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BIODIVERSITY CONSERVATION PLAN
FOR
MUTHIKULAM HIGH VALUE BIODIVERSITY AREA

(2010-2011 to 2019-2020)

KFRI Research Report No.

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Project Team

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Peechi 680 653, Thrissur, Kerala, India

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March 2011

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(Final report of the project KFRI 588/2009 November 2009-March 2010)

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Project proposal

Project No.	: KFRI RP 588/2009
Title	Biodiversity conservation plan for Muthikulam high value biodiversity area
Investigators	C. Renuka, S. Sankar, K. K. Ramachandran, P. Vijayakumaran Nair, K. Swarupanandan, U. N. Nandakumar, George Mathew, V. V. Sudheendrakumar, T. V. Sajeev, E. A. Jayson, N. Sasidharan, C. Mohanan, U. M. Chandrasekhara
Objectives	1. Identification and consolidation of available data sets including maps and images 2. Preparation of a plan for biodiversity management plan
Duration	November 2009-March 2010
Funding Agency	Kerala Forests & Wildlife Department, GOK

Contents

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BIODIVERSITY CONSERVATION PLAN

FOR

MUTHIKULAM HIGH VALUE BIODIVERSITY AREA

PART A: THE EXISTING SITUATION

CHAPTER 1: DESCRIPTION OF LANDSCAPE

1.1 Name, Location, Constitution and Extent.

1.1.1. Name : Muthikulam High Value Biodiversity Area

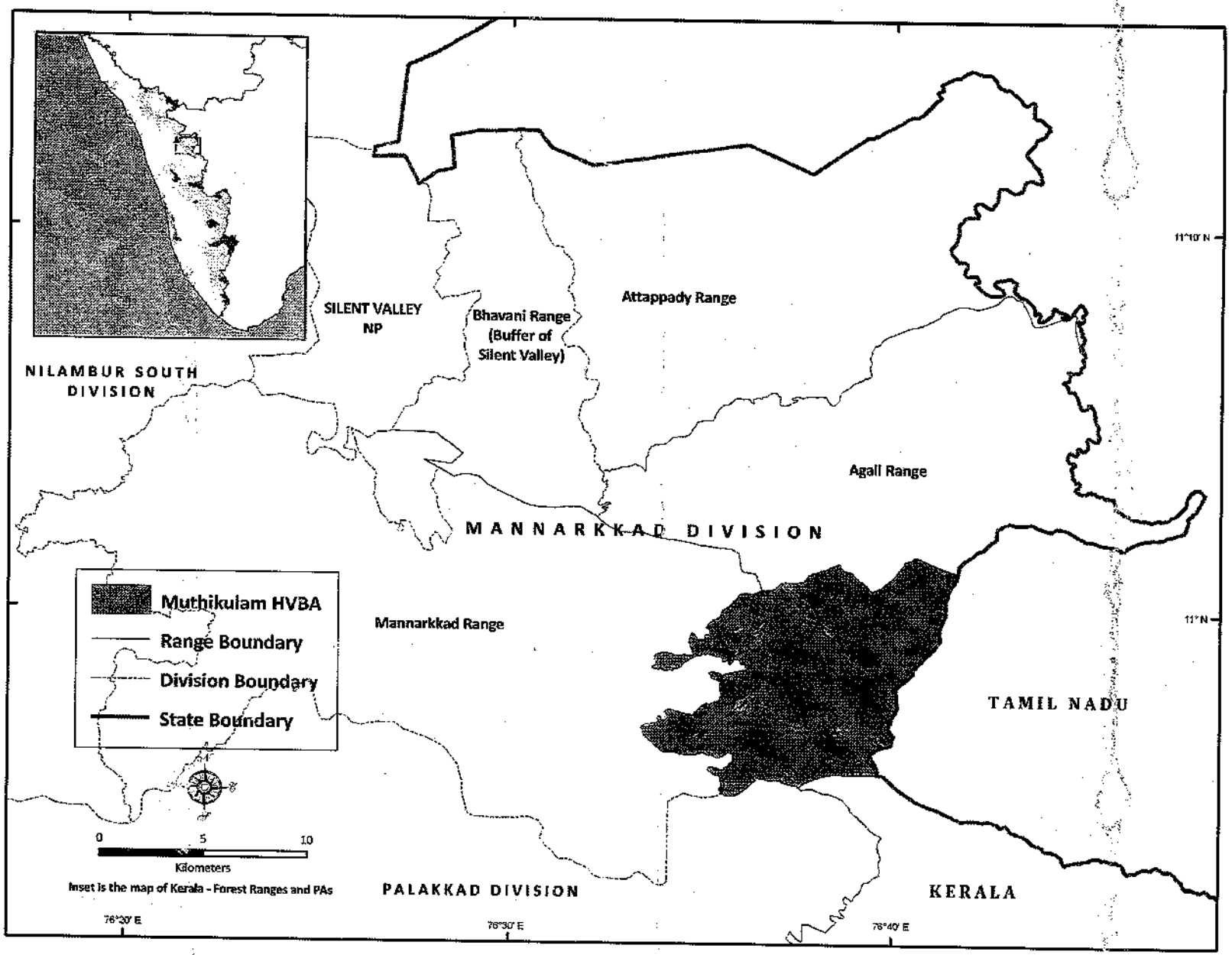
1.1.2. Location: Muthikulam High Value Biodiversity Area is located in Mannarkad Forest Division, which borders the North -western portion of the Western Ghats on the northern side of Palakkad gap in Mannarkad Taluk of Palakkad District. The tract dealt with lies within the north latitude of 10° 14' and east longitudes between 76° 47' and 76° 16' (Map 1)

1.1.3. Constitution: The present Mannarkad Forest Division comprises three Ranges viz., Mannarkad, Attappady and Agali with headquarters at Mannarkad, Mukkali and Kalkandy respectively (Table 1.1). Most of the areas of the Muthikulam High Value Biodiversity Area come under the Agali Range of Mannarkad Forest Division with certain parts of the southern hills falling in Mannarkad Range.

Subsequent to the nationalization of private forests, the vested forests of Palakkad District were brought under a newly created Palakkad Special Division with effect from 10.5.1971. With a view to have a compact area of administrative units with boundaries in consonance with the district and taluk boundaries, for even distribution of the protection task and for better administrative convenience, the three forest divisions in Palakkad District namely Palakkad, Palakkad Special and Nemmara were amalgamated and reorganized. Accordingly, the present Mannarkad Division came into being with all Reserve Forests and Vested Forests of Mannarkad Taluk, Palakkad District.

Table 1.1 – List of Ranges in Mannarkad Division

Sl. No	Range	Headquarters
1.	Mannarkad	Mannarkad
2.	Agali	Kalkandy
3.	Attappady	Mukkali



Map 1. Mannarkkad Forest Division showing Muthikulam High Value Biodiversity Area (HVBA)

1.1.4. Administration

Division of Ranges into Stations: The three Ranges are again divided in to Forest Stations headed by Deputy Rangers. There are three stations each in Agali and Mannarkad and two in Attappady Range (Table 1.2).

Table 1.2. Name of the Stations and their Headquarters

Sl. No.	Range	Forest Station	Headquarters
1	Mannarkad	Palakkayam Thiruvizhamkunnu Mannarkad	Kanjirapuzha Kachcripady Anamooly
2	Attappady	Mukkali Pudur	Mukkali Pudur
3	Agali	Sholayur Ommala Singappara	Sholayur Ommala Singappara

1.1.5. Extent

The total forest area of the Division is 422.45 km^2 including 150.7322 km^2 Reserve forests and 271.7213 km^2 Vested forests. An area of 7.15 km^2 in 49 bits is vested in the Division as Ecologically Fragile Land for which various litigations are going on. Area of Reserved and Vested forests under the three Ranges is given in Table 1.3.

Table 1.3 Range-wise area of Mannarkad Forest Division

Sl. No.	Range	Headquarters	Reserve Forest (km^2)	Vested Forest (km^2)	Total (ha)
1.	Mannarkad	Mannarkad	6.1013	117.9111	124.0124
2.	Agali	Kalkandy	63.8595	65.1507	129.0102
3.	Attappady	Mukkali	80.7714	88.6595	169.4309
Total			**150.7322**	**271.7213**	**422.4535**

1.1.6. Boundaries of Mannarkad Forest Division

The boundaries of Mannarkad Forest Division are provided below:

North - Nilgiri District of Tamil Nadu

East - Coimbatore District of Tamil Nadu

South - Palakkad and Ottapalam Taluks

West - Malappuram District- Perinthalmanna Taluk

1.1.7. Legal Status

Distribution of Area: The total area of forests under this Division consisting of both Vested forests and Reserve forests is 422.4535 km^2. Panakkadan Bit I and Bit II, Attappady Block I, II, III, IV, V and VI are the Reserved Forest falling within the Division. An area of 546 ha of Vested Forests has been leased out to the Plantation Corporation of Kerala Ltd. for cashew planting in Mannarkad Range at Anamooly. The details of the Reserved Forests in the Division are provided in Table 1.4.

Table 1.4. Details of Reserve Forest in Mannarkad Division

Sl. No.	Range	Reserve Forest	Extent (ha)
1.	Attappady	Attappady Bit I	1585.97
2.	-do-	Attappady Bit II to IV	1165.50
3.	-do-	Attappady Bit V	5325.67
		Sub Total	**8077.14**
4.	Agali	Attappady Bit VI	6385.95
		Sub Total	**6385.95**
5.	Mannarkad	Panakkadan with Extension I	447.58
6.	-do-	Panakkadan with Extension II	50.91
7.	-do-	Panakkadan with Extension Mulakuvallam	111.64
		Sub Total	**610.13**
		Grand Total	**15073.22**

Besides the above-mentioned Reserved Forests, the Division is having 271.7213 km^2 of vested forests distributed as 117.9111 km^2, 65.1507 km^2 and 88.6959 km^2 in Mannarkad, Agali and Attappady ranges respectively. The vested forest areas are the private forests vested with Government by virtue of Kerala Private Forest (Vesting and Assignment) Act, 1971. There are still various litigations from Forest Tribunal to Supreme Court regarding Vested Forests.

576 ha of Vested Forests have been leased out to Plantation Corporation of Kerala Ltd. for cashew planting in Mannarkkad Range at Anamooly out of which an unutilized area of 32.8 ha is resumed and protected as natural forest.

An area of 1.15 ha of Vested Forests has been leased out to Meenvallam Hydroelectric Project in Palakkayam Forest Station of Mannarkkad Range.

An area of 1.295 ha of Vested Forest land was leased out to KSEB for construction of 220 KV line in Thriruvizhamkunnu Forest Station of Mannarkkad Range.

There is a claim from the Irrigation Department that 370 ha of forest land is leased to them for the construction of Siruvani Dam. This area falls in Attappady Block VI RF Muthikkulam of Singappara Forest Station in Agali Range.

The list of forest areas leased out from Mannarkad Division is given in Table 1.5.

Table 1.5. List of forest areas leased out in the Division

Sl. No.	Type of forest	Extent (ha)	Date of lease	Govt. Order	Agency's name and purpose
1.	Vested Forests	545.85	1.7.1981	GO (RT) 120/82 AD dt. 26.6.1982	Plantation Corporation of Kerala Ltd. for planting Cashew
2	Vested Forests	1.295		GO (RT) 12/97 F&WLD dt. 8.01. 1997	KSEB for laying 220 KV power line from Panjani to Areakode
3	Vested Forests	1.15	23.6.2009	GO (RT) 202/09 F&WLD dt. 25.04. 2009	Palakkad District Panchayath for construction of Meenvallam Mini Hydro-electric Project

An extent of 1.295 ha was diverted for laying 220 KV electric line from Panjal to Aruvacode vide order no. GO (RT) No. 12/97 F and WLD dated, 8.1.1997 of Government of Kerala [F(c) A/11-2/KER/61/TL dated, 17.12.96 of CCF Central, GOI].

1.1.8. Encroachment and joint verification

The joint verification by forest and revenue officials revealed that 80 plots (34.39 ha) were encroachments prior to 1.1.77 and 1736 plots (557.9752 ha) after 1.1.1977. The encroachers included in the joint verification, who occupied lands after 1.1.1977 are not evicted so far.

1.1.9. Boundary consolidation

Out of total boundary line of 350 km, 263 km length has been consolidated and 8,887 numbers of cairns were constructed. The balance length of the boundary to be consolidated is 87 km. Out of 52.5 km of inter-state boundary, there is a dispute to a distance of 12.5 km.

1.1.10. Rights and concessions

All the reserves are the absolute property of the state and none is encumbered with any rights of importance. Attappady Block I to VI are entirely free from all rights. In Panakkadan Reserved Forests and its additions the following rights are allowed:

Public right of way admitted through the reserve, comprising of a path 9.1 m wide, open to men and cattle. Starting from the north west corner of the addition No (1) the path runs along its northern boundary to its north east corner, then the path runs southwest through the addition for about 100 m till it meets the rock on the eastern boundary of addition; then it runs along the eastern boundary crossing a 'thodu' to the southern corner of the addition.

1.1.11. Notification

The present Mannarkad Forest Division was constituted vide G.O (MS) 121/89 F& WLD dated, 28th December 1989 (Appendix –I), consequent to re-organization of Forest Divisions in Palakkad District and started functioning from 1.4.1990 from Olavakkode. The Head Quarters was shifted to Mannarkad on 18.4.1991. The area under the newly formed Division comprises Mannarkad Range of erstwhile Palakkad territorial Division, Agali Range and northern portion of Thenkara Range of former Palakkad Special Division.

1.2. Drainage and topographical features

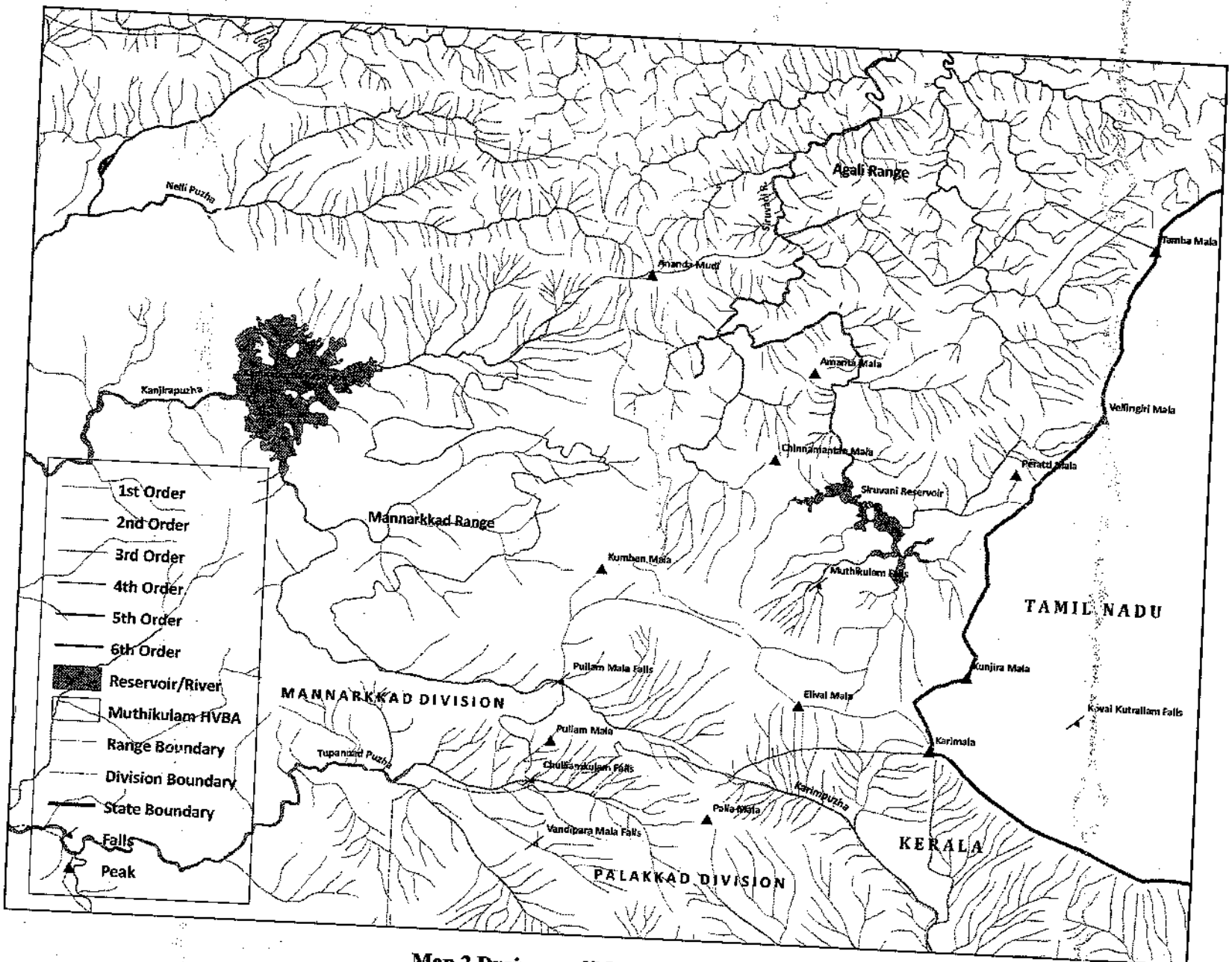
1.2.1. Drainage

The drainage of Muthikulam HVBA is illustrated in Map 2. The eastern ridge encloses the Bolampatti Valley drained by the Noyil river. The southern and western faces of the Palghat Hills are drained by tributaries of the Bharathapuzha, and the Siruvani and the Attappadi plateau by the east flowing Bhavani and its tributaries.

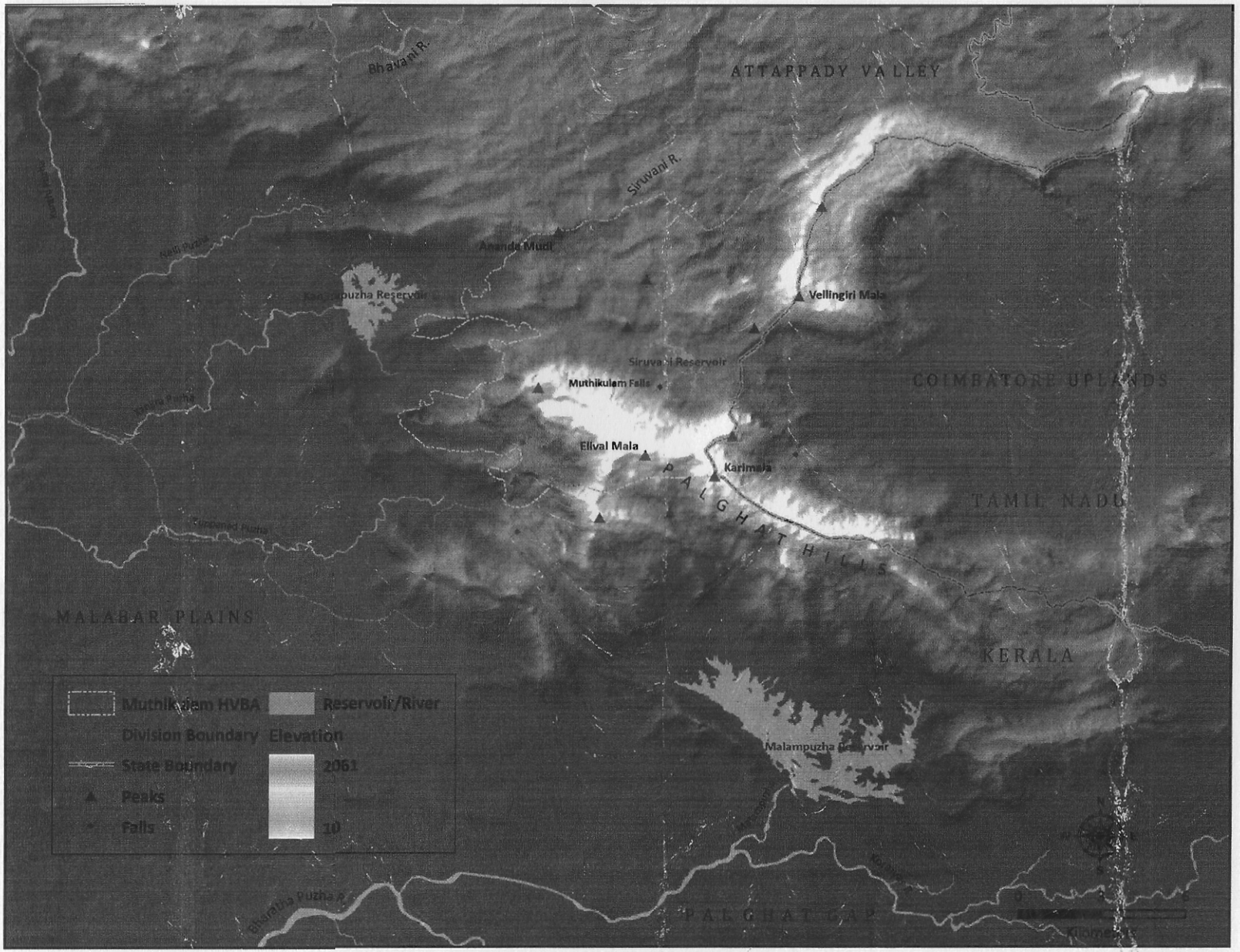
1.2.2. Topography

Muthikulam High Value Biodiversity Area falls under administrative boundary of Mannarkad Taluk in Palakkad District, Kerala. Most of the forest zone comes under the Agali Range of Mannarkad Forest Division with some part of the southern hills falling in Mannarkad Range. The conservation area is bordered in the north by forest ranges of Attappady, in the west by Mannarkad forest range, east by Coimbatore Forest Division, Tamil Nadu and in the south by a narrow strip of Mannarkad Range separating it from the Olavakkode and Walayar Ranges of Palakkad Division. These hills are a part of a wider hill range known as Palghat (Palakkad) Hills. The northern tip of the Palakkad gap rises abruptly from near the Walayar - Madukkara area, as a narrow steep ridge which runs west and curves north along a series of ridges known as the Palamala – Elival - Muthikulam Hills, and then continues north along the Attappady plateau up to the base of the Nilgiris. They include a series of high, steep, almost east-west ridges with fairly undisturbed high elevation tropical moist forests called the Palamala- Elival Hills. This continues to a compact high plateau called the Siruvani (Muthikulam) Hills which in turn continues east and north-east along the edge of Attappady, the Varadimala - Bolampatti Hills and the outer rim of hills along the Attappady western edge. The eastern outer slopes of Palakkad Hills are in Tamil Nadu. The southern ridges around Muthikulam and Karimala lie above 1300m and form a unique high altitudinal habitat (Map 3).

Muthikulam HVBA consists of undulating hills and valleys well clothed with vegetation except for the large grassy area around Muthikulam to the south east and the mass of high hills to the south viz., Elival range. It is a plateau with elevation varying from 610 m at exit of Siruvani to 2,065 m, the highest peak northwest of Elivalmalai. This area forms almost a basin surrounded by the hills forming the outer boundaries of the reserve. The



Map 2.Drainage of Muthikulam HVBA



Map 3. Relief of Muthikulam HVBA

important hills starting from the north are Pulimalai 946 m, then towards the west Periyamandamudi 1,007 m, Anandamudi 1,173 m, then Chinnapparamalai 947 m, Patiyamukkammalai 1,692 m, the Eleval malai 2,027 m at the South and Periyakunjirammudi 1,768m, Parithimalai 975 m, Vellingirimudi 1,183 m, a place famous for Vellingiri temple and ending at Thambimudi 1,523 m in the north east corner. The slope is inward since the area is surrounded by the above hills. The river Siruvani, (Plate 2) a tributary to Bhavani originates from these hills and flows northwards to Tamil Nadu.

1.3. Approach and Access

The area is accessible by all weather road which runs from Palakkayam to Coimbatore traversing the Reserve covering a distance of 16.46 km through the designated area for biodiversity conservation.

1.4. Climate

1.4.1. Winds: Prevailing winds are from the west and southwest during April, September and from north and northeast from October to March. From November to March, strong east winds blowing from early morning till past noon cause drying of forest areas resulting in rapid spread of forest fires.

1.4.2. Temperature: Muthikulam situated at an elevation above 1000 m enjoys salubrious climate with average temperatures not exceeding 22.6^0 C (Figure 1.1). The average annual daily temperature for the past 30 years is 19.6^0 C.

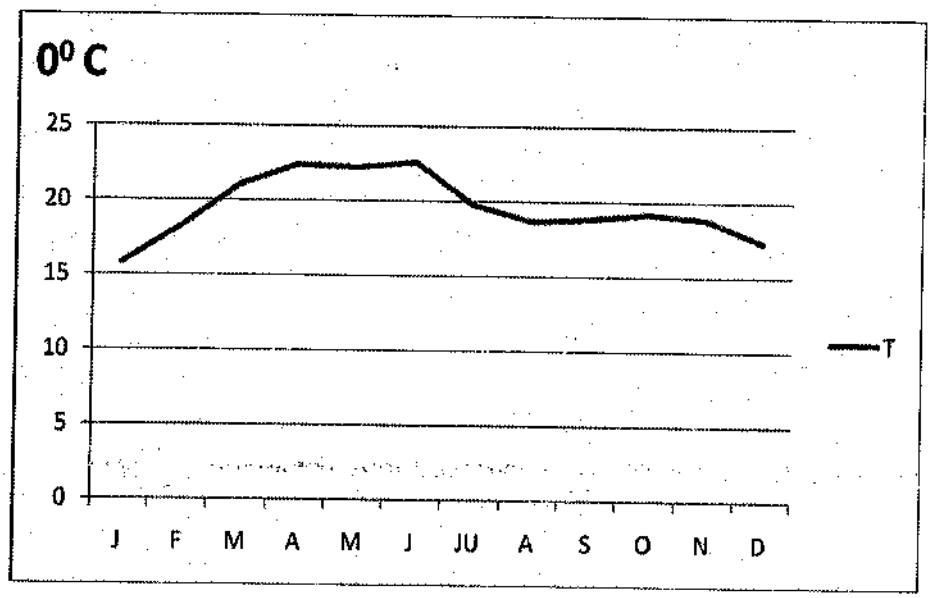


Figure 1.1 Average temperature in Muthikulam (Average of 30 years)

1.4.3. Rainfall: The Muthikulam area receives a heavy annual rainfall. Average rainfall for the past 30 years is provided in Figure 1.2. It is evident that June. July and August provide maximum rainfall. The total rainfall amounts to 4731mm.

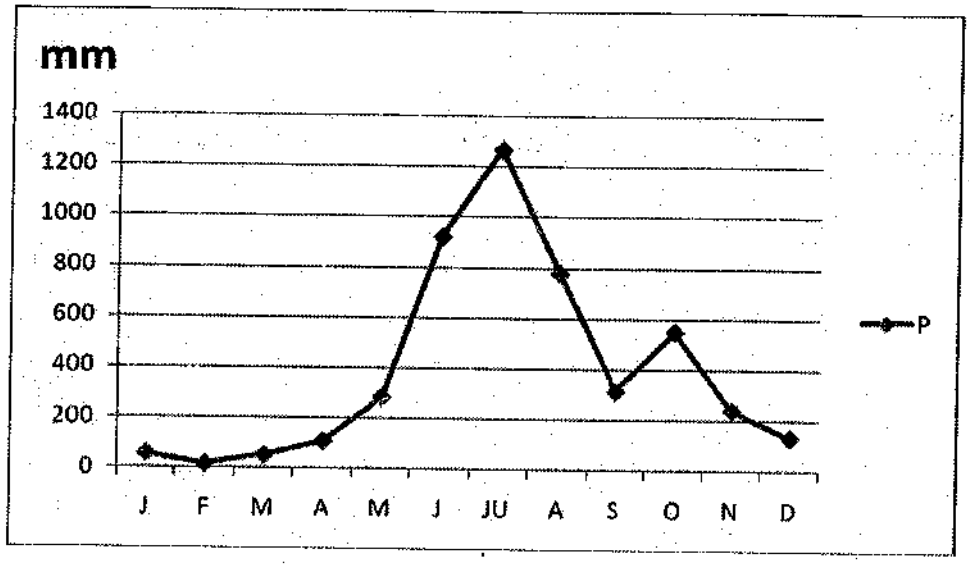


Figure 1.2. Average rainfall in Muthikulam (Average of 30 years)

1.5. Geology, rock and soil

The rock formation in Muthikulam area is of Archaean age comprising gneisses and granites. The soil is formed as a result of weathering of the ancient crystalline and metamorphic rocks. The soils are kaolinitic in nature, acidic in reaction, highly porous and friable. Pieces of lithomarge appear in the soils at lower depths. The presence of unconsolidated iron concretions indicates that the soils under the evergreen vegetation are put to more severe climatic pressures like rainfall and temperature. The soils in the grassland areas contained high amount of organic matter in the surface layers. The gravel content is too high (45%) and texture varies from loam to clay loam and the pH from very strongly acid to strongly acid (Basha, 1987).

1.6. Forest Types

Based on the revised system of classification of the Forests of India by Champion and Seth (1963), following are the forest types occurring in Muthikulam HVBA:

1. West Coast Tropical Evergreen Forests (1A/C4)
2. West Coast Semi Evergreen Forests (2A/C2)
3. Southern Moist Mixed Deciduous Forests (3B/C2)

4. Southern Montane Wet Temperate Forests (11 A/C1)

In addition to this, grasslands are also seen in Muthikulam HVBA.

1.6.1. West Coast Tropical Evergreen Forests (1A/C4)

This forest type is seen in Muthikulam HVBA and receives an annual rainfall of above 3,000 mm and enjoys an annual temperature below 27°C. Very brief dry spell, characterized by occasional precipitation has supported climatic climax vegetation. Lofty evergreen tree species like *Cullenia exarillata, Calophyllum polyanthum, Mesua ferrea, Palaquium ellipticum,* and *Dysoxylum malabaricum* are present (Plate 1).

Floristics

I. The top canopy consists of *Cullenia exarillata, Calophyllum polyanthum, Toona ciliata, Canarium strictum, Hopea parviflora, Dysoxylum malabaricum, Dipterocarpus indicus, Mesua ferrea, Palaquium ellipticum, Bischofia javanica, Vateria indica, Dipterocarpus bourdillonii, Persea macrantha, Poeciloneuron indicum.*

II. Middle canopy consists of *Schleichera oleosa, Cinnamomum malabaricum, Myristica malabarica, Elaeocarpus serratus, Hydnocarpus pentandra, Evodia lunu-ankenda, Holigarna arnottiana, Syzygium cumini, Garcinia tinctoria, Macaranga peltata, Mallotus philippensis, Ochlandra beddomei* and *Calamus* species.

III. Herbs and shrubs consist of *Strobilanthes* sp. *Clerodendron viscosum, Olea dioica,* and *Glycosmis pentaphylla.*

1.6.2. West Coast Semi evergreen forests (2A/C2)

This type of forest is seen in low and medium elevations in the Muthikulam HVBA.

Floristics

I. The top canopy consists of *Dipterocarpus indicus, Bombax ceiba, Polyalthia fragrans, Terminalia bellerica, Ficus species, Stereospermum chelonoides, Tetrameles nudiflora, Alstonia scholaris, Lagerstroemia microcarpa, Spondias pinnata, Albizzia odoratissima, Vitex altissima, and Dysoxylum ficiforme.*

II. Middle canopy consists of *Mallotus phillippensis, Bauhinia malabarica, Miliusa tomentosa, Bridelia crenulata, Hydnocarpus pentandra,* and *Wrightia tinctoria.*

III. Herbs, shrubs and climbers consist of *Acacia intsia, Olea dioica, Dioscorea* and *Calamus* species.

1.6.3. Southern Moist Mixed Deciduous Forests (3B/C2)

This type is seen in low and medium elevations in the Muthikulam HVBA.

Floristics

The component species are *Dillenia pentagyna, Xylia xylocarpa, Dalbergia latifolia, Syzygium cumini, Tectona grandis, Lagerstroemia microcarpa, Grewia tiliifolia, Terminalia paniculata, Anogeissus latifolia, Bridelia crenulata, Albizzia lebbeck, Haldina cordifolia, Strychnos nux-vomica, Bamboosa bamboo, Ochlandra rheedi, Ochlandra travancorica* etc.

1.6.4. Southern Montane Wet Temperate Forests

This type is characterized by dense growth of trees in the depressions and folds of the Ghats surrounded by extensive areas of grasslands. Grasslands constitute about 80 per cent of such forests and tree shows stunted growth with spreading canopy, twiggy branchlets and foliage of different colours. The rainfall is above 3,000 mm per annum and altitude above 1500 m.

1.6.5. Grass lands

The grass lands are interspersed with Montane Temperate Forest and Sub Tropical Hill Forests (Plate 1 and 2). The grass lands are found in upper reaches above 1500 m and the grasses are stunted and carpet like. Though the rainfall is very high, heavy run off is observed due to steep slope and they are exposed to strong winds. The important species that inhabit in these areas are *Gaultheria fragrantissima, Rhododendron nilagiricum,* with grasses like *Arundinella fuscata, Heteropogon contortus* and *Bothrichola pertusa* etc.

1.7. Vegetation Types

Ramesh and others (2002) have mapped the vegetation of South India and in the sheet Coimbatore – Thrissur details on the vegetation types in Muthikulam HVBA are available. Analysing the data, the following vegetation types and corresponding area (in percent) has been worked out (Table 1.6).

Plate 1. A. Evergreen Forest. B. Grass land-Shola

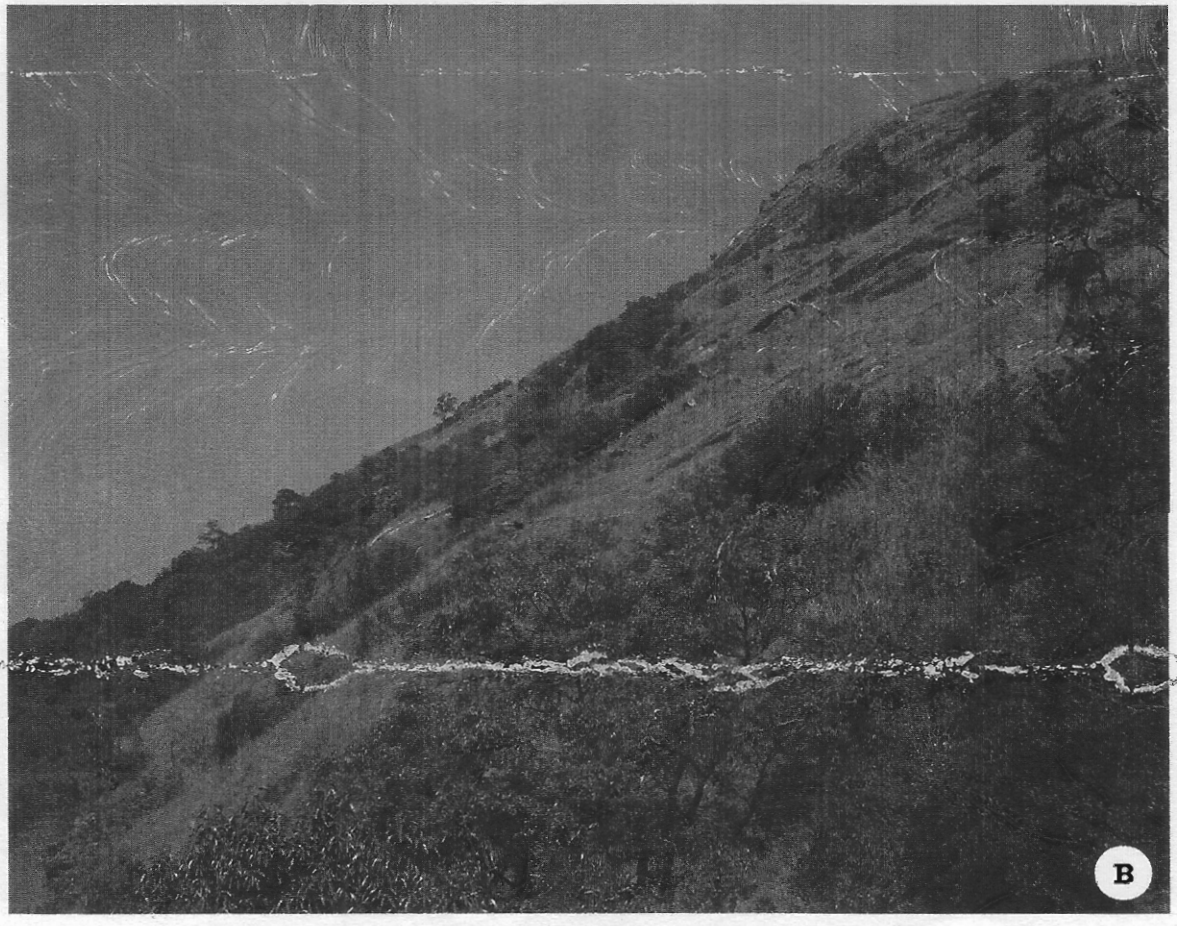


Plate 2. A. Siruvani Reservoir B. Grassland Savannah

Table 1.6. Vegetation types in Muthikulam HVBA

Sl. No.	Vegetation Type	Percentage
1	Dense Evergreen Forests	65.00
2	Semi Evergreen Forests	18.00
3	Secondary Moist Deciduous	2.00
4	Tree to shrub Savanna	6.00
5	Dense Thicket	2.00
6	Discontinuous thicket	1.00
7	Discontinuous thicket to scattered shrub	0.30
8	Shola – Grassland Forests	6.00
	Total	**100.00**

Bulk of the area is occupied by dense evergreen and semi evergreen forests at different elevation ranges from medium to high. Approximately 11% of the area is under different forms of degraded vegetation types from secondary moist deciduous to scattered shrub. At elevations above 1500 m patches of shola- grasslands are seen.

1.8. Wild Fauna and Habitats

Muthikulam HVBA is very rich in fauna too which is constituted by a large variety of mammals, birds, reptiles, amphibians, aquatic fauna, butterflies and other insects as well as microorganisms. The wild fauna includes: Mammals (23 spp.), Amphibians (21 spp.), Birds (48 spp.), Reptiles (52 spp.) and Butterflies (ca. 84 spp.).

Mammals- Important mammals include: Gaur, Lion-tailed Macaque, Bonnet Macaque, Nilgiri Tahr, Elephant, Tiger, Panther, Leopard, Wild boar, Barking Deer, Sambar Deer, Spotted Deer, Mouse Deer, Nilgiri Langur, Sloth Bear, Malabar Giant Squirrel, Flying Squirrel, etc.

Reptiles- There are 52 species of reptiles reported belonging to the families Bataguridae, Agamidae, Gekkonidae, Scincidae, Varanidae, Typhlopidae, Uropeltidae, Boidae, Elapidae and Viperidae, of which 18 species are endemic to Western Ghats (Balakrishnan, 2007)

Birds- The diversity of birds in the Muthikulam HVBA are studied by Nameer *et al.* (2007) and Lalitha *et al.* (2007). Approximately 158 bird species have been recorded from both Muthikulam and Siruvany forests. 48 species are listed from Muthikulam hills. The important birds are Nilgiri Laughing thrush, Great Pied Hornbill, Malabar Trogon, Paddy field Pipit, House Swallow, Black-naped Oriole, Crested Tree Swift, Wayanad Laughing thrush, Malabar Whistling Thrush, White bellied Shortwing , Lesser Fish Eagle, Blue-capped Rock Thrush, Eurasian and Tytler' s Leaf Warbler.

Butterflies- About 48 butterflies are reported from the areas of Koodam, Poolappara, Muthikulam basecamp, Pattiyar base camp and Singampara forests in Muthikulam Forest Reserve. Nymphalidae, Lycaenidae and Papilionidae are dominant families. The species like *Troides minos* Cram, *Graphium sarpedon teredon* Feld., *Pachliopta pandiyana, Udara akasa, Pieris canidia canis, Lethe rohria, Hasora chromus, Lethe drypetis* Moore and *Zipoetis saitis* are reported from Muthikulam Hills.

Amphibians- Around 21 species of amphibians were identified, some of them are *Rana temporalis*, White-nosed bush frog- *Philautus leucorhnus*, Indian Paddy field frog - *Linnonectus liannocaris*, Large Wrinkled Frog *Nyctibatrachus major* and Bedomie's Leaping frog were some significant species recorded from this area. The other amphibians such as Southern Hill toad - *Bufo microtympanum* Boulenger, the threatened Red, the sharp nosed bull frog -*Philautus nasutus* Gray, The Indian bull frog *Hoplobatrachus tigerinus* Daudin are also found in this region.

1.9 Tribal Settlements

There are 34 Tribal settlements in the reserve forests and vested forests of this Division as detailed below. Previously record of rights was issued to many of the Tribals in the settlements. But now new claims are preferred by the tribals for record of rights under Forest Rights Act. The process is not completed. The name of settlements and number of families are provided in Table 1.7.

Table 1.7. Details of tribal settlement in Mannarkkad Forest Division

Sl. No	Settlement	No. of houses	Area (Ha) as per GPS
1	Muthikkulam (Singappara)	36	28.9
2	Pothuppady	91	1.3
3	Karadippara	30	1.2
4	Onthumala	22	6.3
5	Paravalavu	10	0.61
6	Mele Abbannur	29	45.3
7	Chenthumbi	16	35.1
8	Pankanaripallam	15	16.1
9	Murugala	11	25.3
10	Kinattukara	9	19.4
11	Kadukumanna	50	185.1
12	Mele Thudukki	72	59.4
13	Galazi	12	15.5
14	Kurukathikallu	47	88.6
15	Gottiyarkandi	57	101
16	Thazhe Bhoothar	32	17.7
17	Mele Bhoothar	37	62
18	Edavani	30	22.5
19	Ooradam	14	Patta land as enclosure in forest
20	Pottikkal	39	19
21	Thazhe Abbannur	60	2.6
22	Karappadam	5	0.2116
23	Narukkumchola	5	0.5
24	Pampanthode	62	10.4
25	Pangode	10	6.3
26	Maruthankode	16	1.6
27	Vakkodan	17	2.6
28	Achilatty	21	11.7
29	Vettilachola	68	28.00
30	Vellathode	38	3.3
31	Anakkaranam	16	1.7
32	Vakkode	14	4.8
33	Palavalavu	11	2.2
34	Hanumanthan Moola	8	0.1

Adjoining landscape description

The Muthikulam High Value Biodiversity Area (HBVA) comprising dense forested areas of Agali and Mannarkad Ranges is bound on all the four sides by forested areas interspersed with agricultural and human dominated landscapes. The northern side the HBVA

is bound by Agali Range with forests of different degrees of degradation. On the western side moist deciduous forests of Mannarkad Range are formed. On the southern side degraded forests and human dominated landscape coming under the areas of Palakkad Forest Division (Olavakkode Range) are present. On the eastern sides, with the interstate boundary with Tamil Nadu drier forms of vegetation types belonging to Bolampatty Ranges of Coimbatore Forest Division are seen (Plate 3 and 4).

Plate 3.Coimbatore plains - View from Keralamedu (above);
Keralamedu - Interrstate boundary (below)

Plate 4. Pattiyar Bungalow (above); Road from Tamil Nadu - Keralamedu (below)

CHAPTER 2: BIODIVERSITY AND ITS SIGNIFICANCE

Tropical forests are the Earth's biologically richest ecosystems which play vital roles in regional hydrology, carbon storage and the global climate. They are the home to 70 percent of the world's plants and animals - more than 13 million distinct species contain 70 per cent of the world's vascular plants, 30 per cent of all bird species, and 90 per cent of invertebrates (Laurance, 1999). The main reasons for the wide range of decline in biodiversity are habitat alterations, increased rates of invasions of introduced non-native species, over-exploitation of the resources and other human-caused impacts. Hence maintaining and restoring biodiversity in forests promote their resilience and is an 'insurance policy' and safeguard against expected climate change impacts.

The Muthikulam HVBA is a rich repository of a vast variety of flora and fauna. It plays a very vital function in preserving the habitat of several threatened and/or endangered species. The forest areas fall into three forest types viz., West coast Tropical Forest, West coast Semi Evergreen Forest, Southern Montane Wet Temperate Forest and Montane Grasslands. The altitude varies from 200 m to 2000 m.

2.1 . Biodiversity values

2.1.1. Muthikulam Hills: The unique gene banks of endemic flora and fauna

Phytogeographically, the vegetation structure of Muthikulam hills shows more affinities to that of tropical Asia and Sri Lanka, thereby suggesting the existence of land connections in the past. The rate of endemism is comparatively high with most species distributed throughout the Western Ghats. The comparison of floristic diversity of Silent Valley, Muthikulam and Nelliampathy forests indicates (Basha, 1987) that the flora of these areas is of very high Simpson's index above 0.87 with Silent valley (0.94) and Muthikulam (0.93). The main species association in Muthikulam forests is *Myristica – Mesua – Aglaia* and these three species constitute 50% of the tree species.

Lichens

A total of 77 species of micro and macro lichens are reported from Muthikulam hills (Kumar, and Sequiera, 1999; Easa, 2003; Kumar, 2000; Kumar *et al.*, 2008) mainly from four major microhabitats viz., tree trunk, rock, soil and canopy branches. The family Parmeliaceae dominates with 23 species under eight genera followed by Usneaceae (11

species under one genus), Collemataceae (nine species under one genus). The genus *Usnea* dominates with 11 species followed by *Leptogium* (9 species), etc. Among the host plants of lichens, *Palaquium ellipticum* support the highest number of species followed by *Litsea floribunda, Antidesma menasu* and *Poeciloneuron indicum*. Host plants such as *Ardisia pauciflora, Cinnamomum malabatrum, Euonymus angulatus, Flacourtia montana*, , *Litsea floribunda, Litsea stocksii, Syzygium cumini, Syzygium munronii* and *Gomphandra tetrandra* support a substantial number of macrolichens. The list of Lichens is provided in the Appendix II.

Pteridophytes

Eighty-three species of Pteridophytes representing 28 families were recorded from this region which shows extreme variations in habits and habitats. The dominant families are Thelypteridaceae (13 sps.), followed by Pteridaceae (8 sps.) and Polypodaceae (7 sps.). The list of Pteridophytes in Muthikulam HVBA is provided in Appendix III.

Angiosperms

The floristic study reports 488 species of flowering plants, including 387 dicotyledonous, 101 monocotyledonous plants from Muthikulam hills, of which 99 are endemic to the Peninsular India. The most dominant families are Orchidaceae (22 sps.), Poaceae (22 sps.), Rubiaceae (22 sps.), Euphorbiaceae (21), Fabaceae (17 sps.), Lauraceae (17) and Piperaceae (14 sps.) and the dominant genera are *Piper* (9 sps.), *Impatiens* (7), *Ficus* (6 sps.), *Syzigium* (5 sps.) and *Oberonia* (4 sps.). Over and above this, there is a large number of micro flora too, of which no exhaustive list has been made. The number of endemic species found in these forests indicates the bio-geographic significance of the area. A checklist of flora is given as Appendix – IV. Many of the important species to the Western Ghats such as *Vateria macrocarpa, Holigarna arnottiana, Palaquium ellipticum, Cullenia exarillata, Myristica dactyloides, Mesua ferrea, Calophyllum elatum, Hopea ponga, Aglaia elaagnidea, Cinnamomum macrocarpum, Dysoxylum malabaricum, Diospyros bourdillonii* and *Dimocarpus longan* are found in this region (Plate 5 and 6). The rare and threatened species are: *Meliocope lunu ankenda, Saprasma fragrans, Plectranthus rivularis, Pogostemon gardneri, Plectranthus rivularis, Garcinia tinctoria, Poeciloneuron indicum, Ophiorrhiza brunonis, Wendlandia notoniana, Piper galeatum, P. argyrophyllum, Glochidion sisparense, Glochidion ellipticum, Eria albiflora, Liparis viridifolia,*

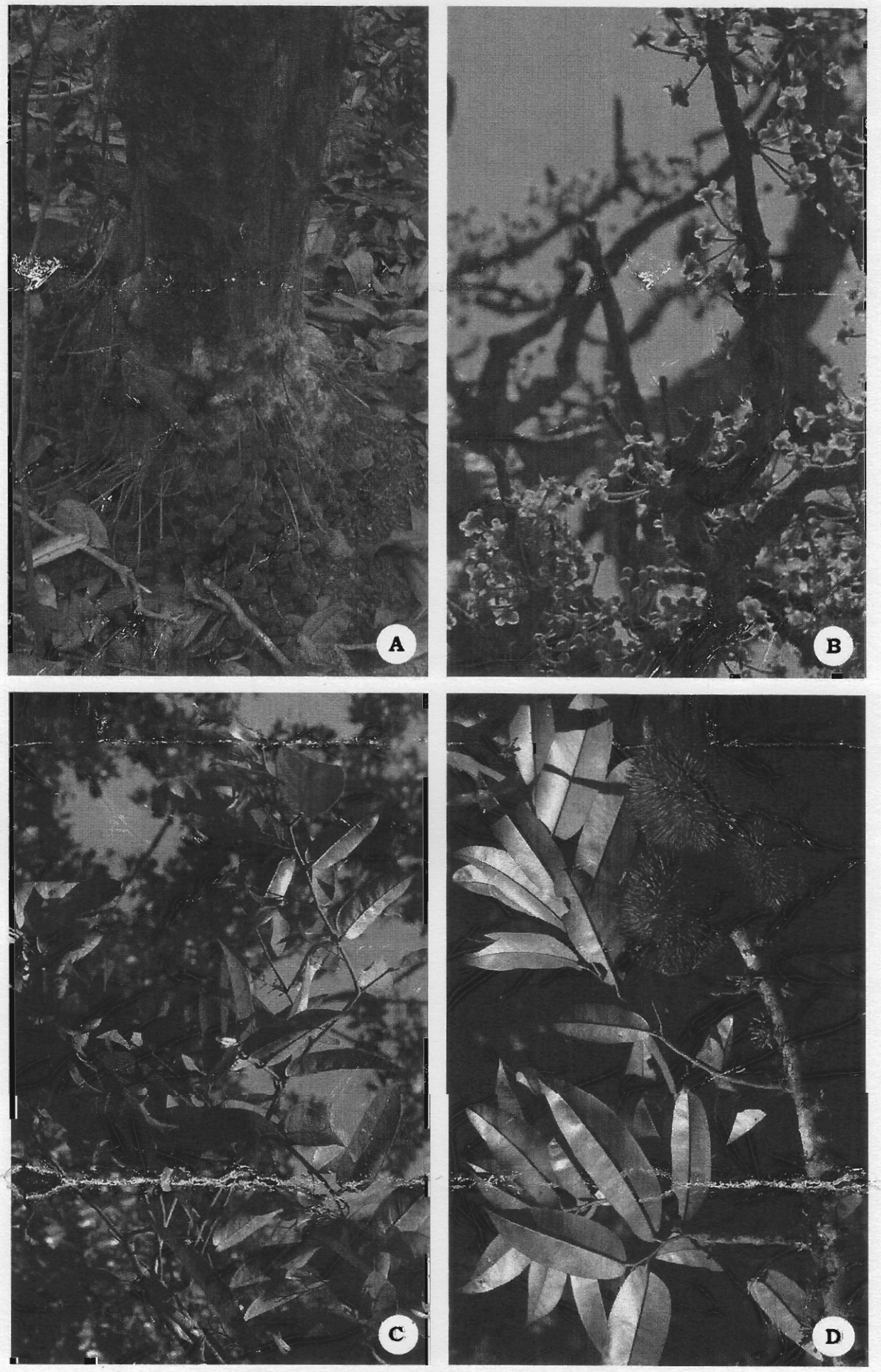
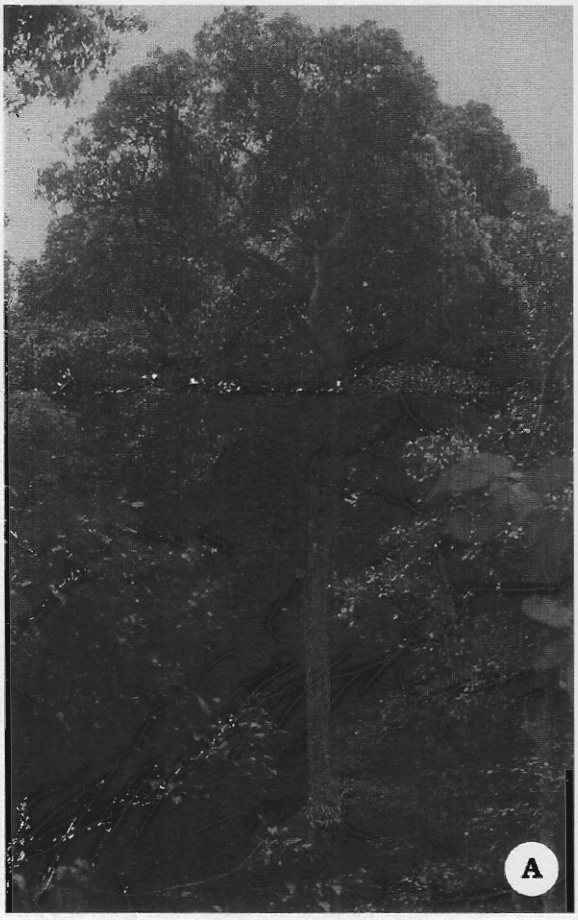
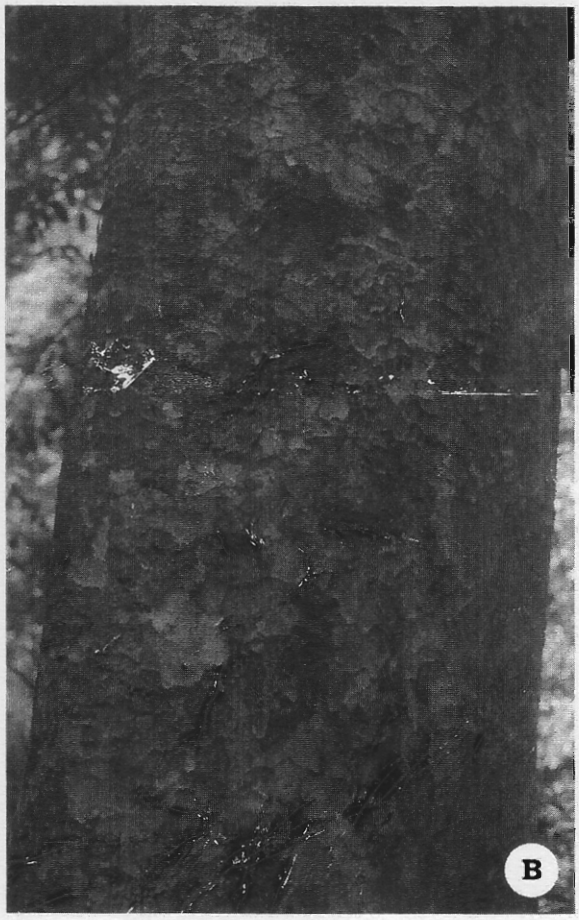
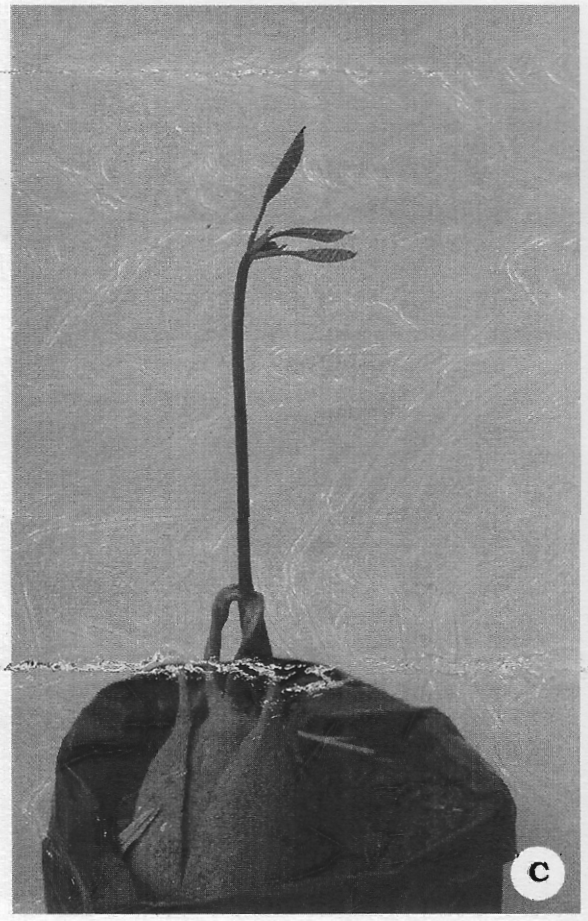


Plate 5. A. Baccaurea courtallensis B. Dillenia pentagyna C. Hopea ponga
D. Cullenia exarillata







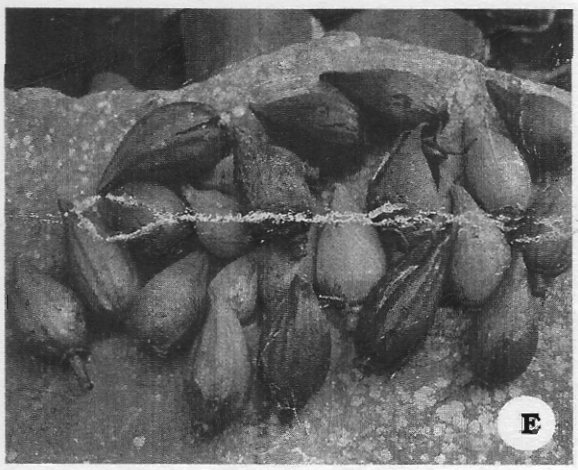


Plate 6. Vateria macrocarpa A. Habit. B. Bark. C. Seedling. D. Inflorescence. E. Fruits.

Ephemerantha macraci, Chrysoglossum maculatum, Dendrobium macrostachyum, Microstylis versicolor, Oberonia brachyphylla and *Oberonia ensiformis.*

Matching the floral wealth, the faunal wealth in Muthikulam HVBA also is endowed with fantastic diversity. The diversity in wildlife is tremendous- be it in case of mammals, birds, reptiles or amphibians. The common and rare mammals seen in this area include Nilgiri Tahr, Lion-tailed macaque, Bonnet macaque, Nilgiri langur, Elephant, Gaur, Sambar deer, Spotted deer, Barking deer, Mouse deer, Wild pig, Malabar giant squirrel, Nilgiri marten, Ruddy mongoose, Indian civet, Sloth bear, Tiger, Leopard, Jungle cat and Wild dog. The Nilgiri Tahr (*Nilgiritragus hylocrius*) an ungulate, endangered (Schedule 1 – Wildlife Protection Act (WPA) species) mountain goat endemic to the Nilgiri Hills and the southern portion of the Western Ghats is reported from higher reaches of Elivalmala with around 60 individuals. Populations of these animals are small and isolated, making them vulnerable to local extinction. A large population of sloth bears (*Melursus ursinus*), which are endemic and vulnerable (IUCN) species of the Indian subcontinent is also reported from Muthikulam HVBA. This species, listed in Appendix I of CITES and Schedule I of the WPA, 1972, is found in a variety of habitats ranging from wet evergreen forest to deciduous and degraded scrub forests. Degradation of the habitat due to overgrazing, tree felling, fire, conversion and reclamation for other uses, and over-extraction of forest resources, appear to be occurring throughout the bear ranges. The Nilgiri langur, (*Trachypithecus johnii*) an endemic to the Western Ghats, exists in almost all habitats. They are more abundant in the evergreen forests of Muthikulam hills. The species is endangered due to forest fragmentation and poaching for its fur and flesh, the latter is believed to have aphrodisiac properties. Lion-tailed macaque is an endangered species (IUCN) listed in Schedule I of W (P) A, 1972. The distribution of this species is restricted to the tropical evergreen forests of Kerala, Karnataka and Tamil Nadu. The population in the Muthikulam HVBA is reported to be severely fragmented and isolated due to conversion of medium elevation evergreen forests into reservoirs and forestry and commercial plantations. The presence of extensive patches of almost undisturbed medium elevation evergreen forests (*Cullenia-Mesua-Palaquium* type) provides an ideal habitat for the species, since they mostly feed on fruits and young leaves of *Cullenia exarillata* (Ramachandran and Joseph, 2000). The threatened amphibians in the Muthikulam HVBA are *Rana curtipes, Bufo microtympanum, Philautus leucorhnus* and *Polypedatus maculates.* The important reptile species are *Draco dussumieri, Orphiophagus hannah, Echis carinatus Trimeresurus malabaricus* and *T. macrolepis*. The conservation status of mammals is

Plate 9. Singappara Forest Station (above); Keralamedu Forest Picket Station (below)

provided in Table 2.1 and a checklist of Mammals, Reptiles and Amphibians is given in Appendix – V

Table 2.1. Status of mammals recorded from Muthikulam HVBA

Sl. No	Species	Local Name	IUCN		Endemism	CITE	WL (P)
			Status	Category			
1	*Macaca radiata* (E. Geoffroy)	Bonnet macaque	LRIc	--	EN- PI	A-II	A-II (1)
2	*Macaca silenus* (Linnaeus)	Lion-tailed macaque	EN	(B1,2c; C2a)	EN-WG	A-I	A-I (1)
3	*Trachypithecus johnii* (J. Fischer)	Nilgiri langur	VU	(BI, B2; C1a)	EN-WG	A-II	A-I (1)
4	*Cuon alpinus adjustes* (Pallas)	Indian wild dog	CR	(D1)		A-II	A-II (1)
5	*Felis chaus* Schreber	Jungle cat	LRnt	--		A-II	A-II (2)
6	*Panthera pardus* (Linnaeus)	Leopard	VU	(C2a)		A-I	A-I (1)
7	*Panthera tigris* (Linnaeus)	Tiger	EN	(C2a)		A-I	A-I (1)
8	*Melursus ursinus* (Shaw)	Sloth bear	VU	--		A-I	A-I (1)
9	*Paradoxurus hermaphroditus* (Pallas)	Common palm civet	LRIc	--		A-III	A-II (2)
10	*Viverricula indica* (Desmarest)	Small Indian civet	LRnt	--		A-III	A-II (2)
11	*Bos gaurus* H.Smith	Gaur or Indian bison	EN			A-I	A-I (1)
12	*Hemitragus hylocrius (Ogilby)*	Nilgiri tahr	EN	(B1, 2acd; C2a)	EN-WG		A-I (1)
13	*Axis axis* (Erxleben)	Spotted deer or chital	LRIc	--			AII(3)
14	*Cervus unicolor* Kerr	Sambar	LRIc	--			AII (3)
15	*Muntiacus muntjak* (Zimmermann)	Barking deer	LRIc	--			AII(3)
16	*Sus scrofa* Linnaeus	Wild boar	LRIc	--			AII(3)
17	*Moschola meminna* (Erxleben)	Mouse deer	LRnt	(A1d)			A-I (1)

Source, Ramesh et al., 2003.

Nameer and others (2007) studied the bird diversity of Siruvani and Muthikulam Hills and reported a total 158 species of which 14 species are endemic to the Western Ghats while nine belonging to the Red Data book species were also seen. Of the total 158 species, 48 species were recorded from Muthikulam hills only **(Appendix V).** All the 22 Western Ghat endemics found in Silent Valley National Park with the exception of Nilgiri Pipit were recorded in Siruvani- Muthikulam forests. The important birds found in the area are *Phylloscopus tytleri, Ficedula nigrorufa, Garrulax cachinnans, Buceros bicornis, Columba elphinstonii* and *Hieraaetus fasciatus.* With regard to diversity of birds in different locations, Kuravampady has the highest diversity, understandably due to the mix of plantations and natural forests leading to several ecotones. This is followed by Pattiyar again due to the proximity of reservoir and hence the diverse habitat types found there. Muthikulam and Karimala recorded the least diversity among the base camps.

The discovery of Nilgiri Laughing thrush in these hills is a landmark achievement in establishing the importance of these habitats. The threatened birds in the area are *Spizaetus cirrhatus*, *Pycnonotus priocephalus*, *Myiophonus horsfieldii*, *Garrulax cachinnans* and *Phylloscopus tytleri*. Considering the diversity and endemism of bird communities, Muthikulam – Siruvani Reserve forest areas were recently added to the Important Bird Area (IBA) category as per the Bird Life International guidelines.

A total of 84 species of butterflies was recorded from the evergreen and semi-evergreen forests in Muthikulam HVBA. Butterflies are dominant in the areas of Koodam, Poolappara, Muthikulam base camp, Pattiyar base camp and Singampara forests. The most abundant and commonly found family was Nymphalidae with its important genera such as *Cupha, Euthalia, Hypolimnas, Junonia, Lethe* and *Mycalesis*. The rare species recorded were Malabar Banded Peacock, Southern Birdwing, Malabar Raven, Plains Cupid and Yam fly. The pattern of butterfly diversity was similar to that of birds, more in evergreen forests followed by deciduous forest in Muthikulam. The studies on butterflies diversity (Lalitha, *et al.* 2007) in Muthikulam, Mukkali and Chindakki areas shows that the maximum diversity was found in Muthikulam Reserve Forest (3.48) followed by Mukkali (3.41) and Chindakki areas (3.13). The Nilgiri Tiger which is endemic to South India was also recorded from here. Southern Bird wing and Malabar Tree Nymph (threatened) endemic to the Western Ghats were recorded mainly in the evergreen forests

A list of Butterflies in the region is provided in Appendix V.

Medicinal plants

The Muthikum HVBA is home to diverse wild aromatic and medicinal plants. The Muduga tribe of this area have a rich ethnic knowledge of these plants. NTFP collection, including the medicinal plants is their main source of income. Gajathippali (*Balanophora fungosa* ssp. *indica*) (Plate 7), Thelli (*Canarium strictum* Roxb.), Manjakoova (*Curcuma zedoaria*) Cheenikka (*Acacia sinuata* (lour.) Merr., Maravettikkuru (*Hydnocarpus pendandra* (Buch.-Ham.) Oken,), Urunjikai (*Sapindus trifoliate* L.,), Kallurvanchi (*Rotula aquatica* Lour.), Analivenga (*Pittosporum neilgherrense* Wt. & Am) and Kattupavakka (*Momordica dioica* Roxb. Ex Willd) are collected from the forests. The other important medicinal plant resources are *Coscinium fenestratum, Dicliptera cuneata, Gymnostachyum febrifugum, Justicia procumbens* L., *Peristrophe paniculata, Rungia parviflora, Dioscorea pentaphylla, Dioscorea oppositifolia, Elettaria cardamomum, Amomum microstephanum, Curcuma neilgherrensis, Artocarpus hirsutus, Phyllanthus niruri, Agrostistachys meeboldii, Cinnamomum sulphuratum, Piper hymenophyllum, P. attenuatum, P. nigrum, P. galegatum, Myristica malabarica, Bacopa monnieri , Sida cordifolia, Sida acuta* and *Naravelia zeylanica.*

Indigenous tribes

Mudugas

Mudugas (Plates 7 and 8), inhabit mostly the forest areas of South –Western foot hills and in the Southern part of the Attapady valley. Though their main livelihood is collection of NTFP, they also practice small scale shifting cultivation and fishing. They also grow in small quantities amaranth, beans, maize, cucumber and plantains. Forest products like bamboo, reed, grass, vines wood, etc. are used to manufacture household items like baskets, brooms, tools and for constructing huts. Gathering in the forest is of great importance both as a means of obtaining food and also as a source of raw materials. The major portion of their diet comes from roots, tubers and green leaves. Mushrooms are highly relished and are picked during rainy season. The roots of Noora Kizhangu (*Dioscorea pentaphylla*) Savel Kizhangu (*D. tomentosa*) and Sole Kizhangu (*Dioscorea sp.)* are the main tubers used by Mudugas. They identify four varieties of honeybees. Mudugas visit the Malleswaram mudi, which is the abode of Siva, once in a year on Sivarathri night and light lamp and offer lengthy pooja.

Plate 7 A. Muduga women
B. Balanophora fungosa ssp.indica collected from the forest.

Plate 8. A. Muduga men. B. Muthikulam settlement.

2.2. Factors affecting values.

- Forest degradation and removal of evergreen patches
- Infestation of noxious weeds and forest fire
- Illicit Ganja cultivation
- Degradation of watersheds
- Overexploitation of NTFPs including reeds, bamboos and medicinal plants

2.3. Threats

Tropical forests cover only twelve percent of the land-area of the Earth, yet they are home to between 50 and 90 percent of the world's species. Because of fast deforestation rate, at least one species is disappearing every day and this rate of extinction is now 400 times faster than at any other period in the history of the planet.

Biodiversity is the foundation for the goods and services provided by ecosystems that are crucial for human survival and well being. Loss of biodiversity has negative effects on several aspects affecting human life such as food and energy security and access to clean water and raw materials. The livelihood of many indigenous and local communities, in particular, is adversely affected since their communities are so directly dependent on the products and services provided by the ecosystems they inhabit. Tourism, an important and fast growing industry in large parts of Asia, is vulnerable to biodiversity loss since rich biodiversity and beautiful nature and countryside have increasingly become major tourist attractions. In general, there is a need to preserve habitats in order to facilitate the long-term adaptation of biodiversity and to fully integrate biodiversity considerations into mitigation and adaptation plans. The link between biodiversity and climate change runs both ways: biodiversity is threatened by climate change, but biodiversity and its components can reduce the impacts of climate change on people and production.

Major threats to Muthikulam HVBA

Muthikulam HVBA forms connectivity between forests north of the Palakkad gap and Silent Valley. However, the major land use changes, selective felling, encroachments, fire and forest degradation are a major threat to the connectivity between Attappadi Block VI and Silent Valley forests.

Annual fires are common in evergreen, semi-evergreen, deciduous forests and plantations. They are caused by hillmen for hunting game or collecting NTFP, by graziers for promoting a flush of young grass, and wayfarers, out of negligence. Forest fires usually occur during the months of December to May each year.

The invasive alien species such as *Eupatorium, Mikania* and *Lantana* are ready colonizers in disturbed areas and cause considerable ecological damage to India's natural areas. They speed up the disappearance of threatened and endemic species and reduce the carrying capacity of pastures. These invasive alien plants can prevent or retard natural succession and reforestation by forming dense infestations. Major weeds in the plantations are *Mikania, Lantana camara* and *Eupatorium.*

The Muthikulam forests adobes the habitats of many rare endangered flora and fauna. The populations of *Vateria macrocarpa, Dipterocarpus bourdilonii, Dysoxylum malabaricum* and *Gluta travancorica* are restricted to small isolated pockets. The selective logging process in the past, caused reduction in population size of many tree species in this area. The alteration of habitats, hunting and poaching the wildlife cause damage to the ecosystem by removing species key to the system's functioning. The loss of habitats, hunting, poaching are the main threat to the remnant populations of the Western Ghats endemic and endangered fauna such as Lion-tailed macaque, Spotted deer, Nilgiri Tahr etc. in Muthikulam HVBA.

2.4. Strategies to address threats

Strategy I. Conserve critical species, ecosystems and gene pools

- Endemic and Rare, Endangered species
- Conservation and restoration of the area.
- Unique ecosystems and species-specific habitats.
- Wildlife corridors

Strategy II. Establish models for cost-effective afforestation, conversion of degraded plantations to natural forests and sustainable utilization of NTFP.

Strategy III. Reduce Human-wildlife conflicts through appropriate methods.

Strategy IV. Develop appropriate measures in natural resource management to avoid issues.

2.5. Indicators of success

Criteria and indicators of sustainable forest management are widely used and many countries produce national reports that assess their progress toward sustainable forest management. There are nine international and regional criteria and indicators initiatives, which collectively involve more than 150 countries. There appears to be growing

international consensus on the key elements of sustainable forest management. Seven common thematic areas of sustainable forest management have emerged based on the criteria of the nine ongoing regional and international criteria and indicators initiatives. The seven thematic areas are:

1. *Extent of forest resources*
2. *Biological diversity*
3. *Forest health and vitality*
4. *Productive functions and forest resources*
5. *Protective functions of forest resources*
6. *Socio-economic functions*
7. *Legal, policy and institutional framework.*

The thematic areas and monitoring indicators and the research needs for the effective management of Muthikulam High Value Biodiversity Area are shown in Table 2.2.

Table 2.2. Criteria and Monitoring indicators in Muthikulam HVBA

Sl. No	Criteria	Monitoring indicators	Research needs
1	*Extent of forest resources*	• Increase in the extent of forest and tree cover • Forest area under encroachment • Area of dense, open and scrub forests • Tree cover outside forest area	• Mapping and analysis of Biodiversity hot spot areas. • Developing a GIS based management system.
2	*Conservation of biological diversity*	• Number of forest dependent species and status • Population levels of representative species from diverse habitats monitored across their range. • Trends in the conservation status of species • Annual removal of non-timber forest products (e.g. medicinal plants etc) compared to the level determined to be sustainable. • Area and percent of forest affected by invasive plant species.	• Identification of threatened species. • Monitor collecting of NTFPs and NTFP dependency of Tribes and fringe area people • Details on actual collection and use of medicinal plants and other non-timber forest products. • Impacts of browsing on wild plant populations • Inventory of lower forms of fauna and flora.

3	*Forest ecosystem health and vitality*	• Area of forest affected by pests, disease, wildfire, etc. (e.g., insect and disease/tree mortality listings/maps, damage appraisal reports, wildfire listings). • Number fires reported by cause and fire danger rating. • Number of sites exhibiting forest health problems that can be attributed to adjacent land uses and activities	• Determination of fire-weather index. • Mapping of fire prone, weed infested and degraded areas.
4	*Conservation and maintenance of soil and water resources*	• Area under watershed treatment, alkaline soils and deserts • Area prone to soil erosion	• Monitoring watersheds and Identifying the cause of degradation and restoration
5	*Optimization of forest resources utilization*	• Demand and supply and recorded removal of Wood and NTFPs.	• Assessing the contribution of forests to the income of forest-dependent people
6	*Socio- economic function.*	• People's benefits are enhanced. • Level of recreation, cultural, religious and aesthetic needs. • Contribution of forest to the income of forest dependent people	• Forest and NTFP dependency of Tribes and fringe area people
7	*Legal, policy and institutional framework.*	• Planning and budget allocation available. • Extent of EDCs, NGO and private sector participation in forestry activities • Accounting forest resources • Changes in number of forest offence • Existence of conflict management mechanisms	Legal, policy and institutional framework.

CHAPTER 3: HISTORY OF PAST MANAGEMENT, PRESENT PRACTICES AND FUTURE CHALLENGES

3.1. Conservation and forest management history

Muthikulam is a part of Attappady Reserve and was under private ownership and subjected to intensive cultivation in the past (Madras District Gazette, 1915). These areas were reserved by the British in the early 1900s. (Table 3.1). There were disputes between three powerful landlords (Jenmis) viz. Mannarghat, Moopil Nair, Palat Krishna Menon and Eralpad Raja for the ownership of the forest which led to bloodshed on 1901 and was provisionally settled by the Divisional Forest Officer by allotting specific areas to the disputants. The following description, as given in the notification of 1901 and cited by Ayyar (1935) gives an idea of the destruction of these forests.

"Unscientific forestry, the ravages of timber thief, the destructive ponam (shifting) cultivation fatal to tree growth, the average Jenmis' (landlord) anxiety to turn his trees into money with the least possible delay, the Moppila (Muslim trader) in the guise of honest merchant removing on payment of kuttikanam (stump fee) three times as many trees as he has paid for – all these contributed to the slow but steady denudation of the forests in the accessible areas, and these gradually became almost destitute of good timber". Dietrich Brandis (Madras Government Records, 1882) stressed the need to protect the evergreen forests which formed the water resources of the Bhavani and its tributaries. The Government accepted his views (Madras Government Records, 1886) and decided to take over all these forests. Porter (1887) inspected these forests and gave a detailed description of the area dividing them into six blocks of which Block I to V formed one chunk adjoining the Silent Valley Reserve at its east and Block VI as a detached unit, forming the catchment of Siruvani River. He described the forests of Block VI as "the shola as this is in one dense mass of evergreen forest with no deciduous forest and but little grassland". The general description of Attappady as furnished by him is "the evergreen forests are magnificent and contain finer trees than I have seen in the Nilgiri or Anamalai sholas. The chief value of these evergreen forests lies in their protective powers both as attracting and storing water". The Government constituted Attappady Block I to IV as Reserved Forests in 1900 (Madras Government

notification, 1900). Lushington (1906) described the way the forests were managed. "If we are really to conserve the areas, our cutting must be limited and most we can expect is to be able to fell mature trees and those sparingly. I do not see why the Forest Department should look only to the commercial side. We are called Conservators, Deputy Conservators etc., I am of opinion that the first idea of the Department should be conservation and the making of revenue is only on secondary importance".

Table 3.1. Details of Reservation of Attappady Block I – VI

Sl. No	Reserved Forest	Area (ha)	Date of Reservation	Particulars of notification	Remarks
1.	Attappday Block I	7510.97	1.9.1900	No.332 of 13.7.1900 on page 1085 of the gazette dt. 17.7.1900	-
2.	Attappady Block II, III & IV	1165.50	1.9.1900	"	-
3.	Panakkadan	447.58	15.10.1906	No.338 of 27.7.1906 on page 831 of the gazette dt. 7.8.1906	-
4.	Attappady Block V	5325.67	1.9.1912	No.314 of 22.6.1912 on page 696 of Part I of gazette dt. 9.12.1912	Acquired under L.A. Act for Rs. 11379.4
5.	Attappady Block VI	6385.95	1.9.1912	No.314 of 22.6.1912 on page 696 of Part I of gazette dt. 9.12.1912	Acquired under L.A. Act for Rs.91571.12
6.	Panakkadan Addition I	50.91	1.4.1916	No.161 of 11.12.1918 approved in GO No. 568/Revenue, dt. 11.2.1918	-
7.	Panakkadan (Kanjiramkunnu and Mulakuvallam)	111.64	30.6.1975	GO (MS) 404/72 Agri.dt.28.11.72 and GO (MS) 204/75 AD Agri.dt 30.6.75.	-
Total		**20998.22**			

Subsequently, Attappady Block V and VI were acquired from the private owners by paying compensation as below (Madras Government Records, 1908). Attappady Block V –

5325.67 ha for Rs. 11,379.25 and Block VI – 6385.95 ha for Rs. 91,571.75. These forests were constituted as Reserved Forests in 1912 (Madras Government Gazette, 1912).

3.2. Research, Monitoring and Wildlife health

There were only few studies on Muthikulam reserve forests in the past conducted by different research institutions and NGOs. The main studies on Muthikuam reserve forests include floristic inventories including angiosperms, lichens and pteridophytes, ecological studies, surveys on birds and Siruvany basins etc. The scientific inventories on floral wealth of the area were published in Flora of Silent Valley by K. S. Manilal in 1988. Chand Basha, (1987) conducted studies on ecology including different forest types, their structure, vegetational sub types, and other phytogeographical aspects of the reserve. The detailed inventory on lichens of the reserve was done by Kumar and Sequiera (1999) who reported the micro and macro lichens. Nameer *et al.* (1997) studied the bird diversity of Siruvani and Muthikulam Hills and pointed the importance of this reserve for conservation priority. There is a big gap in the knowledge of the biodiversity resources of this forest reserve. No systematic studies were carried about lower group of plant kingdom such as algae, liverworts and mosses. There is no information with regard to fish diversity, soil microflora, aquatic micro organisms, arthropods, mollusks and wild animal parasites.

The information about the productivity of various habitats is lacking. Detailed data on the extent of human pressure on the forest is also not available. At present, there is no institutional arrangement to monitor the wildlife health.

3.3 Administration and organization

The Division is headed by a Divisional Forest Officer. The Division is further sub-divided into basic units - Forest Ranges manned by Forest Rangers and each Range is further sub-divided into Stations (Plate 9), Sections, and Beats manned by Deputy Rangers, Foresters and Guards (Table 3.2).

Table 3.2. Existing posts in Mannarkkad Forest Division

Designation	Strength	Division Office	Distribution of staff in Ranges		
			Mannarkkad	Attappady	Agali
Controlling					
Divisional Forest Officer	1	1			
Executive					
Range Officer	3	-	1	1	1
Protective					
Deputy Ranger	8	-	3	2	3
Forester	20	-	8	6	6
Forest Guard	103	-	36	26	41
Reserve Watcher	8	-	3	2	3
Ministerial					
Sr. Superintendent	1	1	-	-	-
Junior Superintendent	1	1	-	-	-
Head Accountant	1	1	-	-	-
U. D. Clerk	8	6	1	1	1
L .D. Clerk	9	5	1	1	1
L. D. Typist	2	2	-	-	-
U. D. Compiler	1	1	-	-	-
D' man Grade I	1	1	-	-	-
Surveyor Grade II	1	1	-	-	-
Peons	7	4	1	1	1
Night Watcher	1	1	-	-	-
Driver	9	1	3	3	2
P. T. Sweeper	5	1	2	1	1

Forest Department does not maintain any permanent labourers; they utilise the services of hired labourers for both skilled and unskilled works. Preference will be given to tribals; from nearby tribal settlements. Work such as raising of nursery, planting, cultural operations and tending including weeding, climber-cutting, soil working, extraction of timber, poles firewood, fire-protection and boundary consolidation works are carried out departmentally, by engaging local labourers. For additional support in tourism management and protection, fringe area people are being engaged on daily wages.

3.4 Future challenges

Conservation and management of the biodiversity and forests in Muthikulam HVBA needs to be guided by the following three principles:

1. The biodiversity has to be documented, evaluated and protected
2. Participation of stakeholders and benefits to them need be assured
3. The capability and capacity of Forest Department staff to conserve and manage Muthikulam HVBA has to be enhanced through training and better material facilities provided to them for achieving professional satisfaction

The challenges in the future refer to participative conservation and management of the forest cover to derive direct and indirect benefits from the forests. The traditional attitudes and methods of protection by the Department staff alone and keeping the resource away from local population will only cause alienation developed negative attitude from stakeholders. This will lead to progressive loss of forest cover, extinction of rare fauna and flora and lowering of environmental services of forests. Hence the challenge before us is to evolve and implement a prospective, significant, sound, conservation oriented management plan for protecting and enhancing the high biodiversity value of Muthikulam HVBA. Further, a capacity building exercise has to be implemented in the Forest Department to enable staff to rise to the current global demands on biodiversity and forest. The present proposal is a humble beginning to achieve this long term goal.

CHAPTER 4: FUNCTIONAL SECTORS IN THE LANDSCAPE

4.1. Forestry (D*)

In Muthikulam HVBA there are six plantations of eucalypts, raised between 1962 and 1987 covering an area of 92.5 ha (Plate 10). All plantations are understocked and belong to the failed category. They are located in grassland area and it is possible to bring back the area to natural conditions. The main reasons for failure are shallow soil, winds and browsing by ungulates.

4.2. Agriculture (D)

Subsistence agriculture is practised around the houses in only one tribal settlement in Muthikulam which has been allotted 74.1 acres. They used to cultivate minor millets and paddy. The tribals are interested to cultivate tree crops like arecanut and pepper but are unable to gain full benefit due to wildlife raids and absence of protection. There are a few rubber plantations and agroforestry homesteads in the northern and western parts of the Muthikulam HVBA.

4.3. Integrated development (Ecodevelopment, Development through District Administration (D).

The Muthikulam tribal settlement is a part of Sholayur Panchayath located about 10 km south-south west as the crow flies, but people have to travel more than 50 km by road to reach the Panchayath HQ. Due to the distance at present there is no involvement of either Panchayath or District Administration in developmental activities. The houses are dilapidated and only an alternative school – Multi Grade Learning Centre (M.G.L.C.) – One Teacher School functions.

4.4. Tourism (D)

Major Tourist Attractions: Muthikulam Reserve comprises thick evergreen forests, sholas and reservoir bound by grasslands. At an elevation of ca. 1000 m, tourists are attracted not only to the rustic sylvan area with muthikulam waterfalls (Plate 10) but also to a very pleasant climate. At present tourism is not that organized at Muthikulam.

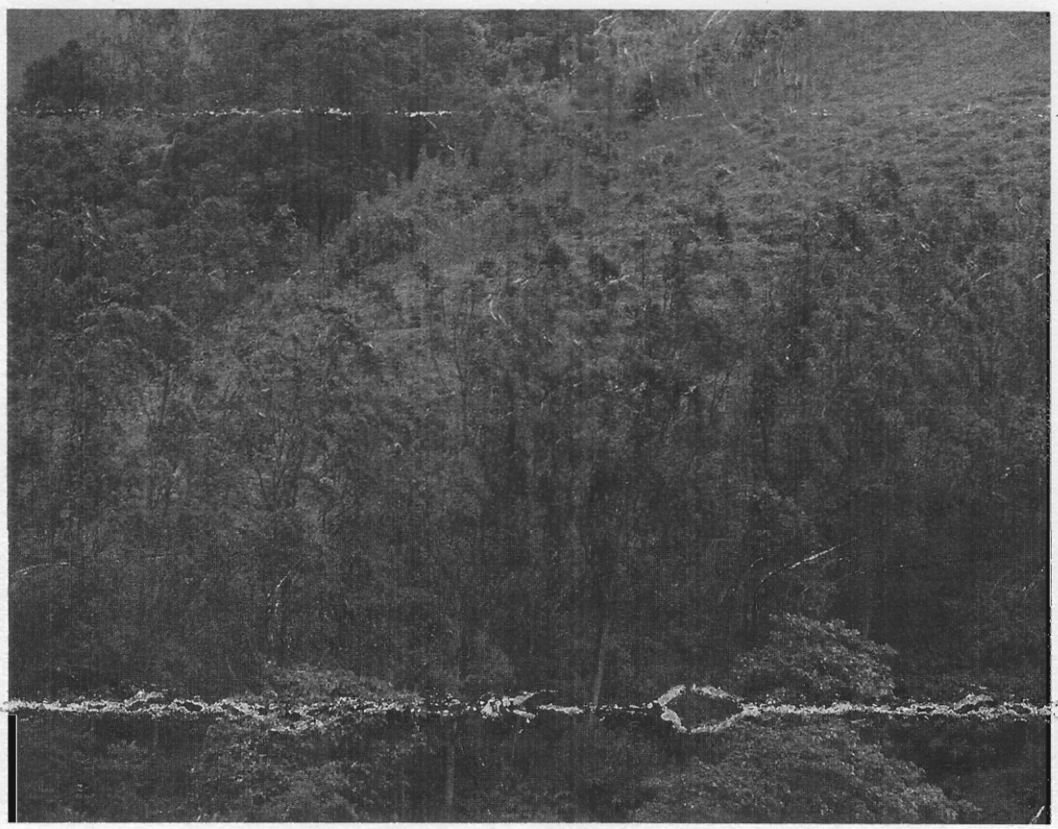


Plate 10. Muthikulam Waterfalls - View from Pattiyar Bungalow (above);
Eucalypts Plantations around Keralamedu (below)

Present Management of Tourism Zone: The Kerala Foerst Department is conducting Ecotourism at Muthikulam called "Siruvani Ecotourism" through a VSS comprising the tribals from the settlement. There are two vehicles for transporting tourists to the destination along Keralamedu and later trecking is conducted.

4.5. Fisheries (D)

Fishing is done in a small scale by the tribals and organized fishery is absent.

4.6. Tea/Coffee Estates (I **)

There are no Tea/Coffee estates in the Muthikulam HVBA.

4.7. Road/ Rail transport (D)

The connecting road from Palakayam to Coimbatore runs through the Muthikulam HVBA.

4.8. Industry (D)

There are no industries in the Muthikulam HVBA

4.9. Mining (D)

There are no mining activities in in the Muthikulam HVBA.

4.10. Thermal power plants (I)

There is no thermal power plant in in the Muthikulam HVBA.

4.11. Irrigation projects (D)

Although, there is no irrigation project in the Muthikulam HVBA, a dam and a small reservoir (74 ha) for supplying drinking water to Coimbatore are present.

4.12. Temple tourism (D)

There is no temple tourism in the Muthikulam HVBA.

4.13. Communication projects (D)

There is no communication project in the Muthikulam HVBA.

* D : Affects wildlife directly
**I : Affects wildlife incidentally

CHAPTER 5: LANDUSE PATTERNS AND CONSERVATION-MANAGEMENT ISSUES

5.1. Landuse Classification

The total extent of the forest coming under the Muthikulam High Value Biodiversity Area is 110.44 km^2 which include both the natural forests and cultivated land. The details of landuse are provided in Table 5.1.

Table 5.1. Landuse of Muthikulam High Value Biodiversity Area

Western–Eco-floristic Zone- Low elevation (below 750m)	km^2	Species composition
1. Dense evergreen forest	6.217	*Dipterocarpus indicus - Kingiodendron - Humboldtia brunonis* type
2. Semi-evergreen forest	14.72	
3. Secondary moist deciduous woodland	0.1144	
4. Tree to shrub savanna	3.6112	
5. Dense thicket	0.3539	
Medium elevation (750-1400m)		
1. Dense evergreen forest	49.45	*Cullenia exarillata – Mesua ferrea- Palaquium ellipticum* type
2. Semi-evergreen forest	5.958	
3. Secondary moist deciduous woodland	2.394	
4. Tree to shrub savanna	1.676	
5. Dense thicket	1.50091	
6. Discontinuous thicket to low scattered shrub	0.4778	
High elevation (1400-1800m)		
1. Dense evergreen forest	11.14	*Schefflera* spp- *Litsea* spp- *Syzygium* spp. type
Eastern and Northern Eco-floristic Zone- Deciduous Types		
1. Dense thicket	0.08380	*Anogeissus latifolia – Chloroxylon swietenia- Albizia amara* type
2. Tree to shrub savanna	0.2711	
Anogeissus latifolia –Pterocarpus marsuplum		
1. Discontinuous thicket to low scattered shrub	0.2459	*Terminalia* spp. type
Evergreen and semi evergreen formations (medium & high elevations)		
1. Dense forest	1.941	*Diospyros ovalifolia – Memecylon lushingtonii – Olea glandulifera* type
2. Tree to shrub savanna	0.2514	
3. Discontinuous thicket to low scattered shrub	0.06719	
Montane Eco- Floristic Zone		
1. Shola forest	6.781	Shola Grassland System
2. Tree to shrub savanna	0.5032	
Cultivated land		
1. Agriculture	1.157	
2. Arboriculture	0.4872	
3. Water body (Siruvani Reservoir)	0.738	
Total	**110. 14**	

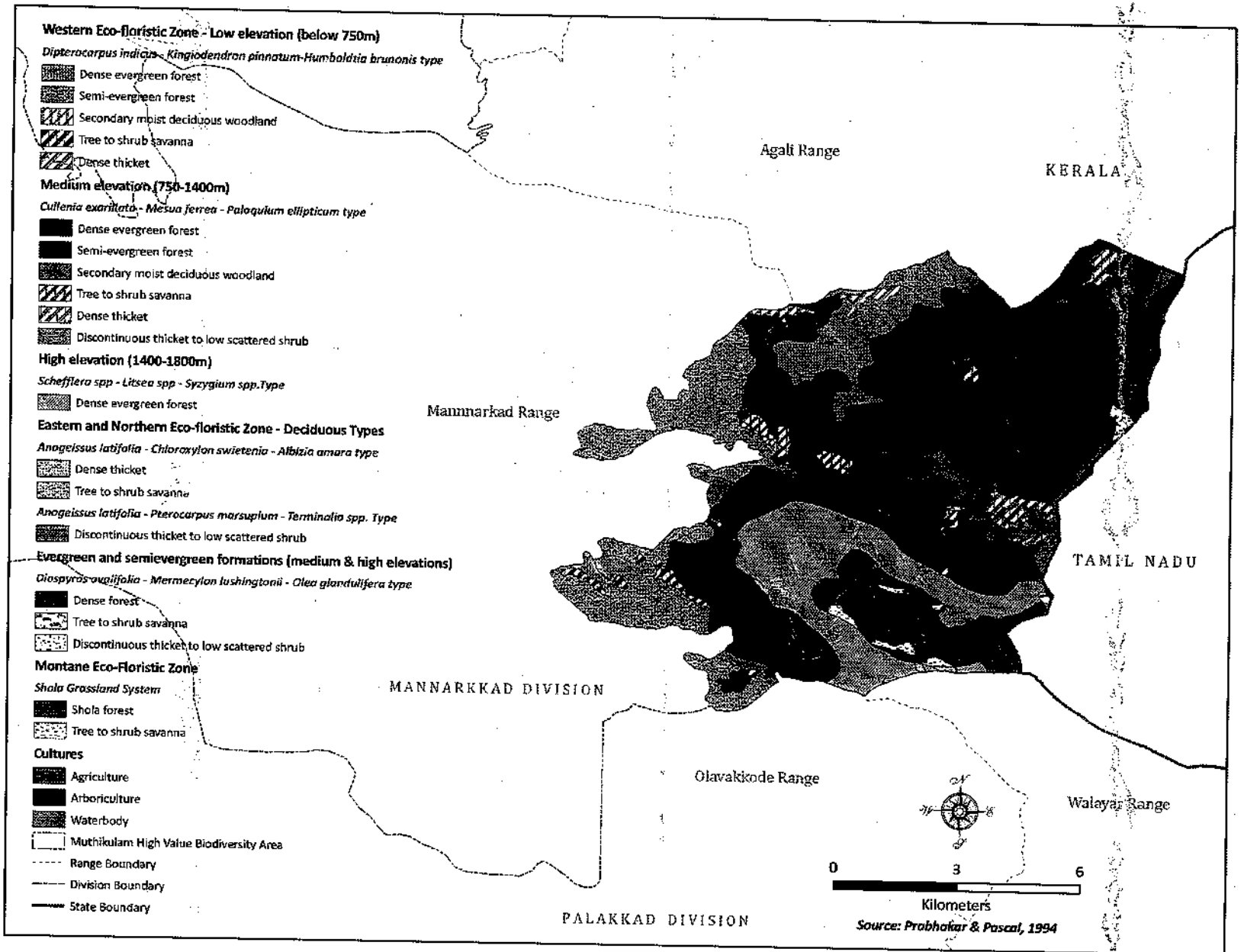
Out of the total 110.14 km^2 area, 25.0165 km^2 area belongs to low elevation (below 750m) evergreen and semi-evergreen forests whereas an area of 61.45671 km^2 includes medium elevation (750-1400m) evergreen, semi-evergreen forests, moist deciduous and dense thickets. The high elevation ((1400 -1800m) consists of *Schefflera* spp- *Litsea* spp- *Syzygium* spp. Type composition with an area covering about 11.14 km^2. The Shola forests occupy about 6.781 km^2 area and cultivated land includes 1.644 km^2 area (Map 4). It is evident from the Table 5.1 that more than 90 percent of the area belongs to evergreen and semi-evergreen forests which is the repository of high value biodiversity of both flora and fauna.

5.2. Socio economic Profile of Villages

The area selected for High Value Biodiversity conservation has only one settlement of the tribe belonging to Muduga community. A general profile of the settlement is provided in Table 5.2.

Table 5.2. Muthikulam tribal hamlet - General profile

Settlement	Sholayoor
Taluk	Mannarkad
Village	Sholayoor
Panchayath	Sholayoor
Ward	9
Range	Agali
Section	Singapara Forest Station
Community	Muduga
Religion	Hindu
Have any family members been religiously converted	No
How the land was obtained	Relocated from Siruvani Reservoir area.



Map 4.Landuse of Muthikulam HVBA

There are 109 residents in the settlement, males accounting for 46% and the rest females (Table 5.3)

Table 5.3. Demographic profile of the settlement

Sex	Number
Male	50 (45.87)
Female	59 (54.13)
Total	109 (100)

The age wise details are provided in Table 5.4, which shows that except for age groups 20-25 and 25-30 all others are more or less equally distributed.

Table 5.4. Agewise classification of the population

Age	Number	Percentage
0-5	5	4.59
5-10	7	6.42
10-15	10	9.17
15-20	5	4.59
20-25	20	18.35
25-30	17	15.60
30-35	9	8.26
35-40	5	4.59
40-45	4	3.67
45-50	13	11.93
50-55	6	5.50
55-60	2	1.83
>60	6	5.50
	109	100.00

Regarding marital status (Table 5.5), 55 are married while 48 are unmarried. There are six widows and no divorcees.

Table 5.5. Marital status of the population

Marital Status	Number	Percentage
Married	55	50.46
Single	48	44.04
Widow	6	5.50
Divorcee	0	0.00
Total	109	100.00

The details of educational achievements are given in Table 5.6. Nearly 60% of the population is literate with three possessing bachelor degree certificates and an equal number with Plus Two qualification.

Table 5.6. Educational qualification of the population

Education	Number	Percentage
LPs	18	16.51
UPs	17	15.60
HS	22	20.18
SSLC pass	2	1.83
HSC	3	2.75
Degree	3	2.75
Illiterate	41	37.61
Others (Infants)	3	2.75
Total	109	100.00
Literacy Rate	59.63 %	

Regarding occupational status (Table 5.7), there is only one Government employee in the settlement. Majority of the residents indulge in collection and marketing of NTFP, 61person go for outside labour. All of them live in separate houses. Most of them do not have a tendency to save and on the whole are not indebted. Out of the 34 families only four rear cattle. Most of the houses are tiled and none of them have a concrete roof. In general all houses are in a shabby condition. No house has toilet facilities. All houses in the colony are

electrified and the people use firewood for cooking. Water sources are available near the settlement, while school and market are far away. The colony is about 500 m away from the main road. Eleven households possess radio, six TV and two families possess tape recorders. Each family has been allotted an area of 3.9 acres for cultivation. Most of them participate actively in VSS and are affiliated to Self Help Groups (SHG).

Table 5.7. Occupational status of the population

Employment	Number
Children	4
Students	17
Government Employee	1
Cultivation	0
Agriculture Labour	0
Forest Labour	3
NTFP Collection	80
Outside Labour	61

5.3.Resource Dependence of Villages

The Tribal settlement in Muthikulam HVBA is to an extent dependent on various resources from the forest for livelihood. They use forest for shelter, building houses, fetching water, fuel wood and at times gather food (yams, tubers, fruits, seeds). They use plants as medicines. To an extent NTFP collection and sale support their livelihood. VSS provides employment to the tribal population. More details are provided in the earlier section.

5.4. Human Wildlife Conflicts

As the forest cover is continuous and of high density, while the population of resident humans is low, the intensity of Human Wildlife Conflict is negligible. The details provided in Table 5.8 support this view.

Table 5.8. Human Wildlife Conflict in Muthikulam

Human-Wildlife Conflict			
	1999-2003	2004-2008	2009 to present
Loss of Life	1	0	0
Human Injury	0	0	0
Crop Damage	0	0	0
Livestock Damage	0	0	0

5.5. Assessments of Inputs of Line agencies / Other Departments

The contribution of line agencies and other departments is nil.

5.6. Stakeholder support

The key stakeholders in the High Value Biodiversity Conservation area are:

1. Local communities
2. Kerala Forest Department
3. Tamil Nadu Irrigation and Forest Departments
4. PFM Institutions
5. Tribal and Local Self Government Departments
6. Academic & Research Institutions
7. Tourists, NGOs, etc.

The achievements in forest management objectives affect these stakeholders. Hence all of them are closely linked to forest management and their support is required for conservation needs although at present only the Forest Department is playing the key role.

5.7. Protection and Management issues

There are several issues in connection with protection of forests. There is a lack of enough trained staff, transportation facilities and fire arms. Although the area to be protected is only 110.44 km^2 in extent and is bound on three sides by mountains, the biodiversity value of area necessitates a more serious look into protection aspects.

Work Environment

A traditional and time tested work environment as in the past exists in the Division. Most approaches are bureaucratic and formal. There is no appreciation for innovative and

community-oriented programmes. The capacity building of human resources is not in the agenda. Staff members are fatigued, disoriented and impulsive.

Research priorities, Main projects and implementation.

Priorities of research must be intended to achieve following objectives:

1. To promote research and monitoring programmes in order to ensure management decision based on sound scientific knowledge.
2. To enhance ecological and cultural integrity.
3. To find solution to threats to biodiversity.
4. To enhance public awareness and people's participation in conservation.

The levels of research priorities are the following

- *Landscape level priority* – diversity of habitats in the conservation zone, the vegetational and climate change, if any, within the different habitats need to be monitored.
- *Ecosystem level priority* - There is a need to document the ecosystem services provided by different zones. Attempts can also be made to assess the monetary value of these ecological goods and services. This will add value to the area and indirectly help in the conservation efforts. The major areas include the ecosystem productivity, integrity, regeneration status, wild life and ecosystem relations, weeds on ecosystem, its impacts, changes in the ecosystems with respect to population of flora and fauna etc.
- *Species level priority* – Research on rare and endangered species as well as endemic plant species (*Vateria macrocarpa* , *Diospyros bourdillonii, Myristica dactloides, Oberonia* and *Dendrobium* species, *Piper* species *etc.*) mammals (Lion- tailed Macaque, Nilgiri langur and Nilgiri tahr), reptiles, birds (Nilgiri Laughing thrush, Darter, Nilgiri wood pigeon), butterflies and insects need to be done. For plants, the phenology, factors affecting natural regeneration, population size estimation are important. The habitat, group size, distribution of LTM, population size, specific niches and nesting patterns of hornbills, habitat suitability, the movement pathway for elephant and tiger also have high priorities.

Human dimension – the major priority includes;

- Levels of participation of VSS in conservation

- Sustainability of VSSs
- Conservation awareness level of local people
- Livelihood options for local people

- The resource assessment, ecology and habitat of fishes, amphibians, and insects need to be studied and documented. The lower groups of plants like algae, fungi, lichens and mosses) and smaller animals (mollusks, helminthes and even the microbes) also need to be studied.
- The wild life health monitoring, mortality, natality, population density and population structure monitoring are also important.

Important research projects

- Land use and vegetation assessment
- Mapping and analysis of Biodiversity Hotspot areas
- Identification of threatened species and methods for conservation
- Mapping of fire prone, weed infested and degraded areas
- Determination of fire- weather index
- Forest and NTFP dependency of Tribes and fringe area people
- Assessment of Wildlife health
- Inventory of lower forms of fauna and flora

Implementation

Monitoring framework

Monitoring and evaluation is a very important part of any management process as it is very essential to measure a management activity. It helps to evaluate the progress and success of the implementation of the plan and also helps to find out the shortcomings and make corrective alterations if necessary. Following activities will be taken up for extensive and intensive monitoring and regular updation (Table 5.9). The things to be monitored are

- Monitoring status of endangered and endemic species
- Monitoring the collection of NTFPs.
- Monitoring illegal hunting and poaching.
- Monitoring of weed eradication.
- Monitoring of fire control measures.
- Monitoring of wildlife health and veterinary care.
- Monitoring of tourist activities in neighboring areas.
- Monitoring of watersheds.
- Monitoring of social welfare activities.

- Monitoring of key sites.
- Monitoring of forest offences.
- Monitoring of activities of eco-development activities

Table 5.9. Monitoring framework

Sl. No.	Things to be monitored	Methods	Who will monitor	When to be monitored
1.	Endangered and endemic species	Daily diaries	Forest Guards Project associates	During regular patrolling and field surveys
2	NTFP collection	Survey and enumeration	Forester in charge BCP	Monthly.
3	Vegetation	Permanent sampling plots, remote sensing, repeat photography.	Ranger in charge BCP	Once in a year.
4	Wild life health and veterinary care	Observational methods	Veterinary surgeon	Monthly.
6.	Watershed monitoring	Run off, siltation, etc.,	Special team needs to be set up. Some external assistance from Research Institutions can be sought.	Regularly. Some equipment can be set up.
7.	Human – Wildlife conflicts	Reports from field staffs, office records	Field protection staff of respective areas	Monthly.
8.	Ecodevelopment activities	Progress reports from field	DFO of concerned area.	Monthly.
9.	Fire prone areas, fire control, illegal hunting	Field visits	Special team BCP	Monthly
10	Social welfare	Tribal hamlet meetings	Special team members BCP	Monthly

Training needs assessment

Training needs of the staff as well as the stakeholders, VSSs etc., needs to be assessed through Training needs assessment workshop. Anticipating inclusions in the curriculum the following themes are suggested:

1. Training in legal issues.
2. Training in survey and demarcations.
3. Training in use of equipments like weapons, GPS.
4. Training in Biodiversity valuation.
5. Training in biological materials collection.
6. Eco-development training.
7. Training in Ecotourism
8. Basic training on System protocol and Professional working.

Human Resource Development (HRD) Plan

HRD plan should include the training needs as well as the staff amenities to be provided. Training is needed for officials, frontline staff as well as VSS members. HRD plan should include the training needs as well as the staff amenities to be provided. On the job training, short term training, specialised trainings etc., can be planned depending on the need. The short term on job training such as computer application especially office packages, statistical data analyses, collection of biological material and interpretation, weapon training, tourism and interpretation can be planned using senior police officers, NGOs, lawyers, senior veterinary surgeons, faculty from KAU, WTI, WII, KFRI and WTI etc. as resource persons. The various subjects of training can be protection (use of arms, unarmed combat, legal issues etc.,), census, monitoring, ecodevelopment, ecotourism, habitat management, wildlife health, GIS etc., Amenities may include provision of ration to interior camps, taking care of the residential, educational and medical needs of staff and their families. Incentives/ awards should also be a part of the HRD plan. Provision of gears such as shoes, ruck sack, sleeping bags, rain coats and medicine kit should also be planned and such amenities are not sufficient at present.

Front line staffs have been given training in use of GPS, camera traps and collection of rainfall data. These trainings should be continued so as to train all the staff.

- The various subjects of training can be protection (use of arms, unarmed combat, legal issues etc.,), census, monitoring, eco-development, ecotourism, pilgrimage management, habitat management, wildlife health, GIS etc.,
- The training for GPS, biodiversity valuation and biological materials collection should be conducted for Foresters and forest guards at KFRI.
- For legal issues training & workshops should be conducted with Public Prosecutors as resource persons

Establishment of a conservation centre and conservatory for Rare, Endangered and threatened (RET) plant species.

A fully equipped conservation centre should be established at Muthikulam HVBA to create awareness among the biological wealth and importance of these forests and this should also provide learning and training facility to all the forest staff of the Division. Library, laboratory facilities can be included in this centre. The sites should be identified for practical demonstrations e.g., key sites of high biodiversity, watersheds, fire prone areas etc. Attached the conservation centre a full fledged conservatory for RET species should be established (Seed Centre, Nursery and hardening units).

Wildlife Health Monitoring

The recent outbreaks of fatal diseases such as swine and avian flu, Ebola hemorrhagic fever prove that wildlife has extensive and growing contact with livestock and human populations. Out breaks of these fatal diseases among the populations of wild animals has lost considerable wild fauna in the past in many parts of country. The studies indicate that about 60 percent of the 1,415 infectious diseases, infecting both humans and animals are originated in animals. In many instances, the poachers that rely on wildlife for meat are vulnerable to pathogens from the forest. The diseases, which pass between wildlife and domestic animals are Avian Influenza (wildfowl, game birds and poultry), Foot and Mouth Disease (cattle, pigs, sheep and deer), Swine Fever (pigs and wild boar) TB (deer, badgers and cattle). Surveys of wildlife are essential to be aware of outbreaks and infestations before they become established, to monitor the effectiveness of quarantine procedures and to assist in the allocation of resources in an emergency. In India, An outbreak of Kyasanur forest disease (monkey fever) was reported during April 2004 in the state of Karnataka, India. The causative agent, the Kyasanur forest virus, is a tick-borne alphavirus (genus Alphavirus, family Togaviridae). The virus was first isolated in 1957 during a fatal epizootic affecting

free living monkeys (species not fully known) from Mysore. Human infection has occurred frequently among forest workers with a mortality rate reaching 10 percent and the principal identified tick vector species is *Haemaphysalis spinigera.* An effective inactivated vaccine is available for protection of those at risk and for post-exposure treatment to moderate the course of the disease. Similarly in other countries also several wildlife diseases were reported such as Bluetongue (USA), Contagious caprine pleuropneumonia (Qatar), avian cholera (S. Africa), Bovine tuberculosis (S. Africa), Brucellosis (Canada), Rabies and lyssavirus (Romania),

The main threats to the Wildlife Health are form

- **Climate Change**

  Shifts in global temperature and precipitation levels, driven by climate change, could welcome some bacteria, parasites, fungi, and viruses into previously inhospitable regions, possibly infecting new species in new ways. Changes in climate can cue wildlife to breed at different times or migrate to different places. Altered distributions of wildlife and livestock, as well as possible reductions in water availability, may bring livestock and wild animals into closer contact. All of these possible outcomes of global climate change might affect a species' survival or that of other species with which they come into new contact

- **Emerging Diseases**

  Emerging diseases such as Ebola, SARS, West Nile virus, avian flu, and swine flu clearly demonstrate the link age between the health of wildlife, humans, and their domestic animals. As wildlife trade and the development of wild lands put humans, livestock, and wild animals into closer contact, diseases have more opportunities to emerge and spread, with detrimental effects on human and animal health, biodiversity, and global economies.

- **Environmental Toxins**

  Wildlife and humans are exposed to toxins via air, water, land, and food. People are responsible for introducing many types of toxins into the environment through industrial emissions, pesticides, medications, fertilizers, oil spills, sewage, garbage, and even lead bullets. The effects of toxins on wildlife is difficult to ascertain and,

usually, harder to remedy. Once toxins are released into the environment, they can have detrimental effects on human and wildlife health and to clear them, it may take many years, studies and funds.

The following strategies can be adopted for Wildlife health monitoring:

- **Establishment of a Veterinary laboratory**

  A veterinary lab is needed to be evolved to undertake parasitological studies with the consultation with College of Veterinary Sciences and Veterinary Department.

- **Observational methods**

Monitoring the condition of animals:

The animal body responds to the changes in its habitat, which is governed by many interrelated component factors which are often seasonal in nature (Fig. 5.1) Conditions of live animals can be assessed by looking at their appearance or body condition and condition of dead animals can be assessed by estimating the extent of fat deposition in the body (Milton, 1987).

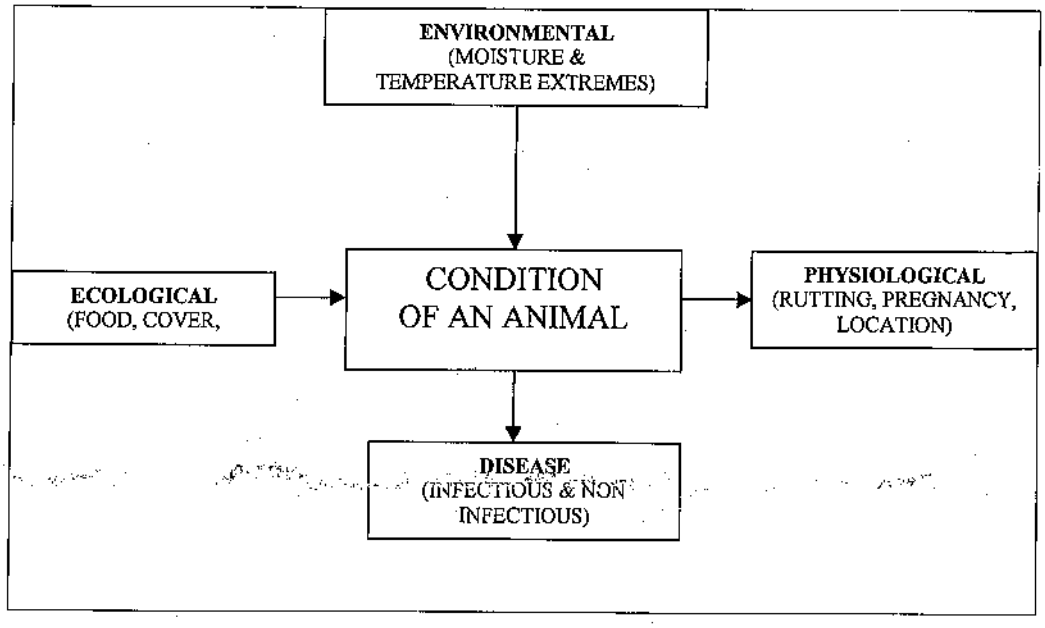


Figure 5.1 Factors affecting condition of an animal

The commonest method of monitoring the appearance of free living mammals is by body condition evaluation (BCE). BCE is generally expressed in the form of indices, referred here as Body Condition Index (BCI). BCE involves judging the physical condition of live animals, based on the visual estimation of the degree of protuberance (on the hip, chest, abdomen, back, head and tail) of bony processes on the body surfaces. In the field one can rate these body parts using a binocular or a spotting telescope. Value of BCI can be obtained by giving scores for different body parts. Records of BCI of different species can be maintained in a specific format (Appendix VI). The 'remarks' column status is for further classification of animals based on their physiological state (pregnancy, lactation) social status (dominant/ subordinate/territorial) and feeding behavior (crop-raider, man–eater).

BCE of ungulates: Riney (1960) described this method. The generalized description and evaluation of different body parts of ungulates is given in Table 5.10 the sum of scores (BCI) can range between 0 and 10. Smaller the BCI, better the health condition of the animal. For all the practical purposes, ungulates with BCI of 0-4 can be considered 'good', 5-7 as 'fair' and those with 8-10 as poor.

Table 5.10 Generalised description and evaluation of different body parts of ungulates

BODY PART	POINT= 0	POINT=1	POINT=2	Score
1. FLANK AREA	Depression is barely visible Flank area outline is indistinct	Flank area slightly concave & outline visible	Depression concave & tucked in	
2. RIBS	Thoracic surface is smooth and ribs are difficult to see	Ribs are visible but not all can be counted with ease	Ribs prominent with distinct inter-costal depressions	
3. PELVIC GIRDLE	Bony projections of pelvic girdle are barely visible	Pelvic girdle outline slightly visible	Bony projections of pelvic girdle are clearly visible	
4. VERTEBRAL COLUMN	When seen laterally, it runs smooth without any breaks. Lumbar processes visible	Lateral processes or lumbar vertebrae are visible but not prominent	Lateral processes of lumbars very prominent. Dorsal processes of vertebrae seen	

5. LUMBAR SHELF	No depression in shelf. Appears almost round from behind	Slight depression on either side	Depression deep and concave	
			Body Condition Index ==	
(Interpretation 0-4= 'Good',5-7= 'Fair', 8-10= 'Poor'				

(Source: Riney, 1960)

BCE of elephants: The description and evaluation of different body parts of Asian elephants is provided in the Table 5.11.

Table 5.11. Description and evaluation of different body parts of Asian elephants

BODY PART	POINT= 0	POINT=1	POINT=2	**Score**
1. TEMPORAL DEPRESSION	Flat and frontal ridge vaguely defined	Slightly concave and frontal ridge defined	Deeply concave	
2. SCAPULA	Spinous process of the scapula not visibie	Spinous process visible	-----	
3. RIBS	Thoracic barrel smooth and ribs barely visible	Ribs visible	Ribs clearly demarcated with pronounced intercostal depressions	
4. FLANK AREA	Flank are depression barely visible	Sunken flank area Depression visible	---------	
5. PELVIC GIRDLE	External angle of ilium not visible	Visible but not pronounced	External angle jutting and pronounced	
6. TAIL	Muscular, not bony	Joints of tail vertebrae seen	Thin & bony. Vertebrae can be easily counted	
7. LUMBAR SHELF	Shelf not present. Round when seen from the rear	Lumbar shelf appears flat and not round	Pronounced concave shelf on either side of the vertebral column	
			Body Condition Index =	
(Interpretation 0-4= 'Good',5-8= 'Fair', 9-12 = 'Poor')				

- **Laboratory based methods of monitoring**

1. Post mortem examination (Necropsy)

From an outbreak point of view, the information on the nature and magnitude of outbreak, evidence of similar outbreak among livestock, species affected, and mortality in different species, history of similar outbreaks, etc. are essential details to be gathered during a disease investigation operation. These particulars have been given in the outbreak history form (Appendix VII). Similarly gathering background information about the nature and probable cause of death is also an important part of the disease investigation procedure. The clinical signs of the animal before death (can be gathered from those who had seen the animal during illness) and the surroundings of the dead animals should be thoroughly investigated for the presence of pug marks, hoof marks, presence or absence of faecal material around the animal, discharge of the body fluid etc. All these things form an important part of the post mortem report (Appendix VIII). The post mortem examination helps for the detection of gross lesions or abnormalities that may point to the presence of clinical or sub-clinical disease. The vast majority of 'new diseases' can be diagnoses initially by post mortem and by through examination with correct collection of samples. It is imperative to retain pathological materials so that they can be used for further studies. When dealing with the threatened species, the establishment of a reference collection that comprise fixed and frozen tissues, blood smears, sera, paraffin blocks, freeze-dried bacterial isolates is required. The Laboratory specimen form is shown in Appendix XI.

2. Faecal analyses of suspected animals

- Parasite screen - Faecal samples should be collected at least semiannually; direct, flotation, and sedimentation should be performed on every sample to detect intestinal parasitism.
- Enteric pathogen screen - Aerobic culture of feces for enteric pathogens should include special media for the detection of *Salmonella spp.*

3. Serological Surveys

Antibody detection by serological investigations is an efficient method of monitoring the prevalence of infectious diseases in a population. This procedure involves the restraint of animals, collection of blood and subjecting the sera for the presence / absence of antibodies against the diseases. A higher prevalence of

antibodies against particular diseases for many years denotes that the disease is endemic to that population.

4. Macro-Parasitological investigations

Helminths and arthropods constitute the category of Macro-parasites. Many wild animals harbour a naturally high number of macro-parasites. Keeping the records of ecto- parasitological findings (ticks, flies, fleas and lice) can provide valuable information on host – parasite relationships such as arthropod species composition and their relative abundance on different species of hosts. Recording details of ectoparasites can be done in the format given in the Appendix IX. Helmithic infections (Endoparasite) can be monitored either by recovering the parasite from the host or by identifying the parasite ova in the faeces. Screening faecal samples for the presence of eggs of helminths and oocytes of coccidian is one of the earliest methods of monitoring prevalence of helminthic infections. The post mortem examination helps to recover the endoparasites from Respiratory system, Liver and Gall bladder (Ahluwalia, 1972). The recording details of endotoparasites can be done the format given in the Appendix X.

5. Screening for micro-parasites

Bacteria, viruses, blood protozoans, fungi and rickettsiae are referred as microparasites or microbes. Through their prevalence can be to some extent known by isolation after postmortem investigations, a systematic screening of different biological materials can contribute to the understanding of not only prevalence, but also of the existence of wildlife and domestic reservoirs of pathogens. These biological materials can be of any source. It can be faeces, blood, saliva, urine, body fluids or aborted fetuses.

Faecal samples can not only be useful for detecting parasite ova of animals, but also many bacterial, viral, fungal and rickettsial organisms. To obtain a successful isolation, however, the samples have to be collected directly from the animal with strict aseptic precautions and preserved under recommended methods to avoid contamination by other organisms. Diseases like Johne's disease, *Salmonellosis*, *Ornithosis*, Q-fever, *Coronovirus* and Parvovirus infections can be diagnosed from freshly collected and appropriately preserved faecal samples. Apart from faeces, blood is another source of biological material for isolation and identification of

organisms that cause *Viremia*, *Bacteremia* and *Parasitemia*. Although the collection of blood and preparation of blood smear from large mammals requires immobilization, this method of disease monitoring can be effortlessly practiced by collecting whole blood from frogs, reptiles, rodents, mongooses and many other species. In fact frogs and small reptiles themselves can make important collection of live specimens for isolating many unknown, but possibly epidemiologically important, organisms.

- Maintenance of sanitation and hygiene at water levels
- Immunization programmes of domestic animals.
  - The immunization programmes have to be conducted to the domestic animals such as dogs, cats, ferrets and livestock should be vaccinated against rabies;
- Regular monitoring of bone marrow
- Health cards for all livestock from the concerned authorities.

- **Creation of awareness among the local peoples**

  Awareness Campaign among local people can be organized with the help of EDCs/ VSS committees about the communicable wildlife diseases and prevention measures.

- **Training of field staff**: the basic ideas of understanding the Wildlife health is an essential component of Wildlife health monitoring. The field staff may be trained about the diseases, symptoms, mode of dissemination etc. so that they will be able to report immediately and take preventive measures. Training workshops also should be organized in the area of wildlife health management, wildlife restraint techniques, wildlife damage control and field investigations of wildlife mortality events.

- **Maintenance of record of disease out break**

The records on all incidences of diseases should be maintained for future reference.

- **Wildlife Rescue Centre**

  The existing Veterinary hospital should be upgraded to different rescue operations, treatment and release operations, health monitoring of wildlife, wildlife health research, laboratory, vaccination of domestic cattle etc. with the help of a veterinary surgeon.

- **Monitoring and evaluation**

  In recent history there are only few records, available for disease outbreak. It may be due to inadequate wild animal health monitoring. Lack of disease survey network may lead to negligence to some very infectious and dangerous disease outbreak. For this, continuous wildlife health monitoring, treatment of sick animals, proper disease preventive work and research are required to be carried out by a team of dedicated experts.

- **Snail survey**

  Snails and slugs are host to an array of different nematode parasites. Several nematodes use snails and slugs as definitive hosts and many others use snails and slugs as intermediate hosts, including nematodes. Snail population could be monitored and controlled if found necessary to identify the larval stages.

Mortality Survey

Mortality means susceptible to death. The mortality of the wildlife may be due to environmental stress, disease outbreak, poisoning or accidents. Heavy mortality rate for any species can change the survival possibility. The data on mortality is very important to know the population dymamics, disease outbreak etc., This will help us to make necessary change in management strategies if needed. This should be a regular phenomena. Field staff should note down the mortality of wild animals if any, the species, reason etc., in their daily diaries and report it to the office. Information can be compiled at the range level and sent to the concerned DFO's office. Mortality survey can be done in following steps:

- Mortality register should be maintained at range level on daily basis for each and every type of mortality.
- Monthly compiled record at range level should be sent to Divisional Forest office.
- Separate record should be maintained for mortality other than that attributable to an offence and mortality attributed to poaching or an act of vandalism.
- Survey record can be maintained in prescribed Form given in Sawarkar guide for "Planning Wildlife Management in Protected Areas and Managed Landscapes".

- All records should be analyzed at RO office monthly and report should be submitted to DFO.
- Mortality data should be collected by the field staff at block.
- All mortality information should be reported instantly to range office and if needed, specimen should be collected and sent for pathological investigation.

BIODIVERSITY CONSERVATION PLAN

FOR

MUTHIKULAM HIGH VALUE BIODIVERSITY AREA

PART B: THE PROPOSED MANAGEMENT

CHAPTER 6: VISIONS, GOALS AND OBJECTIVES

6.1.Vision

The high biodiversity zones and natural forests in the High Value Biodiversity area of Muthikulam should be protected under sound ecosystem management, to retain their wild character and to maintain environmental goods and services to mankind.

6.2.Management Goals

The goal is to scientifically understand the biodiversity value of Muthikulam HVBA and develop strategies and tactics for conservation and management as follows:

- Locate areas of the high biodiversity value, improve the existing forest cover, and enhance their productive capacity for ecological security and environmental goods and services.

- To strengthen the conservation measures for maintaining rich biological diversity and gene pool with the active participation of local communities.

- To enhance the capacity of staff of High Value Biodiversity area of Muthikulam to achieve the objectives of the Biodiversity Conservation Plan.

6.3. Management Objectives

The following objectives are proposed for the Muthikulam HVBA:

- To establish a separate wing under the DFO to plan and implement the programme.
- Identify critical habitats and utilise the information on the distributions, and site-specific locations for conservation of selected flora and fauna.
- Monitor the known populations of RET species and develop appropriate methods for reintroduction.
- Continuous inventory of the medicinal plants, wild edible resources and NTFPs.
- To prepare GIS based database for managing the biodiversity.
- To develop training opportunities to equip forest field staff and VSS about the forest resources and the conservation of biological diversity.

- Train the forest field staff on identification and management of wild and invasive species.
- To protect the wildlife resource and ecological process and critical habitat area vital to the welfare of the wildlife and thereby maintain viable, healthy wildlife populations.
- Promote the sustainable management of Muthikulam area by working with forest communities and to develop the capacity of Vana Samarakshana Samithi (VSS), Panchayath and other groups having interface with forest as appropriate.
- Develop Sustainable and conservation oriented ecotourism in Muthikulam and make the area a plastic free zone.
- Establish an effective nature education and interpretation centre for tourists and other stakeholders.

7.17.1. SWOT analysis

The SWOT analysis of Muthikulam High Value Biodiversity is are shown in Table 7.1

Table 7.1. SWOT analysis of Muthikulam High Value Biodiversity area

Sl. No.	Strength	Weakness	Opportunity	Threat
1.	A chunk of mid elevation evergreen forests	Heavy selection felling in the past (before 1980)	Study regeneration and succession	Invasion of drier formations from south, east and north
2.	*Vateria macrocarpa* endemic to Western Ghats found only in Muthikulam	Isolated patches	Study ecological condition for *V. macrocarpa*	Possible absence of mature trees to sustain a viable population
3.	Breeding and migration path of large mammals	Migration routes fragmented	Restore animal corridors	Encroachment and degradation from northern and western sides
4.	Protected forests control the upstream of Siruvani river	Lion share of water diverted to Coimbatore	Watershed function and valuation of watersheds	Raising the level of water in the reservoir as done in the 70s.
5.	High rainfall area	Water diverted to Tamil Nadu	Initiate forest hydro meteorological studies	Climate change and less rainfall
6.	Presence of primates (two species)	Fragmentation of the reserve by the reservoir	Study on primate conservation	Lion-tailed macaque and Nilgiri langur under threat
7.	Muthikulam provides connectivity between forests north of the Palakkad gap and Silent valley.	Connectivity between Attappadi Block VI and Silent Valley lost	Restoring the connectivity	Encroachments, fire, degradation
8.	Only one settlement of Mudugas (34 families)	Socio economic conditions poor. No land for agriculture	Evolve a biodiversity based enterprise for improving livelihood	Shift from protectors to destroyers
9.	High value biodiversity in forests	Weak protection, inadequate staff infrastructure and	Strengthen protection and research based	Dispassionate approach

		knowledge	bio prospecting	
10.	Presence of large amount of invertebrate migration	No study due to lack of funds	Research to be initiated	Underestimating the importance of species and ecosystem functions.

7.2 Management strategies

Delineation of High Value Biodiversity Conservation Zone and other Zones

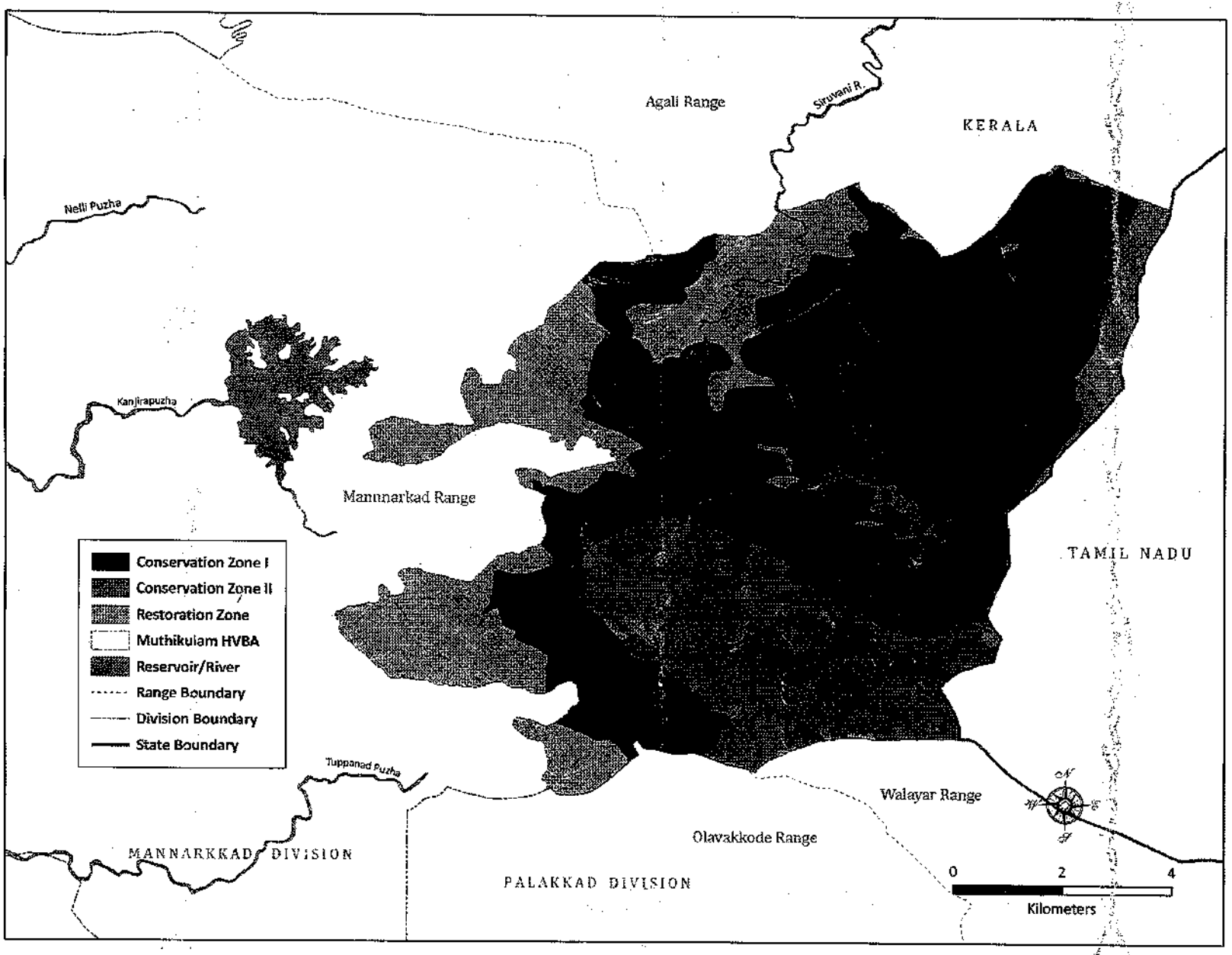
Two zones have been identified in Muthikulam HVBA for the purpose of implementing the Biodiversity Conservation Plan (Map 5). High Value Biodiversity Conservation zone (77.7 km^2), and Ecorestoration zone (32.74 km^2) together constitute 110.44 km^2, which are located in Agali (63.03 km^2) and Mannarkkad (47.41 km^2) Forest Ranges of Mannarkad Forest Division.

1. **High Value Biodiversity Conservation Zone (77.70 km^2)**

The High Value Biodiversity Conservation Zone is subdivided in to Conservation Zone I (59.27 km^2) mainly constituting medium elevation (750 - 1400m) dense evergreen and semi evergreen forests and Conservation Zone II (18.43 km^2) constituting High elevation dense evergreen and shola forests (1400 - 1800m). This has been done as high elevation forests require special attention and separate treatment. The conservation zones are to be managed primarily for their conservation values and the activities that endanger these values need be avoided/ restricted. All these areas are important in terms of floral diversity, specific habitats of fauna and for the dispersal of animals towards eastern and northern directions.

2. **Ecorestoration Zone (32.74 km^2)**

This zone will include areas where degraded natural forests, agriculture and arboriculture are available but at elevations below 750m.



Map 5.Management Zones in Muthikulam HVBA

Zone & theme approaches to management strategies

Zone plans

1. High Value Biodiversity Conservation Zone

Details of the Area:

The natural patches in Karimala, Vellingirimala and Elival mala provide more or less continuous forest cover with different types of forests viz., Dense evergreen, Semi-evergreen with *Cullenia exarillata – Mesua ferrea – Palaqium ellipticum* type vegetation structure. These forests are very important as they are repositories of unique biodiversity (flora and fauna).

Objectives

- Assess the vegetation, identify RET species, protect and improve the biodiversity of these areas.
- Assess the diversity of flora and fauna
- Develop GIS based management system
- Identify corridors for movement of wild animals.

Strategy: - Conserve and restore critical species, ecosystems and gene pools

A. Conservation and Restoration

Action Plans

- The proposed area should be tackled only on scientific principles backed by sound research.
- There will not be any removal of bamboo/reed or dead wood.
- The area should be protected from fire, soil erosion, invasive weeds, grazing, illicit felling and encroachment.
- Any area may be restored with native species only.
- Tourism in the conservation zone is to be prohibited.

B. Rare, Endemic and Threatened species

Action Plans

- Identify and protect the endemic and threatened species and promote their recovery to viable population levels.
- Develop *ex-situ* conservation and *in-situ* recovery plans.

C. Unique ecosystems and species-specific habitats.

Action Plans

- Identify and assess unique ecosystems and species-specific habitats.
- Unique ecosystems such as grasslands, Shola patches, species-specific habitats of tahr, elephant, birds and others need to be identified and their status should be assessed based on the ecological studies.
- Demarcate and map the identified unique ecosystems and species-specific habitats and prepare habitat-specific plans.

D. Wildlife corridors

Action Plans

- Identify, map and document the existing and potential corridor for elephants and other larger mammals.
- Restore the connectivity between Muthikulam HVBA and Silent Valley.
- Conduct studies on ecological, socio-economic, landuse pattern, etc. and assess the status of the corridors.
- Develop specific plan for management of the corridors specifying relocation plan (voluntary), managing through PFM, enriching the corridor, curtailing further encroachment, etc.
- Avoid the reed extraction in wildlife corridors.

2. Eco-restoration Zone

Objectives

1. Maintain environmental stability through preservation and wherever necessary, restoration of ecological balance that has been adversely disturbed by depletion and degradation of forests.
2. Conserve the available natural forests with a variety of flora and fauna, which represent the remarkable biological diversity and genetic resources.

Strategy:-Establish models for cost effective critical species reintroduction, conversion of degraded plantations to natural forests and sustainable utilization of NTFP.

A. Natural forest areas

Action plans

- Ecorestoration of degraded natural forests will be attempted by carrying out operations for assisting natural regeneration (ANR), soil and moisture conservation. The forests will be managed on a sustainable basis in consultation with communities involved.
- Management of Non-Timber Forest Products (NTFP) to be supported by interventions in methods of regeneration, sustainable harvesting and value addition.
- Integration of soil and moisture conservation measures in forestry activities particularly in catchment areas.

B. Poorly stocked plantations/Agriculture/Arboriculture areas

Action plans

- Conduct scientific studies for phasing out poorly stocked and failed plantations into natural forests.
- Carry out long term monitoring of natural succession in poorly stocked plantations.
- Mainstream the agricultural and plantation activities in the fringe areas of Muthikulam HVBA to support wildlife conservation.
- Strictly avoid extraction in wildlife corridors.

C. NTFP areas

Action plans

- Identify the important NTFPs and their habitat in the forest area.
- Stock maps showing the extent and intensity of availability based on inventory for the selected species should be prepared.
- Conduct total inventory of vegetation in a given locality for enumerating the availability of species and their distribution etc. The medicinally important plants and their associates identified and encouraged through managerial interventions.
- Areas where regeneration is poor will be closed to NTFP collection for sufficient period of time and harvested at the discretion of the Range officer in charge.
- The species that regenerate by rhizomes, sufficient rhizomes are to be left behind for propagation.

- The herbs and shrubs, where fruits are collected shall be done only after seeding, in the case of plants that propagate by seeds.
- Injuries like debarking or blazing deep on the tree, cutting or lopping of branches, burning the bottom etc must be prohibited.
- Do not cut deep steps for climbing the trees to collect honey which cause permanent injury and sometimes death of the host.
- Tribes should be trained in scientific methods of collection and its proper management.
- The tendency of the people engaged in collection to set fire for easy collection of certain produce should be prohibited and collection of bark should not be allowed.
- Degraded patches, fire affected patches failed plantations etc., could be taken up to enrichment planting of species like *Pittosporum tetraspermum, Balanophora fungosa, Aristolochia indica, Pseudarthria viscida, Anamirta cocculus, Coscinium fenestratum, Desmodium gangeticum* and *Curcuma zeodara,* etc, for which planting techniques have been suggested by Kerala Forest Research Institute. The VSS can be involved in these works.
- Monthly meeting may be called in each colony to monitor the collection and payments. Officers connected with the society may be directed to attend the meeting and impart training to tribes on importance of sustainable production of NTFPs. No produce should be transported without the valid permits.

Theme Plans

Theme plans include strategies which are common to all zones and include the following.

1. Habitat Management
2. Infrastructure and Communication Development
3. Fire Management
4. Protection
5. Wildlife Health

1. Habitat Management

In habitat management the integrity of forests has to be maintained or enhanced.

Objectives

To improve habitat for flora and fauna

Actions

- **Weed Eradication:** Weeds like *Mikania*, *Lantana* and *Chromolena* should be removed by uprooting during monsoon in phased manner but continuously for three years, then alternate year, wherever needed.
- **Fire control:** Fire lines should be properly maintained. Clearing of grass and weeds for a width of 5.2 m. helps in preventing fire spreading from one area to other. These fire lines also act as patrolling routes for the staff. Fire lines are also to be made in the surroundings of grass lands, shola forest and small evergreen patches. Also along the roads fire lines should be maintained properly.
- **Control burning:** Controlled burning prevents disastrous late fires and provides new shoots for herbivores. A close monitoring of effects of burning should also be carried out and prescriptions modified accordingly.

2. Infrastructure and Communication Development

To provide adequate protection to the biodiversity and manage the conserved area, proper infrastructure and communication are of great importance.

Objectives

Create new infrastructure and communication facilities for Muthikulam HVBA.

Actions

Construct necessary buildings, acquire infrastructure and develop wireless network system on a priority basis.

3. Fire Management

Fire is one of the most destructive elements that disfigures the forests. In natural forests and in plantations the fire is the main problem which retards wood production.

Objectives

- Protect the habitats by minimizing and preventing the occurrence of forest fire.
- Determine fire weather index
- Promote community awareness and fire management through VSS.

Actions

- Construction and maintenance of fire lines
- Determination of fire weather index with the help of automated weather stations.

4. Protection

The main illegal activities are tree felling, unauthorised NTFPs collection especially medicinal plants, poaching, ganja cultivation, grazing etc.

Objectives

Protect the forests and biodiversity by controlling and preventing illicit activities such as encroachment, hunting, poaching, grazing and unauthorised NTFP collection.

Actions

Equip, train and motivate stakeholders in forest protection activities through VSS. Establishment of anti poaching camps, frequent monitoring and patrolling of the boundaries.

5. Wildlife Health and Veterinary care

Veterinary care in areas rich in wildlife can be assured by wildlife health monitoring through direct and indirect observations, post-mortem examinations, free vaccination and preventive measures like de worming domestic livestock and extension awareness to owners. The details are provided in Chapter 5.7– Research, Monitoring, Training and Wildlife Health.

CHAPTER 8: MAINSTREAMING STRATEGY WITH VARIOUS FUNCTIONAL SECTORS

The various production sectors are important to mainstreaming the biodiversity conservation concerns in Muthikulam HVBA. This would involve modification of developmental activities /practices in the key production sectors to make them more 'conservation oriented and environmental friendly'.

8.1. Forestry (D)*

The goal of the forestry sub-sector is sustainable development of forest resources and watersheds to provide environmental, social and economic benefits to the local people. The forestry operations in the failed plantation areas can be phased out slowly to convert them into natural forests.

- Conservation and widening of distribution of threatened and endemic species like *Vateria macrocarpa.*
- Monitoring of watershed.
- Monitoring the wildlife especially populations of Lion-tailed Macaque , Nilgiri Tahr, Tiger, etc in standardised formats
- Foot patrolling by field staff to ensure protection
- Regulating livestock grazing in areas prone to wildlife epidemics.
- Payment of compensation to Human - Wildlife conflicts and crop damages and provision of electric fencing.
- Fire protection through VSS
- Ensuring and regulating collection of Non Timber Forest Produce
- Ensuring sustainable collection of Non Timber Forest Produce like *Canarium strictum, Myristica beddomei, Curcuma zeodaria, Hydnocarpus pentandra, Acacia concinna, Garcinia gummi-gutta, Rotula aquatica, Curcuma sp, Piper sp. Momordica dioica* and *Pittospormum neelgherrense* and *Coscinium fenestratum.*
- Ensuring the availability of species of tubers/ leafy vegetables most frequently used by tribals, in their settlements.
- Ensuring protection of traditional water sources used by tribals.

- Phase out failed plantations and convert them to natural forests through Assisted Natural Regeneration (ANR).
- Maintaining sholas, grassy lands and marshy areas.
- Exchange of wildlife presence data with nearby protected areas.
- Transfer conservation and management activities to VSS and provide necessary capacity building.
- Train Forest Department staff in modern methods of conservation planning and action.

8.2. Agriculture (D)

There is no large scale agricultural practice or shifting cultivation in the tribal settlements of Mudugas, since they get income through NTFP collection. However, the gingers and curcuma are being cultivated in the fringe areas of Muthikulam HVBA. But these are often failures due to wildlife crop damage by elephants, deer and porcupine. The agricultural practices of farmers in the periphery have to be reoriented as follows:

- Adoption of 'eco-agriculture' (organic farming) as a land use to produce food as well as to conserve biodiversity.
- Small units of cultivation of 'cattle grass' can be practiced for producing fodder to reduce grazing pressure in forest areas.
- Discourage sudden change in cropping patterns to avoid accentuating man-wild animal conflicts
- Maintain a habitat mosaic, *viz.* fallow land, cultivation field, fruit orchard, plantation, under planting of spices, small timber etc. to mimic natural forest
- Promote soil conservation.
- Provide economic incentives for safeguarding wildlife concerns
- Provide incentive for carbon, water and other environmental services to local people
- Compensate losses due to crop damage by wildlife
- Recognize the value of traditional farming in conservation
- Foster the use of green manure and discourage use of chemical manures and pesticides
- Facilitate marketing of local products.

8.3. Integrated development (Eco-development, Development through District administration) (D).

The local self government (Panchayath) together with the Tribal and Forest Department can undertake various eco-development activities in Muthikulam HVBA

Eco-development

- Ensure proper drinking water supply to the tribal colonies.
- Provide electric fencing in places where acute human-wildlife conflicts are reported.
- Carry out participatory village level planning and preparation of village level micro plans for eco-development.
- Provide suitable place for cremation facility in tribal settlements.
- Provide inputs for resource substitution, income generation, community welfare, ecotourism for reducing the resource dependency of local people on surrounding forests.
- Ensure reciprocal commitments with the local people through respective Eco-development committees, forming part of a MoU in the micro plan for safeguarding biodiversity conservation interest.

Development through District Administration

This involves a coordination of various sectors operating in the landscape pursuing development, where biodiversity conservation have to be integrated through agreements between the Forest Department, district authorities and Eco-development committees..

8.4. Tourism (D)

The present form of tourism in Muthikulam HVBA may be continued with slight modifications (Environmental interpretation) so that the visitors become more aware about nature and conservation.

Nature Education

Nature education camp can be organized through two - three days camp programme intended for school, college students, members of NGOs and other groups focusing various themes related to environmental education, biodiversity conservation,. The curriculum may include study classes, trekking, field visits, group discussions, film projections, etc. This

programme has been found to be the most important tool for spreading environmental awareness.

8.5. Fisheries (D)

- Regulation fishing.
- Avoid explosives for fishing; Sufficient fishing nets to be provided for sustainable fishing practice. Traditional methods of fishing *Choonda* or *Choondal* is to be encouraged.
- Existing population status and conservation measures can be adopted by assessing the fish diversity programmes and native and ornamental fisheries breeding programmes can be done through VSS.

8.6. Tea / Coffee estates (I) **

There are no tea and coffee estates in Muthikulam HVBA.

8.7. Road / Rail Transport (D)

- The speed limit, noise level of the vehicles should be controlled in the places where there is movement of wildlife.
- Display the signal boards and speed limits sign boards. Traffic signs can be often used to indicate areas of increased animal activity.
- Awareness classes, notices, posters to the tourist people about wildlife corridors and biodiversity to prevent wildlife roadkill.
- Establishment of local vegetation on filled up area and road side land
- Adoption of erosion control measures.
- Protection of drainage system.
- Dumping of excavated material on ecological principles.
- Safeguards to prevent road hits to wild animals.
- Safeguards to prevent fires.
- Compensation for habitat fragmentation and barrier effect.

8.8. Industry (D)

There are no industries functioning at Muthikulam HVBA.

8.9. Mining (D)

There is no mining operation in Muthikulam HVBA

8.10. Thermal power plants (I)

There is no Thermal power plant operating in Muthikulam HVBA

8.11 Irrigation projects (D)

There is no irrigation project in Muthikulam HVBA

8.12 Temple tourism (D)

There is no temple tourism operating in Muthikulam HVBA

9.13 Communication projects (D)

- The new projects should avoid slopes, streams, forest areas and wetlands especially the animal corridors and habitats rich in wildlife.
- The BSNL and KSEB should do the regular checking and maintenance of power lines and telephone lines of existing projects to prevent sagging and hence electrocution of elephants and other animals.
- Joint checking operations should be planned in vulnerable places by KFD and KSEB.

D* = Affects wildlife directly.

I ** = Affects wildlife incidentally

CHAPTER 9: IMPLEMENTATION PLAN

9.1.Enabling environment and HRD plan

Conservation of biodiversity on sustainable principles forestry management practice has to combine both the science of forestry and the science of management. Hence the staff managing high value biodiversity area requires constant training in various subjects:

1. Training on legal issues.
2. Training on survey and demarcations.
3. Training on use of equipments like weapons, GPS.
4. Training on Biodiversity valuation.
5. Training on biological materials collection.
6. Eco-development training
7. Training in Ecotourism
8. Personality development.

Motivation and building morale of staff a strategic point of action and the starting point for creating an environment conducive for pro-active action. Human resource management is of utmost importance and to get the best of human resources an enabling environment to perform must be first created. This begins with a fair placement norm, fair systems of assessment, equal career growth opportunities for all, good departmental culture, professional systems and annual audit of institutions and personnel.

9.2. Management plan and capacity building

9.2.1. Management Planning: A plan detailing the protocols and procedures need be developed in order to implement the HRD and HVBA plans.

9.2.2. Inventorying, assessing, monitoring of habitat and species: Consultancies have to be given for developing protocols for inventorying, assessing both habitat and species. One Research Associate (RA) in each HVBA and research assistants at Range level and two assistants at beat level need be engaged. While the beat assistants will be drawn from the local population others will be biologists, ecologists and sociologists. Provision of modern equipments in computing, satellite maps, GIS and GPS facilities etc. are essential. Necessary vehicles, Camera traps, analytical equipments, weather monitoring station, water monitoring equipments have to be provided.

9.2.3. Staff Development and Capacity Building: Staff development and capacity building will be ensured through trainings, field visits in India and abroad and through conduct of scientific research and preparation and presentation of scientific papers. Staff members are encouraged to visit other countries to learn about better practices and approaches to biodiversity conservation.

Special emphasis on leadership and strategic skills at the middle and top level and managerial skills at the bottom level is essential. Staff morale is to be improved beginning with provision of minimal facilities- furnished accommodation and ration to all field staff.

The scheduling of duties suggested are such that staff would have a fifteen day stay at station followed by a five day break to visit family. Till such time as accommodation is provided for family at nearest town, staff may be paid fare by bus/train to visit home. A system of annual awards is suggested for the Best Beat/Section/Range/Division and for the Best Forest Guard/Forester/Range officer/DFO.

9.2.4. Wildlife Research

Important research projects

- Land use and vegetation assessment
- Mapping and analysis of Biodiversity Hotspot areas
- Identification of threatened species and methods for conservation
- Mapping of fire prone, weed infested and degraded areas
- Determination of fire- weather index
- Forest and NTFP dependency of Tribes and fringe area people
- Assessment of wildlife health
- Inventory of lower forms of fauna and flora

Gaps in information will be bridged through prioritized research. A priority list will be prepared through a participatory workshop with all stakeholders. Basic information will be collected through setting up of weather monitoring station, water monitoring stations, permanent monitoring. Research programmes will be carried out through surveys, Plots/ Transects and periodic census.

9.2.5. Education and Awareness:

Conservation oriented education and awareness about the HVBA are important in the development of the area as envisioned. Local communities, students and others will be targeted to instill the principles of conservation and sustainable development. The local community need develop a sense of ownership. A visitor centre and interpretation centre will be established for conducting regular camps.

Suggested Park Interpretation Themes and use of media:

- Role and significance of Muthikulam HVBA and their relationship with long-term conservation of biodiversity.
- Conservation History of Muthikulam HVBA
- Varied ecosystem found in Muthikulam HVBA
- Rare and endangered species found in Muthikulam HVBA
- Endemism in Muthikulam HVBA
- Media- Explained photo panel exhibit in interpretation centre, video film at visitor centre, computer quiz in interpretation centre

9.2.6.Audit & Certification:

A system of annual audit and certification of institutions and individuals will be introduced. This will ensure transfer of change to field and management and monitoring of this change. Audit and certification will be done for the beat, the station, the range, the Division, the circle and the State.

9.3. Anti-poaching and Infrastructure

(A) Anti poaching:

9.3.1. Strengthening of beat infrastructure: Basic facilities to be provided at the beat level. The staff quarters with water and energy sources and good communication facilities (wireless sets/ mobile phones) for emergency to be provided. Each beat will have suitable basic camping facility (dormitory).

9.3.2. Community beat assistants (four per beat): Each beat to have four beat assistants to support the beat staff. To begin with, two beat assistants may be initially provided. These beat assistants will be drawn from local community and be trained and oriented to document what enters and leaves the beat and monitor the habitat and species within the beat.

9.3.3. Informant networks: The beat staff will develop an informant network so that they receive information on all that happens within their jurisdiction. They must know who and what enters their beat and who and what leaves their beat on a daily basis.

9.3.4. Intelligence network: The Range and Division will develop an intelligence network to monitor the functioning of the beat.

9.3.5. Communications: Field staff to be provided with good communication- wireless, mobile phones, internet.

9.3.6. Vehicles: One jeep for each section/station, Range and Division.

9.3.7. Field rations: All field staff to be provided field rations including facilities to have the food cooked.

9.3.8. Secret funds: Secret funds may be provided at Division level so that information of value is paid for thereby improving the quality of information and upgrading protection.

9.3.9. Crime cells at Division, Circle and State: A Crime Cell to monitor offences, offenders and devise suitable strategy to be set up at Division, Circle and State level. At Circle and State this cell will function under the leadership of an ACF.

(B) Infrastructure:

9.3.10. Offices: Maintenance of offices is provided.

9.3.11. Field camps: Each beat will have one field camp with basic facilities and furnishing.

9.3.12. Staff quarters: Staff quarters are provided for the Range officer and Research Associate.

9.3.13. Staff quarters at nearest education centre: Provision for a staff quarters at nearest education centre

9.3.14. Watch towers: Provision for one watch tower. Location to be chosen by HVBA staff

9.3.15. Road network: Nil

9.3.16. Inspection paths: Creation of new and maintenance of existing trek paths and inspection paths.

9.3.17. Lab and library facilities: Purchase of basic laboratory instruments, books and periodicals.

9.3.18. Communication network (mobile and wireless): Purchase and installation of mobile and wireless net work.

9.3.19. Vehicles: purchase of four wheel jeep.

9.3.20. Field gear for staff: Uniform, foot gears, tents, rain coats, sleeping bags, Head lamps, etc., need to be purchased.

9.3.21. Veterinary care: For vaccination, captive breeding, *ex situ* conservation programmes, rescue etc.,

9.3.22. Staff welfare: For improving living amenities, reimbursing travel costs.

9.4. Restoration of habitat:

9.4.1. Habitat improvement through:

a) Enrichment planting
b) Removal of exotic weeds
c) Soil and moisture conservation
d) Fire protection

9.4.2. Safeguards/retrofitting:

a) Safeguards
b) Retrofitting

9.5. Eco-development and community oriented activities and Mechanism of Stakeholder involvement

9.5.1. Alleviating human –Wildlife conflicts through:

a) Fencing
b) Compensation
c) Relocation of problematic animals

9.5.2. Strengthening co-existence through:

a) Participatory approach (EDC/JFM)
b) Entry point activities
c) Programmes to gain ownership by local community
d) Incentive for protection
e) Eco-development Programmes
f) Relocation
g) Eco-tourism
h) Trans-boundary issues (in case of inter-state/country)

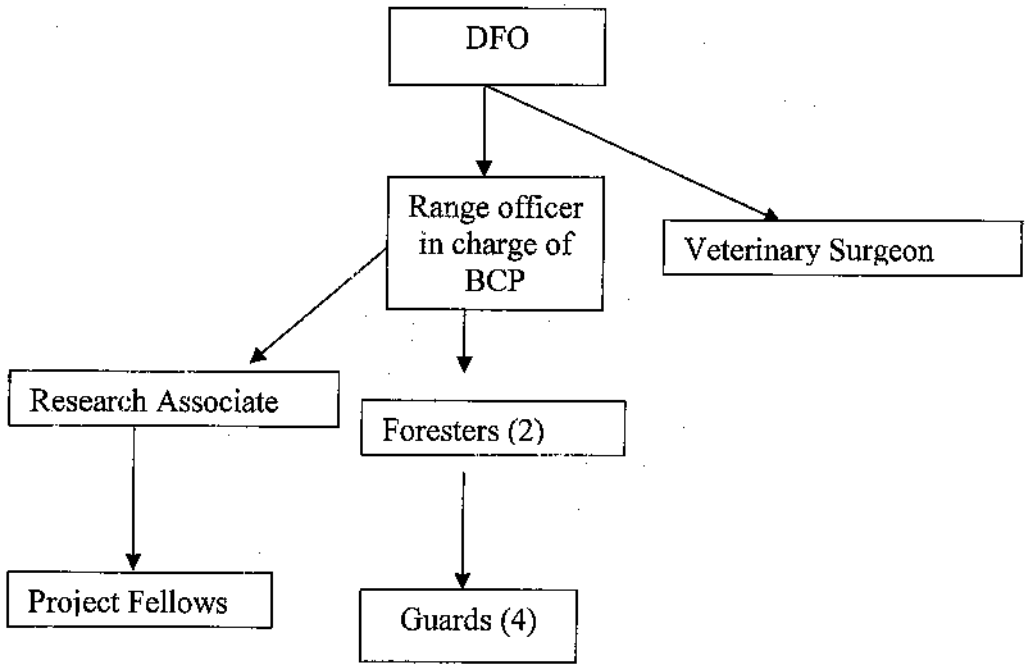
9.6. Systems, protocols and its institutional set up.

The implementation of the Biodiversity Conservation Plan (BCP) of Muthikulam HVBA will be directly carried out by the Divisional Forest Officer under direct supervision of CF

(Olavakkode circle) and guided by the CCF (Biodiversity). The protocol of the implementation is as follows.

- Monthly meeting of RO (BCP) and DFO
- Quarterly meeting of RO and DFO with CF
- Half yearly reporting to CCF (Biodiversity)
- Yearly progress presented before PCCF and other CCFs.

The institutional set up is provided in the chart given below:



9. 7. Duties and responsibilities at each level

- The DFO will assist planning and execution and report to CCF biodiversity through CCF biodiversity through CF Central circle
- The Range Officer in charge of BCP will supervise the field activities and provide financial and fiscal support and report to the DFO.
- The field biologist will implement the intended activities with the help of research and department staff and VSS. He will report to the DFO.

9. 8. Monitoring

Monitoring and evaluation is a very important aspect of any management process as it is very essential to measure the activity. It helps to evaluate the progress and success of the

implementation of the plan and also helps to find out the shortcomings and make corrective measures, if necessary.

To evaluate how effective the management prescriptions fulfill in achieving the desired objective of conservation, the following matrix is used (Table 9.2).

Table 9.2. Monitoring and evaluation of activities

Sl. No	Intended intervention	Management prescriptions	Criteria to evaluate effectiveness
1	Ecological sustainability	Protection	Boundary demarcation, fire lines, trek paths, Less human animal conflicts, illegal activities
2	Protection of the habitat and strengthen the conservation measures	Maintaining integrity of the habitat	Increased biodiversity
3	Integrate human and forest conservation issues	Minimize negative impact of people and increase collaboration with local people	Improved relations between forest officials and villagers, improved employment opportunities, and livelihood, reduction in human wildlife conflicts.
4	Restoration of habitats	Maintenance of riparian ecosystems, grasslands, watersheds and eradication of alien and exotic weeds and eco-restoration of degraded areas	Increased biodiversity ecosystem services
5	Sustainable collection and of NTFPs	Monitoring collection And value addition	Enhanced turn over and profits
6	Human Resource Development	Staff amenities and provision for staff training.	Staff satisfaction, Number of staff trained, Motivation and efficiency of staff increased in conservation activities

7	Strengthening Wildlife health monitoring and veterinary care	Immunization of cattle around the reserve. Direct observation and recording	No instance of epidemics, Monitoring the waterholes, snail survey etc.
8	Tourism and Nature education	Diverse tourism opportunities and facilities.	Tourists satisfied and forests conserved
9	Socio-economic issues	More jobs to local people in protection and intelligence	Whether local people are gainfully employed
10	Recognizing the people's rights	Increasing outreach activities	Informed local people with less conflicts (Human –forests)
11	Succession in failed plantations	Monitoring and assisted natural regeneration	Area under natural forest increased, Biodiversity enhanced

Process

The criteria listed above have to be evaluated. The criteria and the process of evaluation is given in Table 9.3. Some evaluation needs to be done at the level of field staff such as forest guard and watcher and need to be submitted to the Range Officer in charge of conservation and to the Divisional Forest Officer. The result may be evaluated in the District Level Management Committee.

Table 9.3. Criteria and Process of evaluation

Sl. No	What (Criteria)	How	By whom	when
1	Ecological sustainability	Boundary demarcation, fire lines, trek paths, Human animal conflicts, illegal activities	Research Associate (RA), Biodiversity Conservation Programme	Yearly
2	Protection of wildlife and its habitat	Maintaining the integrity of the elephant, tiger habitats	Range Officer (RO) Biodiversity Conservation Programme	
3	Boundary demarcation	Extent/length	RO Biodiversity	Yearly

			Conservation Programme	
4	Fire lines, trek paths	Length	RO Biodiversity Conservation Programme	Yearly
5	Human – animal conflicts	Number	RO, Biodiversity Conservation Programme	Yearly
6	Human Resource Development	Number of trainings conducted and staff trained	RO, Biodiversity Conservation Programme	Yearly
7	Integrate human and forest conservation issues		RO, Biodiversity Conservation Programme	Yearly
8	Strengthening Veterinary Facility	No of cattle immunized	Veterinary Officer, Biodiversity Conservation Programme	Continuous record maintenance
9	Tourism	Study carrying capacity	RA, Biodiversity Conservation Programme	Yearly
10	Pollution effect of tourist areas	Sample plots in zone of influence	RA, Biodiversity Conservation Programme	Before and after peak tourist season
11	Future of the plantation areas	Vegetation Plot monitoring	RA, Biodiversity Conservation Programme	Yearly
12	Socio – economic issues	Functioning of VSS	RA and RO Biodiversity Conservation Programme	Meetings of the Conservation Foundation
13	Recognizing the people's rights	Less number of conflict	RO	Meetings of the Conservation Foundation
14	Animals with poor health condition	Number of animals	Veterinary Officer	Yearly
15	Illegal activities	No. of offence cases	Range Officer	Monthly

16	Research projects	Number	RO and RA	Yearly
17	Weed removal (progress)	Extent (ha)	Range Officer	Monthly/yearly
18	Extent of weed invasion	Sample plots in field	RA Biodiversity Conservation Programme	Yearly
19	Exotics fishes in river (population density)	Capture recapture method	RA Biodiversity Conservation Programme	Yearly
20	Trainings conducted and staff trained	Numbers	RA Biodiversity Conservation Programme	yearly

Strategy

To conserve and enhance the biodiversity wealth of Muthikulam Forest Division through participatory research and action programmes involving stakeholders and trained staff of the Kerala Forest Department.

State Level Monitoring

The State level steering and coordination committee can carry out the monitoring also. The institutional set up is as follows:

Committee

- Principal Chief Conservator of Forests (General) - Chairman
- Principal Chief Conservator of Forests & Chief Wildlife Warden
- Chief Conservator of Forests (Biodiversity) – Member secretary
- Concerned Conservator of Forests
- Concerned Divisional Forest Officer
- Scientists -2
- Non-Government Organizations -2

Regional Level Monitoring and Co-ordination.

Committee

- Conservator of Forests (Olavakode circle) –Chairman
- Conservator of Forests (BCP)
- Divisional Forest Officer Mannarkkad
- Range officer (BCP)
- Territorial Range Officers
- Scientists -2
- Non-Government Organizations -2
- Range Officer (BCP)- Member Secretary
- Research Associate

District Level Management, Monitoring and Co-ordination.

Committee

- District Collector – Chairman
- Divisional Forest Officer - Member
- Representatives of the officials from
  - PWD
  - Social Welfare Department
  - Tribal Welfare Department
  - Health Department
  - Agricultural Department
  - Animal Husbandry Department
  - Education Department
  - Power and Irrigation Department
  - Scientists
  - President of the concerned Panchayath
  - NGOs

Forest Beat Management and Monitoring.

Committee

- Range Officer – Chairman
- Dy. Ranger Member secretary
- Concerned Foresters -2
- Vana Samrakshna Samithis - President
- Non-Government Organization- 1
- Scientist -1

Institutional mechanism.

Implementation

The RO (BCP) will implement through VSS (BCP). He will report to the DFO.

Research

The priority of research will be decided and field biologist will lead the programme assisted by projects staff appointed on temporary basis and report to the RO.

Monitoring and Evaluation

The Monitoring and Evaluation will be carried out by District level, Regional level, and state level committees.

- District level – Once in three months
- Regional level- Once in six months
- State level – Once in a year

Audit and Certification.

The implementation of SFM in each Forest Management Unit will be audited and certified by competent external agencies.

10.1.Structure and administration

Governing body for Biodiversity Conservation programme at Muthikulam Forest areas is given below.

1. Hon'ble Minister of Forest, Govt. of Kerala – Chairman.
2. Principal Secretary to Govt. (F&W), Kerala – Vice chairman.
3. Principal Chief Conservator of Forests, Kerala.
4. Chief Conservator of Forests (Wildlife), Kerala.
5. Chief Wildlife Warden, Kerala – Member Secretary
6. Chief Conservator of Forests (Ecodevelopment and tribal welfare), Kerala
7. Conservator of Forests (Palakkad Circle), Kerala
8. Divisional Forest Officer, Mannarkkad
9. Director, Kerala Forest Research Institute, Peechi, Thrissur
10. Vice Chancellor, Kerala Agricultural University, Mannuthy
11. Member of Legislative Assembly, Mannarkkad.
12. District Panchayat President, Palakkad.

Executive Committee

1. DFO Mannarkkad - Chairperson
2. Range Officer in Charge
3. Research Associate
4. Veterinary Surgeon
5. Dy. Ranger
6. Presidents of VSS

10.2. Co-ordination

- **Co-ordination with other Government Departments**

To ensure the biodiversity conservations of Muthikulam forests the Coordination must be ensured with The District Administration, District, Block and Village Panchayaths, Kerala Tribal Welfare Department, Kerala Tourism Department, KSEB, Agriculture, Animal Husbandry, Irrigation Department of Kerala and PWD Departments of Kerala. Through the

coordination of these Departments periodic seminars, inter-departmental discussions, the awareness about the conservation areas, future management decisions, problems related to management and understanding of integrating conservation inputs into developmental activities can be done.

- **Co-ordination with VSS**

The VSS can be coordinated by biodiversity conservation management committee. Several VSSs, either by their location or activities can be grouped together as Confederation. An advisory body can be constituted out of the Chairpersons of various VSSs forming the Confederation. This will facilitate institution building, seeking resources from the Local Government or the District Administration, and periodically reviewing the working of the VSSs within the Confederation. A higher-level body before the Reserve level can be constituted with the Range Officers as Secretaries to these bodies.

- **Co-ordination with NGOs**

Similarly the active participation of the NGOs like AHADS, Kunthipuzha Samrakshana Samithy, Bharathapuzha Samrakshna Samithy, Nature Education Society, Palakkad etc. and the awareness programmes, training programmes, village eco-development programmes and regular meetings can be coordinated.

10.3. Staff deployment

The existing vacancies of Forest Guards need to be filled at the earliest. The tribal people need to be deployed for the strike force. Means of recruiting them needs to be devised and Govt. orders got to be issued in this regard. Formation of such strike force is very urgent. Sufficient amenities should be provided to the staff. For guards camping in remote places, rations should be provided. Same is the case with other Field gears and equipments. Insurance facilities for staff, medical amenities etc., also should be provided. The proposed staff for implementing Biodiversity Conservation programme at Muthikulam Forest areas in Table 10.1.

Table 10.1. Proposed staff for implementing Biodiversity Conservation Programme at Muthikulam Forests.

Sl. No.	Designation	Strength	Training/ Area of Specialisation
1	Range Officer	1	As per State norms/preferably M.Sc. with aptitude to research
2	Foresters	2	As per State norms
3	Forest Guards	4	As per State norms
4	Field Biologist	1	Doctorate in biological sciences, experience in Forest research
5	Veterinary Surgeon	Need basis	BVSc & AH
6	Research Associates	Project basis	M.Sc. in Botany/Zoology/Forestry with 2 years experience
7	Project Fellows	Project basis	1st Class M.Sc. in Botany/Zoology/Forestry/Sociology
8	Field Staff	Need based	From VSS
9	Protection watchers	Need based	

Suggested Strategies:

- The biodiversity conservation area should be notified and handed over to the management committee immediately.
- Staff requirement should be assessed and existing vacancies should be filled at earliest.
- A trained Range officer on Biodiversity – Wildlife management can be posted.

10.4. Fund raising strategies

The source of funds will be raised from various agencies of Central Government & State Government for implementing the Biodiversity Conservation plan for Muthikulam forests. The activities of line departments such as Rural Development agencies, Panchayats

(LSG), Social Welfare Department, Tribal Welfare Department and Animal Husbandry Department etc. can be coordinated to benefit the cause of conservation efforts. The various schemes available with these departments can be put to use in the proper way to ensure conservation programmes. In addition to this, the following funding sources will also be included:

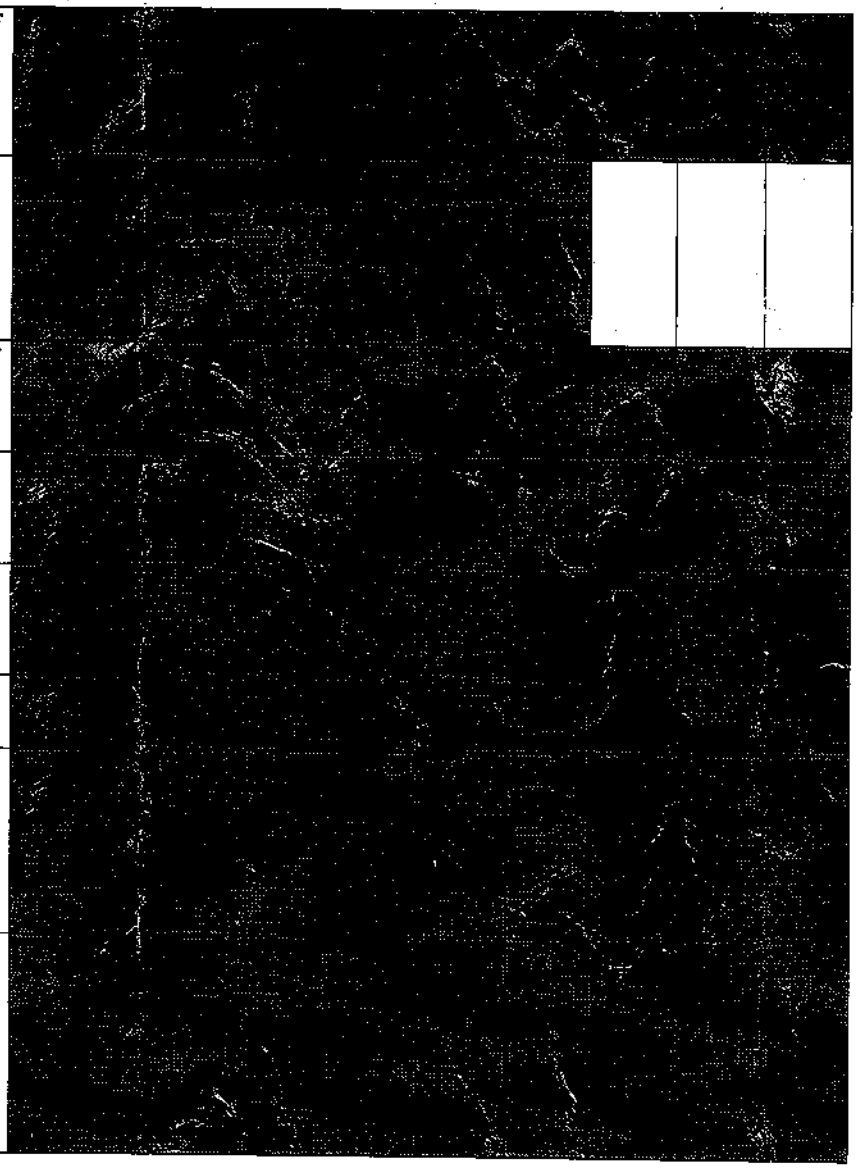
- Ministry of Environment and Forests
- The State Plan for Biodiversity Conservation
- Local Panchayat development
- State and National Medicinal Plant Board.
- Community-based Ecotourism Programmes.
- Centrally Sponsored Schemes for Rural Development
- Centrally Sponsored Schemes for Wildlife and Biodiversity Conservation
- The Tribal Welfare Development Fund / SC-ST Department
- Grants, donation or assistance of any kind from foreign Governments and other external agencies subject to Government rules.

10.5. Calendar of operations: - The details of calendar of operations are given below in Table 10.2.

Table 10.2. Calendar of operations

Sl. No	Activity	Year									
		1	2	3	4	5	6	7	8	9	10
1	Positioning Forest Department Staff										
2	Civil Works										
3	Purchase of permanent equipments										
4	Instrumentation										
5	Reference library setting/ Purchase of books										
6	HRD Training										
Research Programmes											
7	Identification, assessment of flora/fauna and their conservation in Muthikulam High Value Biodiversity Area.										
8	Mapping and restoration of Wildlife corridors in Muthikulam High Value Biodiversity Area.										

9	Cost effective restoration of degraded areas using indigenous (local) tree species.
10	Establishing models for scientific harvesting and value addition of Non Timber Forest Products in Muthikulam forests
11	Control and management of exotic weeds in Muthikulam forests
12	Human - Wildlife conflict assessment and methods for mitigation
13	Establishing weather station and determine fire-weather index in Muthikulam HVBA
14	Identifying and monitoring avifauna in Muthikulam HVBA
15	Population assessment, conservation and restoration of selected rare, endangered and threatened plants in Muthikulam HVBA
16	Population Survey and Conservation of Small mammals in Muthikulam HVBA with special reference to Nilgiri tahr, Lion tailed macaque, Bonnet macaque and Nilgiri langur.



17	Staff amenities
	Action programmes
18	Restoring water holes and Soil and moisture conservation programmes
19	Improving Eco-tourism facilities
20	Providing safeguards measures
21	Habitat improvement programmes
22	Conservation oriented education and awareness programmes
23	Eco-development programmes and Livelihood improvement (Value addition, marketing and enterprise development)
24	Anti poaching activities
25	Wildlife and veterinary care
26	Fire Protection
27	Patrolling and communication
28	Annual audit and certification

12.6 Activity budget

Budget (Rs. in lakhs) for implementing Biodiversity Conservation Plan in Muthikkulam HVBA (Mannarkad Forest Division)													
Sl. No.	**Particulars**	**Para. of the Biodiv.plan**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Total**
I	**Management Planning & Capacity Building**												
1	**Management Planning**												
a	Assistance for preparing inventory	9.2.2	3.0	2.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	8.0
b	Status survey	9.2.2	4.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
c	Development of inventorying, assessing and monitoring protocols for habitat species.	9.2.2	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
d	Development of regional and landscape plans	9.2.2	3.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
e	Procurement of hardware, Software, GIS etc.	9.2.2	4.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
f	Computer and accessories	9.2.2	1.5	1.5	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	4.5
g	GPS	9.2.2	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	2.0
h	Camera, Camera traps	9.2.2	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	3.0
i	Satellite imageries, digitization facilities	9.2.2	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	2.0
j	Consultancies	9.2.2	5.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	24.0
k	Seminars/workshops	9.2.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

2	**Strengthening Wildlife Research, education and nature awareness**												
a	Research	9.2.4	2.0	5.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	23.0
b	Census, Survey	9.2.4	1.0	2.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	6.0
c	Setting up monitoring plots/transects	9.2.4	0.0	3.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
d	Weather stations	9.2.4	1.0	6.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	1.0	11.0
e	Water monitoring stations	9.2.4	2.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
f	Monitoring and evaluation	9.8	0.0	0.0	3.0	0.0	0.0	0.0	3.0	0.0	0.0	1.0	7.0
g	Foreign tours	9.2.3	0.0	0.0	5.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	10.0
h	In country tours	9.2.3	0.0	2.0	0.0	0.0	0.0	2.0	0.0	0.0	2.0	0.0	6.0
i	Consultancies	9.2.3	0.0	3.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	6.0
j	Workshops and Seminars	9.2.2	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	3.0
k	Publications	9.2.5	1.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	5.0
l	Visitor centres	9.2.5	0.0	0.0	6.0	2.0	0.0	0.0	0.0	2.0	0.0	0.0	10.0
m	Interpretation centres	9.2.5	0.0	5.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	10.0
n	Nature camps	9.2.5	1.0	1.1	1.2	1.3	1.5	1.6	1.8	1.9	2.1	2.4	15.9
o	Equipment for research and education	9.2.2	5.0	5.0	5.0	0.0	0.0	0.0	0.0	6.0	6.0	6.0	33.0
3	**Staff Development & Capacity Building**												
a	Basic training in systems and protocols and professional working	9.2.3	1.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	3.0

b	Special training in use of GIS, use of camera traps, antipoaching, legal, forensics	9.2.3	0.0	1.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	3.0
c	Leadership and managerial skills	9.2.3	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.0
d	Fair placement norms	9.2.3	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
e	Grievance redressal mechanism	9.2.3	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.0
f	Awards	9.2.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
4	**Independent evaluation and status survey**												
a	An annual audit of the Division, Range, Station, beat	9.2.6	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	9.0
b	An annual audit of individual performance	9.2.6	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	9.0
c	Annual audit of systems and protocols	9.2.6	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	4.5
II	**Anti-poaching & Infrastructure Development**												
1	**Anti poaching**												
a	Strengthening of beat infrastructure	9.3.1	2.0	2.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	8.0
b	Community beat assistants	9.3.2	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	80.0
c	Informant networks	9.3.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
d	Intelligence network	9.3.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
e	Arms and ammunition	9.3.1	0.0	10.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	20.0
f	Communications	9.3.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0

g	Field rations	9.3.7	2.5	2.8	3.0	3.3	3.7	4.0	4.4	4.9	5.4	5.9	39.8
h	Secret funds	9.3.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
i	Crime cells at Division, Circle and State	9.3.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
2	**Infrastructure**												
a	Offices	9.3.10	0.0	10.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	12.0
b	Field camps	9.3.11	0.0	6.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	7.0
c	Staff quarters	9.3.12	0.0	15.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	17.0
d	Staff quarters at nearest education centre	9.3.13	0.0	7.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	9.0
e	Watch towers	9.3.14	3.0	5.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	10.0
f	Road network		0.0	6.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	10.0
g	Inspection paths	9.3.16	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	11.0
h	Lab and library facilities	9.3.17	0.0	15.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	35.0
i	Communication network (Mobile and Wireless)	9.3.18	0.0	1.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	4.0
j	Vehicles and POL (jeep)	9.3.19	7.0	8.0	3.0	3.0	3.0	3.0	7.0	3.0	3.0	3.0	43.0
k	Field gear for staff	9.3.20	0.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
3	**Wildlife Veterinary care**												
a	Vaccination	9.3.21	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
b	Captive breeding	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c	Ex-situ conservation programme	9.3.21	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	12.0
d	Rescue camps	9.3.21	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.5	0.0	1.5
e	Rescue vehicles	-	0.0	10.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	18.0
f	Monitoring wildlife health	9.3.21	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
g	Medicines etc.	9.3.21	0.0	0.5	0.5	0.0	0.5	0.0	0.5	0.0	0.5	0.0	2.5

h	Maintaining clinics	9.3.21	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
l	Engaging mazdoors	9.3.21	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
4	**Staff welfare**												
a	Improving living amenities for staff	9.3.22	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	20.0
b	Day offs to visit family	9.3.22	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
c	Reimbursing travel costs to visit family	9.3.22	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
III	**Restoration of Habitat**												
1	**Habitat improvement**												
a	Enrichment planting	9.4.1a	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	3.0
b	Removal of exotic weeds	9.4.1b	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
c	Soil and moisture conservation	9.4.1c	1.0	4.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0	5.0	20.0
d	Fire protection	9.4.1d	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	29.0
e	Salt licks	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
f	Vista clearance	-	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	15.0
g	Water holes	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	**Safeguards/retrofitting**												
a	Safeguards	9.4.2a	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
b	High-tension wire/railway line	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c	Retrofitting	9.4.2b	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV	**Eco-development & Community oriented activities**												
1	**Human-wildlife conflict**												
a	Fencing	9.5.1 a	2.0	10.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	10.0	32.0

b	Compensation	9.5.1 b	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
c	Relocation of problematic animals	9.5.1 c	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	9.0
2	**Strengthening co-existence**												
a	Participatory approach (EDC/PFM)	9.2.5a	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
b	Entry point activities	9.2.5b	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
c	Programmes to gain ownership by local community	9.2.5c	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
d	Incentive for protection	9.2.5d	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
e	Eco-development programmes	9.2.5e	0.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	7.0
f	Relocation	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
g	Ecotourism	9.2.5g	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	21.0
h	Trans-boundary issues	9.2.5h	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
V	**Grand Total**		**92.5**	**213.4**	**94.2**	**61.2**	**59.6**	**96.6**	**85.2**	**65.3**	**69.0**	**82.3**	**919.3**

10.7 Fund Requirement (10 year plan)

For the ten year research operation and all management prescriptions the budget required is Rs.**9.193** crores.

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BIODIVERSITY CONSERVATION PLAN
FOR
MUTHIKULAM HIGH VALUE BIODIVERSITY AREA

(2010-2011 to 2019-2020)

PROPOSALS FOR

RESEARCH AND ACTION

RESEARCH PROJECTS

Proposal 1. Identification, assessment of flora/fauna and their conservation in Muthikulam High Value Biodiversity Area.

Background Information

The Muthikulam HVBA is rich repository of a vast variety of flora and fauna and plays a very vital function in preserving the habitat of several threatened and/or endangered species. The forest areas fall into three forest types viz. West coast Tropical forest, West coast Semi Evergreen Forest, Southern Montane Wet temperate forest and Montane grasslands. The altitude varies from 200 m to 2000 m. The comparison of floristic diversity of Silent Valley, Muthikulam and Nelliampathy forests indicates that the flora of these areas is of very high Simpson's index when compared with Silent valley and Nelliampathy. Preliminary studies show that a total of 77 species of lichens are reported from Muthikulam hills. In addition to this there are reports on eighty three species of Pteridophytes representing 28 families, 488 species of flowering plants, including 387 dicotyledon and 101 monocotyledon plants. Many of the important species to the Western Ghats such as *Vateria macrocarpa, Holigarna arnottiana, Palaquium ellipticum, Cullenia exarillata, Myristica dactyloides, Mesua ferrea, Calophyllum elatum, Hopea ponga, Aglaia eleagnidea, Cinnamomum macrocarpum, Dysoxylum malabaricum, Diospyros bourdillonii* and *Dimocarpus longan* are found in this region. The rare and threatened species are: *Meliocope lunu-ankenda, Saprasma fragrans, Plectranthus rivularis, Pogostemon gardneri, Plectranthus rivularis, Garcinia tinctoria, Poeciloneuron indicum, Ophiorrhiza brunonis, Wendlandia notoniana, Piper galeatum, P. argyrophyllum, Glochidion sisparense, Glochidion ellipticum, Eria albiflora, Liparis viridifolia, Ephemerantha macraci, Chrysoglossum maculatum, Dendrobium macrostachyum, Microstylis versicolor, Oberonia brachyphylla* and *Oberonia ensiformis.* Eventhough, fragmented studies on selected flora and faunal groups have done, there is a big gap in the knowledge of the biodiversity resources of this forest Division. No systematic studies were carried on lower groups of plant kingdom such as algae, liverworts, mosses, lichens and ferns. There is no information with regard to soil microflora, aquatic microorganisms, arthropods, mollusks and wild animal parasites. Similarly the status of the present situation of the RET species also need to be assessed.

Objectives

1. Survey and identification of flora and fauna including Rare, endangered and threatened species.
2. Preparation of a vegetation map using GIS techniques.
3. Identification of the critical areas for *in situ* conservation and propose guidelines for conservation and monitoring.

Study area : Muthikulam High Value Biodiversity area.

Methodology

1. Field surveys and transect walk using GPS.
2. Plant collection, identification and herbarium preparation
3. Vegetation analysis and identification of critical areas for the conservation
4. Faunal and bird survey; population estimation
5. Analysis of the collected data and preparation of GIS based maps.

Outline of the research programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Purchase of equipments										
Preparation of baseline maps										
Survey, collection and identification of flora										
Survey of the fauna										
Vegetation analysis										
Identification of critical areas of conservation										
Presentation of data in a state level workshop										

Proposed budget (Rs. in lakhs): 23

Period : 10 years

Proposal 2. Mapping and restoration of Wildlife corridors in Muthikulam High Value Biodiversity Area.

Background Information

Muthikulam HVBA forms connectivity between forests north of the Palakkad gap and Silent valley. However, the major land use changes, selective felling, encroachments, fire and forest degradation is a major threat to loss the connectivity between Attappadi Block VI and Silent Valley forests. The area is main breeding and migration path of large mammals. Due to encroachment and degradation from northern and western sides all the migratory routes are fragmented and these corridors need to be identified and restored. Mapping and restoration of wildlife corridors are important because it allows an exchange of individuals between populations, which may help to prevent the negative effects of inbreeding and reduced genetic diversity (via genetic drift) that often occur within isolated populations.

Objectives

1. To identify areas suitable for establishing corridors at both the local and landscape level and map wildlife corridors
2. To quantify animal occupancy and habitat use patterns over the landscape.
3. To identify cropping patterns, forest dependency and conservation attitudes among local residents, to inform future conservation work.

Study area

The Muthikulam Forest Division

Methodology

1. Mapping the existing corridors using Geographic Information System
2. Assessment of Sign based occupancy surveys, animal movement, numbers, species and season.
3. Evaluation of the status of the corridors.
4. Socioeconomic surveys to assess attitudes to conservation of the local peoples.

Outline of the research programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Interaction with local peoples (Interview, Questionnaire survey)										
Participant observation and monitoring										
Field surveys										
Development of strategies to revitalize the corridors										

Proposed budget (Rs. in lakhs): 18

Period : 5 years

Proposal 3. Cost effective restoration of degraded areas using indigenous (local) tree species.

Background Information

The ecorestoration zone of Muthikulam HVBA is 32.74 km^2 and this zone will include areas coming under Mannarkkad and Agali Ranges where degraded natural forests, agriculture and arboriculture are available at elevations below 750m. There are six plantations of eucalypts, raised between 1962 and 1987 covering an area of 92.5 ha. All plantations are understocked and belong to the failed category. They are located in grassland area and it is possible to bring back the area to natural conditions. The main reasons for failure are shallow soil, winds and browsing by ungulates. The main objectives of cost effective restoration projects are to maintain environmental stability through preservation and wherever necessary, restoration of ecological balance. The cost effective restoration models need to be established in Muthikulam HVBA for effective critical species reintroduction, conversion of degraded plantations to natural forests and sustainable utilization of NTFPs. This will also help to conduct scientific studies for phasing out poorly stocked and failed plantations into natural forests. The natural regeneration in the poorly stocked plantations in Muthikulam HVBA area is very poor and the invasions of alien weeds are also high. In this context, the main aim of this proposal is to transform these plantations, which are failed or poorly stocked to natural forests through research and subsequent action.

Objectives

1. Maintain the environmental stability through preservation and wherever necessary, restoration of ecological balance that has been adversely disturbed by depletion & degradation of forests.
2. To evolve mechanisms for ecological restoration of degraded forest areas in the restoration zone through systematic planning and implementation, in a cost effective manner.
3. To create general awareness to the stakeholders and involve people's movement for promoting afforestation and eco-development with the assistance of voluntary agencies, NGO's and promote participatory and sustainable management of degraded forest areas in restoration zone in Muthikulam HVBA.

Study area

Ecorestoration zone of Muthikulam HVBA under Mannarkkad and Agali Ranges

Methodology

1. Identify potential areas and species suitable for reforestation activities in degraded areas.
2. Developing a reforestation plan together with the various Departments and agencies involved.
3. To train VSS to establish and maintain nurseries of tree species
4. To implement a management plan for the reforestation schemes in the selected areas.
5. Increase awareness of, and educate, people at different levels on sustainable use of all types of energy;
6. Participating in regional, national and international events on reforestation for energy.

Outline of the research programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Identification of the area and developing a cost effective restoration plan.										
Nursery establishment, training.										
Implementation of the restoration plan										

Proposed budget (Rs. in lakhs): 26

Period : 10 years

Proposal 4. Establishing models for scientific harvesting and value addition of Non Timber Forest Products in Muthikulam forests

Background Information

Non-timber forest products (NTFPs) form a very important source of livelihood to communities living in the vicinity. In India, there are about 15,000 plant species out of which nearly 3000 species (20%) yield NTFPs. Sustainable management of the NTFP resources is important, and the Forest Department is increasing its efforts to manage them through the co-operative societies with the help of EDCs. While providing a reliable livelihood to the forest dwelling communities, the species and habitats also need to be conserved. To do so, the communities must be sure of harvesting the product whilst maintaining a viable population, supported by a healthy ecosystem. Hence, the Forest officials and harvesters need to adopt their own rules for sustainable harvesting, based on rigorous research.

The Muthikum HVBA is home to diverse wild aromatic and medicinal plants. The Muduga tribe of this area have a rich ethnic knowledge of these plants. NTFP collection, including the medicinal plants is their main source of income. The main NTFPs are Gajathippali (*Balanophora fungosa* ssp. *indica*.), Thelli (*Canarium strictum* Roxb.), Manjakoova (*Curcuma zedoaria*) Cheenikka (*Acacia sinuata* (lour.) Merr., Maravettikkuru (*Hydnocarpus pendandra* (Buch.-Ham.) Oken,), Urunjikai (*Sapindus trifoliate* L.,), Kallurvanchi (*Rotula aquatica* Lour.), Analivenga (*Pittosporum neilgherrense* Wt. & Am) and Kattupavakka (*Momordica dioica* Roxb. Ex Willd) are collected from the forests. The other important medicinal plant resources are *Coscinium fenestratum, Dicliptera cuneata, Gymnostachyum febrifugum, Justicia procumbens* L., *Peristrophe paniculata, Rungia parviflora, Dioscorea pentaphylla, Dioscorea oppositifolia, Elettaria cardamomum, Amomum microstephanum, Curcuma neilgherrensis, Artocarpus hirsutus, Phyllanthus niruri, Agrostistachys meeboldii, Cinnamomum sulphuratum* and *Piper hymenophyllum* . This project aims at monitoring the effects of harvesting, and experimenting with different levels and methods of harvesting.

Objectives

1. To prepare an inventory of the NTFPs extracted from Muthikulam HVBA.
2. To analyze the present status and identify the main distribution areas of NTFPs.

3. To prioritize NTFPs on the basis of trade value and threat.
4. To provide training for sustainable extraction, methods for the NTFPs especially for honey and resins.
5. To recommend legal and economic regulations in order to enhance opportunities for sustainable resource management and commercial NTFP marketing in particular for small scale producers.

Study area : Muthikulam Forest Division

Methodology

1. Primary data collection by key informant survey, resource mapping and identification of NTFPs.

2. Inventory methods include three different steps; habitat identification, sampling and regeneration study.

3. Habitat identification and sampling studies - The sampling will be conducted in defined habitats. The identification of NTFPs habitats will be done systematically by observing at each of the following characteristics such as altitude, forest type, aspect, slope and plant abundance.

4. Value addition and marketing studies.

Outline of the research programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Key informant survey, resource mapping and identification of NTFPs										
Inventory methods										
Habitat identification and sampling studies										
Training to VSS										
Value addition and marketing studies.										

Proposed budget (Rs. in lakhs): 22

Period : 6 years

Proposal 5. Control and management of exotic weeds in Muthikulam forests

Background Information

The tropical forests in India are severely fragmented and impacted by human activities and weed invasion is now a serious management issue. The control of invasion of obnoxious weeds is a key element of ecologically sustainable land management. The main objective of weed management plan is to prevent new infestations and current invasive plant populations that threaten or have the potential to threaten target communities are controlled or eliminated. Always, the focus is protect the native plant communities, not simply eliminating weeds.

To understand the pattern of invasion the dispersal mechanism, ecological succession, intra-specific competition and impact on biodiversity need to be studied in detail. The common weeds like *Chromolaena*, *Michania, Parthenium* and *Lantana* infestation is found in Mannarkkad and Agali Ranges, mainly found in roadsides.

Objectives

1. To identify the invasive weeds and study their impact on biodiversity
2. To coordinate and standardize weed control efforts to effectively minimize the negative impacts of noxious weeds on watershed functions, wildlife habitat, human and animal health.
3. To develop and implement weeds management programmes and operational plans in accordance for ten years.

Study area

Muthikulam Forest Division

Methodology

1. Survey, mapping and identification of the problem areas
2. Monitoring and filed surveys, permanent plots to study the impacts.
3. Developing eradication strategies.

Outline of the research programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Survey and field visits										
Ecological studies										
Developing eradication techniques and implementation										

Proposed budget (Rs. in lakhs): 5

Period : 10 years

Proposal 6. Assessing human – Wildlife conflicts in Muthikulam forests and developing solution for their mitigation

Background Information

Human-Wildlife Conflict is fast becoming a critical threat to the survival of many globally endangered species. The main driving forces to human – wildlife conflicts include expansion of settlements in and around the protected areas, land use transformation for food and energy, loss, degradation and fragmentation of species habitats, fast development of eco- tourism and increasing access to nature reserves, increasing wildlife population as a result of conservation programmes, climatic factors and stochastic events. In Muthikulam forests, Human – Wildlife conflicts is comparatively few when compared to other Forest Divisions in Kerala. However recently elephant attack are reported in Agali Ranges. Since the conflicts increases in each year, local residents can develop negative attitudes towards reserves and wildlife, exacerbating the conflict and undermining conservation efforts. The wildlife damage management, income generation, conservation education, scientific land-use planning, and management of cultivation programs will be launched jointly during this project.

Objectives

1. To identify the cause of Human –Wildlife conflicts and to develop the prevention and mitigative strategies.

Study area

Muthikulam Forest Division

Methodology

1. Primary data collection by key informant survey, interaction with the residents.
2. Study the cropping patterns and monitoring wildlife prone areas.
3. Conducting workshops to create awareness.

Outline of the research programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Survey and field visits										
Workshops										
Developing prevention, mitigative strategies and its implementation										

Proposed budget (Rs. in lakhs): 51

Period : 10 years

Proposal 7. Establishing weather station and determine fire-weather index in Muthikulam HVBA.

Background Information

Fire is a widespread phenomenon in forests of India. The causes of forest fire may be many but a high proportion of these fires are attributed to man-made reasons, either deliberately or accidentally. Forest fire can broadly be classified into three categories; a) Natural or controlled forest fire b) Forest fires caused by heat generated in the litter and other biomes in summer through carelessness of people (human neglect) and c) Forest fires purposely caused by local inhabitants. The Fire Weather Index (FWI) is a numerical rating used to estimate risk of fire. It takes into account the effects of fuel moisture and surface weather parameters on fire behavior. The essential informations needed to calculate this index are:

1. the humidity of the air at the beginning of the afternoon
2. the temperature in the middle of the afternoon
3. the precipitations during 24h
4. the maximum speed of the average wind.

Annual fires are common in evergreen, semi-evergreen, deciduous forests and plantations in Muthikulam forests. Fire prone areas like Nellipathy, Chittur side VF, Paruthy Malavaram and 1979 Eucalyptus plantation should be frequently monitored. They are caused by hill men for hunting game or collecting NTFPs, by graziers for promoting a flush of young grass or by negligence of wayfarers. These fires affect not only the plantations but the nearby natural forests also which cause large tracts of forests, included in this working circle, to degrade. Adjoining these degraded areas there are pockets of blank areas also.

Objectives

1. To protect the habitats by minimizing and preventing the occurrence of forest fire.
2. To determine fire weather index
3. Promote community awareness and fire management through VSS.

Study & Implementing area

Muthikulam Forest Division

Methodology

1. Installation of automated weather station.
2. Construction and maintenance of firelines
3. Determination of fire weather index with the help of automated weather stations.

Outline of the research

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Installation of weather stations										
Construction and maintenance of firelines										
Determination of fire weather index with the help of automated weather stations										
Training to VSS										
Awareness camps										

Proposed budget (Rs. in lakhs): 40

Period : 10 years

Proposal 8. Identifying and monitoring avifauna in Muthikulam HVBA

Background Information

The preliminary surveys on the diversity of avifauna in Siruvani and Muthikulam Hills reported a total 158 species of which 14 species are endemic to the Western Ghats while nine belong to the Red Data book. Of the total 158 species, 48 species were recorded from Muthikulam hills only. All the 22 Western Ghat endemics found in Silent Valley National Park with the exception of Nilgiri Pipit were recorded in Siruvani- Muthikulam forests. The important birds found in the area are *Phylloscopus tytleri, Ficedula nigrorufa, Garrulax cachinnans, Buceros bicornis, Columba elphinstonii* and *Hieraaetus fasciatus.* With regard to diversity of birds in different locations, Kuravampady has the highest diversity, understandably due to the mix of plantations and natural forests leading to several ecotones. This was followed by Pattiyar again due to the proximity of reservoir and the diverse habitat types found there. Muthikulam and Karimala recorded the least diversity among the base camps. The discovery of Nilgiri Laughingthrush in these hills is a land mark achievement in establishing the importance of these habitats. The threatened birds in the area are *Spizaetus cirrhatus, Pycnonotus priocephalus, Myiophonus horsfieldii, Garrulax cachinnans* and *Phylloscopus tytleri*. Considering the diversity and endemism of bird communities, Muthikulam – Siruvani Reserve forest areas were recently added to the Important Bird Area (IBA) category as per the Bird Life International guidelines. Since the avifauna are important flagships of forests and their ecological importance as seed dispersers, to make a reasonable conservation plan in Muthikulam HVBA, the understanding the basic biology and distribution of bird species are prerequisites and regular monitoring is also needed.

Objectives

1. To study the distribution of avifauna using field surveys and secondary information
2. To identify important conservation areas and develop monitoring protocols.

Study & Implementing area

Muthikulam Forest Division

Methodology

1. Survey and examine broad habitat affiliations using transects in different habitats
2. Identification of specific areas
3. Estimation of population density and developing ecological niche models using the MAXENT program
4. Monitoring habitats using participatory approach
5. Creating awareness about the conservation through nature education camps/ brochures/booklets

Outline of the research

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Survey, transect study										
Population estimation and mapping										
Monitoring net work										
Awareness programmes										

Proposed budget (Rs. in lakhs): 16.5

Period : 10 years

Proposal 9. Population assessment, conservation and restoration of selected rare, endangered and threatened plants in Muthikulam HVBA

Background Information

The Muthikulam forests adobes the habitats of many rare endangered flora and fauna. The population of *Vateria macrocarpa, Dipterocarpus bourdilonii, Dysoxylum malabaricus, Gluta travancorica* are restricted to small isolated pockets. The selective logging process in the past, caused reduction in population size of many tree species in this area. The alteration of habitats, hunting and poaching the wildlife cause damage to the ecosystem by removing species key to the system's functioning. *Vateria macrocarpa* is a large tree of 25-30 m height, an important source of timber, found in Koodam, Poolappara, Muthukanichola, Aduthukkippara and Keralamedu with few individuals. *Dysoxylum malabaricum* (Meliaceae) is a large tree with clear bole growing up to 35 m in evergreen and semi-evergreen forests, between 200 and 1200 m elevation. The tree is endemic to the southern Western Ghats - South and Central Sahyadris and in Kerala it is locally known as "*Purippa or Vellakil*". The wood is durable and used in construction work, for decorating paneling and as air craft plywood. *Dipterocarpus bourdilonii* Brandis (Depterocarpaceae), an endemic tree to the Western Ghats growing to a height of 50 m is also exploited as softwood. This species is restricted to a few pockets in Muthikulam HVBA especially at Urulanthanii areas with less than 200 individuals. Understanding the causes of rarity, distribution, standardizing the nursery practices and ample planting stocks of these two species are urgent to restore these two species to its natural conditions.

Objectives

1. To assess the population status and distribution of selected rare, endangered and threatened plants
2. To standardize the propagation techniques and nursery practices and explore the possibility of reintroduction.
3. To evaluate the post – translocation survival and growth

Study & Implementing area

Muthikulam Forest Division

Methodology

1. Status survey and mapping the existing population and identification of areas.
2. Population assessment using transect studies
3. Establishment of nursery using seed and other standard propagation techniques.
4. The clonal propagation using different aged stem cuttings from adult and juvenile stands and air layering with the help of hormones will be carried out.
5. Collection, processing, categorizing, viability, storage, germination of seeds will be carried out.

Outline of the research

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Survey, data collection										
Population assessment										
Nursery establishment										
Standardizing propagation techniques										
Out planting and assessing post translocation growth										

Proposed budget (Rs. in lakhs): 14

Period : 10 years

Proposal No.16. Population Survey and Conservation of Small mammals in Muthikulam HVBA with special reference to Nilgiri tahr, Lion tailed macaque, Bonnet macaque and Nilgiri langur.

Background Information

Matching the floral wealth, the faunal wealth in Muthikulam HVBA also is endowed with fantastic diversity. The diversity in wildlife is tremendous- be it in case of mammals, birds, reptiles or amphibians. The common and rare mammals seen in this area include Nilgiri Tahr, Lion-tailed macaque, Bonnet macaque, Nilgiri langur, Elephant, Gaur, Sambar deer, Spotted deer, Barking deer, Mouse deer, Wild pig, Malabar giant squirrel, Nilgiri marten, Ruddy mongoose, Indian civet, Sloth bear, Tiger, Leopard, Jungle cat and Wild dog. The Nilgiri Tahr (*Nilgiritragus hylocrius*) an ungulate, endangered (Schedule 1 – Wildlife Protection Act (WPA) species) mountain goat endemic to the Nilgiri Hills and the southern portion of the Western Ghats is reported from higher reaches of Elivalmala. A large population of sloth bears (*Melursus ursinus*), an endemic and vulnerable (IUCN) species of the Indian subcontinent is also reported from Muthikulam HVBA. This species, listed in Appendix I of CITES and Schedule I of the WPA, 1972, is found in a variety of habitats ranging from wet evergreen forest to deciduous and degraded scrub forests. The Nilgiri langur, (*Trachypithecus johnii*) an endemic to the Western Ghats, are more abundant in the evergreen forests of Muthikulam hills. The population in the Muthikulam HVBA is reported to be severely fragmented and isolated due to conversion of medium elevation evergreen forests into reservoirs and forestry and commercial plantations. Even though fragmented information is available about the distribution of small mammals in Muthikulam, the information regarding their current population structure is entirely lacking.

Objectives

1. To assess the status and distribution of small mammals so as to establish baseline information about this population.
2. To develop and introduce a long term population monitoring programme involving the VSS in order to track changes in this population.

Study & Implementing area

Muthikulam Forest Division.

Methodology

1. Survey and adopting a systematic sampling protocol to survey different mammals population.
2. Collecting data on number of groups, their group size and structure
3. Identification of specific areas
4. Organizing a training workshop for the field staff in order to disseminate the survey results and sensitise them about small mammals conservation
5. Developing manuals in Malayalam (vernacular language) on field protocol of monitoring
6. Implementing regular surveys of lion-tailed macaque, Thar, Bonnet macaque, Nilgiri langur based on the present survey protocol

Outline of the research

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Survey, data collection										
Population estimation										
Organizing training workshops										
Developing manuals										
Monitoring net work										
Awareness programmes										

Proposed budget (Rs. in lakhs): 30

Period : 9 years

ACTION PROJECTS

Proposal 1. Developing infrastructure and staff welfare in Muthikulam HVBA.

Background Information

There are several issues in connection with protection of forests. There is a lack of enough trained staff, transportation facilities and fire arms. Although the area to be protected is only 110.44 km^2 in extent and is bound on three sides by mountains, the biodiversity value of area necessitates a more serious look into protection aspects. The existing buildings are very old and there are no sufficient vehicles. Staffs are fatigued, disoriented and impulsive. 3 jeeps are required to carry out conservation and protection activities. The existing buildings and other facilities of the Division, Ranges, stations, beats also need to be improved. There is a lack of enough staff, transportation facilities and fire arms. The area to be protected is very large and one person cannot cover all the areas allotted to him in the stipulated time. New trek paths are needed. Among the measures to overcome these constraints are participative strategies, scientific inputs, technical devises and trained human resource.

Objectives

1. To Develop infrastructure facilities and staff welfare in Muthikulam HVBA

Study area

Muthikulam forest Division

Methodology

1. Creating new offices, field camps, staff quarters, watch towers, road networks, inspection paths, lab and library facilities, wireless networks, vehicle facilities, improving living amenities.

Outline of the programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
New offices building										
Field camps										
Staff quarters										
Staff quarters at nearest education centre										
Watch towers										
Road network										
Inspection paths										
Lab and library facilities										
Communication network (Mobile and Wireless)										
Purchase of a Jeeps										
Maintenance works for Jeep and POL										
Field gear for staff										
Improving living amenities for staff										
Day offs to visit family										
Reimbursing travel costs to visit family										
Improving living amenities for staff										

Proposed budget (Rs. in lakhs): 203

Period : 10 years

Proposal 2. Establishing Anti-poaching networks in Muthikulam HVBA.

Background Information

Poaching is the illegal taking of wild plants or animals, an unlawful practice. Wildlife is on the brink of extinction due to poaching and the pressure on various countries around the world to increase penalties for convicted poachers and to prevent illegal trade has had limited effects. Recently Government of India has opened a national wildlife crime control bureau to curb poaching of tigers and other endangered species. In conserving the wildlife and wild lands of Muthikulam forests, anti poaching network need to be established which work closely with local communities to tap their knowledge of the local ecosystem and to engage them in conservation efforts. The community, civil society and government and non government organizations involve in joint actions to address illegal activities pertaining to endangered and protected flora and fauna in Muthikulam High Value Biodiversity Area. The project is also raise awareness among local communities (community forest users, livestock herders, college students, school children, farmers) for conservation of fauna and flora and the local poachers will change their habit if they get conservation awareness. The project will designed as a collaborative project between forest officials and other conservation based district level and local level stakeholders and community. The participatory patrolling and monitoring method will be very simple and cost effective so the users may themselves take interest in long term involvement. Hence to establish all these activities the Basic facilities to be provided at the beat level viz., furnished accommodation with water and energy source and good communication facilities (wireless sets/ mobile phones) for emergency. Each beat will have suitable basic camping facility and other protection measures and each beat to have beat assistants to support the beat staff from local community and to be trained. The beat staff will develop an informant network so that they receive information on all that happens within their jurisdiction. They must know who and what enters their beat and who and what leaves their beat on a daily basis. In addition to this, the Range and Division will develop an intelligence network to monitor the functioning of the beat. The field staff to be provided with good communication- wireless, mobile phones, internet facilities. 5 jeeps and 2 boats are also needed for the Division. All field staff to be provided field rations including cooking facilities. Secret funds may be provided at Division level and a Crime Cell to monitor offences, offenders and devise suitable

strategy to be set up at Division, Circle and State level. At Circle and State this cell will function under the leadership of an ACF.

Objective

1. ERstablishment of community based Anti-poaching Network to reduce poaching and trade in Muthikulam High Value Biodiversity Area

Implementing area

Muthikulam Forest Division

Methodology

1. Engaging local communities
2. Developing an improved anti-poaching network by building new camps, repairing and maintaining existing camps.
3. Improving the wireless communication network in critical areas through building repeater stations that enable enhanced coverage.
4. Facilitating improved informer network and also aid in sting operations by the Forest Department to improve crime detection and prevention.
5. Institutionalize mechanisms for developing and managing informer network so that the current ad hoc approach is eliminated and information gathering is optimized.
6. Provide basic awareness to local communities through natural camps.

Outline of the programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Strengthening beat infrastructure- Anti poaching sheds										
Posting community beat assistants										
Posting informant networks										
Posting intelligent networks										
Purchase of Arms &										

ammunitions	
Facilities for Communications	
Field rations and secret funds	
Establishing crime cells	
Awareness camps	

Proposed budget (Rs. in lakhs): 177.9

Period : 10 years

Proposal 3. Developing facilities for Wildlife and veterinary care in Muthikulam HVBA.

Background Information

The recent outbreaks of fatal diseases such as swine and avian flu, Ebola hemorrhagic fever prove that wildlife has extensive and growing contact with livestock and human populations. An outbreak of these fatal diseases among the populations of wild animals has led to loss of considerable wild fauna in the past in many parts of the country. The studies indicate that about 60 percent of the 1,415 infectious diseases, infecting both humans and animals are originated in animals. In many instances, the poachers who rely on wildlife for meat are vulnerable to pathogens from the forest. Some important diseases like Foot and mouth disease, rabies, anthrax etc. are reported to spread from wild to domestic animals and vice versa. The zoonotic importance of these diseases has to be borne in mind while setting up control measures and other veterinary facilities among these areas. At present, the veterinary facilities in Muthikulam High Value Biodiverity area are very meager in respect of man-power and machinery. One rescue vehicle need to be purchased at the earliest to carry out rescue operations, since the wildlife conflict is increasing.

Objectives

1. To develop facilities for Wildlife and veterinary care in Muthikulam HVBA.

Implementing area

Muthikulam Forest Division

Methodology

The following methodology can be adopted for wildlife health monitoring in Muthikulam High Value Biodiversity area.

1. Monitoring the condition of animals in the field
2. Maintenance of sanitation and hygiene at water levels
3. The immunization programmes will be conducted to the domestic animals such as dogs, cats, ferrets and livestock will be vaccinated against rabies
4. Regular monitoring of bone marrow

5. Health cards for all livestock from the concerned authorities.
6. Awareness campaign among local people will be organized with the help of EDCs/VSS committees about the communicable wildlife diseases and prevention measures.
7. Maintenance of record of disease outbreak which records on all incidences of diseases will be maintained for future reference.
8. The existing Veterinary hospital should be upgraded to different rescue operations, treatment and release operations, health monitoring of wildlife, wildlife health research, laboratory, vaccination of domestic cattle etc. with the help of a veterinary surgeon.
9. Mortality register should be maintained at range level on daily basis for each and every type of mortality.
10. Monthly compiled record at range level should be sent to Divisional Forest office.
11. Separate record should be maintained for mortality other than that attributable to an offence and mortality attributed to poaching or an act of vandalism.
12. Survey record can be maintained in prescribed Form given in Sawarkar guide for "Planning Wildlife Management in Protected Areas and Managed Landscapes".
13. All records should be analyzed at RO office monthly and report should be submitted to DFO.
14. Mortality data should be collected by the field staff at block. All mortality information should be reported instantly to range office and if needed, specimen should be collected and sent for pathological investigation

Outline of the programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Vaccination										
Rescue camps										
Purchase of rescue vehicle										
Monitoring wildlife health										
Medicines etc.										
Maintaining clinics										
Engaging mazdoors										
Awareness campaign										

Proposed budget (Rs. in lakhs): 69

Period : 10 years

Proposal 4. Developing infrastructure facilities and conducting conservation oriented education and awareness about the Muthikulam HVBA

Background Information

Conservation oriented education and awareness about the Muthikulam HVBA are important in the development of the area as envisioned. Local communities, students and others will be targeted to instill the principles of conservation and sustainable development. The local community need develop a sense of ownership. A visitor centre and interpretation centre need to be established for conducting regular camps.

Suggested Interpretation Themes and use of media:

i. Role and significance of Muthikulam HVBA and relationship with long - term conservation of biodiversity.
ii. Importance of landscape level management in Muthikulam HVBA
iii. Media- Explained photo panel exhibit in Visitor centre and interpretation centre. Video films of various themes related to biodiversity conservation at visitor centre
iv. Conservation History of Muthikulam HVBA
v. Varied ecosystem found in Muthikulam HVBA

Objective

1. To develop Infrastructure facilities and to conduct conservation oriented education and awareness in Muthikulam HVBA.

Study area

Muthikulam Forest Division

Methodology

1. Frequent awareness camps will be conducted using resource persons on various themes.

Outline of the programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Publications										
Visitor centres										
Maintenance works-Visitor centres										
Interpretation centres										
Nature camps										
Equipment for research and education										
Workshops and Seminars										
Consultancies for experts										

Proposed budget (Rs. in lakhs): 82.9

Period : 10 years

Proposal 5. Staff development and capacity building programme in Muthikulam HVBA.

Background Information

Staff development and capacity building will be ensured through trainings, field visits in India and abroad and through conduct of scientific research and preparation and presentation of scientific papers. Staffs are encouraged to visit other countries to learn about better practices and approaches to biodiversity conservation. Special emphasis on leadership and strategic skills at the middle and top level and managerial skills at the bottom level is essential. Staff morale is to be improved beginning with provision of minimal facilities- furnished accommodation and ration to all field staff. The scheduling of duties suggested is such that staff would have a fifteen day stay at station followed by a five day break to visit family. Till accommodation is provided for family at nearest town, staff may be paid traveling allowance to visit home. A system of annual awards is suggested for the Best Beat/Section/Range/Division and for the Best Forest Guard/Forester/Range officer/DFO. The condition of Forest Department staff working in Muthikulam Forest Division is above average. Most have accommodation and access to transport through the state highway. The five ranges are equipped with jeeps, wireless sets, etc. and the headquarters is only 40 km away. Training is needed for officials, frontline staff as well as VSS members. On the job training, short-term training, specialized trainings etc., can be planned depending on the need. The short term on-job training such as computer application especially office packages, statistical data analyses, collection of biological material and interpretation, weapon training, tourism and interpretation can be planned using senior police officers, NGOs, lawyers, senior veterinary surgeons, faculty from KAU, WTI, WII, KFRI and WTI etc. as resource persons. The various subjects of training can be protection (use of arms, unarmed combat, legal issues, etc.), census, monitoring, ecodevelopment, ecotourism, habitat management, wildlife health, GIS, etc. Amenities may include provision of ration to interior camps, taking care of the residential, educational and medical needs of staff and their families. Incentives/ awards should also be a part of the HRM plan. Provision for gears such as shoes, rucksack, sleeping bags, rain coats and medicine kit should also be planned. Such amenities are not sufficient at present and the same trend needs to be maintained.

Front line staff has been given training in use of GPS, camera traps and collection of rainfall data. These trainings should be continued so as to train all the staff.

Objectives

1. To develop Capacity building of the staff in Muthikulam HVBA.

Study area

Muthikulam forest Division

Methodology

1. The subjects of training will be protection (use of arms, unarmed combat, legal issues etc.,), census, monitoring, eco-development, ecotourism, pilgrimage management, habitat management, wildlife health, GIS, etc.
2. The training in GPS, biodiversity valuation and biological materials collection will be conducted for foresters and forest guards at KFRI.
3. For legal issues training and workshops will be conducted with Public Prosecutors as resource persons.
4. Training needs of the staff as well as the stakeholders, VSSs etc., will assessed through training needs assessment workshop.
5. The following themes are suggested in the curriculum:

    - Training on legal issues.
    - Training on survey and demarcations.
    - Training on use of equipments like weapons, GPS.
    - Training on Biodiversity valuation.
    - Training on biological materials collection.
    - Eco-development training
    - Training in Ecotourism
    - Personality development.

Outline of the programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Basic training in systems and protocols and professional working										
Special training in use of GIS, use of camera traps, antipoaching, legal, forensics										
Leadership and managerial skills										
Fair placement norms										
Grievance redressal mechanism										
Awards										
Foreign tours										
In country tours										

Proposed budget (Rs. in lakhs): 36.5

Period : 10 years

Proposal 6. Developing independent evaluation and status survey in Muthikulam HVBA.

Background Information

A system of annual audit and certification of institutions and individuals need to be introduced in Muthikulam High Value Biodiversity area. This will ensure transfer of change to field and management and monitoring of this change. Audit and certification will be done for the beat, the station, the range, the Division, the circle and the State.

Objectives

1. To conduct annual audit of the Division, Range, Station and beat in Muthikulam HVBA.

Implementing area

Muthikulam forest Division

Methodology

1. Annual audit of Division, Range, Station and beat will be conducted.
2. Annual audit of individual performance.
3. Annual audit of systems and protocols.

Outline of the programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Annual audit of Division, Range, Station and beat will be conducted.										
Annual audit of individual performance.										
Annual audit of systems and protocols										

Proposed budget (Rs. in lakhs): 29.5

Period : 10 years

Proposal 7. Restoring water holes and Soil and moisture conservation programmes in Muthikulam HVBA.

Background Information

One of the important watershed in Muthikulam HVBA is Shiruvani, which stretches both in Agali and Attappady ranges and fall under the villages of Kottathara, Sholayur, part of Palakkayam, part of Kallamala and part of Agali. Out of the total area of 23609. 91 ha, 6385.95 ha are reserved forests, 5873.21 ha are vested forests and 11350.75 ha are revenue lands.

Degradation of forest cover results in accelerated soil erosion, which has to be controlled for ecosystem benefits. Soil/moisture conservation treatments like gully plugging, contour bunds, staggered trenches; tending natural regeneration - tending of existing seedlings, sowing of seeds of native species. Sowing and planting (not more than 100 seedlings per ha. if necessary. The location requiring planting of seedlings should be specifically shown on the treatment map and identified separately in the field. Planting operations if any, will be carried out in the second year of operations only. It s followed by tending and maintenance of sown /planted seedlings.

Soil and Moisture Conservation Methods

Gully Plugging and Construction of Check Dams: Plugging gullies is highly imperative to ensure soil and water conservation Gullies can be plugged and controlled by construction of check dams depending on depth and length. Checks dams can be constructed along streams and nallahs to conserve water during lean period. These may be of simple structure of stones, random rubble or brush wood. Frequent observation of soil deposit in the gullies should be recorded.

Contour Bunding: In order to prevent surface run off construction of bunds along contours is necessary. These can be staged or intermittent. On sleeper slopes the bunds should be closer and in gentle slopes, wider.

Planting along River Banks:

During peak flow, rivers and streams run to full capacity which will lead to erosion of banks. Rate of erosion is less where river banks have hard soil. Planting species like bamboos, reeds etc. are necessary to prevent stream banks erosion and shallowing rivers. Restoring water holes and Soil and moisture conservation programmes are essential to maintain a long- term sustainable productivity and to prevent loss of life and property owing to natural calamities like landslides, fire, floods and drought.

Objectives

To improve the habitat through the vista clearance soil and moisture conservation programmes in Muthikulam HVBA.

Implementing area

Muthikulam forest Division

Methodology

1. Identify and prioritize areas that have accelerated soil erosion.
2. Gully plugging with vegetative barriers
3. Soil moisture conservation trenches, contour bunding
4. Sunken ponds
5. Planting along river banks, tending natural regeneration, augment planting

Outline of the programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Identify and prioritize areas										
Gully plugging with vegetative barriers										
Soil moisture conservation trenches										
Preparation of sunken ponds										
Tending natural regeneration, augment planting										

Proposed budget (Rs. in lakhs): 27

Period : 10 years

Proposal 8. Improving Eco-tourism facilities in Muthikulam HVBA.

Background Information

The Forest Department is conducting Ecotourism at Muthikulam called "Siruvani Ecotourism" through a VSS comprising the tribals from the settlement. There are two vehicles for transporting tourists to the destination along Keralamedu for trekking. The present form of tourism in Muthikulam HVBA may be continued with slight modifications (Environmental interpretation) so that the visitors become more aware about nature and conservation. Developing minimum basic infrastructure facilities in these areas for tourists, maintaining environmental hygiene for full enjoyment of tourists which would include drinking water, garbage disposal, toilets, maintenance of existing treck paths, engaging trained tribal men for safety of the tourists, creating awareness among public through classes, distribution of pamphlets etc. and arranging adventurous trekking on the prescribed routes with the help of trained VSS guides are needed.

To manage the tourism effectively the following things need to be implemented.

- Monitoring and strict regulation of dumping of wastes
- Monitoring non-degradable objects like carry bags, bottles, tea cups, and snack cases made of plastics.
- Visitor/tourist zones need to be earmarked and dangerous/ restricted areas set out of bounds.
- Providing clean drinking water and toilet facilities
- Installing sufficient attractive signboards at the entry point by the authorities, stating the do's and don'ts of a natural recreation site, a layout of the recreation spots with pictures (the trek paths, among others), and details of how they may benefit by visiting these places

Objectives

2. To implement various eco-development activities in Tourism zones in Muthikulam HVBA.

Implementing area

Muthikulam Forest Division

Methodology

- The various activities and guidelines mentioned will be implemented as per the outline.

Outline of the programme

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Display boards; Sign boards;										
Beautification of existing spots										
Upgrading of Bath rooms/ Toilets										
Upgrading of drinking water facilities										

Proposed budget (Rs. in lakhs): 21

Period : 10 years

Proposal 9. Providing safeguards measures in Muthikulam HVBA.

Background

Muthikulam High Value Biodiversity Area is accessible by all weather road which runs from Palakkayam to Coimbatore traversing the Reserve covering a distance of 16.46 kms. This road is closed and there is no accessibility to the public except up to Singappara. Regulation on traffic has to be enforced by

1. Installing check posts and regulating traffic
2. Installing road signs and boards to alert drivers regarding animal movement, non-littering of the hazards

Objectives

1. To improve the safeguard measures in Muthikulam HVBA.

Implementing area

Muthikulam Forest Division

Methodology

To provide safeguard measures the following things need to be implemented.

1. Sufficient attractive signboards will be put up at the entry point, stating the do's and don'ts of a natural recreation site, a layout of the recreation spots with pictures (the trek paths, among others), and details of how they may benefit by visiting these places
2. Monitoring the speed limit, noise level of the vehicles in the places where there is movement of wildlife.
3. Display the signal boards and speed limits sign boards. Traffic signs can be often used to indicate areas of increased animal activity.
4. Awareness classes, notices, posters, to the tourist people about wildlife corridors and biodiversity to prevent wildlife road kill.
5. Regulation of traffic flow in tourist spots.
6. Adoption of erosion control measures
7. Protection of drainage system
8. Safeguards to prevent road hits to wild animals and to prevent fires

Outline of the programmes

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Installing Sufficient attractive display, information on flora/fauna, signboards, signal boards, speed limit boards etc.										
Monitoring the speed limit, night traveling,										
Awareness classes										

Proposed budget (Rs. in lakhs): 10

Period : 10 years

Proposal 10. Eco-development programmes in Muthikulam HVBA.

Background

The area selected for High Value Biodiversity conservation has only one settlement of the tribe belonging to Muduga community. There are 109 residents in the settlement, males accounting for 46% and the rest females. Regarding occupational status, there is only one Government employee in the settlement. Majority indulges in collection and marketing of NTFP, 61 people go for outside labour. All of them live in separate houses. Most of them do not have a tendency to save and on the whole are not indebted. Out of the 34 families only four rear cattle. Most of the houses are tiled and none of them have a concrete roof. In general all houses are in a shabby condition. No house has toilet facilities. All houses in the colony are electrified and the people use firewood for cooking. Water sources are available near the settlement, while school and market are far away. The colony is about 500 m away from the main road. Eleven households possess radio, six TV and two families possess tape recorders. Each family has been allotted an area of 3.9 acres for cultivation. Most of them participate actively in VSS and are affiliated to Self Help Groups (SHG). The living condition of this colony needs to be improved by implementing various eco-development programmes.

Objectives

1. To implement various Eco-develompment programmes Muthikulam HVBA to improve the living conditions of tribals in each colonies.

Implementing area

Muthikulam HVBA

Methodology

The following Eco-development programmes will be implemented

- Ensuring proper drinking water supply to the indigenous tribal colonies.
- Electric fencing and improvement of solar light facilities
- Provision of medical camp with supply of medicines.
- Strengthening 'Aganvadies' in each settlement.

- Participatory village level planning and preparation of village level micro plans for eco - development.
- Providing inputs for resource substitution, income generation, community welfare, ecotourism for reducing the resource dependency of local people on surrounding forests

Outline of the programmes

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Drinking water supply and maintenance										
Electric fencing and improvement of solar light facilities and its maintenance										
Strengthening 'Aganvadies'										
Medical camp										

Proposed budget (Rs. in lakhs): 19

Period : 10 years

Proposal 11. Habitat improvement programmes in Muthikulam HVBA.

Background Information

The habitat improvement programmes includes enrichment planting, removal of exotic weeds, soil and moisture conservation works, fire protection and vista clearance. Except the last two programmes separate proposals are already given along with research components

Soil and Moisture conservation

The forest ecosystems of Muthikulam HVBA are located mostly on steep areas. Land slide is common during monsoon season. Degradation of forest cover results in accelerated soil erosion, which has to be controlled for ecosystem benefits. This includes the following actions.

- Identify and prioritize areas that have accelerated soil erosion.
- Gully plugging with vegetative barriers
- Soil moisture conservation trenches
- Sunken ponds

Soil/moisture conservation treatments like gully plugging, contour bunds, staggered trenches; tending natural regeneration - tending of existing seedlings, sowing of seeds of native species. Sowing and planting (not more than 100 seedlings per ha. if necessary. The location requiring planting of seedlings should be specifically shown on the treatment map and identified separately in the field. Planting operations if any, will be carried out in the second year of operations only. It s followed by tending and maintenance of sown /planted seedlings.

Soil and Moisture Conservation Methods

Gully Plugging and Construction of Check Dams: Plugging gullies is highly imperative to ensure soil and water conservation Gullies can be plugged and controlled by construction of check dams depending on depth and length. Checks dams can be constructed along streams and nallahs to conserve water during lean period. These may be of simple structure of stones, random rubble or brush wood. Frequent observation of soil deposit in the gullies should be recorded.

Contour Bunding: In order to prevent surface run off construction of bunds along contours is necessary. These can be staged or intermittent. On sleeper slopes the bunds should be closer and in gentle slopes, wider.

Planting along River Banks:

During peak flow, rivers and streams run to full capacity which will lead to erosion of banks. Rate of erosion is less where river banks have hard soil. Planting species like bamboos, reeds etc. are necessary to prevent stream banks erosion and shallowing rivers.

Objective

To improve the habitat through the vista clearance, soil and moisture conservation programmes in Muthikulam HVBA

Implementing area

Muthikulam HVBA

Methodology

1. Soil/moisture conservation treatments like gully plugging, contour bunds, staggered trenches; tending natural regeneration - tending of existing seedlings, sowing of seeds of native species.

Outline of the programmes

Item	Years									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Identify and prioritize areas	■	■	■			■	■	■		
Gully plugging with vegetative barriers			■	■	■			■	■	■
Soil moisture conservation trenches		■	■	■	■	■	■	■	■	■
Preparation of sunken ponds		■		■		■		■		■
Vista clearance	■	■	■	■	■	■	■	■	■	■

Proposed budget (Rs. in lakhs): 7

Period : 5 years

BIODIVERSITY CONSERVATION PLAN FOR MUTHIKKULAM HIGH VALUE BIODIVERSITY AREA (2010-2011 to 2019-2020)

Summary of

PROPOSALS FOR RESEARCH AND ACTION

Sl. No	Proposal Name	Budget in lakhs	Budget Breakup (Amount in lakhs)		
			Section	Subsection	Amount
1	Identification, assessment of flora/fauna and their conservation in Muthikkulam High Value Biodiversity Area	23	I	1a	8
				1e	10
				1f	2
				1j	3
2	Mapping and restoration of Wildlife corridors in Muthikkulam High Value Biodiversity Area	18	I	2a	10
				1i	2
				1j	6
3	Cost effective restoration of degraded areas using indigenous (local) tree species	26	I	2a	13
				1d	5
				1j	5
			III	1a	3
4	Establishing models for scientific harvesting and value addition of Non Timber Forest Products in Muthikkulam forests	22	IV	2a	10
				2e	7
			I	1k	5
5	Control and management of exotic weeds in Muthikkulam forests	5	III	1b	5
6	Assessing human – Wildlife conflicts in Muthikkulam forests and developing solution for their mitigation	51	IV	1a	32
				1b	10
				1c	9
7	Proposal Establishing weather station and determine fire-weather index in Muthikkulam HVBA.	40	I	2d	11
			III	1d	29
8	Identifying and monitoring avifauna in Muthikkulam HVBA	16.5	I	2b	6
				2c	5
				1j	3
				1f	2.5
9	Population assessment, conservation and restoration of selected rare, endangered and threatened plants in Muthikkulam HVBA	14	I	1b	7
			I	1j	7

10	Population Survey and conservation of small mammals in Muthikkulam HVBA with special reference to Nilgiri tahr, Lion tailed macaque, Bonnet macaque and Nilgiri langur	13	I	1c	3
				1h	3
				1g	2
				1k	5
Action Programmes					
1.	Developing infrastructure and staff welfare in Muthikkulam HVBA.	203	II	2a	12
				2b	7
				2c	17
				2d	9
				2e	10
				2f	10
			II	2g	11
				2h	35
				2i	4
				2j	43
				2k	10
				4a	20
				4b	10
				4c	5
2	Establishing Anti-poaching networks in Muthikkulam HVBA.	177.9	II	1a	8
				1b	80
				1c	5
				1d	5
				1e	20
				1f	10
				1g	39.9
				1h	5
				1i	5
3	Developing facilities for Wildlife and veterinary care in Muthikkulam HVBA.	69	II	3a	5
				3b	0
				3c	12
				3d	1.5
				3e	18
				3f	10
				3g	2.5
				3h	10
				3i	10
4	Developing infrastructure facilities and conducting conservation oriented education and awareness about the Muthikkulam HVBA	82.9	I	2i	6
				2j	3
				2k	5
				2l	10
				2m	10

			I	2n	15.9
				2o	33
5	Staff development and capacity building programme in Muthikkulam HVBA.	36.5	I	2g	10
				2h	6
				3a	3
				3b	3
				3c	2
				3d	0.5
				3e	2
				3f	10
6	Developing independent evaluation and status survey in Muthikkulam HVBA.	29.5	I	2f	7
				4a	9
				4b	9
				4c	4.5
7	Restoring water holes and Soil and moisture conservation programmes in Muthikkulam HVBA.	27	III	1c	20
			I	2e	7
8	Improving Eco-tourism facilities in Muthikkulam HVBA.	21	IV	2g	21
9	Providing safeguards measures in Muthikkulam HVBA.	10	III	2a	10
10	Eco-development programmes and strengthening co-existence in Muthikkulam HVBA.	19	IV	2b	4
				2c	5
				2d	5
				2h	5
11	Habitat improvement programmes in Muthikkulam HVBA.	15	III	1f	15
	Grand Total (Rs in Lakhs)		**919.3**		

LIST OF APPENDICES

APPENDIX - I

GO. No. 121/89 Government of Kerala

ABSTRACT

1. Forest Department - Forest Divisions - Reorganisation of Nemmara Territorial, Palghat Special and Palghat Divisions through formation of Mannarghat, Palghat and Nemmara Divisions - Orders issued.

Forest & Wildlife (E) Department

G.O. (MS) 121/89/F&WLD Dated, Trivanduram, 28-12-1989

Read : Letters No. P4-15450/89 dated 25-7-1989 and 17-10-1989 of the Chief Conservator of Forests (Development)

ORDER

The Chief Conservator of Forests (Development) in his letters read above has proposed that the reserve forests and vested forests falling in Palghat (Territorial); Palghat Special and Nemmara divisions be amalgamated and reorganised as Divisions / Ranges with compact areas of administrative units so as to achieve the objective of bringing the forest divisions boundaries in accordance with the District / Taluk boundaries. It is also reported that the proposed reorganisation would result in the even distribution of the protection task and for better administrative convenience.

2. **The details of the existing division and ranges are as follows:**

Division	Range	Area (Sq. Km)	Reserve Forest (Sq. Km.)	Vested Forest (Sq. Km.)
Nemmara	Nelliampathy	210	210	-
Palakkad	Olavakkode	138	138	–
"	Mannarkkad	145	145	-
Palakkad Special	Agali	311	-	311
"	Thenkara	180	-	180
"	Palakkad	153	-	153
"	Nemmara	108	-	108

3. Government accept the proposal of Chief Conservator of Forests (Development) in total and order that the existing Palghat Territorial, Palghat Special and Nemmara Divisions be reorganised as detailed below with immediate effect.

i) Mannarkkad Division:

The jurisdiction of this division will be the whole area of Mannarkkad Taluk. This will have three ranges viz. Agali, Mannarkkad and Attappady with the extent of 11,877 ha, 13,555 ha, 22,830 ha respectively. The headquarters of Agali range will be

at Kalkkandy, that of Attapady range at Mukkali and Mannarkkad range at Mannarkkad. The headquarters of the division will be at Mannarkkad.

ii) Palakkad Division:

The areas falling in Palakkad and Ottapalam Taluks will form the newly proposed Palakkad Division. There will be three ranges, viz., Olavakkode, Ottapalam and Walayar with an extent of 8400 ha, 5000 ha and 12800 ha respectively. The headquarters of the new division will be at Palakkad, that of Ottapalam range at Ottapalam, Olavakkode range at Olavakkode and Walayar range at Kanjikode.

iii) Nemmara Division:

The whole area of Alathur and Chittur Taluks will be included in this division. The headquarters of the division will be at Nemmara. There will be 3 ranges in this division, viz., Alathur with an extent of 7800 ha, with headquarters. Vadakkancherry, Kollangode comprising an area of 7000 ha with headquarters at Kollangode,and Nelliampathy with an extent of 20862 ha with headquarters at Nemmara.

iv) It is further ordered that the two posts of Rangers additionally required consequent on the reorganisation would be positioned through redeployment of the staff in Mobile Squad, Agali and Special Duty Ranger, Special Division, Palakkad.

v) The statement showing the areas of reserve forests and vested forests falling within the new divisions are appended. The boundary description of the newly reorganised divisions of Mannarkkad, Palakkad and Nemmara divisions are appended.

vi) It is also ordered that the Mobile Squad, Agali and Special Duty Ranger, Special Division, Palakkad will stand abolished with immediate effect and the Ranger in position there will be accommodated within the new Ranges in the reorganised divisions.

By Order of the Governor,
M.S.K. RAMASWAMI,
Agrl. Production Commissioner & Secretary (Forests)

To

The Chief conservator of Forests (Development)
(in charge of Principal Chief Conservator of Forests)

The Chief conservator of Forests (Protection), Trivandrum / Social Forestry & Projects, Trivandrum / World Food Programme, Trivandrum / Wildlife, Trivandrum/Vigilance,Trivandrum.

The Director of Public Relations for publicity.

The Superintendent of Govt. Presses, Trivandrum for publication in gazette.

The Accountant General (A&E) / (Audit), Kerala, Trivandrum.

Office of the Chief Conservator of Forests, Trivandrum
Endt. No. P4-5450/89 Dt.15-1-1990.

Copy with enclosures communicated to the Conservator of Forests Northern Circle, Kozhikode/Custodian & conservator of Forests, Vested Forests, Kozhikode/ Divl. Forest Officer, Palakkad (Territorial) Divl. Forest Officer, Nemmara / Divl. Forest Officer, Palakkad Special for necessary further action.

1. This reorganisation order shall come into force with immediate effect.
2. The newly constituted Mannarkkad forest division shall be under the control of Custodian & Conservator of Forests, Vested Forests Circle, Kozhikode.
3. All the cases relating to the vested forests of all the forests divisions in Palakkad District will be looked after by the Custodian and Conservator of Forests, Vested Forests, Kozhikode as is being done in Nilambur (North) and Nilambur (South) divisions.

Copy communicated to all conservators of Forests / Divl. Forest Officers / Asst. conservators of Forests / Wildlife Wardens for information.

Copy to 'A' section for further necessary action for getting monitor powers to Divl. Forests Officer, Mannarkkad.

Copy to Administrative Officer for necessary action.

Copy to all Branch Officers.

STATEMENT SHOWING THE AREAS OF RESERVE FORESTS & VESTED FORESTS FALLING IN THE DIVISIONS

Division	Range	HQ	Taluk	Reserved forests	Vested forests
Mannarkkad	Agali	Kalkandy	Mannarkkad	20998	32910
"	Attappady	Mukkali	"		
"	Mannarkkad	Mannarkkad	"		
Palakkad	Ottappalam	Ottappalam	Palakkad & Ottappalam	6500	19700
"	Olavakkode	Olavakkode	"		
"	Valayar	Kanjikode	"		
Nemmara	Alathur	Vadakkenchery	Alathur & Chittoor	14800	20862
"	Kollengode	Kollengode	"		
"	Nelliampathy	Nemmara	"		
Total				**42298**	**73472**

Mannarkkad Division:

Headquarters: Mannarkkad (Office and Headquarters to be constructed)
Mannarkkad Taluk - Area under the jurisdiction
No. 66121/B2/68/RD. – Notification Dated 6.6.1969.

Boundaries:

North: Niligiri District (Puthur Village), Ootakkumandu Taluk

East: Coimbatore District - Avinasi Taluk and Coimbatore Taluk

South: Palakkad Taluk and Ottapalam Taluk.

West: Malappuram District - Perinthalmanna Taluk.

1. *Agali Range:* Headquarters - Kalkandy (Office and Quarters available)
Boundaries:

North: Starting from the point where the southern boundary of Kallamala village crosses the Mannarkkad - Anakkatty road at Mandanpotty, the northern boundary runs along the Mannarkkad - Anakkatty road till it reaches the inter-state boundary at Anakkatty.

East: From the above point where the Mannarkkad - Anakkatty road meet, the inter-state boundary at Anakkatty, the boundary runs towards south along the inter-state boundary of Kerala and Tamilnadu till the southern boundary of Sholayur village touches the inter-state boundary.

South: Starting from the above point, the southern boundary roads towards northwest direction along the southern and western boundaries of Sholayur village till it touches the southern boundary of Kallamala village to it reaches the Mannarkkad-Anakkatty road at Mandanpotty.

II. Attappady Range:
Headquarters – Mukkali (Office & Headquarters to be constructed)
Boundaries:

North: Starting from the tri-junction point of inter-state boundaries of Coimbatore, Nilgiri and Palakkad districts, the boundary runs towards west along the inter-state boundary of Kerala and Tamilnadu up to Anjinadamudi, where the northeastern corner of Silent Valley National Park and the western boundary of Pudur village meet in the inter-state boundary.

East: The boundary starts form the starting point of the northern boundary and runs towards south along the interstate boundary up to the point where Mannarghat-Anakkatty road crosses the inter-state boundary.

South: Starting from the starting point of northern boundary of Agali range the boundary roads towards northeast direction along Mannarghat-Anakkatty road up to the end point of the eastern boundary of this range (northern boundary of Agali range).

West: Starting from the end point of northern boundary at Anjindamudi, the western boundary runs towards south along the east southern boundary of Silent valley National Park then it goes along southern boundary of Silent Valley National Park till it reaches at Aruvanpara, then it runs towards south along the inter Panchayath boundaries of Mannarghat and Agali Panchayath till it meet the Mannarghat-Anakkatty road at Mandanpotty.

III. Mannarghat Range:
Headquarters: Mannarghat (Office and Quarters available)
Boundaries.

North: Starting from the jurisdiction of Perinthalmanna taluk, Mannarghat Taluk and Eranad Taluk, the boundary runs towards east along the inter-district boundary of Malappuram and Palghat districts till it reaches the common boundary of Mannarghat I village and Padavayal village touches the inter-district boundary of Malappuram and Palghat districts and from there the boundary runs towards southeast direction along the common boundary of Mannarghat I and Padvaual villages and then along the southern boundary of Agali Panchayath till it crosses the Mannarghat Anakkatty road at Madanpotty and from there the boundary runs towards east along the southern boundary of Agali range till it touches Sholayur village boundary.

East: Starting from the end point of the northern boundary it runs towards south along the western and southern boundaries of Sholayur village till it reaches the inter-state boundary and from there the boundary runs towards south along the inter-state boundary till it reaches the point where boundaries of Palghat and Mannarghat Taluks and the Coimbatore District meet.

South: Starting from the above point, the boundary runs towards west along the inter-Taluk boundary of Palghat and Mannarghat Taluks and then continues towards west along the inter-taluk boundary of Mannarghat and Ottappalam Taluks till it reaches the southern corner of Thachanattukara II village (near Chethellur).

West: Starting from the above end point of southern boundary, the western boundary runs towards north along the inter-district boundary of Palghat and Malappuram districts up to the starting point of northern boundary.

APPENDIX – II

LIST OF LICHENS IN MUTHIKULAM HIGH VALUE BIODIVERSITY AREA

Sl. No	Scientific name	Family
1	*Graphina acharii*	Graphidaceae
2	*G. dimorphodes*	Graphidaceae
3	*G. leucocarpoides*	Graphidaceae
4	*Graphis zeylanica*	Graphidaceae
5	*Ocellularia patwardhwanii*	Megalosporaceae
6	*Thelotrema depressum*	Megalosporaceae
7	*T. tuberculiferum*	Megalosporaceae
8	*Letrouitia vulpina*	Brigantiaceae
9	*Pyrenula interducta*	Pyrenulaceae
10	*Cladonia farinacea*	Cladoniaceae
11	*C. glauca*	Cladoniaceae
12	*C. pityrea*	Cladoniaceae
13	*Coccocarpus erythroxyli*	Coccocarpiaceae
14	*C. palmicola*	Coccocarpiaceae
15	*Leptogium adpressum*	Collemataceae
16	*L. brebissoni*	Collemataceae
17	*L. burnetiae*	Collemataceae
18	*L. chloromelum*	Collemataceae
19	*L. fallax*	Collemataceae
20	*L. phyllocarpum*	Collemataceae
21	*L. pichneum*	Collemataceae
22	*L. tenuisssissimum*	Collemataceae
23	*L. ulvaceum*	Collemataceae
24	*Bulbothrix isidiza*	Parmeliaceae
25	*B. setschwanensis*	Parmeliaceae
26	*Catraria wallichiana*	Parmeliaceae
27	*Everniastrum cirrhatum*	Parmeliaceae
28	*E. vexans*	Parmeliaceae
29	*Hypotrachyna adducta*	Parmeliaceae
30	*H. awasthii*	Parmeliaceae
31	*H. crenata*	Parmeliaceae
32	*H. exsecta*	Parmeliaceae
33	*H. infirma*	Parmeliaceae
34	*Parmelaria thomsonii*	Parmeliaceae
35	*Parmelina expallida*	Parmeliaceae
36	*P. horrescens*	Parmeliaceae
37	*P. manipurensis*	Parmeliaceae
38	*P. mullelleri*	Parmeliaceae
39	*P. spathulata*	Parmeliaceae
40	*P. wallichiana*	Parmeliaceae
41	*Parmotrema eunetum*	Parmeliaceae
42	*P. grayanum*	Parmeliaceae
42	*P. kamatii*	Parmeliaceae
43	*P. praesorediosum*	Parmeliaceae
44	*P. pseudonilgherrense*	Parmeliaceae
45	*P. sanctae - angeli*	Parmeliaceae
46	*P. tinctorum*	Parmeliaceae

47	*Relicina abstrusa*	Parmeliaceae
48	*Psorella psorina*	Phyllosporaceae
49	*Dirinaria confuluens*	Physciaceae
50	*Heterodermia coronata*	Physciaceae
51	*H. diadermata*	Physciaceae
52	*H. dissecta*	Physciaceae
53	*H. incana*	Physciaceae
54	*H. isidiophora*	Physciaceae
55	*H. lecomela*	Physciaceae
56	*H. podocarpa*	Physciaceae
57	*Ramalina inflata*	Ramalinaceae
58	*R. sinensis*	Ramalinaceae
59	*R. taitensis*	Ramalinaceae
60	*Sticta cyphelluata*	Ramalinaceae
61	*S. henryana*	Ramalinaceae
62	*S. limbata*	Ramalinaceae
63	*S. neocaledonica*	Ramalinaceae
64	*S. orbicularis*	Ramalinaceae
65	*Teloschistes flavicans*	Teloschistaceae
66	*Usnea albopunctata*	Usneaceae
67	*U. complanata*	Usneaceae
68	*U. fischeri*	Usneaceae
69	*U. dentritica*	Usneaceae
70	*U. maculata*	Usneaceae
71	*U. misamisensis*	Usneaceae
72	*U. nilgirica*	Usneaceae
73	*U. orientalis*	Usneaceae
74	*U. picta*	Usneaceae
75	*U. rigidula*	Usneaceae
76	*U. rubicunda*	Usneaceae
77	*U. vegae*	Usneaceae

APPENDIX - III

LIST OF PERIDOPHYTES IN MUTHIKULAM HVBA

Sl. No	Species and Family
	ADIANTACEAE
1	*Adiantum incisum*
	ANEMIACEAE
2	*Anemia schimperiana*
	DAVELLICEAE
3	*Davallia bullata*
	ANGIOPTERIDACEAE
4	*Angiopteris evecta*
	DRYOPTERIDACEAE
5	*Arachniodes aristata*
6	*A. coniifolia*
7	*A. tripinnata*
8	*Tectaria polymorpha*
9	*Tectaria paradoxa*
10	*Polystichium kunthianum*
	ASPLENIACEAE
11	*Asplenium cheillosorum*
12	*A. tenuifolium*
13	*A. crinicaule*
14	*A. polyodon*
	POLYPODIACAE
15	*Drynaria quercifolia*
16	*Phymatosorus nigrescens*
17	*Pleopeltis macrocarpa*
18	*Pyrosia adnascens*
19	*Pyrosia mollis*
20	*Microsorum punctatum*
21	*M. membranaceum*
22	*Nistarika bahupunctika*
	LYCOPODACEAE
23	*Lycopodium cernum*
24	*Lycopodium macrostachys*
25	*Lycopodium selago*
26	*Lycopodium phlegmaria*
27	*Lycopodium squarrosum*
	LYGODIACEAE
28	*Lygodium microphyllum*
	MARATTIACEAE
29	*Marattia fraxina*
	DENNSTAEDTIACEAE
30	*Microlepia platyphylla*
31	*Microlepia speluncae*
	OLEANDRACEAE

32	*Nephrolepis tuberosa*
33	*Nephrolepis hirsutula*
34	*Oleandra musifolia*
	THELYPTERIDACEAE
35	*Nephrodium arbuscula*
36	*Nephrodium pteroides*
37	*Christella dentata*
38	*Christella papillio*
39	*Christella parasitica*
40	*Christella subpubescens*
41	*Mcrothelypteris ornata*
42	*Macrothelypteris torresiana*
43	*Pneumatopteris truncate*
44	*Pronephrium articulatum*
45	*Phonephrium hetereocarpum*
46	*Phonephrium thwaitesii*
47	*Pseudocyclosorus arbuscula*
	EQUISETACEAE
48	*Equisetum arvense*
	LOMARIOSPIDIACEAE
49	*Bolbities semocordata*
50	*Egenolfia appendiculta*
51	*Elaphoglossum viscosum*
52	*Elxphoglossum beddomei*
53	*Elaphoglossum krangina*
	BLECHNACEAE
54	*Blechnunm orientale*
	OPHIOGLOSSACEAE
55	*Botrychium daucifolium*
	CYATHEACEAE
56	*Cyathea spinulosa*
57	*Cyathea walkerae*
58	*Cyathea gigantea*
59	LOMARIOSPIDIACEAE
60	*Bolbities semocordata*
61	*Egenolfia appendiculta*
62	*Elxphoglossum viscosum*
63	*Elxphoglossum beddomei*
64	*Elaphoglossum krangina*
	DAVALLIACEAE
65	*Araisostegia pulchra*
66	*Davallia bullata*
	GLEICHENISCEAE
67	*Gleichenia linearies*
	HYMENOPHYLLACEAE
68	*Gonocormus minitus*
69	*Mecodium exsertum*
70	*Selendesmium obscurum*

	CHEILABTHACEAE
71	*Hemionitis arifolia*
	OSMUUNDACEAE
72	*Osmunda regalis*
	HYPOLIEPIDACEAE
73	*Pteridium aquillinum*
74	*Hypolespis punctata*
	PTERIDACEAE
75	*Pityrogramma calomennos*
76	*Pityrogramma chrysophylla*
77	*Pteris biaurita*
78	*Pteris geminata*
79	*Pteris cretica*
80	*Pteris longipes*
81	*Pteris quadriaurita*
82	*Pteris martensioides*
	SELAGINELLACEAE
83	*Selaginella involvens*
84	*Selaginella delicatula*
	LINDSAEACEAE
85	*Schizoloma ensifolium*
86	*Sphenomeris chinesis*
87	*Lindsea malabarica*

APPENDIX - IV

LIST OF ANGIOSPERMS IN MUTHIKULAM HVBA

Sl.No	Family and Botanical name
	RANUNCULACEAE
1	*Naravelia zeylanica* (L).DC
2	*Clematis gouriana* Roxb. *ex* Dc
	MANGOLOACEAE
3	*Michelia nilagirica* Zenk.
	ANONACEAE
4	*Polyalthia fragrans* (Dalz.) Bedd.*
5	*Polyalthia coffeoides* Thw. Ex Hook.f
6	*Miliusa eriocarpa* Dunn*
7	*Uvaria narum* (Dunal) Wall. *ex* Hook.f. & Thomas.
8	*Miliusa tomentosa* (Roxb.) Sinclair
	MENISPERMACEAE
9	*Cissampelos pareira* L. var *hirsute* (Ham. ex DC.)
10	*Cyclea peltata* (Lam.) Hook. f. & Thomas.
11	*Tiliacora acuminata* (Poir.) Miers *ex* Hook.f. & Thomas.
12	*Diploclisia glaucescens* (Bl.) Diels
13	*Stephania japonica* (Thunb.) Miers.
14	*Stephania wightii* (Arn.) Dunn
15	*Anamirta cocculus* (L.) Wight & Arn
	BIXACEAE
16	*Bixa orellana* L.
	FLACOURTIACEAE
17	*Scolopia crenata* (Wight & Arn.)
18	*Hydnocarpus pentandra* (Buch.- Ham.) Oken
19	*Flacourtia montana* Graham
20	*Flacourtia indica* (Burm. f.) Merr.
	POLYGALACEAE
21	*Polygala elongata* Klein ex Willd.
22	*Polygala arillata* Buch.- Ham. *ex* D.Don
23	*Polygala javana* DC.
	HYPERICACEAE
24	*Hypericum mysurense* Heyne *ex* Wight & Arn.
25	*Hypericum wightianum* Wall. ex Wight & Arn.
	GUTTIFERAE (CLUSIACEAE)
26	*Garcinia morella* (Gaertn.) Desv.
27	*Garcinia xanthochymus* Hook.f. *ex* Anders.
28	*Calophyllum polyanthum* Wall. *ex* Choisy
29	*Mesua thwaitesii* Planch. & Triana
30	*Mesua ferrea* L.*
	BONNETIACEAE
31	*Poeciloneuron indicum* Bedd.
	THEACEAE
32	*Ternstroemia gymnanthera* (Wight & Arn.) Bedd
33	*Eurya nitida* Korth.
34	*Gordonia obtusa* Wall. *ex* Wight & Arn.
	DIPTEROCARPACEAE
35	*Hopea parviflora* Bedd.*

36	*Hopea ponga* (Dennst.) Mabb.*
37	*Dipterocarpus indicus* Bedd.
38	*Vateria indica* L.
39	*Vateria macrocarpa* Gupta
40	*Dipterocarpus bourdillonii* Brandis
	ANCISTROCLADACEAE
41	*Ancistrocladus heyneanus* Wall *ex* Graham*
	MALVACEAE
42	*Urena lobata* L.
43	*Sida cordifolia* L.
44	*Sida spinosa* L.
45	*Sida acuta* Burm.f.
46	*Abelmoschus angulosus* Wall. *ex* Wight & Arn.
47	*Fioria vitifolia* (L.) Mattei
	BOMBACACEAE
48	*Bombax ceiba* L.
49	*Cullenia exarillata* Robyns*
	STERCULIACEAE
50	*Heritiera papilio* Bedd.
51	*Helicteres isora* L.
52	*Klienhovia hospita* L.
53	*Pterospermum reticulatum* Wight & Arn.*
54	*Pterospermum rubiginosum* Heyne *ex* Wight*
	TILIACEAE
55	*Grewia abutilifolius* Juss.
56	*Triumfetta pilosa* Roth
	ELAEOCARPACEAE
57	*Elaeocarpus serratus* L.
58	*E. munronii* (Wight)Mast*
59	*E. tuberculatus* Roxb.
60	*E. grandulosus* Wall. *ex* Merr.
	ERYTHROXYLACEAE
61	*Erythroxylum moonii* Hochr.
62	*E. obtusifolium* (Wight) Hook.f
	OXALIDACEAE
63	*Oxalis corniculata* L.
	BALSAMINACEAE
64	*Impatiens jerdoniae* Wight*
65	*I. tomentosa* Heyne *ex* Wight & Arn*
66	*I. gardneriana* Wight *
67	*I. munronii* Wight*
68	*I. fruticosa* Lesch. ex DC.*
	RUTACEAE
69	*Meliocope lunu-akenda* (Gaertn.) Hartley *
70	*Toddalia asiatica* (L.)Lamk.
71	*Acronychia pedunculata* (L.) Miq.
72	*Glycosmis pentaphylla* (Retz.) DC.
73	*Clausena indica* (Dalz.) Oliver
74	*C. austroindica* Stone & Nair*
75	*Luvunga eleutherandra* Dalz *
76	*Atalantia wightii* Tanaka *

	DILLENIACEAE
77	*Dillenia pentagyna* Roxb.
	BURSERACEAE
78	*Canarium strictum* Roxb.
	MELIACEAE
79	*Naregamia alata* Wight & Arn.
80	*Dysoxylum malabaricum* Bedd. ex Hiern*
81	*Aglaia elaeagnoides* (A.Juss.)Benth.
82	*Aphanamixis polystachya* (Wall.) Parker
83	*Toona connaroides* (Wight & Arn.) Bentv.
84	*Toona □cumina* Roem.
	OLACACEAE
85	*Olax □cuminate* Roxb.
	ICACINACEAE
86	*Gomphandra coriacea* Wight.
87	*Nothapodytes nimmoniana* (Graham) Mabb.
	CELASTRACEAE
88	*Euonymus indicus* Heyne ex Roxb.
89	*Euonymus angulatus* Wight.
	RHAMNACEAE
90	*Ventilago bombaiensis* Dalz.
91	*Zizyphus oenoplia* (L.) Mill.
92	*Zizyphus xylopyrus* (Retz.)Willd
93	*Zizyphus rugosa* Lam.
94	*Z. xylopyrus* (Retz.) Willd.
95	*Gouania microcarpa* DC
	VITACEAE
96	*Cayratia pedata* (Lam.) A.Juss *ex* Gagnep.
97	*Cissus repens* Lam.
98	*Cissus glyptocarpa* (Thw.) Planch.
99	*Cissus vitiginea* L.
100	*Parthenocissus semicordata* (Wall.) Planch.*
	STAPHYLEACEAE
101	*Turpinia cochinchinensis* (Lour.)Merr.
	SAPINDACEAE
102	*Allophylus serratus* (Roxb.) Kurz.
103	*Lepisanthes tetraphylla* (Vahl.) Radlk.
104	*Filicium decipiens* (Wight. & Arn.)Thw.
105	*Otonephelium stipulaceum* (Bedd.) Radlk.
106	*Schleichera oleosa* (Lour.) Oken
	SABIACEAE
106	*Meliosma pinnata* (Roxb.)
	ANACARDIACEAE
107	*Spondias pinnata* (L.f.) Kurz.
108	*Nothopegia racemosa* (Dalz.)
109	*Holigarna arnottiana* Hook.f.*
110	*Holigarna nigra* Bourd.*
111	*Holigarna beddomei* Hook.f.*
112	*Holigarna grahamii* (Wight) Kurz.*
	CONNARACEAE
113	*Connarus sclerocarpus* (Wight & Arn.) Schellenb.

	FABACEAE
114	*Crotalaria mysorensis* Roth
115	*Crotalaria triquerta* Dalz.
116	*Indigofera wightii* Graham *ex* Wight & Arn.
117	*Tephrosia pulcherrima* (Wight ex Baker) Gamble
118	*Smithia setulosa* Dalz.*
119	*Alysicarpus glumaceus* (Vahl.)DC
120	*Desmodium laxum* DC.
121	*Uraria rufescens* (DC.) Schind.
122	*Shuteria involucrata* (Wall.) Wight & Arn.
123	*Erythrina stricta* Roxb.
124	*Indigofera hirsuta* L.
125	*Centrasaema pubscens* Benth.
	CAESALPINIACEAE
126	*Caesalpinia bonduc* (L.) Roxb.
127	*Caesalpinia mimosoides* Lam.
128	*Parkinsonia aculeata* L.
129	*Acrocarpus fraxinifolius* Wight & Arn.
130	*Cassia roxburghii* DC.
131	*Bauhinia racemosa* Lam.
132	*Bauhinia phoenicea* Wight. & Arn.
	MIMOSACEAE
133	*Adenanthera pavonina* L.
134	*Entada rheedei* Spreng.
135	*Xylia xylocarpa* (Roxb.) Taub.
	ROSACEAE
136	*Prunus ceylanica* (Wight) Miq.
137	*Rubus ellipticus* Sm.
138	*Rubus niveus* Thunb.
139	*Photinia integrifolia* Lindl.
140	*Eriobotrya japonica* (Thunb.) Lindl.
141	*Rubus glomeratus* Bl.
	RHIZOPHORACEAE
142	*Carallia brachiata* (Lour.) Merr.
	MYRTACEAE
143	*Callistemon citrinus* (Curt.)Skeels
144	*Syzygium densiflorum* Wall. *ex* Wight & Arn.
145	*Syzygium jambos* (L.) Alston
146	*Syzygium laeta* (Buch.-Ham.) Gandhi
147	*Syzygium hemisphericum* (Wight) Alston
148	*Syzygium neesianum* Arn.
149	*Syzygium gardneri* Thw.
150	*Syzygium palghatense* Gamble*
151	*Syzygium cumini* (L.)Skeels var, *cumini*
	LECYTHIDACEAE
152	*Careya arborea* Roxb.
	MELASTOMATACEAE
153	*Osbeckia zeylanica* L.
154	*Osbeckia gracilis* Bedd.
155	*Medinilla beddomei* Cl.
156	*Sonerila elegans* Wight.*

157	*Sonerila wallichii* Bennett*
158	*Sonerila rotundifolia* Bedd.*
	LYTHRACEAE
159	*Lagerstroemia microcarpa* Wight.*
	ONAGRACEAE
160	*Ludwigia prostrata* Roxb.
	FLACOURTIACEAE
161	*Casearia ovate* (Lam.) Willd.
162	*C.rubescens* Dalz.*
	CUCURBITACEAE
163	*Zanonia indica* L.
164	*Zehneria mysoorensis* (Wight & Arn.) var *mysoorensis*
165	*Trichosanthus nervifolia* L.
	BEGONIACEAE
166	*Begonia malabarica* Lam.
	UMBELLIFERAE
167	*Hydrocotyl javanica* Thunb.
168	*Centella asiatica* (L.) Urban
169	*Bupleurum wightii* Kozo-Poij.
170	*Pimpinell heyneana* (DC.) Kurz.
	ARALIACEAE
171	*Polyscias acuminata* (Wight) Seem.
172	*Schefflera racemosa*(Wight) Hams
	CORNACEAE
173	*Mastixia arborea* (Wight) Bedd.
	CAPRIFOLIACEAE
174	*Vibrnum punctatum* Buch.- Ham. *ex* D.Don
	RUBIACEAE
175	*Wendlandia thyrsoidea* (Schult.) Steud.
176	*Neurocalyx purpurea* (Roxb.) Merr.
177	*Neurocalyx calycinus* (R.Br. ex Bennett.) Robins
178	*Ophiorrhiza brunonis* Wight & Arn. Var *johnsonii* Hk.f.*
179	*Ophiorrhiza hirsutula* Wight *ex* Hook.f.*
180	*Ophiorrhiza mungos* L.
181	*Knoxia mollis* Wight & Arn.
182	*Psilanthus wightiianus* (Wight & Arn.) Leroy
183	*Ixora brachiata* Roxb. *ex* DC.
184	*Pavetta zeylanica* (Hook.f.) Gamble
185	*Psychotria anamalayana* Bedd.*
186	*Psychotria nigra* (Gaertn.)Alston var *peninsularis* (Hk.f.)
187	*Psychotria truncate* Wall.*
188	*Coffea robusta* L. Linden
189	*Saprosma glomerata* (Gard.) Bedd.
190	*Lasianthus jackianus* Wight*
191	*Lasianthus parvifolius* Wight*
192	*Lasianthus ciliatus* Wight*
193	*Saprosma fragrans* Bedd*
194	*Tarenna monosperma* (Wight & Arn.) Raju
195	*Rubia cordifolia* L.
196	*Gallium asperifolium* Wall.
197	*Tarenna asiatica* (L.) O.Ktze *ex* K Schum.

	COMPOSITAE
198	*Blumea membranacea* Wall. *ex* DC var. *gracilis* Hook.f.
199	*Blumea heiracifolia* (D.Don) DC
200	*Cissampelopsis corymbosa* (Wall. *ex* DC.) Jeffrey & Chen.
201	*Conyza bonariensis* (L.) Cronq.
202	*Conyza canadensis* (L.) Cronq.
203	*Dichrocephala intergrifolia* (L.f.) O. Ktze.
204	*Dichrocephala chrysanthemifolia* (Bl.) DC
205	*Blumea belangeriana* DC.
206	*Blumea lanceolaria* (Roxb). Druce
207	*Blumea mollis* (D.Don) Merr.
208	*Gnaphalium pulvinatum* Delile.
209	*Laggera crispate* (Vahl) Hepper & Wood
210	*Gynura tavancorica* W.W.Smith
211	*Emilia sonchifolia* (L.) DC.
212	*Senecio intermedius* Wight.
213	*Sonchus oleraceus* L.
214	*Chromolaena odorata* (Linn.) King & Robins.
	LOBELIACEAE
215	*Lobelia nicotianifolia* Roth *ex* Roem.
	ERICACEAE
216	*Gautheria fragrantissima* Wall.
	VALERIANACEAE
217	*Valeriana hookeriana* Wight & Arn.
	MYRSINACEAE
218	*Maesa indica* (Roxb.) DC
219	*Rapanea capitellata* (Wall.) Mez
220	*Embelia ribes* Burm.f.
221	*Ardisia pauficlora* Heyne *ex* Roxb.
	SAPOTACEAE
222	*Chrysophyllum roxburghii* G.Don.
223	*Isonandra lanceolata* Wight forma *anfractuosa* (Cl.) Jeuken
224	*Palaquium ellipticum* (Dalz.) Baill*
	EBENACEAE
225	*Diospyros sylvatica* Roxb.
226	*Diospyros assimilis* Bedd.
	SYMPLOCACEAE
227	*Symplocos obtusa* Wall. *ex* G. Don
	OLEACEAE
228	*Jasminum rottlerianum* Wall. *ex* DC. var *rottlerianum*
229	*Jasminum bignoniaceum* Wall. *ex* A.DC.
230	*Ligustrum perrottetii* A.DC.
231	*Olea dioica* Roxb.
232	*Ligustrum robustrum* (Roxb.) Bl. ssp *walkerii*
233	*Ligustrum decaisnei* Cl.
234	*Myxopyrum smilacifolium* (Wall.) Bl.
	APOCYNACEAE
235	*Chilocarpus denudatus* Bl.

236	*Carissa inermis* Vahl.*
237	*Rauvolfia serpentina* (L.) Benth. *ex* Kurz.
238	*Alstonia scholaris* (L.) R. Br.
239	*Tabernaemontana divaricata* (L.) R. Br.
	PERIPLOCACEAE
240	*Hemidesmus inducus* (L.) R. Br. var *indicus**
241	*Cryptolepis buchanani* Roem & Schult.
	ASCLEPIADACEAE
242	*Hoya pauciflora* Wight.
243	*Hoya wightii* Hook.f.*
244	*Ceropegia elegans* Wall
245	*Ceropegia decaisneana* Wight.
	BUDDLEIACEAE
246	*Buddleja asiatica* Lour.
	LOGANIACEAE
247	*Fagraea ceylanica* Thunb.
248	*Strychnos vanprukii* Craib.
	GENTIANACEAE
249	*Exacum tetragonum* Roxb.
250	*Exacum wightianum* Arn.*
251	*Canscora diffusa* (Vahl.) R. Br.
252	*Swertia corymbosa* Wight *ex* Cl.*
	CONVOLVULACEAE
253	*Argyreia cuneata* (Wild.) Ker-Gawl.
254	*Ipomea wightii* (Wall.) Choisy
255	*Merremia umbellata* (L.) Hall. f.
256	*Merremia vitifolia* (Burm.f.) Hall.f
	SOLANACEAE
257	*Physalia peruviana* L.
258	*Solanum denticulatum* Bl.
259	*Solanum torvum* Sw.
260	*Solanum seaforthianum* Andr.
261	*Solanum virginianum* L.
262	*Solanum erianthum* D. Don
	SCROPHULARIACEAE
263	*Pedicularis perrottetii* Benth.*
264	*Bacopa monnieri* (L.) Pennell.
	OROBANCHACEAE
265	*Aeginetia pedunculata* Wall.
266	**LENTIBULARIACEAE**
267	*Urticularia uliginosa* Vahl.
268	*Urticularia scandens* Benj.
269	*U.malabarica* Janarth & Henry*
	GESNERIACEAE
270	*Aeschynanthus perrotteti* A.DC.*
271	*Epithema carnosum* (G.Don) Benth. var. *hispida* Cl.*
272	*Rhyncotechum permolle* (Nees) Burtt.
273	*Didymocarpus humboldtiana* Gard.
	ACANTHACEAE
274	*Thunbergia mysorensis* (Wt.) Anders.*
275	*Strobilanthes kunthianus* (Nees.) Anders. ex Benth.

276	*Strobilanthes lawsonii* Gamble
277	*Strobilanthes neilgherrensis* Bedd.
278	*Strobilanthes violaceus* Bedd.
279	*Nilgirianthus gracilis* Bedd. *
280	*Lepidagathis incurve* Buch.-Ham *ex* D.Don.
281	*Justicia procumbens* L.
282	*Justicia adathoda* L.
	VERBENACEAE
283	*Lantana camara* L. var *splendens* (Medic.) Moldenke
284	*Stachytarpheta indica* (L.) Vahl.
285	*Callicarpa tomentosa* (L.) Murr.
286	*Clerodendrum viscosum* Vent.
	LAMIACEAE
287	*Orthosiphon aristatus* (Blume) Miq.
288	*Plectranthus rivularis* Wight *ex* Hook.f.*
289	*Plectranthus coleoides* Benth.
290	*Pogostemon pubescens* Benth.
291	*Pogostemon gardneri* Hook.f.*
292	*Anisochilus suffruticosus* Wight.
293	*Colebrookea oppositifolia* Smith
294	*Eusteralis quadrifolia* (Benth.) Panigrahi
	PLANTAGINACEAE
295	*Plantago erosa* Wall.
	AMARANTHACEAE
296	*Achyranthes bidentata* Bl.
297	*Indobanalia thyrsiflora* (Miq.) Henry & Roy *
	POLYGONACEAE
298	*Polygonum chinense* (L.) Gross.
	ARISTOLOCHIACEAE
299	*Thottea siliquosa* (Lam.) Ding Hou
300	*Aristolochia tagala* Cham.
	PIPERACEAE
301	*Piper galeatum* Cas.*
302	*Piper longum* L.
303	*Piper wightii* Miq.
304	*Piper nigrum* L. var. *nigrum*
305	*Piper hymenophyllum* Miq.
306	*Piper argyrophyllum* Miq.
307	*Piper triocum* Roxb.
308	*Piper mullesua* Buch.-Ham *ex* D. Don
309	*Piper schmidtii* Hook.f. *
310	*Piper trichostachyon* (Miq.) C. DC.
311	*Peperomia heyneana* Miq.
312	*Peperomia portulacoides* (Lam.) Dietr.
313	*Peperomia blanda* (Jacq.) Kunth.
314	*Peperomia tetraphylla* (G.Forst.) Hook. & Arn.
315	*Lepianthes umbellata* (L.) Rafin.
	CHLORANTHACEAE
316	*Sarcandra chloranthoides* Gard.
	MYRISTICACEAE
317	*Myristica malabarica* Lam.

318	*Myristica beddomei* King var. *beddomei* de Wilde
319	*Knema attenuate* (Hook. f. & Thomas) Warb.
	LAURACEAE
320	*Cinnamomum macrocarpum* Hook.f
321	*Cinnamomum malabatrum* (Burm.f) Bl.
322	*Cinnamomum macrocarpum* Hook.f.*
323	*Cinnamomum sulphuratum* Nees*
324	*Alseodaphne semecarpifolia* Nees var. *semecarpifolia*
325	*Persea macrantha* (Nees.) Kosterm.
326	*Phoebe lanceolata* Nees
327	*Actinodaphne salicina* Meisner*
328	*Actinodaphne malabarica* Balakr.
329	*Actinodaphne tadulingamii* Gamble
330	*Litsea laevigata* (Nees) Gamble*
331	*Litsea oleoides* (Meisner) Hook.f.*
332	*Litsea stocksii* (Meisner) Hook.f.var *glabrescens* (Meisner) Hook.f.*
333	*Litsea wightiana* (Nees) Hook.f.*
334	*Litsea floribunda* (Blume) Gamble
335	*Neolitsea cassia* (L.) Kosterm.
336	*Neolitsea scrobiculata* (Meisner) Gamble
	LORANTHACEAE
337	*Helixanthera hookeriana* (Wight & Arn.) Dasner
338	*Helixanthera obtusata* (Schult.) Dasner*
339	*Macrosolen parasiticus* (L.) Dasner*
340	*Taxillus tomentosus* (Heyne *ex* Roth) Tieghem
	SANTALACEAE
341	*Santalum album* L. *
342	*Osyris quadripartita* Salzm. *ex* Decne.
343	*Scleropyrum pentandrum* (Dennst.) Mabb.
	BALANOPHORACEAE
344	*Balanophora fungosa* J.R. & G. Forst.ssp *indica* (Arn.) Hansen
	BUXACEAE
345	*Sarcococca saligna* (D. Don) Muell.-Arg.
	ULMACEAE
346	*Celtis timorensis* Span.
347	*Trema orientalis* (L.) Bl.
	MORACEAE
348	*Ficus mollis* Vahl.
349	*Ficus beddomei* King*
350	*Ficus racemosa* L.
351	*Ficus guttata* (Wight) Kurz *ex* Hook.f.*
352	*Ficus microcarpa* L.
353	*Ficus hispida* L.
354	*Artocarpus heterophyllus* Lam.
355	*Artocarpus hirsutus* Lam.*
	EUPHORBIACEAE
356	*Phyllanthus amarus* Schum. & Thonn.
357	*Phyllanthus emblica* L.
358	*Antidesma montanum* Bl.

359	*Antidesma bunius* (L.) Spreng.
360	*Breynia retusa* (Dennest.) Alston
361	*Glochidion condolleanum* (Wight & Arn.) Chakrab. & Gangop.
362	*Glochidion ellipticum* Wight*
363	*Bridelia retusa* (L.) Spreng.
364	*Baccaurea courtallensis* (Wight) Muell.-Arg.*
365	*Daphniphyllum neilgherrense* (Wight) K Rosenth.
366	*Bischofia javanica* Bl.
367	*Croton malabaricus* Bedd.*
368	*Croton caudatus* Geisel.
369	*Croton zeylanius* Muell.-Arg.
370	*Agrostistachys borneensis* Becc.
371	*Mallotus tetracoccus* (Roxb.) Kurz.
372	*Mallotus philippensis* (Lam.) Muell.- Arg. Var. *philippensis*
373	*Macaranga indica* Wight
374	*Macaranga peltata* (Roxb.) Muell.- Arg.
375	*Acalypha brachystachya* Hornem.
376	*Tragia muelleriana* Pax & Hoffm.
	URTICACEAE
377	*Laportea bulbifera* (Sieb. & Zucc.)
378	*Elatostema acuminatum* (Poir.) Brongn.
379	*Elatostema sessile* J.R.Forst. & J.G.A. Forst.
380	*Pilea melastomoides* (Poir.) Bl.
381	*Oreocnide integrifolia* (Gaud.) Miq.
382	*Pouzolzia wightii* Bennett var. *wightii* Wight *
383	*Pozolzia bennettiana* Wight var. *bennettiana*
384	*Laportea interrupta* (L.) Chew.
385	*Boehmeria glomerulifera* Miq.
386	*Debregeasia longifolia* (Burm.f.) Wedd.
387	*Elatostema lineolatum* Wight var. *lineolatum*
	HYDROCHARITACEAE
388	*Hydrilla verticillata*
	BURMANNIACEAE
389	*Burmannia championii*
	ZINGIBERACEAE
390	*Curcuma neilgherrensis* Wight. *
391	*Curcuma zedoaria* (Christm.) Rosc.
392	*Hedychium coronarium* Koenig
393	*Amomum hypoleucum* Thw.
394	*Amomum pterocarpum* Thw.*
395	*Amomum muricatum* Bedd. *
396	*Elettaria cardamomum* (L.) Maton
	ORCHIDACEAE
397	*Acanthephippium bicolor* Lindl.
398	*Bulbophyllum silentvalliensis* Sharma & Srivasthava *
399	*Chrysoglossum maculatum* (Thw.) Hook.f.
400	*Coelogyne breviscapa* Lindl.
401	*Coelogyne nervosa* A.Rich.
402	*Dendrobium wightii* Hawkers & Heller

403	*Dendrobium aqueum* Lindl.*
404	*Dendrobium heyneanum* Lindl.
405	*Dendrobium nanum** Hook.f.
406	*Eria exilis* Hook.f.
407	*Eria albiflora* Rolfe*
408	*Eria braccata* (Lindl.) Lindl.*
409	*Eria dalzellii* (Hook. *ex* Dalz.) Lindl.*
410	*Liparis viridiflora* (Blume) Lindl.
411	*Oberonia bicornis* Lindl.
412	*Oberonia brachyphylla* Blatt & McCann.*
413	*Oberonia brunoniana* Wight*
414	*Oberonia falconeri* Hook.f.
415	*Oberonia santapaui* Kapad. *
416	*Pachystoma pubescens* Bl.
417	*Porpax reticulata* Lindl.
418	*Tainia bicronis* (Lindl.) Reichb.
	MARANTACEAE
419	*Schumannianthus virgatus* (Roxb.) Rolfe.
	MUSACEAE
420	*Musa superbum* (Roxb.) Cheesman.
	HAEMODORACEAE
421	*Ophiopogon intermedius* D.Don.
	AMARYLLIDACEAE
422	*Crinum latifolium* L.
	DIOSCOREACEAE
423	*Dioscorea intermedia* Thw.
424	*Dioscorea pentaphylla* L. var. *rheedi* Prain & Burkill.
425	*Dioscorea tomentosa* Koenig *ex* Spreng.
	LILIACEAE
426	*Protasparagus racemosus* (Willd.) Oberm.
427	*Chlorophytum malabaricum* Baker*
428	*Dianella ensifolia* (L.) DC.
429	*Gloriosa superb* L.
430	*Iphigenia indica* (L) A.Gary *ex* Kunth*
	SMILACACEAE
431	*Smilax aspera* L.
432	*Smilax perfoliata* Lour.
433	*Smilax zeylanica* L.
	COMMELINACEAE
434	*Commelina diffusa* Burm.f.
435	*Commelina clavata* Cl.
436	*Cyanotis fasciculate* (Heyne *ex* Roth.) Schult.f*
437	*Cyanotis villosa* (Spreng.) Schult.f.
438	*Murdannia dimorpha* (Dalz.) Brueck.
439	*Murdannia simplex* (Vahl.) Brenan.
	Pollia secundiflora (Bl.) Bahk.f.
	ARECACEAE
440	*Arenga wightii* Griff*
441	*Calamus gamblei* Becc.*ex* Becc. & Hook.f.*
442	*Calamus hookerianus* Becc. *
443	*Calamus pseudo tenuis* Becc.*ex* Becc. & Hook.f.*

444	*Calamus thwaitesii* Becc. & Hook.f.*
445	*Caryota urens* L. *
446	*Phoenix loureirii* var. *humilis* (Becc.) Barrow*
447	*Pinanga dicksonii* (Roxb.) Bl.*
	PANDANACEAE
448	*Pandanus thwaitesii* Mart.
	ARACEAE
449	*Arisaema leschenaultii* Bl.*
450	*Arisaema muricaudatum* Sivad*
451	*Lagenandra meeboldii* (Engl.) Fischer
452	*Remusatia vivipara* (Roxb.) Schoot
453	*Theriophonum fischeri* Sivad.*
	GRAMINEAE
454	*Arthraxon lancifolius* (Trin.) Hochst.
455	*Arundinella mesophylla* Nees ex Steud.
456	*Arundnella ciliate* (Roxb.) Nees ex Miq.
457	*Bothrichola pertusa* (L.) A. Camus
458	*Brachiaria ramose* (L.) Stapf
459	*Chrysopogon aciculatus* (Retz.) Trin.
460	*Chysopogon asper* (Heyne ex Hook.f.) Blatt. & Mc Cann.
461	*Cymbopogon caesius* (Nees ex Hook.f. & Arn.) Stapf
462	*Cymbopogon citrates* (DC.) Stapf
463	*Digitaria wallichiana* (Wight & Arn. Ex Steud.)
464	*Heteropogon contortus* (L.) P. Beauv. Ex Roem.
465	*Imperate cylindrical* (L.) Raeusch.
466	*Ischaemum commutstum* Hack.
467	*Ochlandra scriptoria* (Dennst.)
468	*Ochlandra travancorica* (Bedd.) Benth. Ex Gamble*
469	*Oplismenus compositus* (L.) P. Beauv.
470	*Oplismenus burmanni* (Retz.) P. Beauv.
471	*Panicum repens* L.
472	*Paspalum conjugatum* Berg.
473	*Pennisetum pedicellatum* Trin.
474	*Pseudanthistiria polystachya.*(HBK) Stapf
475	*Themedia tremula* (Nees ex Steud.) Hack
	ERIOCAULACEAE
476	*Eriocaulon setaceum* L.
477	*Eriocaulon robustum* Steud.*
478	*Eriocaulon truncatum* Buch. - Ham. Ex Mart.
479	*Eriocaulon xeranthemum* Mart.
	CYPERACEAE
480	*Kyllinga bulbosa* P. Beauv.
481	*Mariscus cyperinus* (Retz.) Vahl.
482	*Fimbristylis complanata* (Retz.) Link
483	*Bulbostylis barbata* (Rottb.) Kunth *ex* Clarke spp *barbata*
484	*Carex baccans* Nees
485	*Carex maculate* Boot.
486	*Carex phacota* Sspreng.
487	*Cyperus compressus* L.
488	*Cyperus ira* L.

**Endemic to Penisular India.*

APPENDIX – V

LIST OF FAUNA IN MUTHIKULAM HIGH VALUE

BIODIVERSITY AREA

Mammals

Sl. No.	Common name	Scientific name	Family
1	Lion-tailed Macaque	*Macaca silenus* Linnaeus	Cercopithecidae
2	Bonnet macaque	*Macaca radiata* Geoffroy	Cercopithecidae
3	Nilgiri Langur	*Trachypithecus johnii* J.Fischer	Cercopithecidae
4	Asian Elephant	*Elephas maximus* Linnaeus	Elephantidae
5	Gaur	*Bos gaurus* H.Smith	Bovidae
6	Sambar Deer	*Cervus unicolor* Kerr	Cervidae
7	Chital or Spotted Deer	*Axix axis*	Cervidae
8	Barking Deer	*Muntiacus muntjak* Zimmermann	Cervidae
9	Mouse Deer	*Moschiola meminna* Erxleben	Tragulidae
10	Wild Boar	*Sus scrofa* Linnaeus	Suidae
11	Malabar Giant Squirrel	*Ratufa indica* Erxleben	Sciuridae
12	Small Indian Civet	*Viverricula indica* Desmarest	Viverridae
13	Common Palm Civet	*Paradoxurus hermaphrodites* Pallas	Viverridae
14	Sloth Bear	*Melursus ursinus* Shaw	Ursidae
15	Tiger	*Panthera tigris* Linnaeus	Felidae
16	Leopard	*Panthera pardus* Linnaeus	Felidae
17	Jungle Cat	*Felis chaus* Guldenstaedt	Felidae
18	Wild Dog	*Cuon alpinus* Pallas	Canidae
19	Nilgiri Tahr	*Hemitragus hylocrius* Ogilby	Bovidae
20	Ruddy mongoose	*Herpestes smithi*	Muridae
21	Common Mongoose	*Herpestes edwardsii* Geoffroy	Herpestidae
22	Nilgiri marten	*Martes gwatkinsii*	Sciuridae
23	Brown mongoose	*Herpestes fuscus*	Mantidae

Reptiles

Sl. No.	Scientific name	Family
1	*Melanochelys trijuga*	Bataguridae
2	*Calotes versicolor*	Agamidae
3	*Calotes calotes*	Agamidae
4	*Calotes ellioti**	Agamidae
5	*Calotes rouxii**	Agamidae
6	*Calotes nemoricola**	Agamidae
7	*Calotes grandisquamis**	Agamidae
8	*Salea horsfieldii**	Agamidae
9	*Draco dussumieri**	Agamidae
10	*Psmmophilius blanfordanus*	Agamidae
11	*Cnemaspis indica**	Gekkonidae
12	*Cnemaspis indraneildasii**	Gekkonidae
13	*Cnemaspis wynadensis**	Gekkonidae
14	*Hemidactylus brookii*	Gekkonidae
15	*Hemidactylus frenatus*	Gekkonidae
16	*Mabuya macularia*	Scincidae
17	*Mabuya carinata*	Scincidae
18	*Mabuya beddomei*	Scincidae
19	*Scincella laterimaculata**	Scincidae
20	*Ristella beddomii**	Scincidae
21	*Sphenomorphus dussumieri**	Scincidae
22	*Varanus bengalensis*	Varanidae
23	*Ramphotyphlo braminus*	Typhlopidae
24	*Uropeltis ceylanieus*	Uropeltidae
25	*Uropeltis phipsonii*	Uropeltidae
26	*Python molurus*	Boidae
27	*Ahaetulla nasuta*	Colubridae

28	*Ahaetulla perroteti**	Colubridae
29	*Ahaetulla pulverulenta*	Colubridae
30	*Amphiesma beddomei**	Colubridae
31	*Boiga nuchalis*	Colubridae
32	*Boiga forsteni*	Colubridae
33	*Boiga ceylonensis**	Colubridae
34	*Dendrelaphis grandoeulis**	Colubridae
35	*Dendrelaphis tristis*	Colubridae
36	*Lycodon aulieus*	Colubridae
37	*Lycodon travaneoricus*	Colubridae
38	*Maeropisthodon plumbicolor*	Colubridae
39	*Oligodon arnensis*	Colubridae
40	*Ptyas mucosa*	Colubridae
41	*Xenoehrophis piscator*	Colubridae
42	*Chrysopelea ornata*	Colubridae
43	*Coelognathus helena*	Colubridae
44	*Oligodon taeniolatus*	Colubridae
45	*Ophiophagus hannah*	Elapidae
46	*Calliophis nigrescens*	Elapidae
47	*Bungarus caeruleus*	Elapidae
48	*Naja naja*	Elapidae
49	*Hypnale hypnale*	Viperidae
50	*Trimeresurus macrolepis**	Viperidae
51	*Trimeresurus malabaricus**	Viperidae
52	*Daboia russelii*	Viperidae

**Endemic to Western Ghats*

Amphibians

Sl. No.	Common name	Scientific name	Family	Status
1		*Bufo parietalis* Boulenger	Bufonidae	Threatened
3	Southern Hill Toad	*Bufo microtympanum* Boulenger	Bufonidae	Threatened
6		*Rana curtipes*	Ranidae	Threatened
7	Fungoid frog	*Rana malabarica*	Ranidae	Threatened
8	Brownzed frog	*Rana temporalis*	Ranidae	Vulnerable
9	Beddome's Leaping Frog	*Indirana beddomii* Gaunther	Petropedetidae	Vulnerable
10	Malabar Flying Frog	*Rhacophorus malabaricus* Jerdon	Rhacophoridae	Lower risk
11	Large Wrinkled Frog	*Nyctibatrachus major*	Nyctibatrachidae	Vulnerable
12		*Philautus signatus*	Rhacophoridae	Vulnerable
14		*Ramanella triangularis* Gauther	Microhylidae	Vulnerable
15	Indian Bull Frog	*Hoplobatrachus tigerinus*	Dicroglossidae	-
17		*Fejervarya nilagirica*	Dicroglossidae	-
18	Common Tree frog	*Polypedatus maculates* Gray	Rhacophoridae	Threatened
19		*Philautus variabilis* Gaunther	Rhacophoridae	Threatened
20	Sharp nosed bull frog	*Philautus nasutus* Gray	Rhacophoridae	-
21		*Philautus leucorhnus*	Rhacophoridae	Threatened

Birds

Sl. No.	Common name	Scientific name	Conservation Status
1	Black Eagle	*Ictinaetus malayensis*	
2	Bonelli' s Eagle	*Hieraaetus fasciatus*	
3	Rufous-bellied Eagle	*Hieraaetus kienerii*	
4	Changeable Hawk-Eagle	*Spizaetus cirrhatus*	Endangered
5	Common Kestrel	*Falco tinnunculus*	
6	Red Spur fowl	*Galloperdix spadicea*	
7	Grey Jungle fowl	*Gallus sonneratii*	
8	Nilgiri Wood- Pigeon	*Columba elphinstonii*	Vulnerable
9	Emerald Dove	*Chalcophaps indica*	Threateded
10	Mountain Imperial- Pigeon	*Ducula badia*	
11	Malabar Trogon	*Harpactes fasciatus*	
12	White cheeked Barbet	*Megalaima viridis*	
13	Common Golden backed Woodpecker	*Dinopium javanense*	
14	Dusky Crag Martin	*Hirundo concolor*	
15	House Swallow	*Hirundo tahitica*	
16	Grey Wagtail	*Motacilla cinerea*	
17	Paddy field Pipit	*Anthus rufulus*	
18	Scarlet Minivet	*Pericrocotus flammeus*	
19	Grey-headed Bulbul	*Pycnonotus priocephalus*	Endangered
20	Red whiskered Bulbul	*Pycnonotus jocosus*	
21	Yellow browed Bulbul	*Iole indica*	Threatened
22	Black Bulbul	*Hypsipetes leucocephalus*	
23	Blue-headed Rock-Thrush	*Monticola cinclorhynchus*	
24	Malabar Whistling- Thrush	*Myiophonus horsfieldii*	Endangered
25	Orange headed Thrush	*Zoothera citrina*	
26	Eurasian Blackbird	*Turdus merula*	
27	White-bellied Shortwing	*Brachypteryx major*	Vulnerable
28	Indian Blue Robin	*Luscinia brunnea*	
29	Wynaad Laughingthrush	*Garrulax delesserti*	
30	Nilgiri Laughingthrush	*Garrulax cachinnans*	Endangered
31	Spotted Babbler	*Pellorneum ruficeps*	endemic
32	Indian Scimitar- Babbler	*Pomatorhinus horsfieldii*	
33	Black-headed Babbler	*Rhopocichla atriceps*	
34	Quaker Tit- Babbler	*Alcippe poioicephala*	
35	Blyth' s Reed- Warbler	*Acrocephalus dumetorum*	
36	Tickell' s Warbler	*Phylloscopus affinis*	
37	Greenish Leaf-Warbler	*Phylloscopus trochiloides*	
38	Large-billed Leaf-Warbler	*Phylloscopus magnirostris*	
39	Tytler' s Leaf- Warbler	*Phylloscopus tytleri*	Near threatened
40	Western Crowned Warbler	*Phylloscopus occipitalis*	
41	Black and Orange Flycatcher	*Ficedula nigrorufa*	Near threatened
42	Nilgiri Flycatcher	*Eumyias albicaudata*	Vulnerable
43	Grey-headed Flycatcher	*Culicicapa ceylonensis*	
44	Black-lored Yellow Tit	*Parus xanthogenys*	
45	Plain Flower pecker	*Dicaeum concolor*	
46	Small Sunbird	*Nectarinia minima*	
47	Oriental White-eye	*Zosterops palpebrosus*	
48	Ashy Drongo	*Dicrurus leucophaeus*	

Butterflies

Sl. No.	Scientific name	Family
1	*Troides minos* Cram	Papilionidae
2	*Graphium sarpedon teredon* Feld.	Papilionidae
3	*Graphium agamemnon*	Papilionidae
4	*Pachliopta aristolochiae* Fb	Papilionidae
5	*Papilio liomedon*	Papilionidae
6	*Papilo helenus*	Papilionidae
7	*Papilo polytes*	Papilionidae
8	*Papilo polymnestor*	Papilionidae
9	*Papilio paris*	Papilionidae
10	*Papilio polytes polytes*	Papilionidae
11	*Papilio clytia clytia*	Papilionidae
12	*Papilio liomedon*	Papilionidae
13	*Pachliopta hector*	Papilionidae
14	*Graphium sarpedon teredon*	Papilionidae
15	*Pachliopta pandiyana*	Papilionidae
16	*Appias albina*	Pieridae
17	*Appias lyncida* Cram.	Pieridae
18	*Appias paulina* Feld.	Pieridae
19	*Catopsilia pomona* Fb.	Pieridae
20	*Catopsilia pyranthe* Lin.	Pieridae
21	*Cepora nadina*	Pieridae
22	*Delias eucharis* Drury	Pieridae
23	*Eurema blanda* Boisd.	Pieridae
24	*Eurema hecabe* Lin.	Pieridae
25	*Leptosia nina* Fb.	Pieridae
26	*Ixias Marianne* Cram.	Pieridae
27	*Colotis eucharis eucharis*	Pieridae
28	*Caleta caleta decidia*	Lycaenidae
29	*Udara akasa*	Lycaenidae
30	*Zizula hylax*	Lycaenidae
31	*Euchrysops cnejus*	Lycaenidae
32	*Arhopala pseudocentaurus* Doubleday	Lycaenidae
33	*Castalius rosimon* Fb.,	Lycaenidae
34	*Cheritra freja* Fb.	Lycaenidae
35	*Chilades pandava* Horsfield	Lycaenidae
36	*Lampides boeticus* linne	Lycaenidae
37	*Spindasis vulcanus vulcanus* Fb.	Lycaenidae
38	*Loxura atymus* Carm.	Lycaenidae
39	*Tajuria cippus* Fb.	Lycaenidae
40	*Megisba malaya* Moore	Lycaenidae
41	*Jamides elecio* Field	Lycaenidae
42	*Pieris canidia canis*	Lycaenidae
43	*Ixias pyrene sesia*	Lycaenidae
44	*Jamides celeno*	Lycaenidae
45	*Ariadne merione Cram*	Nymphalidae
46	*Cirrochora thaia Fb.*	Nymphalidae
47	*Cupha erymanthis Drury.*	Nymphalidae
48	*Euthalia garuda* Moore	Nymphalidae
49	*Euthalia lubentina* Cram.	Nymphalidae

50	*Hypolimnas bolina* Lin.	Nymphalidae
51	*Hypolimnas misippus* Lin.	Nymphalidae
52	*Junonia atlites* Lin	Nymphalidae
53	*Junonia hierta* Fb.	Nymphalidae
54	*Junonia almana almana* Lin.	Nymphalidae
55	*Junonia iphita* Cram	Nymphalidae
56	*Junonia orithya*	Nymphalidae
57	*Kanishka canace*	Nymphalidae
58	*Junonia lemonias*	Nymphalidae
59	*Tirumala limniace*	Nymphalidae
60	*Tirumala sertentrionis*	Nymphalidae
61	*Phalanta phalantha* Drury.	Nymphalidae
62	*Vanessa indica* Frushstorfer	Nymphalidae
63	*Eupolea sylvester*	Nymphalidae
64	*Euploea core*	Nymphalidae
65	*Melanitis leda*	Nymphalidae
66	*Lethe rohria*	Nymphalidae
67	*Lethe drypetis todara*	Nymphalidae
68	*Lethe rohira neelgheriensis*	Nymphalidae
69	*Idea malabarica*	Nymphalidae
70	*Mycalesis perseus*	Nymphalidae
71	*Mycalesis mineus polydecta*	Nymphalidae
72	*Mycalesis oculus*	Nymphalidae
73	*Zipoetis saitis*	Nymphalidae
74	*Charaxes solon solon*	Nymphalidae
75	*Acraea violae*	Nymphalidae
76	*Hasora chromus*	Hesperiidae
77	*Iambrix salsala*	Hesperiidae
78	*Elymnias caudate* Butler	Satyridae
79	*Melanitis leda* Lin.	Satyridae
80	*Mycalesis anaxias* Hewit	Satyridae
81	*Zipoetis saitis* Hewit	Satyridae
82	*Lethe drypetis* Moore	Satyridae
83	*Mycalesis mineus polydecta* Cram.	Satyridae
84	*Ypthima baldus*	Satyridae

APPENDIX - VI
BODY CONDITION EVALUATION FORM

PROTECTED AREA: ..... **SPECIES:** .....

DATE	LOCALITY	AGE & SEX	SCORES FOR DIFFERENT BODY PARTS									BCI	REMARKS
			1	2	3	4	5	6	7	8	9		

1. Flank area
2. Ribs
3. Pelvic girdle
4. Vertebral column
5. Temporal depression
6. Tail contour
7. Lumbar shelf

INVESTIGATOR : .....

SIGNATURE : .....

APPENDIX -VII
DISEASES OUTBREAK HISTORY FORM

1. Nature and magnitude of outbreak isolated case/Sporadic/ epidemic/poaching/.....
2. If sporadic /isolated case, species affected .....
3. If epidemic, a) Any morbidity /mortality among livestock :Yes/No/Unknown/.....
   b) Past history of similar or other epidemic :.....
   c) Habitat description of the epidemic area : .....

		Species of Wildlife and Livestock affected							
d) Species of animals affected in the order of severity									
e) Mortality	1. Actually seen								
	2. A guesstimate								
f) Age class & sex of dead individuals	ADULT MALE								
	ADULT FEMALE								
	SUBADULT MALE								
	SUBADULT FEMALE								
	YEARLINGS								
	JUVENILES								
g) Date of onset of deaths									
h) Date of last death seen									
i) Number of ailing animals									
j) Census figures									

4. Proximity of wildlife deaths to the location of villages (Distance) :.....
5. Livestock component a) Cattle movement in the park : Seasonal/daily/.....
   b) Extent of livestock-wildlife overlap : .....
   c) Areas of such overlap :.....
6. Environmental conditions a) Season ..... b) Food availability .....
   c) Others factors .....

Protected area : .....

Name & Address : .....

Date : ..... ***Signature*** : .....

G. HEAD 1. BUCCAL & NASAL CAVITIES 2. TONGUE 3. BRAIN AND SPINAL CORD		
H. MUSCULATURE		
I. SKELETON		
3. STOMACH	(i) Rumen (ii) Reticulum (iii) Omasum (iv) Abomasum	
4. SMALL INTESTINES	(i) Duodenum (ii) Jejunum (iii) Ileum	
5. LARGE INTESTINES	(i) Colon (ii) Caecum (iii) Rectum	
6. LYMPH GLANDS (Mesenteric)		
J. UROGENITAL ORGANS 1. URINARY BLADDER 2. KIDNEYS (Appearance) 3. KIDNEYS (Colour and appearance)		
1. REPRODUCTIVE ORGANS	(i) Testes/Ovary (ii) Penis/Uterus	
5. LYMPH GLANDS		

IV. SUMMARY OF MAJOR FINDINGS

V. SPECIMENS COLLECTED FOR LABORATORY DIAGNOSIS

1)..... 4).....

2)..... 5).....

3)..... 6).....

VI. PROVISIONAL DIAGNOSIS

VII. REMARKS

.....

.....

.....

PLACE :..... **SIGNATURE :**.....

DATE :..... **NAME :**.....

ADDRESS:..... **DESIGNATION:**.....

.....

APPENDIX - IX

RECORD SHEET FOR ECTOPARASITES

HOST :..... PROTECTED AREA :.....

SEX : ..... LOCALITY :.....

AGE :..... PRESERVATIVE USED :.....

STATE : Dead/ill/health/ ..... BODY CONDITION INDEX :..... COLLECTED BY :.....

DATE OF COLLECTION :.....

SPECIMEN CONTAINER CODE :.....

ECTOPARASITE	SPECIES/ TYPE	BODY SITE	NUMBERS PRESENT	NUMBERS COLLECTED	INDIVIDUAL SPECIMEN CONTAINER NO.	REMARKS
1. TICK	1.					
	2.					
	3.					
2. FLEAS	1.					
	2.					
3. FLIES	1.					
	2.					
4. LICE	1.					
	2.					
5. MITES (Scab/Mange)						
6. SKIN WARBLES						

INVESTIGATOR'S NAME :.....

DESIGNATION :.....

SIGNATURE :.....

DATE :.....

ADDRESS : .....

APPENDIX - X

RECORD SHEET FOR ENDOPARASITES

SPECIES ..... BODY CONDITION INDEX .....
AGE & SEX ..... FAT RESERVES .....
DATE OF DEATH ..... CAUSE OF DEATH .....

BODY REGION	PARASITE TYPE	YES /NO	LOCATION	DEGREE OF INFECTION	INDIVIDUAL CONTAINER NO.
A. Subcutaneous tissue	1. Round worms				
	2. Warble fly larvae				
	3. Others				
B. Body cavities	1. Cysts in abdomen				
	2. Cysts in thorax				
	3. Cysts in pelvis				
	4. Filarid worms				
C. Respiratory system	1. Worms in passage				
	2. Lungworms				
	3. Cysts in lung				
	4. Cysts in diaphragm				
D. Liver and Gall bladder	1. Flukes				
	2. Tape worms				
	3. Round worms				
	4. Cysts in liver				
E. Heart and blood vessels (Take blood smear for protozoans)	1.Worms in heart muscle				
	2. Cysts in heart muscle				
	3. Filarid worms				
	4. Blood flukes in vessels				
F. Digestive system (Take faeces for egg & oocyst count)	1. Rumen flukes				
	2. Tape worms				
	3. Round worms				
	4. Others				
G. Urogenital organs (Collect urine)	1. Kidney worms				
	2. Others				
H. Head	1. Eye worm				
	2. Larvae (in cavities)				
I. Muscles	1. Round worms 2. Cysts				

PROJECTED AREA :..... SIGNATURE :..... LOCALITY :.....
NAME :.....
DATE :..... DESIGNATION :.....
ADDRESS :.....

APPENDIX - VIII.

RECORD OF POST MORTEM EXAMINATION

SPECIES :	PROTECTED AREA : .....
AGE :	LOCALITY : .....
SEX :	HABITAT : .....
CAPTIVE/WILD :	WEATHER : .....
WEIGHT :	DATE & TIME OF DEATH : .....
AMBIENT TEMPERATURE :	TIME OF PM EXAMINATION : .....

I. HISTORY OF DEATH/ OUTBREAK

1.Clinical signs before death :.....
.....
.....
2. Surroundings of the carcass.....
.....
3. Other information
.....

II. EXTERNAL EXAMINATON

BODY CONDITION INDEX : .....
PRESENCE OF WOUNDS :.....
RIGOR MORTIS :.....
SUPERFICIAL LYMPH GLANDS : .....
MUCOUS –MEMBRANE :.....
NATURAL ORIFICES : .....
OTHER ABNORMALITIES :.....

III. INTERNAL EXAMINATION

A. SUBCUTANEOUS TISSUE	
B. BODY CAVITIES 1. POSITION OF VISCERAL ORGANS 2. PERITONEAL CAVITY 3. PLEURAL CAVITY AND PLEURA	
C. RESPIRATORY SYSTEM 1. LARYNX 2. BRONCHI AND BRONCHIOLES 3. LUNGS (Appearance & Colour) 4. LYMPH GLANDS 5. DIAPHRAGM	
D. HEPATIC SYSTEM 1. LIVER (Appearance, size, colour) 2. LIVER TISSUE 3. GALL BLADDER 4. LYMPH GLANDS	
E. CIRCULAORY & LYMPHATIC SYSTEMS 1. PERICARDIAL SAC 2. HEART MUSCLE 3. HEART CHAMBERS 4. LARGE BLOOD VESSELS 5. SMALL BLOOD VESSELS (Mesenteric) 6. SPLEEN (Appearance, size, colour) 7. SPLENIC TISSUE	
F. DIGESTIVE TRACT 1. PHARYNX 2. OESOPHAGUS	

APPENDIX - XI
LABORATORY SPECIMEN FORM

Please examine the specimen for:.....
.....

SPECIMEN NO :..... SPECIES :.....

SPECIMEN TYPE :..... SEX :.....

PRESERVATIVE USED :..... AGE :.....

COLLECTION DATE :..... WEIGHT :.....

PROTECTED AREA :.....

DISEASE SUSPECTED: .....

HISTORY OF AILMENT/DEATH/OUTBREAK:.....
.....
.....
.....

TIME LAG BETWEEN DEATH & COLLECTION:.....

TIME LAG BETWEEN COLLECTION & PRESERVATION:.....

MODE OF DESPATCH : Post/rail/air/bus/messenger :.....

TIME OF DESPATCH :.....

Investigator's name :..... Signature :.....

Sender's Address :	**Laboratory Address :**