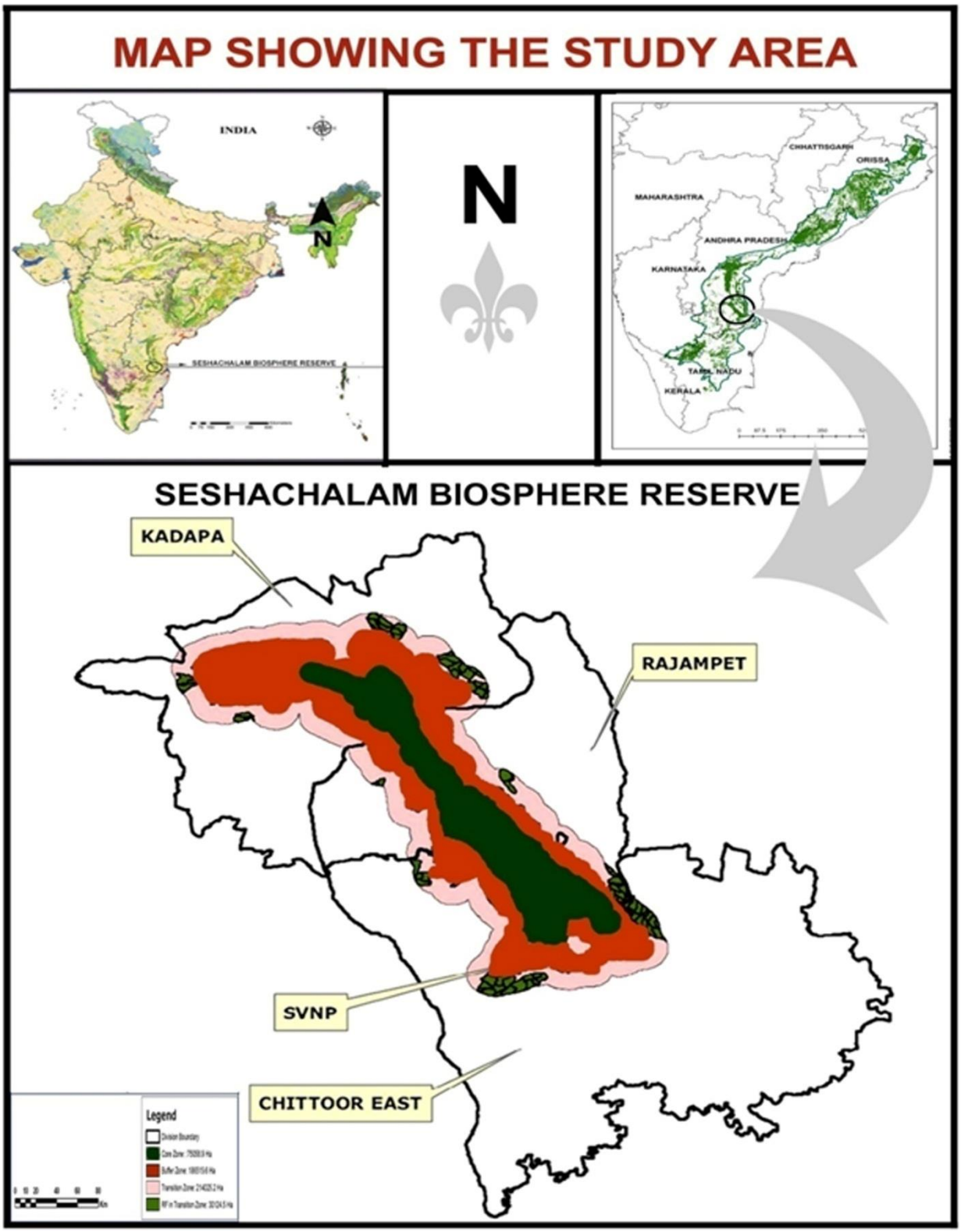

Figure1: Map showing study area of Seshachalam Biosphere Reserve

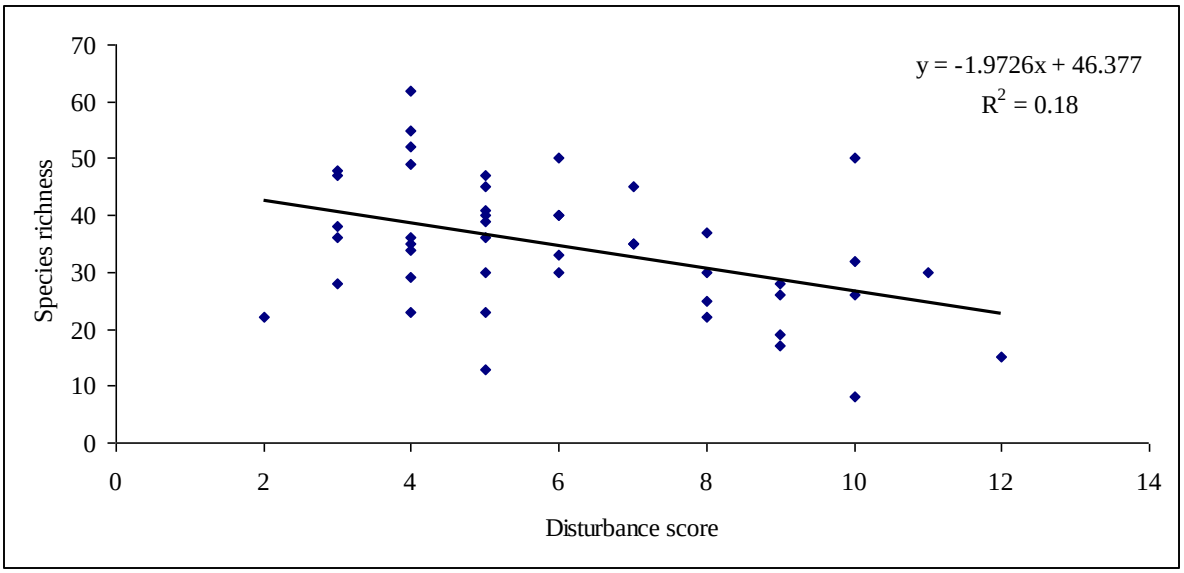

Figure 2a: Correlation of species richness and disturbance score

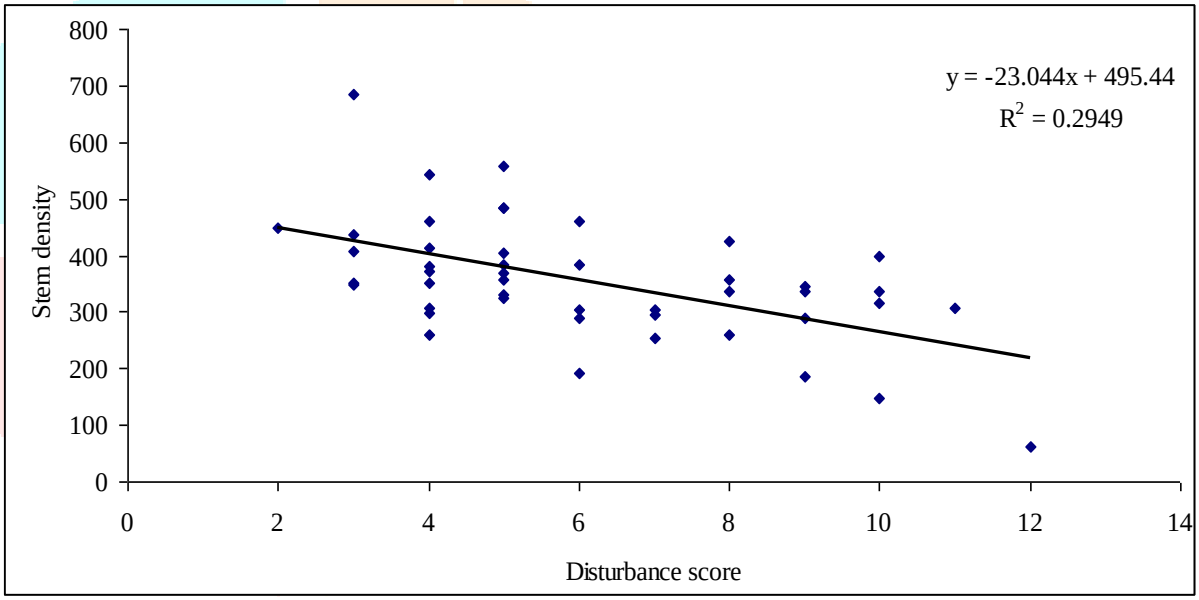

Figure 2b: Correlation of stem density and disturbance score

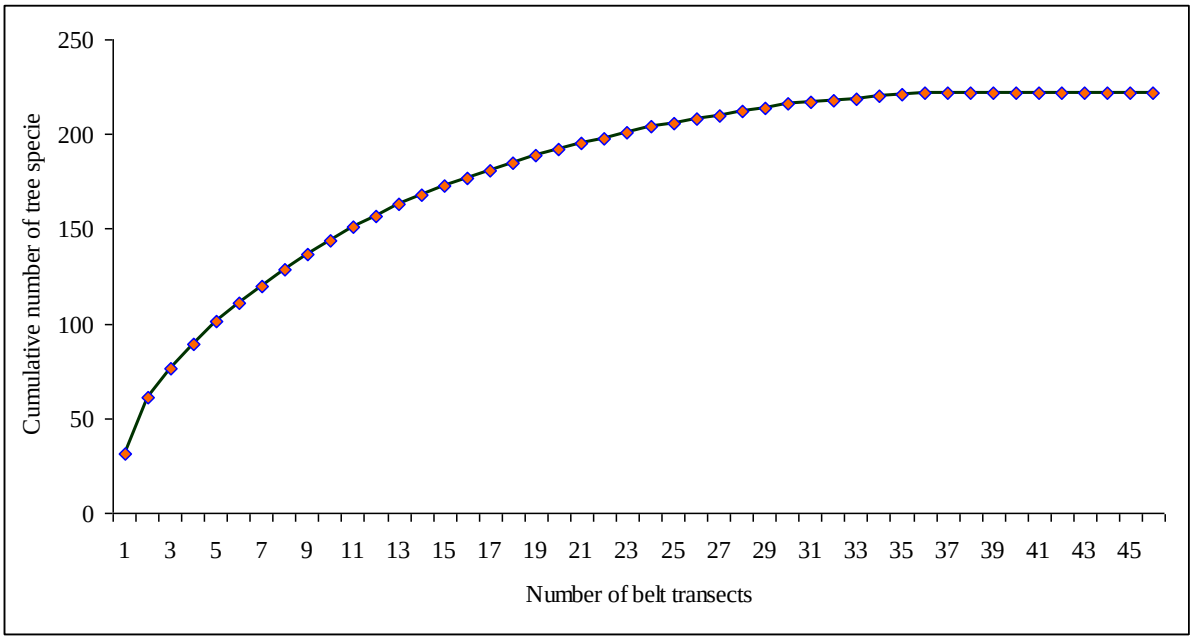

Figure 3: Species - area curves of trees

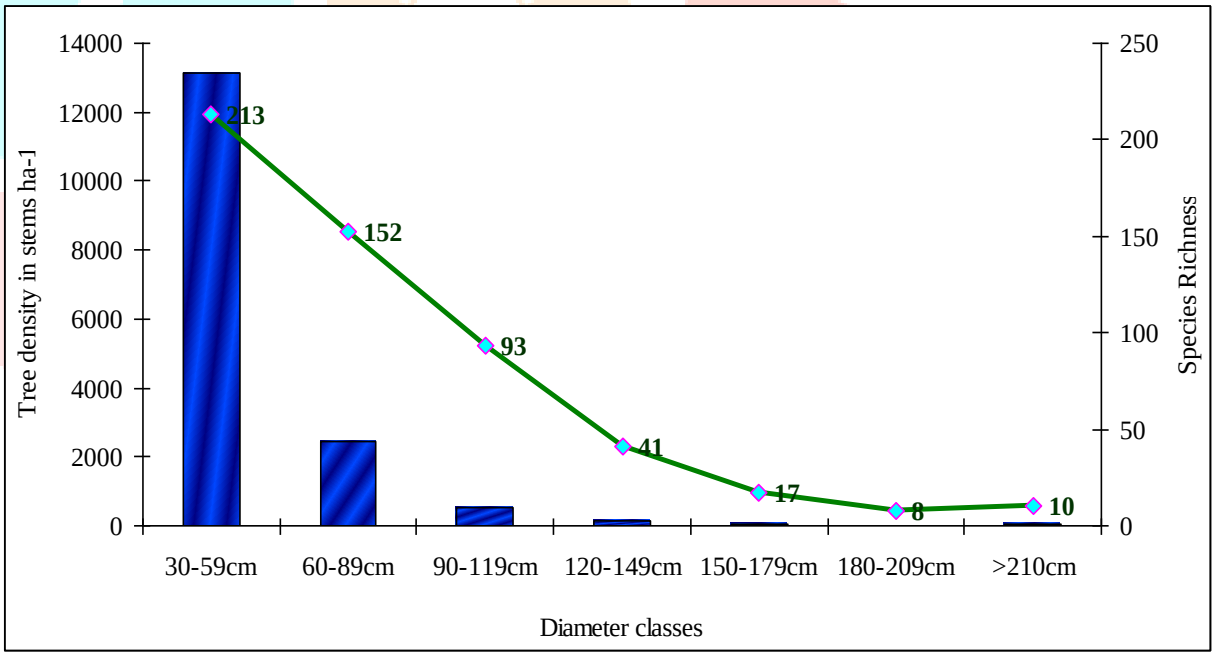

Figure 4: Girth class distribution of density and species richness

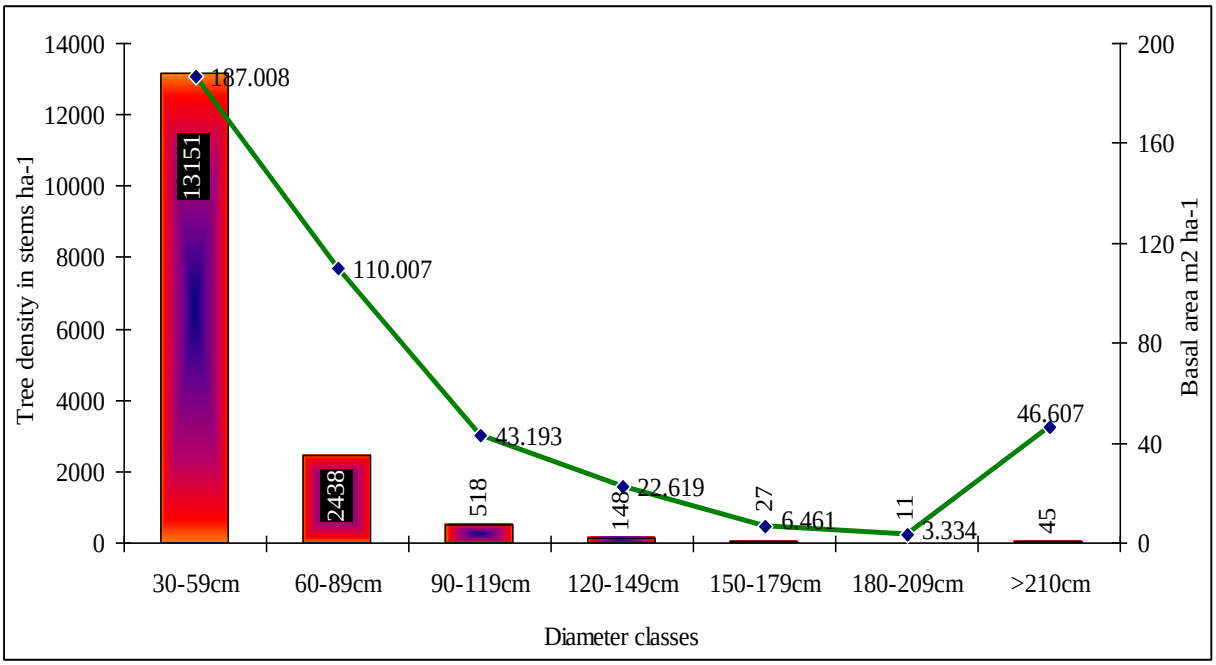

Figure 5: Girth class distribution of general forest stand in Seshachalam Biosphere Reserve

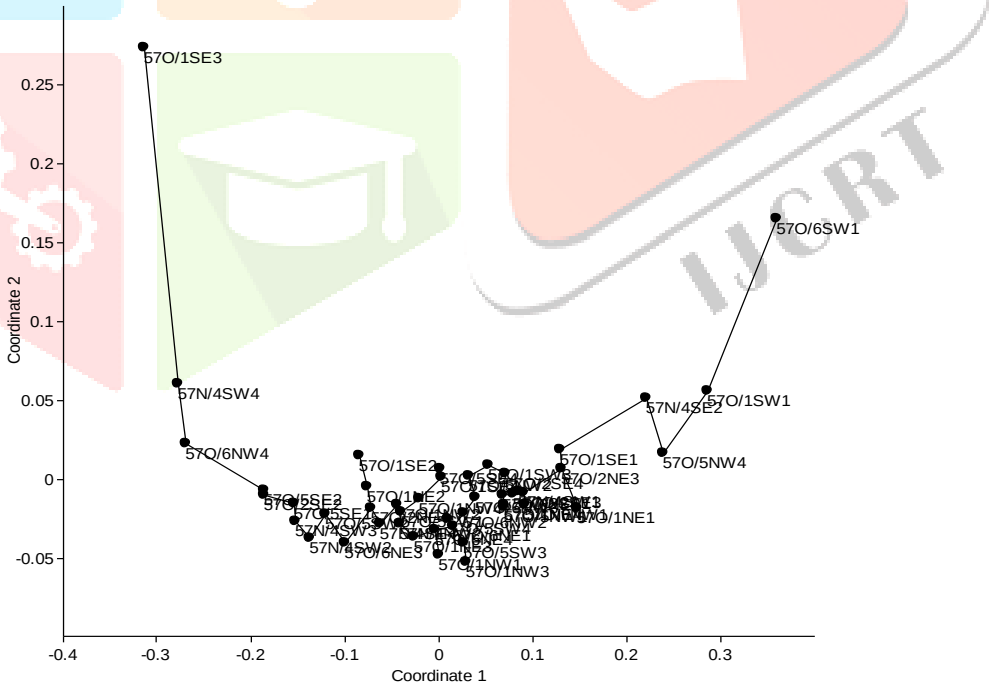

Figure 6: NMS ORDINATION OF GRIDS