KFRI Research Report No.208 ISSN 0970-8103

VEGETATION MAPPING AND ANALYSIS OF NEYYAR WILDLIFE SANCTUARY USING REMOTE SENSING TECHNIQUES

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[Final report of the project KFRI 260/96, August 1996 - August 2000]

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ABSTRACT OF PROJECT PROPOSAL

1.	Project No.	:	KFRI 260/96
2.	Title	:	Vegetation Mapping and Analysis of Neyyar Wildlife Sanctuary Using Remote Sensing Techniques
3.	Objectives	:	1. To mape the vetation (small and large scale mapping) 2. To estimate the area of different, major vegetation types 3. To prepare drainage map of the area 4. To study the structural aspects of permanent vegetation
4.	Date of commencement	:	August 1996
5.	Scheduled date of completion	:	July 2000
6.	Funding Agency	:	Kerala Forest Department (Wildlife Wing)
7.	Project Team		
	Principal Investigator	:	A. R. R. Menon
8.	Study area	:	Neyyar Wildlife Sanctuary
9.	Duration of study	:	4 years

ABSTRACT

Vegetation of Neyyar Wildlife Sanctuary was mapped using remote sensing techniques. Maps were prepared in 1: 25,000 scale using Black and White aerial photographs of 1: 15,000 scale and in 1: 50,000 scale using IRS 1B geocoded satellite imagery of 1: 50,000 scale. A set of supplementary maps viz. digital, drainage and watershed, contour etc. were also prepared. Vegetation analysis of the area for major forest types was also carried out and structural data supplemented.

Key words: Vegetation mapping, Vegetation analysis, Remote sensing, Neyyar Wildlife Sanctuary.

CONTENTS

INTRODUCTION

In India, at present there is considerable regression in the forest area. Much of the wildlife, once widely distributed is now seen only in certain pockets. Hence, *in situ* conservation of wildlife has become necessary. In Kerala, there are at present 12 Wildlife Sanctuaries and two National Parks encompassing about 5.96 percent of the geographic area of the State.

Inventory and monitoring of forest ecosystems have become increasingly important in recent years. Timely and accurate forest inventory information are essential for management, as well as for providing the basis for addressing current issues of national concerns such as, deforestation, reforestation and decline or loss of biodiversity. Forest surveys in India have traditionally been carried out through ground survey by the Survey of India, but such surveys are laborious and time consuming. With the development of remote sensing techniques, a new era has started in the field of vegetation mapping and analysis. Management and monitoring the changes; forest inventory information like extent, location, types etc. can now be obtained at a very fast rate, (Bansal, 1985). Vegetation maps provide a framework for forest resources and serve as a standard record of time for comparative study about a stand of vegetation in future. Above all it helps considerably in designing the present and future management strategies. Estimation of actual area of different strata in each vegetation cover is the most crucial part in resource evaluation. Satellite remote sensing technique coupled with aerial photographs have been found to be very useful in identification, delineation and density stratification of forest types (Gupta *et.al.*,1992). This technique is not only far more accurate than the conventional one but is also quick and cost effective. It becomes multipurpose and provides more valuable information about ecosystem when superimposed with soil and geological maps. In addition, vegetation maps help in manifold ways viz. in easily locating sample stands, in helping analytical research of plant communities, in realising the status of certain rare and threatened species and to provide information like endemism.

To meet such an inevitable need of management, the present study was undertaken and it included broadly two aspects viz. vegetation mapping and vegetation analysis, with the following objectives:

i. To map the vegetation (both in small and large scales),
ii. To estimate the area of different major cover types,
iii. To prepare drainage map of the area,
iv. To study the structural aspects of permanent vegetation and
v. To carry out digital analysis of the area.

STUDY AREA

Neyyar Wildlife sanctuary is located on the western slopes of the Western Ghats along the South East corner of Kerala in Neyyattinkara Taluk of Thiruvananthapuram District. This tract is more or less contiguous with a vast stretch of reserved forests and lies between 8°29' 30" and 8° 37' 30" North latitude and between 77° 8' 20" and 77° 17' 05" East longitude. This tract is surrounded by Peppara WLS and Agasthyavanam Biological Park in the North, Patta land in the South and West; and Tamil Nadu forests (Kalakkad-Mundanthurai Sanctuary) in the East (Fig. 1).

BOUNDARY DESCRIPTION

For easy identification the boundaries are further described as follows:

North

Starting from Mlavetty, a point about 2.41 km north-east of Neyyar Dam site, the boundary runs along the eastern boundary of Paruthipally Range of Thiruvananthapuram Division up to Karimalaikari at 636 m, passing Chattuparai at 491 m and then along the common boundary of Neyyar and Peppara Sanctuaries. The boundary runs on a northeastern direction along the watershed line between Neyyar and Karamana rivers passing Meppimalai at 710 m, Kannukunnu, Nachiyadikunnu at 985 m up to Athirumalai at 1594 m.

East

Starting from Athirumalai the boundary runs along the state boundary passing Agasthiyarmalai at 1868 m, Vavattimalai at 1892 m, Varayattumudi at 416 m, and the points of 662 m and 701 m up to Vengulamalai at 756 m.

South

From Vengulamalai the boundary runs along the state boundary up to Anamugham and then along the Full Reservoir Level (F.R.L.) to Neyyar dam site.

West

From dam site the boundary runs along the F.R.L. up to Thooripara a portion of Kottoor extension reserve and then along the boundary of Nettukaltheri Reserve Forest (R.F.) up to Mlavetty, the starting point.

GEOMORPHOLOGY

The configuration of the ground is very irregular. The rugged terrain, deep lake, virgin forests and the rushing brooks are the peculiarities of this locality. Flat meadows and gentle to steep slopes ranging from 90 m at lake level to 1868 m at the hill top are noteworthy. The entire area lies within the catchment area of Neyyar river which originates from the slopes of Agasthiar peak at an elevation of 1868 m. It flows in the westerly direction and in torrential stages with greater rapidity over steep rocks and ridges of over 20-50 m high till it reaches the foot hills in about 7 km. Here it is joined by its main tributaries, the Kallar and Mullayar. The Chottupara and Varayattumudi ridges and the lofty Agasthiar peak in the background are the conspicuous landmarks of the tract dealt with. The rocks at the exposed areas of summits and slopes are mostly gnessic. The most common are Charnokites associated with Morities, Granulites, Leptinites etc. Laterites are extensively present. Soil is mostly loamy, the depth of which varies and deep soil is available in the valleys. Due to heavy wash by the running waters, large proportion of laterites, gravel and broken pieces of other rocks are seen accumulated at slopes and elevated plateau. Extensive clear felling, annual devastating fires, soil washing etc. have attributed to the thorough depletion of the soil.

CLIMATE

Temperature

The climate in the tract is moderately hot and humid. The high hills are cooler and drier compared to foot hills and valleys. The maximum mean daily temperature during the hottest month of March is about 35°C and the mean daily minimum during the coldest month of January is about 16°C.

Precipitation

The mean annual rainfall is about 3000 mm from both South-West (May-July) and North-East (October-November) monsoons.

Wind

The wind following the two monsoons are harmful. The wind following the North-East monsoon has a drying effect, causing heavy leaf fall which attracts wild fires.

Water

A number of rivers, streams and tributaries are encountered in this tract. Rivers like Neyyar, Mullayar, Kallar Valliyar etc. are the major feeder rivers of Neyyar Reservoir. Most of these rivers turn dry if drought prolongs. Neyyar reservoir is the major source of irrigation to the agricultural fields in Neyyatinkara and Nedumangade Taluks and Vilavangode Taluk of Tamil Nadu.

Threats

The habitat for the wildlife is heavily disturbed due to commercial exploitations and other biotic interferences. As the population in and around the sanctuary increased, their needs also proportionally increased and as a result smuggling of timber and firewood as well as poaching increased. Fishing and grazing are quite frequent and regular. Occurrence of fire is a common annual phenomenon during dry season. As more and more pilgrims started visiting Agasthiyar Peak, the quality and density of the undergrowth and ground flora diminished day by day.

Flora

A detailed description of the vegetation is given in the subsequent chapter, 'Results and Discussion'.

Fauna

The fauna is very meager in this tract at present whereas it was once abundant. Compared to other areas in the tract, Chottupara ridge enjoy some protection from poachers due to its inaccessibility and the presence of animal life in this part is notable. Elephant herds are seen frequently towards the reservoir during dry season.

As per past working plans of Thiruvananthapuram Wildlife Division, following is the list of animals reported to exist here:

1.	Indian Elephant	: (*Elephas maximus*)
2.	Sambar	: (*Cervus unicolor*)
3.	Barking Deer	: (*Muntiacus mutijack*)
4.	Spotted Deer	: (*Axix axis*)
5.	Indian Wild Boar	: (*Sus serofa*)
6.	Indian Porcupine	: (*Hystrix Indica*)
7.	Three Stripped squirrel	: (*Funambulus Plamrum*)
8.	Malabar Squirrel	: (*Ratufa Indica*)
9.	Flying Squirrel	: (*Petaurista petourists*)
10.	Tiger	: (*Panthera tigris*)
11.	Lion Tailed Macaque	: (*Macaca sileneus*)
12.	Nilgai	: (*Boselaphus tragecamelus*)

In addition to the above, Nilgiri tahr, reptiles like Cobra, Viper, Python, etc. are also seen in the wild.

Large varieties of colourful birds are also found here. Some of them are:

1.	Common Myna	: (*Acridotheres tristis*)
2.	Common Kingfisher	: (*Alcedo Athis*)
3.	White Breasted Water Hen	: (*Amaurorinis phoenicus*)
4.	Little Green Heron	: (*Butorides straitus*)
5.	Malabar Golden Backed Wood pecker	: (*Barachypternus Bengelensis*)
6.	House Crow	: (*Corvs splendens*)
7.	Indian Cuckoo	: (*Cuculus micropterus*)
8.	Koel	: (*Eudynamis scolopaceus*)
9.	Grey Jungle Fowl	: (*Gallus sommeratii*)
10.	Hoppoe	: (*Upupa epops*)
11.	Jungle Myna	: (*Acridotheres fuscus*)
12.	Indian Hill Myna	: (*Anhinga rufa*)
13.	Darter (Snake bird)	: (*Anhinga rufa*)
14.	Little Comorent	: (*Phalacrocorax niger*)
15.	Little Egret	: (*Egretta gerzetta*)

To add to the charm and entertainment potential of the sanctuary, a Deer Park at Meenmutty was started some years back, but later abandoned. Quite a large number of sambars were also introduced into the area. Now there is a crocodile farm with about 190 crocodiles and a Lion Safari Park with 3 lions.

METHODOLOGY

VEGETATION MAPPING

To meet the objectives of the study standard remote sensing techniques were adopted using different remotely sensed data products.

DATA PRODUCTS

Aerial photographs, Geocoded false colour composite and satellite digital data in CD's are the major data products used. The photographs used in the present study are 1:15,000 scale Black and White vertical aerial photographs of 23 x 23 cm format with glossy and single weight. The other details are as given below: Task number- 108, Camera-RMK 15/23, Focal length- 153 mm, Film- Kodak xx aerographic 2405 B & W, Year-1990, Months-January to March. To meet the geometric accuracies, precision satellite data products like, geocoded false colour composite of IRS1B, LISS 2 B2 were also used. The data preprocessed for radiometric and geometric corrections with orientation to true north, are having the following specifications: Photo product scale -1:50000, Output resolution- 25 x 25 (meters), Path & row 25 – 62, Bands –2 (0.52-0.59 microns) – 3 (0.62-0.68 microns) – 4 (0.77-0.86 microns) and acquired on - 07-Feb-93, 11:07:12. The satellite data products available in the form of CD's were analysed digitally using EASIPACE software. In the present study IRS-1B, LISS 2 data of December 1988 were used.

VISUAL INTERPRETATION OF AERIAL PHOTOGRAPHS AND SATELLITE IMAGERIES

Recognition of objects on aerial photographs and satellite imageries were done with the help of photoelements like tone, texture, pattern, etc. The standard interpretation technique based on various photoelements (Tomer and Masleakar, 1972) were adopted. An interpretation key was prepared with the help of above mentioned pictorial elements for aerial photographs (Table 1).

FIELD CHECKING

The units deliniated on the aerial photographs and satellite imageries were checked with ground details at random to verify the accuracy of interpretation.

Table 1. Interpretation key for land cover mapping using pan-chromatic aerial photographs

No.	Symbol	Covertype	Tone	Texture	Pattern	Remarks
1.	eg	Evergreen forest	Black	Fine	Smooth	-
2.	se	Semievergreen forest	Black	Medium	Smooth	-
3.	md	Moist deciduous forest	Dark grey	Medium	Coarse	-
4.	sco	Scrub open	Greyish white	Medium	Medium	-
5.	scd	Scrub dense	Dark grey	Medium	Coarse	-
6.	st	Subtropical hill forest	Deep black	Fine	Smooth	-
7.	g	Grass land	White	Fine	Smooth	-
8.	eu	Regeneration	Light grey	Fine	Smooth	Distinct crown shape
9.	tk	Teak plantations	Light grey	Medium	Coarse	-
10.	t	Tribal settlements	Yellow white	Coarse	-	Distinct appearance
11.	x	Exposed rock	Light grey	Rough	-	-
12.	w	Water body	Dark black	Fine	-	-

DIGITAL IMAGE ANALYSIS

The digital image processing was carried out on IBM RISC 9000 system using EASIPACE software available at Regional Remote Sensing Service Center (RRSSC), Bangalore. Supervised classification technique using maximum likelihood classifier was adopted to classify the landcover classes. In order to correct the satellite data geometrically with reference to the Survey of India (SOI) toposheets, the following 1:50,000 scale toposheets (58H2 and 58H6) were used:. The toposheets were individually fixed on the digitizer table and Ground Control Points (GCP) were generated for the common points in the IRS IC LISS-II image and the toposheets. The image was re-sampled with a root mean square error (RMSE) of around 100 m. 'Maximum Likelihood' classification procedure has been adopted to deliniate various forest and other land cover classes. Based on the preliminary classified forest output image, it was found that, there was a fairly large amount of mixing in the spectral behaviour of non-forested and

forested areas, predominantly consisting of homesteads and plantations having evergreen species, which exhibit similar spectral behaviour as the natural forest. This obviously creates spectral confusion in segregating the forest and non-forest classes accurately. In order to enhance the spectral classification accuracy, a mask was created to segregate forested areas and non-forested areas. Further, the image was segmented accordingly and supervised classification using maximum likelihood algorithm was performed to distinguish various cover classes. The problems arising from some points of the image due to non-availability of cloud free data were taken care of by giving training sets for classification as well as by segmentation and post-classification image editing procedures of these specific areas. The sanctuary boundary vector layer was registered with reference to the corrected images and overlaid on the image and classification was done (Plate 1.)

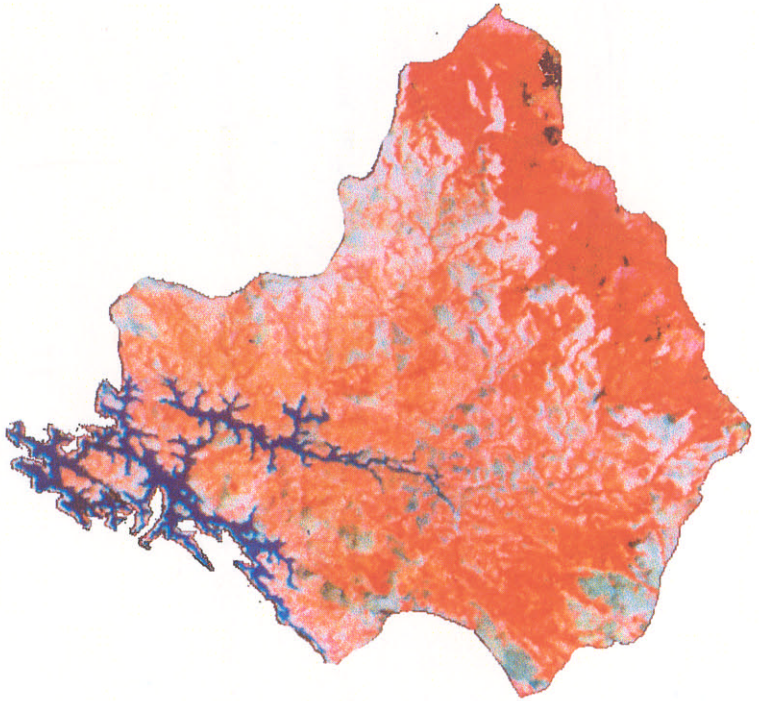
ACCURACY EVALUATION AND DENSITY SLICING

Mapping accuracy assessment was undertaken by estimation of commissioned omission errors (Congalaton *et. al.*, 1983). The 1995 classified satellite image in the form of a hard copy on 1: 50,000 scale was used for ground checking for the various classes. 'Stratified Random Sampling' approach was followed in allocating the sample points in different strata of forest covers classes. Depending on accessibility in different vegetation classes twenty one, randomly distributed points were selected based on proportional contribution in terms of aerial extent for different forest cover classes. The coordinates of these point locations were taken from the geo-referenced classified image. On ground, these points were identified with the help of 5 channel hand held Global Position System (Magellan Pro 5000). The patches of different cover classes selected for accuracy assessment were more than 10 pixel by 10 pixel to avoid inaccuracies due to coarse resolution of the hand held GPS receiver. The overall mapping accuracy was found to be 70 percent. The inaccuracies were mostly contributed by the commission of four points of a forest crown density class to the forest class of the next crown density.

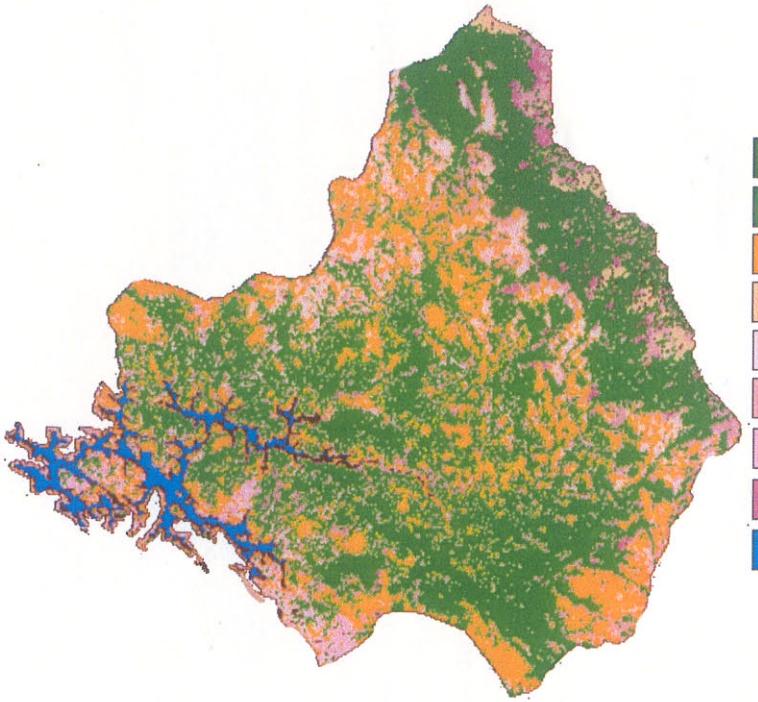
PREPARATION OF DRAINAGE MAP

A drainage map was prepared using 1:15,000 B and W aerial photographs and Survey of India Topograhic sheets. All major and minor rivers were identified and marked.

NEYYAR WILDLIFE SANCTUARY - VEGETATION



FALSE COLOUR COMPOSITE



CLASSIFIED IMAGE

- EVERGREEN
- SEMI-EVERGREEN
- MOIST DECIDUOUS
- REED BRAKE
- GRASSLAND
- SCRUBLAND
- HABITATION
- EXPOSED ROCK
- RESERVOIR

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PHYTOSOCIOLOGICAL STUDIES

Champion and Seth's (1968) classification was used for the identification of forest types. Stratified random sampling quadrat techniques were adopted to gather vegetational data from each forest type. Twenty one randomly selected quadrats of the size of .1ha in each locality were established to characterise the floristic composition and structural aspects of vegetation. The quadrat data thus obtained were analysed to understand the floristic composition and diversity of the community.

PRIMARY ANALYSIS

Primary analysis of the vegetation was carried out to obtain the values of various parameters like, density, frequency, abundance, basal area and Importance Value Index (Gates, 1949; Curtis and McIntosh, 1950; Misra and Puri, 1954; Curtis, 1951; Phillips, 1959; Misra, 1969; Mueller-Dombois and Ellenberg, 1974), using the standard formulae:

$$\text{Density} = \frac{\text{Total No. of individuals}}{\text{Total No. of quadrats studied}}$$

ii. $$\text{Relative Density (RD)} = \frac{\text{Density of a species}}{\text{Sum of density of all species}} \times 100$$

iii. $$\text{Percentage frequency (\%F)} = \frac{\text{No. of quadrats in which species occurred}}{\text{Total No. of quadrats studied}} \times 100$$

iv. $$\text{Abundance (AB)} = \frac{\text{Total No. of individual s of the species}}{\text{Total No. of quadrats of occurrence}}$$

v. Basal Area (BA) = $Gbh^2/4$ pi.[pi = 3.14]

vi. $$\text{Relative Basal Area (RBA)} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all species}} \times 100$$

viii. Importance Value Index (IVI) = Relative density + Relative basal area + Relative frequency

A total picture of the ecological status of a species with respect to a community structure can be obtained only by synthesising the percentage values of relative frequency, relative density and relative basal area. The values when added together give the IVI based on which an association is derived (Phillips, 1959).

DIVERSITY INDEX

Margalef's (1958) formula was used for calculating Shannon's Index (Shannon and Wiener, 1963) of general Diversity i.e.,

$$H = -\Sigma [(ni/N) \ln_2 (ni/N)]$$

Where H is the Index value and 'ni' number of species and 'N' is total number of species in that habitat.

CONCENTRATION OF DOMINANCE

To evaluate the concentration of dominance of a species within a community Simpson's (1949) Index of Dominance was used; where:

$$C = \Sigma(ni/N)^2$$

ni = Number of individuals of the species

N = Number of individuals of all species

RESULTS AND DISCUSSION

VEGETATION ANALYSIS

1. West coast tropical evergreen forest

This type of forest is seen in comparatively smaller extent in areas like, Thalamuttippu and Sooryanthanakuzhi in this sanctuary. These forests are characterised by bewildering multiplicity of lifeforms and overpowering preponderance of greenness. These forests are lofty, dense and characterised by a large number of species of trees which occur together. Component species of the various strata are evergreen. Top canopy is formed of tall trees, (45 m or even more in height) and canopy is almost unbroken. This forest is characterised by luxurious growth of evergreen trees of different sizes and shapes arranged in serial tiers. Above the ground layer of herbs and shrubs, the crown of the trees form three or more superimposed stories, but strata of trees are sometimes never clearly defined. The crown of trees in each storey has a distinguished shape. In the top storey the trees are usually umbrella shaped, in the middle they are more or less candle flame shaped and are markedly conical at bottom. Buttressed roots are characteristic in this type. The following species exhibit buttress formation: *Elaeocarpus tuberculatus, Cullenia exarillata, Palaquium ellipticum,* and *Poeciloneuron indicum.* The boles are long, cylindrical, with thin and smooth barks. The leaves are thick and glossy, rarely finely pinnate or hairy and are very often white or pinkish when young. Another feature of this type of forest is cauliflory. The presence of *Cullenia exarillata, Poeciloneuron indicum* and high proportion of *Mesua, Calophyllum,* etc. indicate that west cost tropical evergreen forest of this sanctuary belongs to high level evergreen forest of Chandrasekharan (1962 a, b & c). *Cullenia exarillata* and *Poeciloneuron indicum* are exclusively limited to this type. The most noticeable difference from the low evergreen forest is the high percentage of occurrence of above species when the precipitation is particularly heavy or the soil moisture particularly favourable. The general floristics of this type of forest is given below:

Top canopy consists of *Palaquium ellipticum, Hopea parviflora, Cullenia exarillata, Poeciloneuron indicum, Lophopetalum withtianum, Artocarpus hirsutus, Vateria indica, Myristica malabarica, Diospyros microphylla, Mesua ferrea, Dipterocarpus indicus, Hardwickia pinnata, Mangifera indica, Chukarassia tabularis,* etc.

Lower canopy constitutes species of the younger members of the top canopy and other species like, *Canarium strictum*, *Polyalthia fragrans*, *Mallotus philippensis*, *Holigarna arnottiana*, *Zanthoxylum rhesta*, *Garcinia* spp. *Spondias mangifera*, *Pterospermum rubiginosum*, *Ixora* spp., etc. Undergrowth consists of *Canthium* spp., *Murraya exotica*, *Pavetta* spp., *Calamus rotang*, *Calamus travancoricus*, *Ixora* spp., *Arenga wightii*, *Strobilanthes* spp., *Laportea crenulata*, Ferns, etc.. Herbaceous ground vegetation comprises of *Curcuma* spp., *Strobilanthes* spp. and *Laportea crenulata*. Following climbers are also seen; *Entada scandens*, *Pothos* spp., *Butea* spp., *Bauhinia vahlii*, *Dioscrorea* spp. and *Derris* spp..

The details of primary analysis like density, abundance, percentage frequency, basal area, relative density, relative percentage frequency, relative basal area, Importance value index and distribution of species of each locality are given in appendix 1-5 and 22.

The relative mean values of density of species were calculated and the following species show high density values; *Mesua ferrea* (14.65) and *Cullenia exarillata* (10.55) (Appendix 22). The species which have high mean frequency are: *Mesua ferrea* (9.46) and *Cullenia exarillata* (8.52) and *Palaquium ellipticum* (7.50).

The species with maximum relative mean basal area are: *Elaeocarpus tuberculatus* (8.59) followed by *Antiaris toxicaria* (7.24); *Artocarpus hirsutus* (6.78) and *Vateria indica*(6.38) respectively. The mean total basal area cover is 75.68 m^2 /ha. The species which have maximum mean IVI are *Mesua ferrea*, *Cullenia exarillata* and *Hopea parviflora*. *Mesua ferrea* is well represented at high altitudes, but, with limited occurrence at medium elevation.

2. West coast tropical semi-evergreen forest

It is a closed high forest with heterogeneous mixture of evergreen and deciduous species, the former generally dominating. It is found adjoining the evergreen forest, mostly along the lower slopes. The lower slopes being more easily accessible have been subjected to heavy anthropic interferences in the past. Floristic composition of this type depends on the component species of the original evergreen forest and those of the deciduous seral communities. Percentage of the evergreen and deciduous species in this heterogeneous mixture varies depending on various factors. Species diversity is high but most of the typical evergreen species are absent. Buttressed stems continue to be frequent and occur in both evergreen and deciduous species. Bark tends to be

thick and rough and cauliflory is not common. The canopy is typically less dense than in the true evergreen and the evergreen undergrowth rather more copious; climbers tend to be very heavy. Bamboos and reeds are usually present in certain localities. Epiphytes with many ferns and orchids are abundant. Before the establishment of Neyyar Wildlife Sanctuary tribals practiced shifting cultivation here. Most often cessation of cultivation is followed by invasion of the under-growth, *Ochlandra*. Hence, in many regions the semi-evergreen forests have an undergrowth of *Ochlandra*.

The top canopy species are: *Hopea parviflora, Vateria indica, Palaquium ellipticum, Myristica spp., Cinnamomum zeylanicum, Aglaia roxburghiana, Lagerstroemia lanceolata, Polyalthia fragrans, Euphoria longana, Holigarna arnottiana, Persea macrantha, Terminalia paniculata, Stereospermum personatum, Artocarpus hirsutus, Elaeocarpus tuberculatus, Dysoxylum malabaricum, Toona ciliata, Pterocarpus marsupium, Terminalia bellerica, Mangifera indica, Macaranga peltata, Bischofia javanica,* etc.

The lower canopy is composed of species like, *Mallotus philippensis, Actinodaphne bourdillonii, Aporusa lindleyana, Olea dioica, Diospyros* spp. *Xanthophyllum arnottianum, Cinnamomum zeylanicum, Lannea coromandelica, Grewia tiliaefolia, Spondias mangifera,* etc.

Undergrowth consists of *Bambusa bambos, Ochlandra rheedii and Ochlandra wightii. Chromolaena odorata* is found in places where the canopy is heavily opened up. *Leea indica, Strobilanthes* spp., *Curcuma* spp., *Ixora* spp., *Murraya paniculata* and a number of other herbs and shrubs form the undergrowth. Following climbers are also seen: *Entada scandens, Spathalobus roxburghii, Dioscorea* spp., *Smilax macrophylla.*

Primary analysis of the vegetation

In semi-evergreen forest the following species show high relative density: *Aporusa lindleyana* (16.01), *Tabernaemontana heyneana* (10.64), *Pterocarpus marsupium* (9.57), *Terminalia paniculata* (9.26). The mean stand density is 755 trees/ha. The most abundant species are: *Aporusa lindleyana and Vitex altissima.* In this forest *Aporusa lindleyana* records the high mean percentage frequency value of 10.43, followed by *Terminalia paniculata* (9.08) *Tabernaemontana heyneana* (751) and *Pterocarpus marsupium* (7.35) – Appendix -23.

The dominant species based on mean IV1 (Appendix-23) are: *Pterocarpus marsupium* (31.64), *Terminalia paniculata* (27.78) and *Aporusa lindleyana* (27.56).

3. Southern secondary moist mixed deciduous forests

It is a closed high forest of about 30 to 36 m. and the dominant species are deciduous. Due to the availability of considerably high soil moisture a few evergreen species are also seen. Compared to the moist mixed deciduous forests and secondary moist teakbearing forests; secondary moist mixed deciduous forest area is having high rainfall. This region has the climate to support the evergreen forest. Bamboos are common in some areas especially in the lowlands near reservoir. Bamboo tends to spread when the canopy is open. The undergrowth is luxuriant where the ground is not covered by grasses. Epiphytes are seen and large climbers are abundant. The trees mostly have rounded crown and tall cylindrical bole. Buttress formation is also found in some species. The trees in this type generally have thick bark, mostly fibrous and fissured in all shapes. The chief feature of the moist deciduous forest is a leafless period in the dry season (March-April). An appreciable number of the deciduous trees, however, come into new leaf (and often flower) long before the monsoon when one would expect them to experience water stress. The ground in almost all places are covered by grasses and annual fire is a common phenomenon. The fires result in the spread of the grasses which become heavy and continuous especially when the canopy is open.

Top canopy consists of *Terminalia paniculata, Pterocarpus marsupium, Terminalia bellerica, Terminalia crenulata, Dalbergia latifolia, Dillenia pentagyna, Phyllanthus emblica, Adina cordifolia,* etc. Lower storey constitutes *Wrightia tinctoria, Cassia fistula, Careya arborea, Buchanania lanzan, Randia dumatorum,* etc. *Dendrocalamus strictus* is seen very rarely. Shrubs like, *Chromolaena odorata, Leea indica* are also seen. Climbers like, *Ipomea campanulata, Butea parviflora, Cyclea peltata, Mucuna prurita, Discorea* spp. etc. are quite common (appendix -24).

The species showing mean high density values are: *Terminalia paniculata* (32.12) and *Pterocarpus marsupium* (25.38) (Appendix -23). The stand density of trees/ha. is 660. *Pterocarpus marsupium* (14.50) and *Terminalia paniculata* (16.29) show high rate of mean percentage frequency in this type.

Only one species, *Terminalia crenulata* shows mean relative basal area value of more than 20 (Appendix -23). The other species showing comparatively high basal areas are: *Pterocarpus marsupium* (19.70), *Terminalia paniculata* (10.45) and *Careya arborea* (11.15) and *Terminalia bellirica* (12.06) (Appendix -23).

VEGETATION MAPPING

The vegetation map prepared from 1:50,000 geocoded satellite imagery (Fig. 4) have only seven different land cover types excluding reservoir/waterbody. There are units of evergreen and semi-evergreen forest types often merged together. Similarly smaller units of semi-evergreen vegetation types are not delineated properly due to high undulating terrain and geomorphology. The landcover classification based on by visual interpretation technique includes major forest types along with exposed rocks and tribal settlements. The total area of the sanctuary estimated from the 1:50,000 scaled map, excluding reservoir area is 107.705 sq. km. The area of moist deciduous forest type estimated from the map is rightly higher than that of 25,000 scaled map generated from aerial photographs (Table 2). Similarly, there is reduction in the estimated area of evergreen/semi-evergreen type, mainly due to the highly undulating terrain and also due to temporal variation of the remote sensing data products. Areawise distribution of the different major cover classes are given in Table 2.

Table 2. Area estimated from 1:50,000 Geo-coded satellite imagery

No.	Type of Area	Area in km^2
1.	Evergreen Forest	25.551
2.	Semi-evergreen Forest	18.762
3.	Moist Deciduous Forest	39.382
4.	Grassland	8.451
5.	Scrubland	6.619
6.	Tribal Settlement	4.013
7.	Exposed Rock	4.506
8.	Unidentified Area	0.421
	Total (excluding reservoir)	107.705

Table 3. Area estimated from 1:15,000 black and white aerial photographs

No.	Cover types	Density status			Total area in km^2
		Low	Medium	High	
1.	Evergreen forest	1.385	6.890	9.504	17.779
2.	Semi-evergreen forest	9.273	8.125	15.631	33.029
3.	Moist deciduous	7.866	12.94	9.547	30.353
4.	Grassland				7.172
5.	Scrubland				8.801
6.	Bamboo				0.177
7.	Teak plantation				0.088
8.	Regeneration				1.181
9.	Tribal settlement				4.249
10.	Exposed rock				3.865
11.	Reservoir				8.457
	TOTAL (including reservoir)				115.151

There are more land cover types recorded in the vegetation map prepared from aerial photographs (Fig. 5). These include, bamboo areas and of different forest plantations. The details regarding the actual distribution status of various cover types are given in Table 3. The total area of the wildlife sanctuary estimated from 1:25,000 scaled vegetation map, including reservoir area is 115.15 sq. km. Along the banks of the reservoir, the settlers are confined mainly in the outer banks, to a distance covering 36 km. Probably this is one of the reasons for the increase in man-wildlife conflict recorded from the area.

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ACKNOWLEDGEMENTS

I am thankful to Dr. J. K. Sharma, Director, KFRI and Dr. K. Balasubramanyan, Scientist-in-charge, Ecology Division for their encouragement throughout the period of this study. My thanks are also due to Dr. K. S. S. Nair, former Director, KFRI for his keen interest during the initial phases.

I appreciate the financial help and cooperation extended by the Kerala Forest Department (Wildlife Wing). I also thank Dr. N. Sasidharan, Scientist (NWFP) and Dr. S. Sankar Scientist (Agroforestry) of KFRI for their valuable comments and suggestions in improving the manuscript.

I am also indebted for the help rendered by Mr. O. L. Pious, Mr. B. Jithesh, Mr. C. R. Krishnakumar and Mr. V. Jayan in the field work and data entry and Mr. V. Asokan for DTP.

Appendix –1. Westcoast Evergreen Forests Adirumalai - Vegetation Analysis

	NAME	D	%F	AB	BA	RD	RF	RBA	IVI
1.	*Aporusa lindleyana*	2.20	20	2.75	447.85	16.92	10	1.73	28.65
2.	*Cullenia exarillata*	1.60	80	2.00	1146.50	12.3	10	4.43	26.73
3.	*Mesua ferrea*	1.80	80	2.25	575.24	13.85	10	2.22	26.07
4.	*Antiaris toxicaria*	0.40	20	1.00	4030.65	3.07	2.5	15.4	20.97
5.	*Macaranga peltata*	0.20	20	1.00	4030.65	1.54	2.5	15.4	19.44
6.	*Palaquium ellipticum*	1.00	60	1.67	877.79	7.69	7.5	3.39	18.58
7.	*Elaeocarpus tuberculatus*	0.20	20	1.00	3511.15	1.54	2.5	13.58	17.62
8.	*Xanthophyllum arnottianum*	1.20	60	2.00	199.09	9.23	7.5	0.77	17.50
9.	*Vateria indica*	0.80	60	1.33	877.79	6.15	7.5	3.39	17.04
10.	*Poeciloneuron indicum*	0.80	60	1.33	509.55	6.15	7.5	1.97	15.62
11.	*Artocarpus hirsutus*	0.40	40	1.00	1912.82	3.07	5	7.4	15.47
12.	*Mitragyna tubulosa*	0.20	20	1.00	2167.60	1.54	2.5	8.38	12.42
13.	*Diospyros buxifolia*	0.20	20	1.00	2167.60	1.54	2.5	8.38	12.42
14.	*Meiogyne pannosa*	0.20	20	1.00	1560.50	1.54	2.5	6.04	10.08
15.	*Dimocarpus longan*	0.40	40	1.00	390.13	3.07	5	1.51	9.58
16.	*Alstonia scholaris*	0.40	40	1.00	199.40	3.07	5	0.77	8.84
17.	*Persea macrantha*	0.20	20	1.00	718.55	1.54	2.5	2.78	6.82
18.	*Bassia latifolia*	0.40	20	2.00	127.39	3.07	2.5	0.49	6.06
19.	*Holigarna arnottiana*	0.20	20	1.00	390.13	1.54	2.5	1.51	5.55
20.	*Dipterocarpus bourdillonii*	0.20	20	1.00	71.66	1.54	2.5	0.27	4.31

Species diversity H^{l} = 2.64, Concentration of dominance C = 0.07

Appendix –2. Westcoast Evergreen Forests Vavattimalai- Vegetation Analysis

	NAME	D	%F	AB	BA	RD	RF	RBA	IVI
1.	*Hopea parviflora*	1.6	80	2.00	1052.95	15.09	11.76	6.52	33.37
2.	*Hydnocarpus macrocarpa*	0.2	20	1.00	4211.78	1.88	2.94	26.08	30.9
3.	*Elaeocarpus tuberculatus*	0.6	40	1.5	2579.62	5.66	5.88	15.97	27.51
4.	*Cullenia exarillata*	1.4	60	2.33	796.12	13.2	8.82	4.93	26.95
5.	*Symplocos cochinchinensis*	1.0	60	1.66	963.38	9.43	8.82	5.96	24.21
6.	*Baccaurea courtallensis*	1.0	60	1.66	877.79	9.43	8.82	5.43	23.68
7.	*Poeciloneuron indicum*	1.0	60	1.66	199.04	9.43	8.82	1.23	19.48
8.	*Mesua ferrea*	0.6	40	1.5	718.55	5.66	5.88	4.45	15.99
9.	*Palaquium ellipticum*	0.8	40	2.00	340.71	7.54	5.88	2.11	15.53
10.	*Aporusa lindleyana*	0.4	40	1.00	390.13	3.77	5.88	2.41	12.06
11.	*Persea macrantha*	0.2	20	1.00	1146.50	1.88	2.94	7.10	11.92
12.	*Artocarpus hirsutus*	0.2	20	1.00	796.12	1.88	2.94	4.93	9.75
13.	*Stereospermum colais*	0.2	20	1.00	644.90	1.88	2.94	3.99	8.81
14.	*Dimocarpus longan*	0.2	20	1.00	447.85	1.88	2.94	2.77	7.59
15.	*Xanthophyllum arnottianum*	0.4	20	2.00	127.39	3.77	2.94	0.78	7.49
16.	*Mallotus philippensis*	0.2	20	1.00	286.62	1.88	2.94	1.77	6.59
17.	*Elaeocarpus glandulosus*	0.2	20	1.00	240.85	1.88	2.94	1.49	6.31
18.	*Alstonia scholaris*	0.2	20	1.00	199.04	1.88	2.94	1.23	6.05
19.	*Lagerstroemia microcarpa*	0.2	20	1.00	127.39	1.88	2.94	0.78	5.6

Species diversity H^{l} = 2.66, Concentration of dominance C = 0.06

Appendix -3. Westcoast Evergreen Forests Chandanakunu - Vegetation Analysis

	NAME	D	%F	AB	BA	RD	RF	RBA	IVI
1.	*Mesua ferrea*	2.6	80	3.25	644.90	18.57	9.52	3.45	31.54
2.	*Calophyllum apetalum*	0.4	20	2.00	4211.78	2.85	2.38	22.54	27.77
3.	*Hopea parviflora*	2	80	2.5	509.55	14.28	9.52	2.73	26.53
4.	*Artocarpus hirsutus*	0.2	20	1.00	4030.65	1.43	2.38	21.57	25.38
5.	*Vateria indica*	0.8	60	1.33	2300.96	5.71	7.14	12.31	25.16
6.	*Cullenia exarillata*	1.6	80	2.00	240.84	11.42	9.52	1.28	22.22
7.	*Aporusa lindleyana*	1.2	60	2.00	127.39	8.57	7.14	0.68	16.39
8.	*Plaquium ellipticum*	1	60	1.66	340.71	7.14	7.14	1.82	16.1
9.	*Knema attenuata*	0.4	40	1.00	1451.03	2.86	4.76	7.76	15.38
10.	*Cinnamomum verum*	0.6	60	1.00	240.84	4.28	7.14	1.28	12.7
11.	*Symplocos cochin* - chinensis	0.4	40	1.00	644.90	2.86	4.76	3.45	11.07
12.	*Poeciloneuron indicum*	0.6	40	1.5	286.62	4.28	4.76	1.53	10.57
13.	*Garcinia gummi* - gutta	0.4	40	1.00	390.13	2.86	4.76	2.08	9.7
14.	*Ficus hispida*	0.2	20	1.00	963.38	1.43	2.38	5.15	8.96
15.	*Bischofia javanica*	0.2	20	1.00	644.90	1.43	2.38	3.45	7.26
16.	*Terminalia crenulata*	0.4	20	2.00	340.71	2.86	2.38	1.82	7.06
17.	*Syzygium cumini*	0.2	20	1.00	509.55	1.43	2.38	2.73	6.54
18.	*Elaeocarpus serratus*	0.2	20	1.00	390.13	1.43	2.38	2.08	5.89
19.	*Dimocarpus longan*	0.2	20	1.00	161.23	1.43	2.38	0.86	4.67
20.	*Diospyros condolleana*	0.2	20	1.00	127.31	1.43	2.38	0.68	4.49
21.	*Actinodaphne bourdillonii*	0.2	20	1.00	127.39	1.43	2.38	0.68	4.49

Species diversity H^{1} = 2.66, Concentration of dominance C = 0.07

Appendix -4. Westcoast Evergreen Forests Mulli - Vegetation Analysis

	Name	D	%F	AB	BA	RD	RF	RBA	IVI
1.	*Mesua ferrea*	2.0	80	2.5	509.55	17.8	10.8	2.88	31.48
2.	*Hopea parviflora*	1.4	80	1.75	1052.95	12.5	10.8	5.95	29.25
3.	*Vateria indica*	0.6	60	1.00	2167.60	5.35	8.1	12.25	25.7
4.	*Antiaris toxicaria*	0.2	20	1.00	3680.33	1.78	2.7	20.81	25.29
5.	*Cullenia exarillata*	0.8	40	2.00	1791.40	7.14	5.4	10.13	22.67
6.	*Persea macrantha*	0.6	20	3.00	1673.96	5.35	2.7	9.46	17.51
7.	*Aporusa lindleyana*	0.4	60	1.33	390.13	7.14	8.10	2.20	17.44
8.	*Palaquium ellipticum*	0.8	60	1.33	340.71	7.14	8.10	1.92	17.16
9.	*Poeciloneuron indicum*	0.8	40	2.00	340.71	7.14	5.4	1.92	14.46
10.	*Kingiodendron pinnatum*	0.4	40	1.00	644.90	3.57	5.4	3.64	12.61
11.	*Elaeocarpus tuberculatus*	0.2	20	1.00	963.38	1.78	2.7	5.44	9.92
12.	*Dimocarpus longan*	0.4	40	1.00	97.53	3.57	5.4	0.55	9.52
13.	*Alstonia scholaris*	0.6	20	3.00	199.04	5.35	2.7	1.12	9.17
14.	*Mitragyna tubulosa*	0.2	20	1.00	796.12	1.78	2.7	4.5	8.98
15.	*Knema attenuata*	0.2	20	1.00	796.12	1.78	2.7	4.5	8.98
16.	*Xanthophyllum arnottianum*	0.2	20	1.00	796.12	1.78	2.7	4.5	8.98
17.	*Vitex altissima*	0.2	20	1.00	447.85	1.78	2.7	2.53	7.01
18.	*Macaranga peltata*	0.2	20	1.00	390.13	1.78	2.7	2.20	6.68
19.	*Mitragyna parviflora*	0.2	20	1.00	340.71	1.78	2.7	1.92	6.4
20.	*Wendlantia bicuspidata*	0.2	20	1.00	199.04	1.78	2.7	1.12	5.6
21.	*Terminalia paniculata*	0.2	20	1.00	62.42	1.78	2.7	0.35	4.83

Species diversity H^{1} = 2.74, Concentration of dominance C = 0.06

Appendix –5. Westcoast Evergreen Forests Venkullam - Vegetation Analysis

	NAME	D	%F	AB	BA	RD	RF	RBA	IVI
1.	*Mesua ferrea*	2.4	100	2.4	340.71	17.39	11.11	1.87	30.37
2.	*Palaquium ellipticum*	1.4	80	1.75	509.55	10.14	8.88	2.80	21.82
3.	*Vateria indica*	1.2	80	1.5	718.55	8.69	8.88	3.95	21.52
4.	*Terminalia bellirica*	0.2	20	1.00	3184.71	1.44	2.22	17.53	21.19
5.	*Cullenia exarillata*	1.2	80	1.5	644.90	8.69	8.88	3.55	21.12
6.	*Poeciloneuron indicum*	1	60	1.66	509.55	7.24	6.66	2.80	16.7
7.	*Cinnamomum verum*	1.2	60	2.00	71.66	8.69	6.66	0.39	15.74
8.	*Xanthophyllum arnottianum*	1	60	1.66	71.66	7.24	6.66	0.39	14.29
9.	*Hopea parviflora*	0.2	20	0.5	1912.82	1.44	2.22	10.53	14.19
10.	*Elaeocarpus tuberculatus*	0.4	20	2.00	1451.03	2.88	2.22	7.99	13.09
11.	*Gmelina arborea*	0.2	20	0.5	1560.50	1.44	2.22	8.59	12.25
12.	*Mitragyna tubulosa*	0.2	20	1.00	1451.03	1.44	2.22	7.99	11.65
13.	*Persea macrantha*	0.2	20	0.5	1345.54	1.44	2.22	7.4	11.06
14.	*Aporusa lindleyana*	0.2	20	0.5	1345.54	1.44	2.22	7.4	11.06
15.	*Goniothalamus rhyncantherus*	0.4	20	2.00	575.24	2.88	2.22	3.16	8.26
16.	*Cinnamomum zeylanicum*	0.2	20	0.5	718.55	1.44	2.22	3.95	7.61
17.	*Carallia brachiata*	0.4	20	0.5	286.62	2.88	2.22	1.57	6.67
18.	*Wendlantia bicuspidata*	0.2	20	1.00	390.13	1.44	2.22	2.14	5.8
19.	*Mallotus philippensis*	0.2	20	0.5	240.84	1.44	2.22	1.32	4.98
20.	*Baccaurea courtallensis*	0.2	20	0.5	240.84	1.44	2.22	1.32	4.98
21.	*Ficus beddomei*	0.2	20	0.5	161.23	1.44	2.22	0.88	4.54
22.	*Lagerstroemia microcarpa*	0.2	20	0.5	161.23	1.44	2.22	0.88	4.54
23.	*Gluta travancorica*	0.2	20	1.00	71.66	1.44	2.22	0.39	4.05
24.	*Tabernaemontana heyneana*	0.2	20	0.5	71.66	1.44	2.22	0.39	4.05
25.	*Terminalia paniculata*	0.2	20	0.5	71.66	1.44	2.22	0.39	4.05
26.	*Dimocarpus longan*	0.2	20	1.00	49.76	1.44	2.22	0.27	3.93

Species diversity $H^1 = 2.89$, Concentration of dominance C = 0.03

Appendix – 6. Westcoast Semi - Evergreen Forests Kappukadu - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Artocarpus hirsutus*	0.10	1.00	10.00	7159.9	1.19	2.17	49.79	53.15
2.	*Aporusa lindleyana*	1.50	3.00	50.00	86.63	17.86	10.87	0.60	29.33
3.	*Tabernaemontana heyneana*	1.20	2.40	50.00	35.08	14.29	10.87	0.24	25.40
4.	*Dalbergia lanceolaria*	1.20	3.00	40.00	140.33	14.29	8.70	0.98	23.97
5.	*Cinnamomum verum*	0.70	2.33	30.00	71.60	8.33	6.52	0.50	15.35
6.	*Careya arborea*	0.40	1.33	30.00	509.15	4.76	6.52	3.54	14.82
7.	*Terminalia crenulata*	0.20	2.00	10.00	1407.2	2.38	2.17	9.79	14.34
8.	*Pterocarpus marsupium*	0.50	2.50	20.00	484.01	5.95	4.35	3.37	13.67
9.	*Terminalia paniculata*	0.30	1.50	20.00	588.39	3.57	4.35	4.09	12.01
10.	*Actinodaphne bourdillonii*	0.20	1.00	20.00	748.53	2.38	4.35	5.21	11.94
11.	*Xanthophyllum arnottianum*	0.30	3.00	10.00	843.99	3.57	2.17	5.87	11.61
12.	*Elaeocarpus tuberculatus*	0.30	1.00	30.00	140.33	3.57	6.52	0.98	11.07
13.	*Buchanania lanceolata*	0.10	1.00	10.00	997.93	1.19	2.17	6.94	10.30
14.	*Vitex altissima*	0.20	1.00	20.00	509.15	2.38	4.35	3.54	10.27
15.	*Lophopetatum wightianum*	0.30	1.50	20.00	45.82	3.57	4.35	0.32	8.24
16.	*Garcinia gummi-gutta*	0.20	1.00	20.00	215.12	2.38	4.35	1.50	8.23
17.	*Symplocos macrophylla ssp.rosea*	0.20	1.00	20.00	86.63	2.38	4.35	0.60	7.33
18.	*Persea macrantha*	0.20	1.00	20.00	38.50	2.38	4.35	0.27	7.00
19.	*Ixora arborea*	0.10	1.00	10.00	206.92	1.19	2.17	1.44	4.80
20.	*Baccaurea courtallensis*	0.10	1.00	10.00	31.82	1.19	2.17	0.22	3.58
21.	*Hydnocarpus pentandra*	0.10	1.00	10.00	31.82	1.19	2.17	0.22	3.58

Species diversity H^1= 2.65, Concentration of dominance C = 0.09

Appendix –7. Westcoast Semi - Evergreen Forests Meppimalai - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Tabernaemontana heyneana*	2.00	4.00	50.00	76.45	25.32	11.90	0.62	37.84
2.	*Aporusa lindleyana*	1.10	2.75	40.00	58.00	13.92	9.52	0.47	23.91
3.	*Dimocarpus longan*	0.10	1.00	10.00	2436.4	1.27	2.38	19.86	23.51
4.	*Pterocarpus marsupium*	0.40	2.00	20.00	1493.2	5.06	4.76	12.17	21.99
5.	*Terminalia paniculata*	0.50	1.25	40.00	616.07	6.33	9.52	5.02	20.87
6.	*Hopea parviflora*	0.10	1.00	10.00	1790.0	1.27	2.38	14.59	18.24
7.	*Lannea coromandelica*	0.70	3.50	20.00	121.00	8.86	4.76	0.99	14.61
8.	*Careya arborea*	0.30	1.50	20.00	588.39	3.80	4.76	4.80	13.36
9.	*Dalbergia lanceolaria*	0.40	1.33	30.00	91.96	5.06	7.14	0.75	12.95
10.	*Vateria indica*	0.10	1.00	10.00	1070.5	1.27	2.38	8.73	12.38
11.	*Terminalia bellirica*	0.10	1.00	10.00	1052.1	1.27	2.38	8.58	12.23
12.	*Calophyllum inophyllum*	0.10	1.00	10.00	1015.8	1.27	2.38	8.28	11.93
13.	*Xanthophyllum arnottianum*	0.40	2.00	20.00	97.45	5.06	4.76	0.79	10.61
14.	*Semecarpus travancorica*	0.10	1.00	10.00	764.04	1.27	2.38	6.23	9.88
15.	*Actinodaphne bourdillonii*	0.20	2.00	10.00	588.39	2.53	2.38	4.80	9.71
16.	*Knema attenuata*	0.30	1.50	20.00	42.08	3.80	4.76	0.34	8.90
17.	*Mastixia arborea subsp.meziana*	0.20	1.00	20.00	86.63	2.53	4.76	0.71	8.00
18.	*Symplocos macrocarpa ssp.rosea*	0.20	1.00	20.00	53.78	2.53	4.76	0.44	7.73
19.	*Gymnacranthera fraquehariana*	0.20	2.00	10.00	49.72	2.53	2.38	0.41	5.32
20.	*Vitex altissima*	0.10	1.00	10.00	53.78	1.27	2.38	0.44	4.09
21.	*Cinnamomum verum*	0.10	1.00	10.00	49.72	1.27	2.38	0.41	4.06
22.	*Artocarpus hirsutus*	0.10	1.00	10.00	45.82	1.27	2.38	0.37	4.02
23.	*Calophyllum apetalum*	0.10	1.00	10.00	25.78	1.27	2.38	0.21	3.86

Species diversity H^{l} = 2.63, Concentration of dominance C = 0.11

Appendix –8. Westcoast Semi - Evergreen Forests Aananeerathi- Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Terminalia bellirica*	0.10	1.00	10.00	7159.9	1.54	2.78	64.82	69.14
2.	*Tabernaemontana heyneana*	1.70	3.40	50.00	127.29	26.15	13.89	1.15	41.19
3.	*Aporusa lindleyana*	1.40	2.80	50.00	42.08	21.54	13.89	0.38	35.81
4.	*Terminalia paniculata*	0.70	1.75	40.00	1164.8	10.77	11.11	10.55	32.43
5.	*Pterocarpus marsupium*	0.30	1.00	30.00	1493.2	4.62	8.33	13.52	26.47
6.	*Hopea parviflora*	0.30	1.00	30.00	231.98	4.62	8.33	2.10	15.05
7.	*Dalbergia lanceolaria*	0.40	2.00	20.00	58.00	6.15	5.56	0.53	12.24
8.	*Ixora arborea*	0.30	1.50	20.00	38.50	4.62	5.56	0.35	10.53
9.	*Helicteres isora*	0.30	1.50	20.00	28.72	4.62	5.56	0.26	10.44
10.	*Symplocos macrocarpa ssp.rosea*	0.20	1.00	20.00	31.82	3.08	5.56	0.29	8.93
11.	*Nothopegia travancorica*	0.20	2.00	10.00	154.02	3.08	2.78	1.39	7.25
12.	*Careya arborea*	0.10	1.00	10.00	276.93	1.54	2.78	2.51	6.83
13.	*Fahrenheitia zeylanica*	0.10	1.00	10.00	81.46	1.54	2.78	0.74	5.06
14.	*Agrostistachys borneensis*	0.10	1.00	10.00	81.46	1.54	2.78	0.74	5.06
15.	*Xanthophyllum arnottianum*	0.10	1.00	10.00	31.82	1.54	2.78	0.29	4.61
16.	*Knema attenuata*	0.10	1.00	10.00	25.78	1.54	2.78	0.23	4.55
17.	*Ixora brachiata*	0.10	1.00	10.00	17.90	1.54	2.78	0.16	4.48

Species diversity H^{1} = 2.32, Concentration of dominance C = 0.12

Appendix – 9. Westcoast Semi - Evergreen Forests Kunnattumudi - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Knema attenuata*	1.10	2.75	40.00	38.50	20.75	12.50	0.32	33.57
2.	*Terminalia paniculata*	0.20	2.00	10.00	2781.9	3.77	3.12	23.04	29.93
3.	*Tabernaemontana heyneana*	0.70	1.75	40.00	97.45	13.21	12.50	0.81	26.52
4.	*Aporusa lindleyana*	0.70	2.33	30.00	161.10	13.21	9.38	1.33	23.92
5.	*Pterocarpus marsupium*	0.40	2.00	20.00	1184.1	7.55	6.25	9.81	23.61
6.	*Terminalia crenulata*	0.20	2.00	10.00	1790.0	3.77	3.12	14.83	21.72
7.	*Diospyros buxifolia*	0.10	1.00	10.00	1790.0	1.89	3.12	14.83	19.84
8.	*Careya arborea*	0.20	1.00	20.00	1126.6	3.77	6.25	9.33	19.35
9.	*Helicteres isora*	0.50	1.67	30.00	31.82	9.43	9.38	0.26	19.07
10.	*Persea macrantha*	0.10	1.00	10.00	1243.0	1.89	3.12	10.30	15.31
11.	*Stereospermum chelonoides*	0.10	1.00	10.00	910.82	1.89	3.12	7.54	12.55
12.	*Hydnocarpus alpina*	0.30	1.50	20.00	49.72	5.66	6.25	0.41	12.32
13.	*Calophyllum inophyllum*	0.10	1.00	10.00	602.15	1.89	3.12	4.99	10.00
14.	*Baccaurea courtallensis*	0.10	1.00	10.00	62.37	1.89	3.12	0.52	5.53
15.	*Madhuca neriifolia*	0.10	1.00	10.00	58.00	1.89	3.12	0.48	5.49
16.	*Ixora brachiata*	0.10	1.00	10.00	49.72	1.89	3.12	0.41	5.42
17.	*Elaeocarpus tuberculatus*	0.10	1.00	10.00	45.82	1.89	3.12	0.38	5.39
18.	*Xanthophyllum arnottianum*	0.10	1.00	10.00	31.82	1.89	3.12	0.26	5.27

Species diversity H^{1} = 2.56, Concentration of dominance C = 0.08

Appendix -10. Westcoast Semi - Evergreen Forests Mattikettakunnu- Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Diospyros buxifolia*	0.10	1.00	10.00	2752.3	2.17	3.03	28.53	33.73
2.	*Terminalia crenulata*	0.40	1.00	40.00	1164.8	8.70	12.12	12.07	32.89
3.	*Knema attenuata*	0.70	1.40	50.00	81.46	15.22	15.15	0.84	31.21
4.	*Tabernaemontana heyneana*	0.80	2.00	40.00	86.63	17.39	12.12	0.90	30.41
5.	*Helicteres isora*	0.80	2.00	40.00	28.72	17.39	12.12	0.30	29.81
6.	*Careya arborea*	0.50	1.67	30.00	240.65	10.87	9.09	2.49	22.45
7.	*Terminalia paniculata*	0.40	1.33	30.00	198.89	8.70	9.09	2.06	19.85
8.	*Pterocarpus marsupium*	0.10	1.00	10.00	1145.6	2.17	3.03	11.88	17.08
9.	*Calophyllum inophyllum*	0.10	1.00	10.00	1070.5	2.17	3.03	11.10	16.30
10.	*Wendlandia thyrsoidea*	0.10	1.00	10.00	910.82	2.17	3.03	9.44	14.64
11.	*Vateria indica*	0.10	1.00	10.00	811.54	2.17	3.03	8.41	13.61
12.	*Mangifera indica*	0.10	1.00	10.00	733.17	2.17	3.03	7.60	12.80
13.	*Dalbergia latifolia*	0.10	1.00	10.00	249.48	2.17	3.03	2.59	7.79
14.	*Calophyllum apetalum*	0.10	1.00	10.00	71.60	2.17	3.03	0.74	5.94
15.	*Aporusa lindleyana*	0.10	1.00	10.00	62.37	2.17	3.03	0.65	5.85
16.	*Ixora brachiata*	0.10	1.00	10.00	38.50	2.17	3.03	0.40	5.60

Species diversity H^{l} = 2.39, Concentration of dominance C = 0.12

Appendix –11. Westcoast Semi - Evergreen Forests Minmutti - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Aporusa lindleyana*	0.60	1.50	40.00	191.01	15.00	11.43	1.18	27.61
2.	*Terminalia paniculata*	0.50	1.25	40.00	367.86	12.50	11.43	2.28	26.21
3.	*Terminalia crenulata*	0.30	1.50	20.00	1672.6	7.50	5.71	10.36	23.57
4.	*Prunus ceylanica*	0.20	2.00	10.00	1790.0	5.00	2.86	11.09	18.95
5.	*Alstonia scholaris*	0.30	1.00	30.00	435.64	7.50	8.57	2.70	18.77
6.	*Carallia brachiata*	0.20	1.00	20.00	1107.7	5.00	5.71	6.86	17.57
7.	*Careya arborea*	0.20	1.00	20.00	1033.9	5.00	5.71	6.41	17.12
8.	*Hopea parviflora*	0.10	1.00	10.00	1886.7	2.50	2.86	11.69	17.05
9.	*Vitex altissima*	0.10	1.00	10.00	1649.6	2.50	2.86	10.22	15.58
10.	*Gluta travancorica*	0.20	1.00	20.00	733.17	5.00	5.71	4.54	15.25
11.	*Pterocarpus marsupium*	0.20	1.00	20.00	644.39	5.00	5.71	3.99	14.70
12.	*Stereospermum chelonoides*	0.10	1.00	10.00	1164.8	2.50	2.86	7.22	12.58
13.	*Artocarpus hirsutus*	0.10	1.00	10.00	1070.5	2.50	2.86	6.63	11.99
14.	*Ficus tsjahela*	0.10	1.00	10.00	860.46	2.50	2.86	5.33	10.69
15.	*Calophyllum inophyllum*	0.10	1.00	10.00	401.03	2.50	2.86	2.48	7.84
16.	*Xanthophyllum arnottianum*	0.10	1.00	10.00	315.75	2.50	2.86	1.96	7.32
17.	*Garcinia gummi-gutta*	0.10	1.00	10.00	249.48	2.50	2.86	1.55	6.91
18.	*Carallia brachiata*	0.10	1.00	10.00	198.89	2.50	2.86	1.23	6.59
19.	*Artocarpus heterophyllus*	0.10	1.00	10.00	175.74	2.50	2.86	1.09	6.45
20.	*Knema attenuata*	0.10	1.00	10.00	86.63	2.50	2.86	0.54	5.90
21.	*Ixora nigricans*	0.10	1.00	10.00	53.78	2.50	2.86	0.33	5.69
22.	*Hydnocarpus pentandra*	0.10	1.00	10.00	49.72	2.50	2.86	0.31	5.67

Species diversity $H^1 = 2.88$, Concentration of dominance C = 0.81

Appendix –12. Westcoast Semi - Evergreen Forests Chandanakunnu - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Pterocarpus marsupium*	0.40	1.33	30.00	2932.7	10.53	8.82	17.93	37.28
2.	*Ficus tsjahela*	0.30	1.50	20.00	2752.3	7.89	5.88	16.82	30.59
3.	*Careya arborea*	0.50	1.67	30.00	748.53	13.16	8.82	4.58	26.56
4.	*Vateria indica*	0.30	1.00	30.00	1145.6	7.89	8.82	7.00	23.71
5.	*Humboldtia vahliana*	0.30	1.00	30.00	860.46	7.89	8.82	5.26	21.97
6.	*Tabernaemontana heyneana*	0.30	1.00	30.00	336.12	7.89	8.82	2.05	18.76
7.	*Terminalia crenulata*	0.20	1.00	20.00	1126.6	5.26	5.88	6.89	18.03
8.	*Aporusa lindleyana*	0.30	1.00	30.00	161.10	7.89	8.82	0.98	17.69
9.	*Terminalia paniculata*	0.10	1.00	10.00	1649.6	2.63	2.94	10.08	15.65
10.	*Vitex altissima*	0.10	1.00	10.00	1365.2	2.63	2.94	8.34	13.91
11.	*Hydnocarpus pentandra*	0.20	1.00	20.00	305.81	5.26	5.88	1.87	13.01
12.	*Palaquium ellipticum*	0.10	1.00	10.00	1203.6	2.63	2.94	7.36	12.93
13.	*Artocarpus heterophyllus*	0.20	1.00	20.00	191.01	5.26	5.88	1.17	12.31
14.	*Gluta travancorica*	0.10	1.00	10.00	748.53	2.63	2.94	4.58	10.15
15.	*Mallotus tetracoccus*	0.10	1.00	10.00	534.92	2.63	2.94	3.27	8.84
16.	*Helicteres isora*	0.10	1.00	10.00	198.89	2.63	2.94	1.22	6.79
17.	*Goniothalamus wightii*	0.10	1.00	10.00	49.72	2.63	2.94	0.30	5.87
18.	*Actinodaphne bourdillonii*	0.10	1.00	10.00	49.72	2.63	2.94	0.30	5.87

Species diversity H^{1} = 2.73, Concentration of dominance C = 0.04

Appendix –13. Westcoast Semi-Evergreen Forests Eadamalai - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Aporusa lindleyana*	1.80	3.60	50.00	276.93	38.30	15.15	2.04	55.49
2.	*Terminalia paniculata*	0.30	1.00	30.00	2871.9	6.38	9.09	21.18	36.65
3.	*Pterocarpus marsupium*	0.20	1.00	20.00	2664.2	4.26	6.06	19.65	29.97
4.	*Calophyllum apetalum*	0.30	1.00	30.00	962.61	6.38	9.09	7.10	22.57
5.	*Lagerstroemia speciosa*	0.20	1.00	20.00	1203.6	4.26	6.06	8.88	19.20
6.	*Vateria indica*	0.10	1.00	10.00	1790.0	2.13	3.03	13.20	18.36
7.	*Mesua nagasarium*	0.30	1.00	30.00	315.75	6.38	9.09	2.33	17.80
8.	*Vitex altissima*	0.30	1.00	30.00	286.40	6.38	9.09	2.11	17.58
9.	*Gluta travancorica*	0.10	1.00	10.00	1203.6	2.13	3.03	8.88	14.04
10.	*Diospyros buxifolia*	0.30	1.50	20.00	191.01	6.38	6.06	1.41	13.85
11.	*Tabernaemontana heyneana*	0.20	1.00	20.00	336.12	4.26	6.06	2.48	12.80
12.	*Ficus tsjahela*	0.20	1.00	20.00	223.47	4.26	6.06	1.65	11.97
13.	*Knema attenuata*	0.10	1.00	10.00	811.54	2.13	3.03	5.98	11.14
14.	*Diospyros paniculata*	0.10	1.00	10.00	258.47	2.13	3.03	1.91	7.07
15.	*Carallia brachiata*	0.10	1.00	10.00	133.73	2.13	3.03	0.99	6.15
16.	*Hydnocarpus pentandra*	0.10	1.00	10.00	31.82	2.13	3.03	0.23	5.39

Species diversity H^{l} = 2.97, Concentration of dominance C = 0.15

Appendix –14. Westcoast Semi - Evergreen Forests Pechiyam - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Pterocarpus marsupium*	0.30	1.50	20.00	1515.0	8.11	7.14	17.52	32.77
2.	*Aporusa lindleyana*	0.60	1.50	40.00	154.02	16.22	14.29	1.78	32.29
3.	*Ficus tsjahela*	0.50	1.25	40.00	267.62	13.51	14.29	3.10	30.90
4.	*Mesua nagasarium*	0.50	2.50	20.00	140.33	13.51	7.14	1.62	22.27
5.	*Gluta travancorica*	0.10	1.00	10.00	1303.4	2.70	3.57	15.08	21.35
6.	*Calophyllum apetalum*	0.10	1.00	10.00	1303.4	2.70	3.57	15.08	21.35
7.	*Agrostistachys borneensis*	0.10	1.00	10.00	1243.0	2.70	3.57	14.38	20.65
8.	*Kingiodendron pinnatum*	0.10	1.00	10.00	1184.1	2.70	3.57	13.70	19.97
9.	*Tabernaemontana heyneana*	0.30	1.50	20.00	378.76	8.11	7.14	4.38	19.63
10.	*Elaeocarpus tuberculatus*	0.20	1.00	20.00	336.12	5.41	7.14	3.89	16.44
11.	*Xanthophyllum arnottianum*	0.20	1.00	20.00	108.91	5.41	7.14	1.26	13.81
12.	*Terminalia paniculata*	0.20	2.00	10.00	336.12	5.41	3.57	3.89	12.87
13.	*Vitex altissima*	0.10	1.00	10.00	223.47	2.70	3.57	2.59	8.86
14.	*Hydnocarpus pentandra*	0.10	1.00	10.00	62.37	2.70	3.57	0.72	6.99
15.	*Syzygium mundagam*	0.10	1.00	10.00	38.50	2.70	3.57	0.45	6.72
16.	*Symplocos macrocarpa* ssp. *macrocarpa*	0.10	1.00	10.00	31.82	2.70	3.57	0.37	6.64
17.	Cinnamomum malabatrum	0.10	1.00	10.00	17.90	2.70	3.57	0.21	6.48

Species diversity H^{l} = 2.59, Concentration of dominance C = 0.09

Appendix –15. Westcoast Semi - Evergreen Forests Erinjamalai - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Aporusa lindleyana*	0.90	2.25	40.00	296.02	27.27	17.39	3.18	47.84
2.	*Terminalia paniculata*	0.60	2.00	30.00	1089.0	18.18	13.04	11.68	42.90
3.	*Pterocarpus marsupium*	0.30	1.50	20.00	2113.7	9.09	8.70	22.68	40.47
4.	*Terminalia crenulata*	0.10	1.00	10.00	1365.2	3.03	4.35	14.65	22.03
5.	*Palaquium ellipticum*	0.10	1.00	10.00	1145.6	3.03	4.35	12.29	19.67
6.	*Xanthophyllum arnottianum*	0.30	1.50	20.00	103.10	9.09	8.70	1.11	18.90
7.	*Cullenia exarillata*	0.10	1.00	10.00	1052.1	3.03	4.35	11.29	18.67
8.	*Careya arborea*	0.10	1.00	10.00	459.51	3.03	4.35	4.93	12.31
9.	*Vitex altissima*	0.10	1.00	10.00	401.03	3.03	4.35	4.30	11.68
10.	*Lagerstroemia speciosa*	0.10	1.00	10.00	389.82	3.03	4.35	4.18	11.56
11.	*Ixora arborea*	0.10	1.00	10.00	286.40	3.03	4.35	3.07	10.45
12.	*Ficus tsjahela*	0.10	1.00	10.00	223.47	3.03	4.35	2.40	9.78
13.	*Mitragyna tubulosa*	0.10	1.00	10.00	127.29	3.03	4.35	1.37	8.75
14.	*Garcinia gummi-gutta*	0.10	1.00	10.00	114.88	3.03	4.35	1.23	8.61
15.	*Tabernaemontana heyneana*	0.10	1.00	10.00	103.10	3.03	4.35	1.11	8.49
16.	*Actinodaphne malabarica*	0.10	1.00	10.00	49.72	3.03	4.35	0.53	7.91

Species diversity H^{l}= 2.37, Concentration of dominance C = 0.13

Appendix –16. Southern Mixed Moist Deciduous Forests Kappukadu - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Terminalia paniculata*	7.33	7.33	100.00	231.98	43.14	15.00	4.93	63.07
2.	*Pterocarpus marsupium*	2.33	2.33	100.00	1089.0	13.73	15.00	23.16	51.89
3.	*Terminalia crenulata*	1.00	1.50	66.67	1070.5	5.88	10.00	22.77	38.65
4.	*Careya arborea*	2.00	2.00	100.00	231.98	11.76	15.00	4.93	31.69
5.	*Terminalia chebula*	0.33	1.00	33.33	910.82	1.96	5.00	19.37	26.33
6.	*Dillenia pentagyna*	0.67	1.00	66.67	561.34	3.92	10.00	11.94	25.86
7.	*Tabernaemontana divaricata*	1.00	3.00	33.33	357.12	5.88	5.00	7.60	18.48
8.	*Artocarpus hirsutus*	0.67	2.00	33.33	97.45	3.92	5.00	2.07	10.99
9.	*Phyllanthus emblica*	0.67	2.00	33.33	35.08	3.92	5.00	0.75	9.67
10.	*Trema orientalis*	0.33	1.00	33.33	49.72	1.96	5.00	1.06	8.02
11.	*Aporusa lindleyana*	0.33	1.00	33.33	35.08	1.96	5.00	0.75	7.71
12.	*Helicteres isora*	0.33	1.00	33.33	31.82	1.96	5.00	0.68	7.64

Species diversity H^{l}= 1.90, Concentration of dominance C = 0.26

Appendix –17. Southern Mixed Moist Deciduous Forests Meppimalai - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Terminalia paniculata*	11.00	11.00	100.00	175.74	49.25	12.50	2.79	64.54
2.	*Pterocarpus marsupium*	2.33	2.33	100.00	1695.8	10.45	12.50	26.90	49.85
3.	*Terminalia crenulata*	0.33	1.00	33.33	2353.5	1.49	4.17	37.34	43.00
4.	*Terminalia chebula*	1.33	2.00	66.67	509.15	5.97	8.33	8.08	22.38
5.	*Careya arborea*	1.33	2.00	66.67	346.54	5.97	8.33	5.50	19.80
6.	*Tabernaemontana divaricata*	1.33	2.00	66.67	168.34	5.97	8.33	2.67	16.97
7.	*Buchanania lanzan*	0.67	1.00	66.67	336.12	2.99	8.33	5.33	16.65
8.	*Dalbergia latifolia*	1.33	2.00	66.67	42.08	5.97	8.33	0.67	14.97
9.	*Phyllanthus emblica*	0.67	1.00	66.67	127.29	2.99	8.33	2.02	13.34
10.	*Madhuca neriifolia*	0.33	1.00	33.33	215.12	1.49	4.17	3.41	9.07
11.	*Artocarpus hirsutus*	0.33	1.00	33.33	127.29	1.49	4.17	2.02	7.68
12.	*Dalbergia lanceolaria*	0.67	2.00	33.33	25.78	2.99	4.17	0.41	7.57
13.	*Macaranga peltata*	0.33	1.00	33.33	108.91	1.49	4.17	1.73	7.39
14.	*Terminalia bellirica*	0.33	1.00	33.33	71.60	1.49	4.17	1.14	6.80

Species diversity H^{I} = 1.88, Concentration of dominance C = 0.26

Appendix –18. Southern Mixed Moist Deciduous Forests Minmutti - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Terminalia paniculata*	7.67	7.67	100.00	258.47	32.39	10.71	4.86	47.96
2.	*Terminalia bellirica*	0.33	1.00	33.33	1790.0	1.41	3.57	33.66	38.64
3.	*Dillenia pentagyna*	2.67	2.67	100.00	534.92	11.27	10.71	10.06	32.04
4.	*Terminalia crenulata*	1.67	2.50	66.67	644.39	7.04	7.14	12.12	26.30
5.	*Careya arborea*	1.33	1.33	100.00	423.95	5.63	10.71	7.97	24.31
6.	*Buchanania lanzan*	1.00	1.50	66.67	602.15	4.23	7.14	11.32	22.69
7.	*Tabernaemontana divaricata*	3.00	4.50	66.67	42.08	12.68	7.14	0.79	20.61
8.	*Terminalia chebula*	1.00	1.50	66.67	315.75	4.23	7.14	5.94	17.31
9.	*Phyllanthus emblica*	1.00	1.50	66.67	35.08	4.23	7.14	0.66	12.03
10.	*Elaeocarpus glandulosus*	0.67	1.00	66.67	81.46	2.82	7.14	1.53	11.49
11.	*Aporusa lindleyana*	0.67	1.00	66.67	28.72	2.82	7.14	0.54	10.50
12.	*Trema orientalis*	0.33	1.00	33.33	286.40	1.41	3.57	5.39	10.37
13.	*Dalbergia lanceolaria*	1.33	4.00	33.33	31.82	5.63	3.57	0.60	9.80
14.	*Semecarpus anacardium*	0.67	2.00	33.33	114.88	2.82	3.57	2.16	8.55
15.	*Actinodaphne bourdillonii*	0.33	1.00	33.33	127.29	1.41	3.57	2.39	7.37

Species diversity H^{l} = 2.26, Concentration of dominance C = 0.14

Appendix –19. Southern Mixed Moist Deciduous Forests Ananerathi - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	PF	RBA	IVI
1.	*Pterocarpus marsupium*	6.00	6.00	100.00	1089.0	40.91	16.67	24.49	82.07
2.	*Terminalia paniculata*	2.67	2.67	100.00	1052.1	18.18	16.67	23.66	58.51
3.	*Terminalia crenulata*	1.67	1.67	100.00	764.04	11.36	16.67	17.18	45.21
4.	*Careya arborea*	1.00	1.50	66.67	1070.5	6.82	11.11	24.07	42.00
5.	*Tabernaemontana divaricata*	1.00	3.00	33.33	49.72	6.82	5.56	1.12	13.50
6.	*Knema attenuata*	0.67	2.00	33.33	38.50	4.55	5.56	0.87	10.98
7.	*Ixora arborea*	0.33	1.00	33.33	114.88	2.27	5.56	2.58	10.41
8.	*Macaranga peltata*	0.33	1.00	33.33	97.45	2.27	5.56	2.19	10.02
9.	*Dillenia pentagyna*	0.33	1.00	33.33	81.46	2.27	5.56	1.83	9.66
10.	*Symplocos macrophylla* ssp. *zeylanicus*	0.33	1.00	33.33	71.60	2.27	5.56	1.61	9.44
11.	*Trema orientalis*	0.33	1.00	33.33	17.90	2.27	5.56	0.40	8.23

Species diversity H^{l} = 1.85, Concentration of dominance C = 0.20

Appendix –20. Southern Mixed Moist Deciduous Forests Kunattumudi - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Pterocarpus marsupium*	6.67	6.67	100.00	658.79	48.78	21.43	31.05	101.26
2.	*Terminalia crenulata*	2.33	2.33	100.00	602.15	17.07	21.43	28.38	66.88
3.	*Terminalia paniculata*	2.33	2.33	100.00	367.86	17.07	21.43	17.34	55.84
4.	*Careya arborea*	1.00	1.50	66.67	258.47	7.32	14.29	12.18	33.79
5.	*Terminalia bellirica*	0.67	2.00	33.33	140.33	4.88	7.14	6.61	18.63
6.	*Dillenia pentagyna*	0.33	1.00	33.33	62.37	2.44	7.14	2.94	12.52
7.	*Macaranga peltata*	0.33	1.00	33.33	31.82	2.44	7.14	1.50	11.08

Species diversity H^{1}= 1.47, Concentration of dominance C = 0.28

Appendix –21. Southern Mixed Moist Deciduous Forests Mattikettakunnu - Vegetation Analysis

	NAME	D	AB	%F	BA	RD	RF	RBA	IVI
1.	*Pterocarpus marsupium*	6.67	6.67	100.00	435.64	38.46	21.43	12.61	72.50
2.	*Terminalia paniculata*	5.67	5.67	100.00	315.75	32.69	21.43	9.14	63.26
3.	*Terminalia bellirica*	1.00	1.50	66.67	1070.5	5.77	14.29	30.98	51.04
4.	*Terminalia crenulata*	2.67	4.00	66.67	548.05	15.38	14.29	15.86	45.53
5.	*Dillenia pentagyna*	0.33	1.00	33.33	509.15	1.92	7.14	14.73	23.79
6.	*Careya arborea*	0.33	1.00	33.33	423.95	1.92	7.14	12.27	21.33
7.	*Tabernaemontana divaricata*	0.33	1.00	33.33	121.00	1.92	7.14	3.50	12.56
8.	*Phyllanthus emblica*	0.33	1.00	33.33	31.82	1.92	7.14	0.92	9.98

Species diversity H^{1}= 1.48, Concentration of dominance C = 0.26

Appendix –22. Westcoast evergreen forests - vegetation analysis (Mean values)

	NAME	RD	RF	RBA	IVI
1.	*Mesua ferrea*	14.65	9.46	2.97	27.08
2.	*Cullenia exarillata*	10.55	8.52	4.86	23.93
3.	*Hopea parviflora*	8.66	6.86	5.14	20.66
4.	*Vateria indica*	5.18	6.32	6.38	17.88
5.	*Palaquium ellipticum*	7.93	7.50	2.40	17.83
6.	*Aporusa lindleyana*	7.56	6.66	2.88	17.10
7.	*Poeciloneuron indicum*	6.84	6.62	1.89	15.35
8.	*Elaeocarpus tuberculatus*	2.37	2.66	8.59	13.62
9.	*Persea macrantha*	2.04	2.07	6.08	10.19
10.	*Artocarpus hirsutus*	1.27	2.06	6.78	10.11
11.	*Xanthophyllum arnottianum*	4.40	3.96	1.28	9.64
12.	*Antiaris toxicaria*	0.97	1.04	7.24	9.25
13.	*Symplocos cochin - chinensis*	2.45	2.71	1.88	7.04
14.	*Dimocarpus longan*	2.27	3.58	1.19	7.04
15.	*Mitragyna tubulosa*	0.95	1.48	4.17	6.60
16.	*Hydnocarpus macrocarpa*	0.37	0.58	5.21	6.16
17.	*Baccaurea courtallensis*	2.17	2.20	1.35	5.72
18.	*Cinnamomum verum*	2.59	2.76	0.33	5.68
19.	*Calophyllum apetalum*	0.57	0.47	4.50	5.54
20.	*Macaranga peltata*	0.66	1.04	3.52	5.22
21.	*Knema attenuata*	0.92	1.49	2.45	4.86
22.	*Alstonia scholaris*	2.06	2.18	0.62	4.86
23.	*Terminalia bellirica*	0.28	0.44	3.50	4.22
24.	*Kingiodendron pinnatum*	0.71	1.08	0.72	2.51
25.	*Diospyros buxifolia*	0.30	0.50	1.67	2.47
26.	*Gmelina arborea*	0.28	0.44	1.71	2.43
27.	*Mallotus philippensis*	0.66	1.03	0.61	2.30
28.	*Wendlantia bicuspidata*	0.64	0.98	0.68	2.30
29.	*Lagerstroemia microcarpa*	0.66	1.03	0.33	2.02
30.	*Meiogyne pannosa*	0.30	0.50	1.20	2.00
31.	*Garcinia gummi - gutta*	0.57	0.95	0.41	1.93
32.	*Ficus hispida*	0.28	0.47	1.03	1.78
33.	*Terminalia paniculata*	0.64	0.98	0.14	1.76
34.	*Stereospermum colais*	0.37	0.58	0.79	1.74
35.	*Goniothalamus rhyncantherus*	0.57	0.44	0.63	1.64
36.	*Cinnamomum zeylanicum*	0.28	0.44	0.79	1.51
37.	*Bischofia javanica*	0.28	0.47	0.69	1.44
38.	*Terminalia crenulata*	0.57	0.47	0.36	1.40
39.	*Vitex altissima*	0.35	0.54	0.50	1.39
40.	*Carallia brachiata*	0.57	0.44	0.31	1.32
41.	*Syzygium cumini*	0.28	0.47	0.54	1.29
42.	*Mitragyna parviflora*	0.35	0.54	0.38	1.27
43.	*Elaeocarpus glandulosus*	0.37	0.58	0.29	1.24
44.	*Bassia latifolia*	0.61	0.50	0.09	1.20
45.	*Elaeocarpus serratus*	0.28	0.47	0.41	1.16
46.	*Holigarna arnottiana*	0.30	0.50	0.30	1.10
47.	*Ficus beddomei*	0.28	0.44	0.17	0.89
48.	*Actinodaphne bourdillonii*	0.28	0.47	0.13	0.88
49.	*Diospyros condolleana*	0.28	0.47	0.13	0.88
50.	*Dipterocarpus bourdillonii*	0.30	0.50	0.05	0.85
51.	*Tabernaemontana heyneana*	0.28	0.44	0.07	0.79
52.	*Gluta travncorica*	0.28	0.44	0.07	0.79

Appendix –23. West Coast Semi-evergreen Forests - Vegetation Analysis (Mean values)

	NAME	RD	RF	RBA	IVI
1.	*Pterocarpus marsupium*	9.57	7.35	14.72	31.64
2.	*Terminalia paniculata*	9.26	9.08	9.44	27.78
3.	*Aporusa lindleyana*	16.01	10.43	1.12	27.56
4.	*Tabernaemontana heyneana*	10.64	7.51	1.23	19.38
5.	*Terminalia crenulata*	3.82	4.69	7.09	15.60
6.	*Careya arborea*	4.89	5.31	5.33	15.53
7.	*Ficus tsjahela*	3.11	3.34	2.93	9.38
8.	*Vitex altissima*	2.08	2.95	3.15	8.18
9.	*Terminalia bellirica*	0.28	0.51	7.34	8.13
10.	*Knema attenuata*	2.97	3.41	0.88	7.26
11.	*Artocarpus hirsutus*	0.49	0.74	5.67	6.90
12.	*Vateria indica*	1.34	1.72	3.73	6.79
13.	*Xanthophyllum arnottianum*	2.71	2.84	1.12	6.67
14.	*Gluta travancorica*	1.24	1.52	3.54	6.30
15.	*Calophyllum apetalum*	1.25	1.80	2.31	5.36
16.	*Hopea parviflora*	0.83	1.35	2.83	5.01
17.	*Dalbergia lanceolaria*	2.55	2.14	0.22	4.91
18.	*Diospyros buxifolia*	0.85	0.90	2.99	4.74
19.	*Helicteres isora*	2.46	2.06	0.17	4.69
20.	*Mesua ferrea*	1.98	1.62	0.39	3.99
21.	*Ixora arborea*	1.11	1.76	0.74	3.61
22.	*Calophyllum inophyllum*	0.59	0.82	2.18	3.59
23.	*Hydnocarpus pentandra*	1.37	1.75	0.33	3.45
24.	*Palaquium ellipticum*	0.56	0.72	1.96	3.24
25.	*Lagerstroemia speciosa*	0.72	1.04	1.30	3.06
26.	*Actinodaphne bourdillonii*	0.75	0.96	1.03	2.74
27.	*Elaeocarpus tuberculatus*	0.89	1.36	0.48	2.73
28.	*Agrostistachys borneensis*	0.39	0.62	1.50	2.51
29.	*Symplocos macrophylla* ssp.*rosea*	0.79	1.46	0.13	2.38
30.	*Carallia brachiata*	0.71	0.87	0.78	2.36
31.	*Garcinia gummi-gutta*	0.79	1.15	0.42	2.36
32.	*Dimocarpus longan*	0.12	0.23	1.98	2.33
33.	*Humboldtia vahliana*	0.78	0.88	0.52	2.18
34.	*Kingiodendron pinnatum*	0.27	0.35	1.37	1.99
35.	*Cinnamomum verum*	0.96	0.89	0.09	1.94

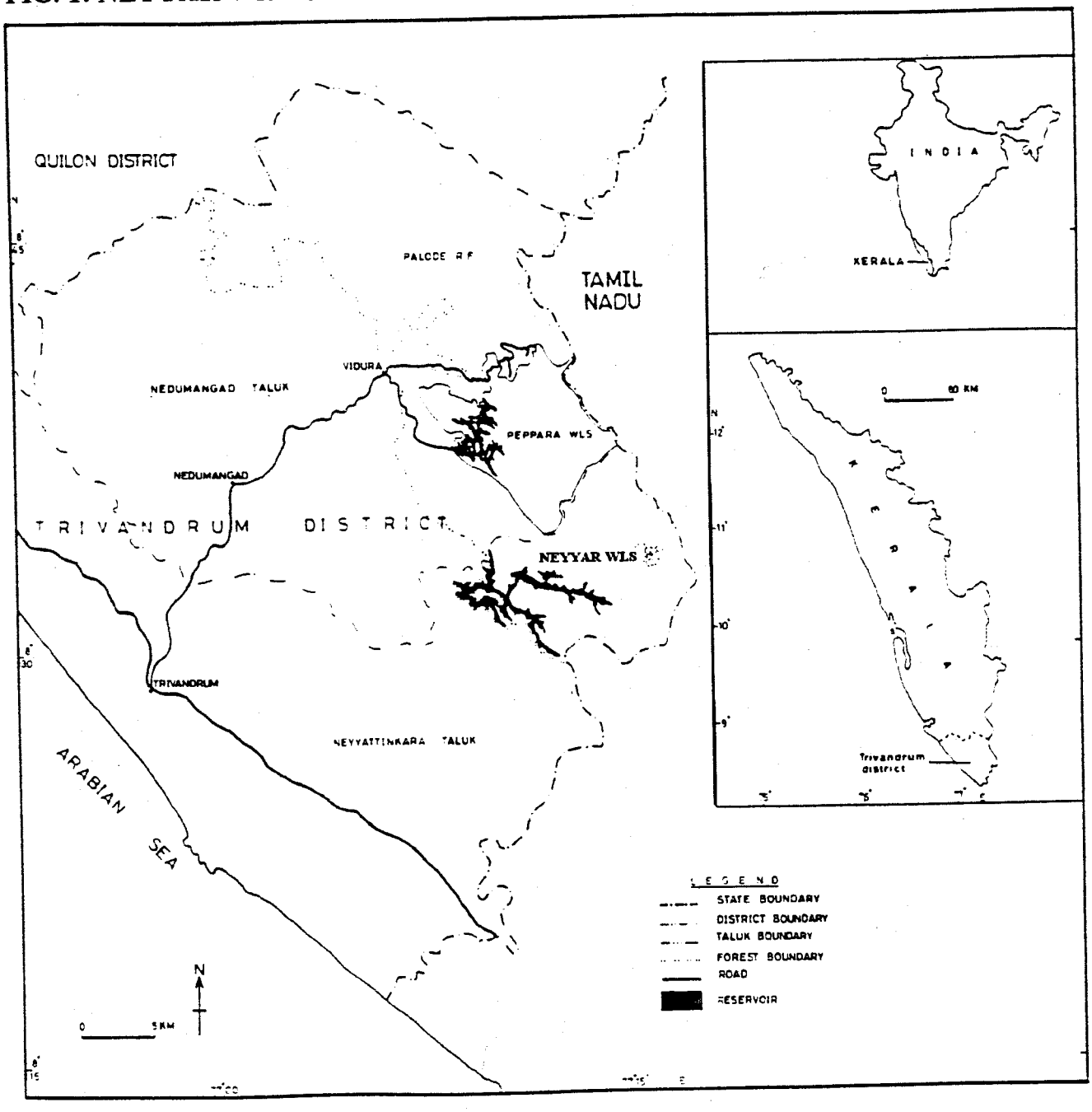
Appendix 23 contd.

	NAME	RD	RF	RBA	IVI
36.	*Prunus ceylanica*	0.50	0.28	1.10	1.88
37.	*Astonia scholaris*	0.75	0.85	0.27	1.87
38.	*Artocarpus heterophyllus*	0.77	0.87	0.22	1.86
39.	*Cullenia exarillata*	0.30	0.43	1.12	1.85
40.	*Wendlandia bicuspidata*	0.21	0.30	0.94	1.45
41.	*Lannea coromandelica*	0.88	0.47	0.09	1.44
42.	*Persea macrantha*	0.48	0.72	0.15	1.35
43.	*Tabernaemontana divaricata*	0.68	0.55	0.11	1.34
44.	*Mangifera indica*	0.21	0.30	0.76	1.27
45.	*Stereospermum chelonoides*	0.25	0.28	0.72	1.25
46.	*Buchanania lanceolata*	0.11	0.21	0.69	1.01
47.	*Macaranga peltata*	0.22	0.55	0.21	0.98
48.	*Semecarpus travancorica*	0.12	0.23	0.62	0.97
49.	*Dillenia pentagyna*	0.22	0.55	0.18	0.95
50.	*Symplocos macrophylla* ssp. *zeylanicus*	0.22	0.55	0.16	0.93
51.	*Mallotus tetracoccus*	0.26	0.29	0.32	0.87
52.	*Mitragyna tubulosa*	0.30	0.43	0.13	0.86
53.	*Lophopetatum wightianum*	0.35	0.43	0.03	0.81
54.	*Trema orientalis*	0.22	0.55	0.04	0.81
55.	*Mastixia arborea* ssp. *meziana*	0.25	0.47	0.07	0.79
56.	*Actinodaphne malabarica*	0.30	0.43	0.05	0.78
57.	*Dalbergia latifolia*	0.21	0.30	0.25	0.76
58.	*Diospyros paniculata*	0.21	0.30	0.19	0.70
59.	*Nothopegia travancorica*	0.30	0.27	0.13	0.70
60.	*Syzygium mundagam*	0.27	0.35	0.04	0.66
61.	*Symplocos macrocarpa* ssp. *macrocarpa*	0.27	0.35	0.03	0.65
62.	*Cinnamomum malabatrum*	0.27	0.35	0.02	0.64
63.	*Goniothalamus wightii*	0.26	0.29	0.03	0.58
64.	*Ixora nigricans*	0.25	0.28	0.03	0.56
65.	*Ixora brachiata*	0.21	0.30	0.04	0.55
66.	*Gymnacranthera fraquehariana*	0.25	0.23	0.04	0.52
67.	*Fahrenheitia zeylancica*	0.15	0.27	0.07	0.49
68.	*Dipterocarpus indicus*	0.15	0.22	0.01	0.38
69.	*Baccaurea courtallensis*	0.11	0.21	0.02	0.34

Appendix –24. Southern mixed moist deciduous forests - vegetation analysis (Mean values)

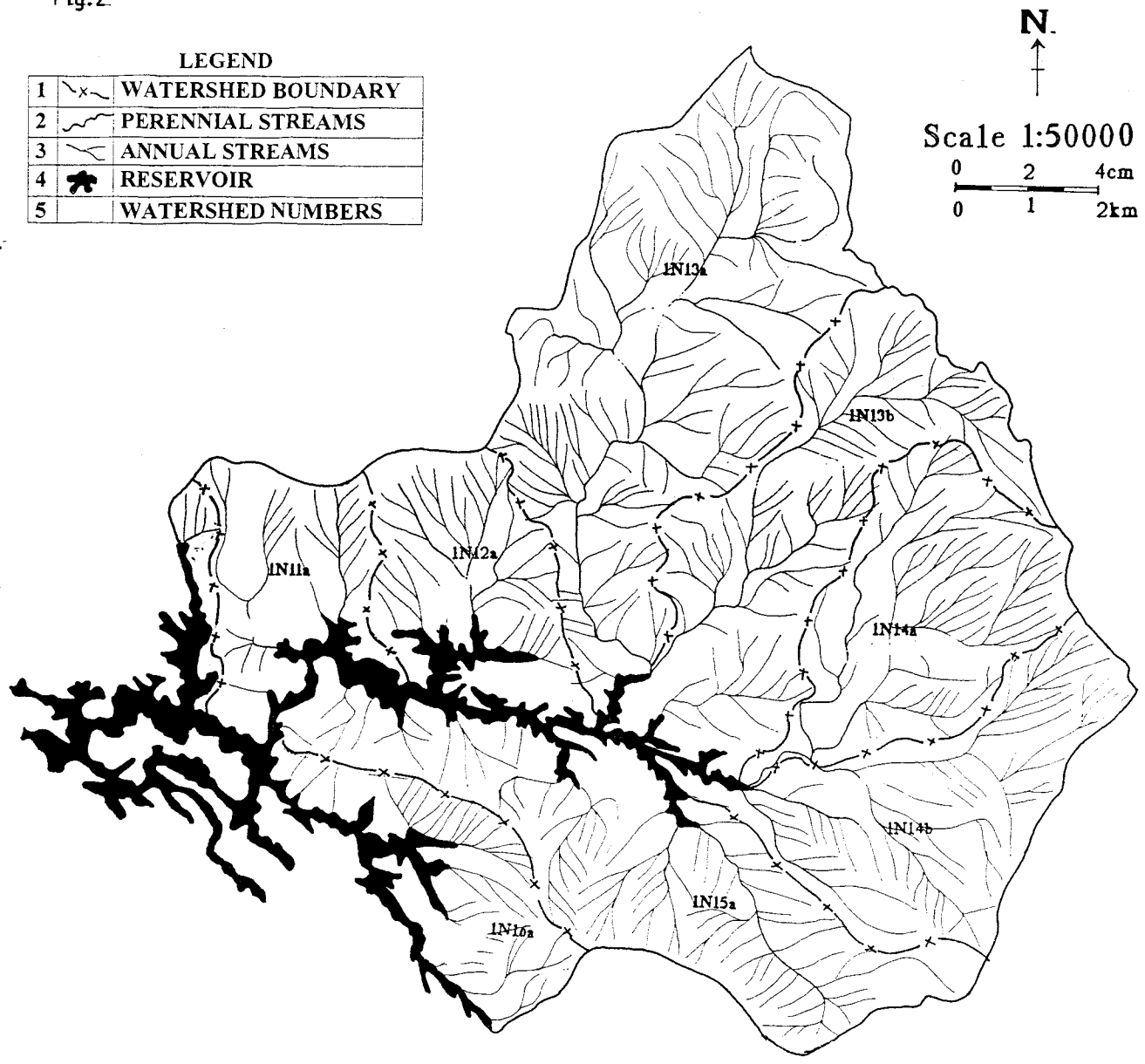
	NAME	RD	RF	RBA	IVI
1.	*Pterocarpus marsupium*	25.38	14.50	19.70	59.58
2.	*Terminalia paniculata*	32.12	16.29	10.45	58.86
3.	*Terminalia crenulata*	9.70	12.28	22.27	44.25
4.	*Careya arborea*	6.57	11.09	11.15	28.81
5.	*Terminalia bellirica*	2.25	4.86	12.06	19.17
6.	*Dillenia pentagyna*	3.63	6.05	6.91	16.59
7.	*Tabernaemontana divaricata*	5.54	5.52	2.61	13.67
8.	*Terminalia chebula*	2.02	3.51	5.56	11.09
9.	*Phyllanthus emblica*	2.17	4.60	0.72	7.49
10.	*Buchanania lanzan*	1.20	2.57	2.77	6.54
11.	*Macaranga peltata*	1.03	2.81	0.90	4.74
12.	*Trema orientalis*	0.94	2.35	1.12	4.41
13.	*Artocarpus hirsutus*	0.90	1.52	0.68	3.10
14.	*Aporusa lindleyana*	0.79	2.02	0.21	3.02
15.	*Dalbergia lanceolaria*	1.43	1.29	0.16	2.88
16.	*Dalbergia latifolia*	0.99	1.38	0.11	2.48
17.	*Elaeocarpus glandulosus*	0.47	1.19	0.25	1.91
18.	*Knema attenuata*	0.75	0.92	0.14	1.81
19.	*Ixora arborea*	0.37	0.92	0.43	1.72
20.	*Symplocos macrophylla* ssp. *zeylanicus*	0.37	0.92	0.26	1.55
21.	*Madhuca neriifolia*	0.24	0.69	0.56	1.49
22.	*Semecarpus anacardium*	0.47	0.59	0.36	1.42
23.	*Helicteres isora*	0.32	0.83	0.11	1.26
24.	*Actinodaphne bourdillonii*	0.23	0.59	0.40	1.22

FIG. 1: NEYYAR WILDLIFE SANCTUARY - LOCATION



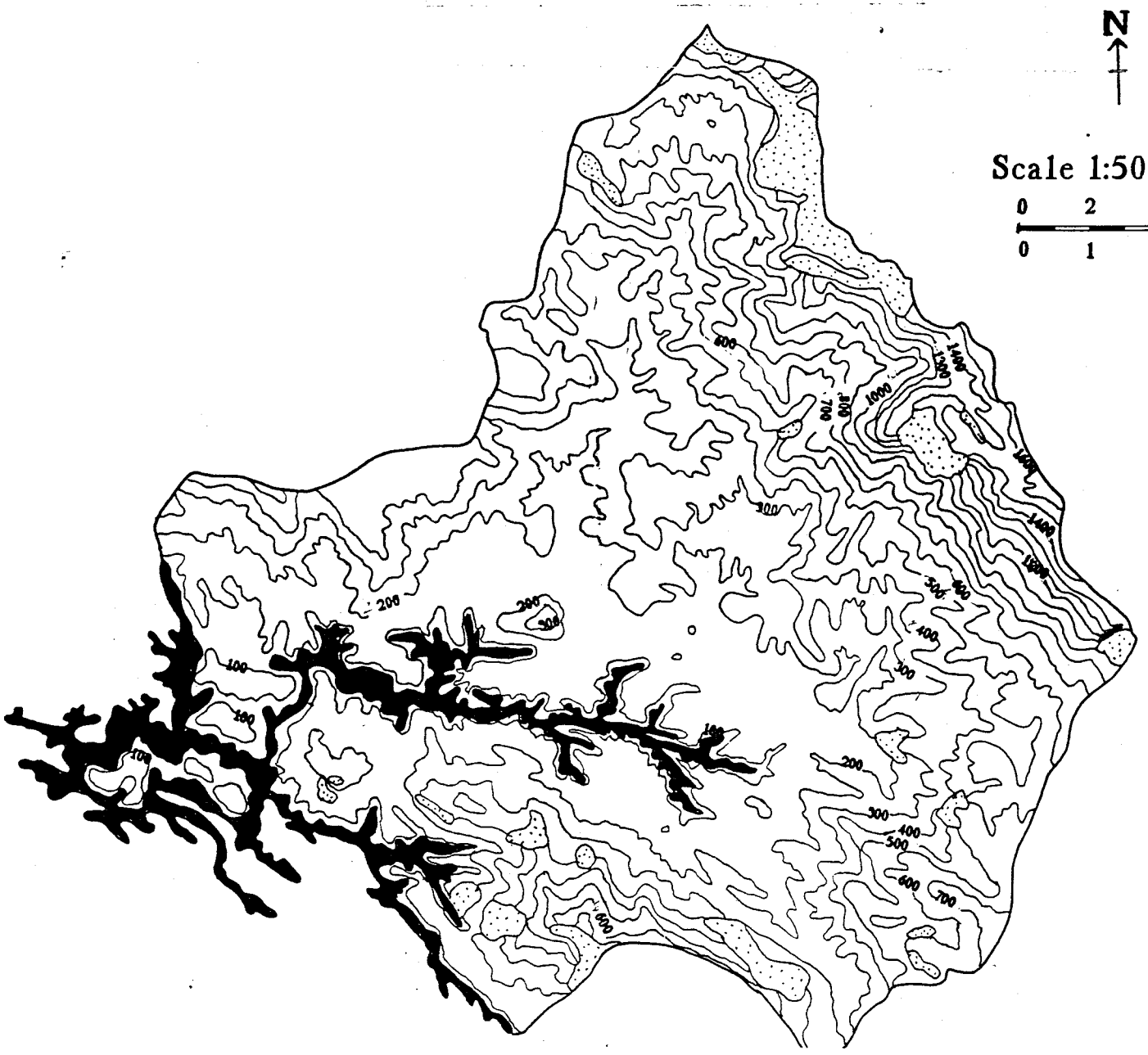
NEYYAR WILDLIFE SANCTUARY – DRAINAGE AND WATERSHED

Flg.2



NEYYAR WILDLIFE SANCTUARY – CONTOUR (M.)

Fig. 3



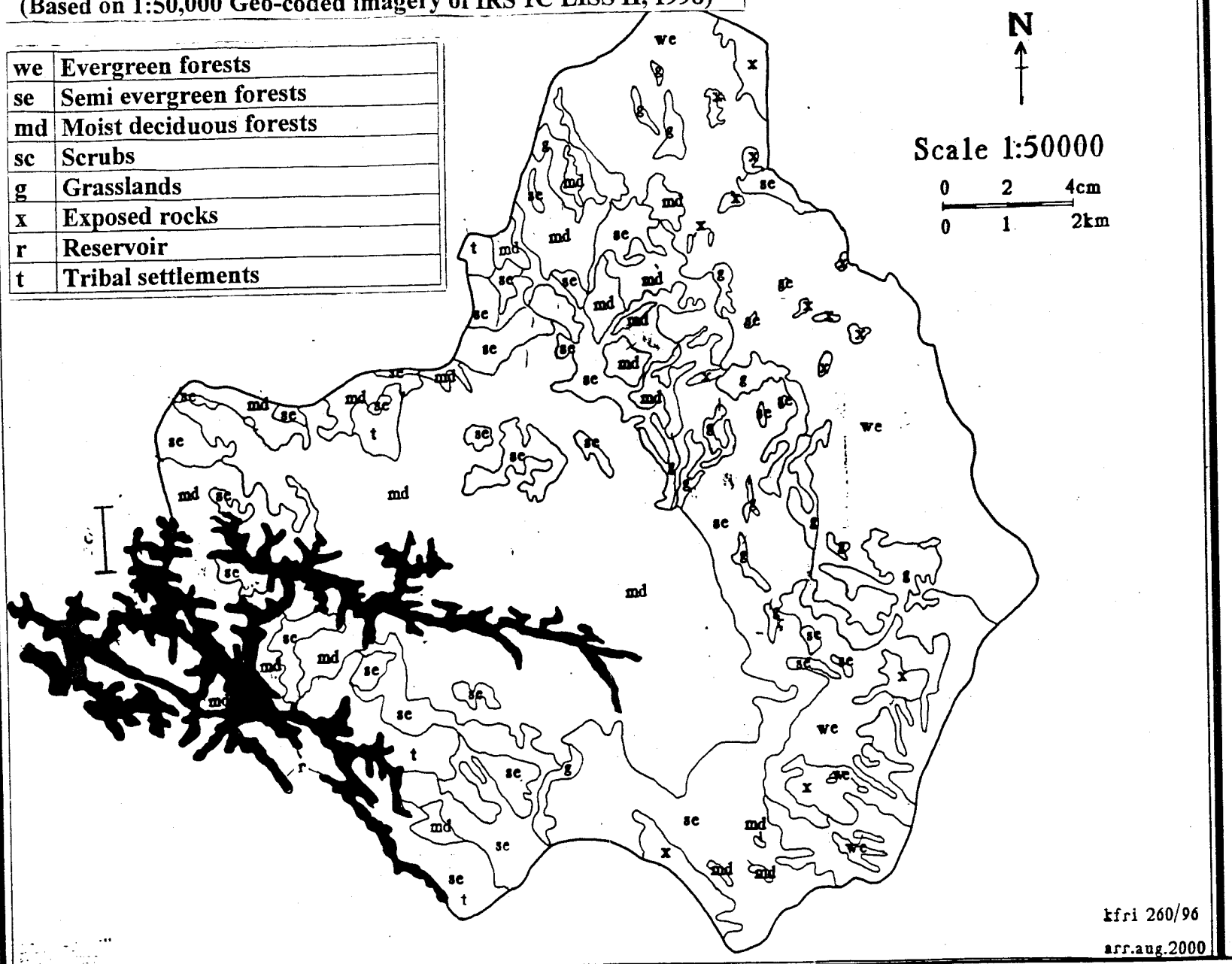
kfri 260/96

VEGETATION MAP OF NEYYAR WILDLIFE SANCTUARY

(Based on 1:50,000 Geo-coded imagery of IRS 1C LISS II, 1998)

Fig. 4

we	Evergreen forests
se	Semi evergreen forests
md	Moist deciduous forests
sc	Scrubs
g	Grasslands
x	Exposed rocks
r	Reservoir
t	Tribal settlements



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