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***Research Article***

# BIODIVERSITY SIGNIFICANCE, LANDUSE PATTERN AND CONSERVATION OF MALAYATTUR FORESTS IN THE WESTERN GHATS OF KERALA, INDIA

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## ABSTRACT
The paper deals with the conservation planning of Malayattur Forest Division in the Southern Western Ghats of Kerala, India. Field visits and participatory interactions were conducted to collect the biodiversity significance. Using Geographical Information System (GIS) tools, the forest types and the landuse pattern of the Division were analyzed and biodiversity rich and vulnerable areas were identified for the conservation management. The forest is rich in endemic and endangered flora and fauna. Two zones viz., conservation and restoration zones were delineated based on the biodiversity richness, landuse pattern and conservation priorities. The present study will help to conserve the existing high value biodiversity areas, sustainable utilization of the available resources and restoration of the degraded patches.

***Key Words:*** *Western Ghats, High Value Biodiversity Area, GIS, Conservation Planning*

## INTRODUCTION
The global biodiversity is at a crisis and diminishing at unprecedented rates (Myers, 1980). A biodiversity hotspot in the third world tropics experiences an enormous anthropogenic pressure (Kinnaird *et al.*, 2003), which has resulted in accelerated forest loss. Given the alarming situations of extreme habitat alterations due to anthropogenic activities, it is important to have accurate assessments of distribution and conservation status of a threatened species and habitats, in particular, to prevent future loss of global biodiversity. In the 21st Century, one of the biggest challenges in geography lies in exploring the 'nature of spatial thinking, reasoning and abilities' (Cutter *et al.*, 2002). The geographical knowledge emerges from spatial thinking and reasoning is essential for finding out the space 'where the things are' and to make decisions to solve the problems applied in that particular space (Golledge, 2002). The spatially explicit thinking thus evolved and opened up the new vistas of integrated science and enhanced the understanding of the physical environments and its relations with humans locally and globally. The information on spatial distribution of resources is one of the most crucial part of the systematic conservation planning and management of biodiversity (Margules & Pressey, 2000). The information on the conservation aspects such as distribution, abundance and habitat quality (Baillie *et al*., 2004), is important to identify threats, which enables to derive a management strategy.
The Western Ghats, a biodiversity hotspot of India and Sri Lanka holds one of the world's most endangered forests (Puyravaud *et al*., 2010). In the state of Kerala, nearly two third of the available biodiversity is found outside the protected areas. The territorial forests or the "Working Divisions" concentrate mainly at the extraction of commercially important timber and other non timber forest produces (Nair, 1991). The utilization of the resources are largely done with unscientific approaches, which more often results in over exploitation and loss of forest resources. The lack of baseline data on the biodiversity richness and the non-availability of the forest quality information are mainly attributed for this problem. The present paper addresses this question by exploring the available information such as biodiversity significance and land use pattern in Geographical Information System (GIS) platform for a territorial forest division of Kerala, India. The paper also identifies the biodiversity rich and vulnerable

areas in GIS for the conservation management. It suggests the management zones for the state forest department to be incorporated in to the respective working plan to conserve the existing high value biodiversity areas, sustainably utilize the available resources and restore the degraded patches.

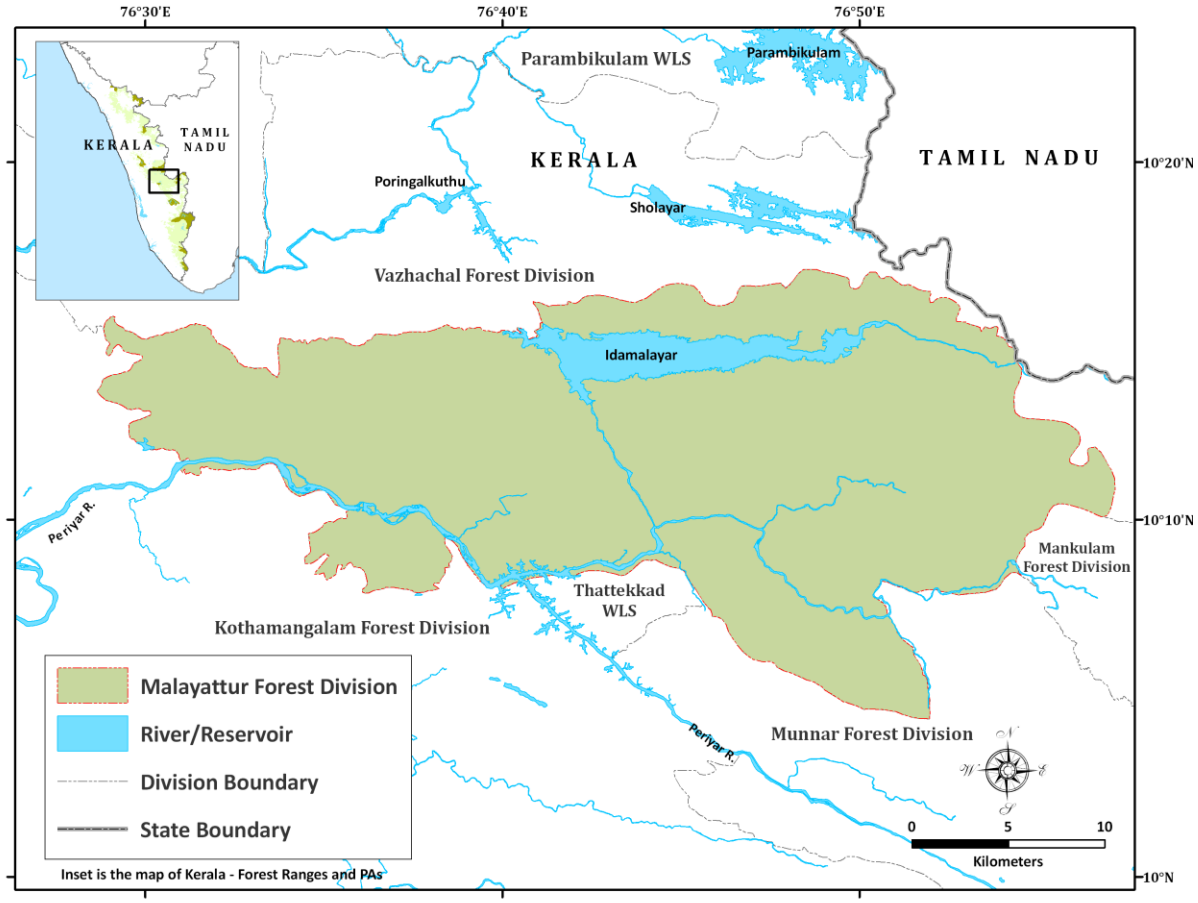


**Figure 1: Map of Malayattur Forest Division**

***Study Area***

The Malayattur Forest Division is one of the oldest Divisions in the Western Anamalais landscape of the Kerala part of Western Ghats in the State of Kerala (Fig.1). The tract lies between 10° N and 10° 30' N latitudes and 76° E and 76° 57' E longitudes. The administrative jurisdiction of the Division mainly lies in the Ernakulum District. The area is surrounded by Vazhachal Forest Division in the north, Tamil Nadu, Munnar and Mankulam Forest Divisions in the East, Kothamangalam Forest Division in the South and to the West is the Plains of Kerala. The total forest area under the Division is 617.76 $km^2$ which includes 92.53 $km^2$ of forest plantations, 10.81 $km^2$ areas leased to Hindustan Newsprints Limited for raising captive plantations and a leased area of 46.09 $km^2$. The Forest Division is divided into five forest ranges and there are 15 notified reserved forests (RFs) in the division. Malayattur Reserve is the largest Reserve with an extent of 573.51 $km^2$ covering all the five Ranges. The elevation varies from 50 m to 1,347 m. The terrain is highly undulating and hilly in nature. The forests are drained by the streams of the River Idamalayar, which is the tributary of the River Periyar, one of the largest rivers of the South West India. Nearly 48 $km^2$ of the Idamala valley has been submerged under the Idamala Hydroelectric scheme (Idamalayar Reservoir), the reservoir of which is the longest and second largest in Kerala State.

## MATERIALS AND METHODS

The study was conducted during October 2009 to March 2010. Field trips were arranged to explore and enumerate the richness of the flora and fauna of the Malayattur Forest Division. Apart from that the earlier study of the Kerala Forest Research Institute (Nair, 1989) was used to finalize the plant species richness in the division. Rapid surveys were organized to visit and confirm the species presence in the reported localities. The plant species collected and compiled were identified and the endemism and the conservation status were analyzed based on Ahmedullah and Nayer, (1986) and IUCN criteria. Wildlife habitat use and abundance information were compiled from the available literature (Easa and Jayaraman, 1997; Easa *et al*., 2002; Sivaram *et al*., 2005; Sivaram *et al*., 2007), local knowledge and field trips. Various tribal hamlets were visited and interactions were made with the local people, forest department and other agencies concerned with the forest division. The tribal population details living inside the forest area were collected during the field visits. A base map of the Malalattur Forest Division was made in the GIS platform depicting the division and range boundaries. The Survey of India Topographic (SOI) Sheets 58 B7, 8, 11, 12, 15 and 16 were used to delineate the boundaries of Malayattur Forest Division. The topographic maps were scanned at a resolution of 300 dpi in a flat bed scanner and geo-referenced with the raster processing software Erdas. Then the individual sheets were digitized in the GIS software ArcGIS. Various categories of forest type information available in the toposheets were digitized and the biodiversity information obtained through fieldwork and collected through secondary means were plotted to identify the biodiversity rich areas. The management oriented forest map of South India proposed by Pascal (1993) was followed and a recent forest type map published by Ramesh *et al*., (2007) for the western Anamalais landscape unit at the scale of 1:75,000 and the Forest Map of South India – Coimbatore-Trichur Sheet with a scale of 1: 250,000 (Ramesh *et al*., 2002) were used to combine the land use map of the region. The Spatial Analyst tool of ArcGIS was used to calculate the area of different forest types. A SWOT (Strength-Weakness-Opportunities-Threat) analysis was done with all the available information. The conservation and restoration zones were delineated based on the biodiversity richness, landuse pattern and based on the outcomes of the SWOT analysis.

## RESULTS AND DISCUSSION

A wide variety of floral and faunal species were found to be present in the forests of Malayattur Forest Division. The forest division is very rich in fauna too which is constituted by a variety of mammals, birds, reptiles, amphibians, aquatic fauna, butterflies and other insects as well as microorganisms. There are a total of 13 tribal settlements inside the division who were solely dependent on the forest resources for their survival.

### *Floristic richness*

The present study had identified 385 species of angiosperms from the Malayattur forests. The low and mid elevation areas of Idamalayar -Pooyamkutty valley supports good quality patches of low evergreen forests. Reed breaks with regenerating culm of *Ochlandra travancorica* is of common occurrence in these forest areas. The Edamala - Pooyamkutty upper reaches of region contain 171 taxa of flowering plants of which about 35% are endemic to Peninsular India. The main Western Ghat endemics like *Baccaurea courtallensis* (Wt.) Muell.-Arg., *Calophyllum elatum* Bedd., *Bhesa indica* (Bedd.) Ding Hou, *Chilocarpus malabaricus* Bedd., *Palaquium ellipticum* (Dalz.) Baill., *Ormosia travancorica* Bedd., *Willisia selaginoides* (Bedd.) Warm. ex Willis, *Ardisia pauciflora* Heyne, *Syzygium laetum* (Ham.) Gandhi, *Syzygium occidentale* (Bourd.) Gandhi, *Syzygium mundagam* (Bourd.) Chithra, *Microtropis latifolia* Wt., *Aglaia barberi* Gamble, *Dysoxylum malabaricum* Bedd. ex Hiern, *Gomphostemma keralensis* Vivek., Gopal. et Ansari, *Psychotria anamallayana* Bedd., *Miliusa tomentosa* (Roxb.) Sinclair etc. The main rare threatened plants in the forest are *Vateria indica* L., *Vateria macrocarpa* Gupta, *Dipterocarpus indicus* Bedd., *Hopea glabra* Wt. et Arn., *Hopea parviflora* Bedd., *Nothopegia beddomei* Gamble, *Myristica malabarica* Lamk., *Litsea bourdillonii* Gamble and *Diospyros ovalifolia* Wt.

The survey shows that the important pteridophytes in the area are *Lycopodium wightianum, Pteris longipes, P. pellucida, Adiantum caudatum, A. hispidum, A. lunulatum, A. raddianum, Antrophyum coriaceum, A. reticulatum, Nephrolepis hirsutula, N. exaltata, Oleandra musfolia, Asplinium crinicaule, A. ensiforme, A. erectum, A. nidus, A. nitidum, A. tenerum* and *Blechnum orientale*.

***Faunal Importance***

The forests of Malayattur support 38 mammals, 29 reptiles, 27 amphibians, 270 birds, 55 fishes and 76 butterfly species. The reed patches in the low evergreen forests of Malayattur supports a large of population of endangered Asian elephants. The density of elephants in Malayattur forests is the highest for the state of Kerala. The Malayattur forests are part of the Anamalai Parambikulam elephant reserve which is notified as Elephant Reserve No.9 by the Ministry of Environment and Forests under its '*Project Elephant'*. The migration of elephants from the Parambikulam Plateau, across the Chalakudy River to Malayattur forests forms an important wildlife corridor. The Parambikulam plateau has been deforested and planted with teak by the Forest Department under its plantation and afforestation programmes. During summer, water and vegetation is scarce in the eastern part of Anamalais and consequently the migration of the elephants occurs to the moist Pooyamkutty forests in the Periyar river basin. Apart from this, a subpopulation of the endangered primate Lion-tailed macaque occurs in the medium elevation evergreen forests and the endangered ungulate Nilgiri Tahr occurs in Sulimala, Vagiriyan and Manjakallan grassland areas.

***Landuse Pattern***

In the whole region two types of primary forests and their respective degraded stages are discerned. They are the wet forests of the low and medium elevations and moist deciduous forests and its variants (Pascal, 1988). The two major wet evergreen climax forests and degraded stages are further classified into low (0-800m) and medium (850-1450m) types. The eastern part of the Malayattur Division is with the primary vegetation type and only those areas are analyzed in area computations. This area is the 'High Value Biodiversity Area' of Malayattur. It falls in the two administrative ranges viz., Idamalayar and Kuttampuaha. The Western part of the Malayattur is of commercial and forest plantations. The total area thus obtained is 371.24 $km^2$ (Table 1). Out of this, 36.188 $km^2$ represents medium elevation evergreen, 48.21 $km^2$ low elevation evergreen forests. About 106.56 $km^2$ is occupied by evergreen type mixed with reed. Nearly an area of 80 $km^2$ represents dense forests in Malayattur division.

***Forest Dependent Communities***

The different tribal inhabitants are Mannan, Malayar, Muduvan and Arayan. There are 13 tribal colonies in this Division. The dwellers mainly depend on Non Timber Forest Products for their subsistence. Non Timber Forest Produce like *Canarium strictum, Myristica beddomei***,** *Curcuma Zeodaria, Hydnocarpus pentandra, Acacia concinna, Garcinia gummi-gutta, Sapindus trifoliata, Rotula aquatica, Curcuma sp, Piper sp. Momordica dioica*, *Pittospermum neelgherrense* and *Coscinium fenestratum.* There are Malayar colonies at Pongumchuvadu and Thalumkandom and Muduvan colonies are found in Therakudy, Adichilthottykudy, Arakappukudy, Kunjipara, Uriyampettykudy, Variam, Vellaramkuthu, Thalavachapara kudy, Metnampara and Kallelimedu. The Mannan and Arayan are settled in Mannankudy and Uriyampettykudy respectively. The main NTFP source areas are Arakkamuthy, Kathippara, Anakkulam, Keerithodu, Valiyakadavu, Amanthuli, Pattambli, Varium, Uchanthi, Nadappara and Uriyankatty.

***SWOT Analysis and Conservation Zonation***

The main factors affecting the biodiversity values in Malayattur forests are i) Forest degradation and removal of evergreen patches, ii) Human-Wild life conflicts, iii) Infestation of noxious weeds, iv) Degradation of watersheds, v) Alteration to Wildlife corridors and vi) Overexploitation of NTFPs including reeds, bamboos and medicinal plants. The strengths of the Malayattur Forest Division are the biodiversity richness with endemic flora and fauna, plenty of reed and bamboo patches, good quality low elevation evergreen forests that supports the highest density of elephant population in Kerala state and

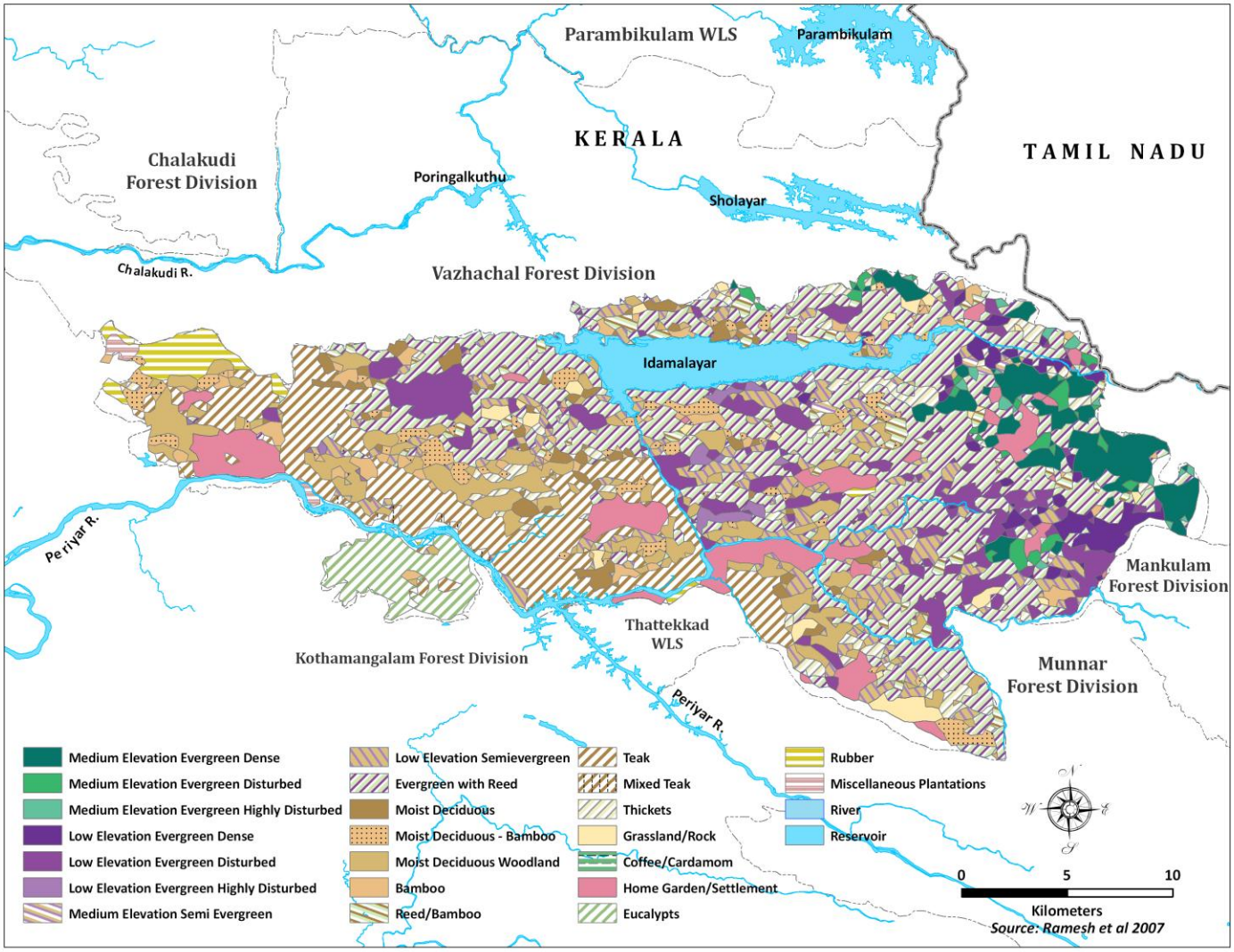


**Figure 2: Forest Type Map of Malayattur Forest Division**

watershed of important tributaries of the River Periyar. Apart from this an isolated population of *Dysoxylum malabaricum* and the largest viable population of *Dipterocarpus bourdilonii*, a critically endangered species with a total population of less than 200 matured trees is found in the Urulanthanni area of this division. The main threats are the expansion of reed areas due to human interference, development projects, invasive weeds, poaching of wild fauna and prevalence of annual fires. The possibility of the proposed Pooyankutty Hydro electric project directly threatens the endangered flora and fauna through habitat loss, fragmentation and local extinction. The weakness of this division includes overexploitation of reed and bamboos, loss of continuity in the canopy due to fires, unmanaged tourism in certain parts and insufficient funding and facilities with the Forest Department. Despite all this there is ample opportunity to conserve the biodiversity potential of this forest. A proper planning and implementation of a conservation action plan will preserve quality of this forest for a long term. To meet this requirement we propose a "High Value Biodiversity Area (HVBA)" of Malayattur with two different zones for conservation and management.

**Table 1. Major Landuse of Malayattur High Value Biodiversity Area**

| Sl.No. | Vegetation | Area ($km^2$) |
|---|---|---|
| 1. | Medium Elevation Evergreen Dense | 28.01 |
| 2. | Medium Elevation Evergreen Disturbed | 5.77 |
| 3. | Medium Elevation Evergreen Highly Disturbed | 2.42 |
| 4. | Low Elevation Evergreen Dense | 12.71 |
| 5. | Low Elevation Evergreen Disturbed | 31.4 |
| 6. | Low Elevation Evergreen Highly Disturbed | 4.10 |
| 7. | Medium Elevation Semi-evergreen | 9.91 |
| 8. | Low Elevation Semi-evergreen | 27.20 |
| 9. | Evergreen mixed with reed | 106.56 |
| 10. | Moist Deciduous | 2.93 |
| 11. | Moist Deciduous Bamboo | 11.10 |
| 12. | Moist Deciduous Woodland | 18.02 |
| 13. | Bamboo | 6.09 |
| 14. | Reed/Bamboo | 9.86 |
| 15. | Teak plantation | 6.73 |
| 16. | Thickets | 14.38 |
| 17. | Grassland /rock | 8.52 |
| 18. | Home gardens and settlement | 17.21 |
| 19. | Rubber | 0.35 |
| 20. | Water body | 48.00 |

Of the total extent of Malayattur Forest Division covering an area of 617.77 $km^2$, two ranges *viz.*, Kuttampuzha and Idamalayar (371.24 $km^2$) and Idamalayar Station of Thundathil Range have been designated as HVBA for long term conservation. Within the HVBA, two zones (Conservation and Ecorestoration and Ecodevelopment) have been identified for the purpose of implementing the Biodiversity Conservation Plan (Fig. 3). The conservation zone (188 $km^2$) and ecorestoration and ecodevelopment zone (183.24 $km^2$) together constitute 371.24 $km^2$ which is 58% of the total area of Malayattur Forest Division.

***Conservation and Ecorestoration/Ecodevelopment Zones***

Areas (Idamalayar and Kuttampuzha Ranges) in the conservation zone are to be managed primarily for conservation values and the activities that endanger these values will be avoided/ restricted. Only, NTFP collection on a sustainable basis will be permitted and extraction of reed will not be permitted. These are highly biodiversity-significant areas, important for intensive conservation. All these areas are important in terms of floral diversity, specific habitats of fauna and for the dispersal of animals towards south east and north direction. The natural forests in Idamalayar and Kuttampuzha ranges provide more or less continuous cover with three main types of forests viz., Evergreen, Semi-evergreen and Moist deciduous (pure and mixed with reed). These forests are very important as they are repositories of unique biodiversity (flora and fauna). Locations of High Biodiversity Value viz., Pallikkallanmudi, Keerithodu, Palavanpadi, Kappayam, Thera, Edinjakuthu, Elavanchodu, Pattambli in Idamalayar Range and Anakkulam, Koonthrapuzha, Thottikkayam, Pothidukki, Chethikkandam, Uriyankatty, Vazhippara and Varunthalakkulam areas in Kuttampuzha Range are important conservation areas. The ecorestoration/ecodevelopment zones include areas where degraded natural forests, plantations of poor

stocking and human settlements are present. The degraded plantations in Kuttampuzha can be gradually restored with the native species.

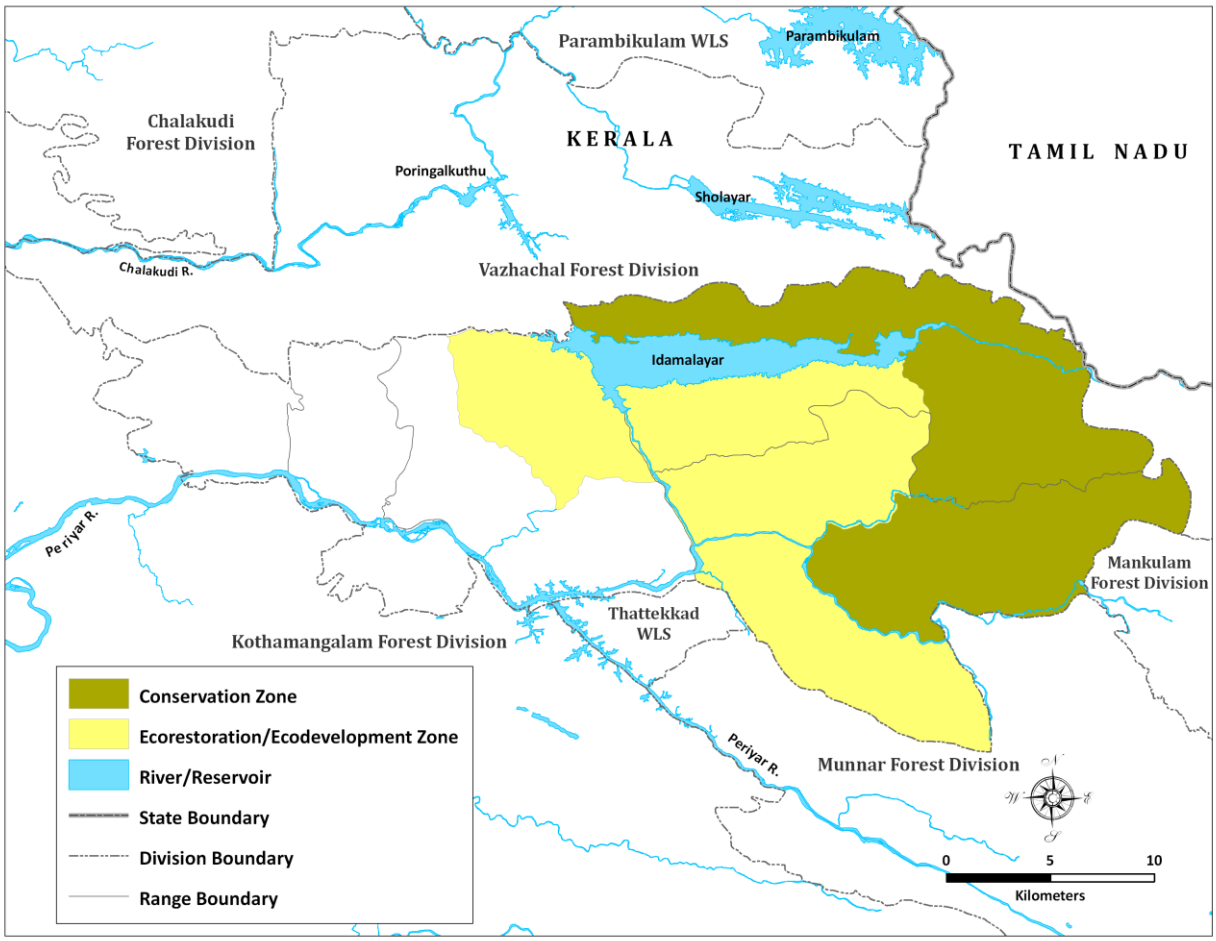


**Figure 3: High Value Biodiversity Area of Malayattur Forest Division**

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