

Database on Nilgiri Biosphere Reserve

Introduction

The idea of 'Biosphere Reserves' was initiated by UNESCO in 1973-'74 under its Man and Biosphere (MAB) Programme. The MAB, launched in 1970 by UNESCO, is a broad based ecological programme aimed to develop within the natural and social sciences, a basis for the rational use and conservation of the resources of the biosphere for the improvement of the relationship between man and the environment, predict the consequences of today's actions on tomorrow's world and thereby to increase man's ability to manage efficiently the natural resources of the biosphere. Biosphere reserves are nominated by National Government which meet a minimal set of criteria and adhere to minimal set of conditions for inclusion in the world network of biosphere reserves under the MAB programme of UNESCO. According to UNESCO, in total there are 631 biosphere reserves in 119 countries, including 14 trans boundary sites. They are distributed as follows: a) 64 in 28 countries in Africa b) 27 in 11 countries in the Arab States c) 130 in 23 countries in Asia and the Pacific d) 290 in 36 countries in Europe and North America e) 120 in 21 countries in Latin America and the Caribbean (Kumari, 2015).

India, as part of the UNESCO's MAB Programme, launched the Indian National Man and Biosphere Programme in the 1970s to identify areas, which are representative of the various bio-geographical zones that can be set-aside as biosphere reserves (Daniel, 1996). The Department of Science and Technology had constituted a committee under the chairmanship of Professor Madhav Gadgil of the Indian Institute of Science, Bangalore to survey and demarcate the exact limits of the proposed biosphere reserve in the Nilgiris. Consequently, the Nilgiris was identified as representative of the Western Ghats. As per the first document on this proposed biosphere reserve, the total area demarcated was around 5670 km² of which 2020 km² were designated as the core zone, 2290 km² as manipulation (forestry) zone, 1330 km² as manipulation (agriculture) zone and a mere 30 km² as restoration zone (Anon., 1980).

The Nilgiri Biosphere Reserve (NBR) is an International Biosphere Reserve located in the Western Ghats and was the first biosphere reserve in India established during 1986. It has a wide range of ecosystems and species diversity. The NBR is under consideration by the UNESCO World Heritage Committee for selection as a World Heritage Site (Kumari, 2015).

1.1 Objectives of Creating NBR

Biosphere reserves are designed to play three basic roles in relating conservation, development and logistic support for comparative research and monitoring. (a) Conservation role: Biosphere reserves provide non-conventional protection of indigenous genetic resources, plant and animal species, ecosystems and landscapes of value for the conservation of the world's biological diversity; (b) Development role: Biosphere reserves seek to combine conservation concerns with sustainable use of ecosystem's resources through close co-operation with local communities, taking advantage of traditional knowledge, indigenous products and appropriate land management (c) Logistic role: Biosphere reserves are linked

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through a global network; they provide facilities for research, monitoring, education and training for local purposes as well as for international or regional comparative research and monitoring programmes (GOI, 2007).

The NBR was mainly established to conserve *in-situ* genetic diversity of species, to restore degraded ecosystems to their natural conditions, to provide baseline data for ecological and environmental research and education and to function as an alternate model for sustainable development.

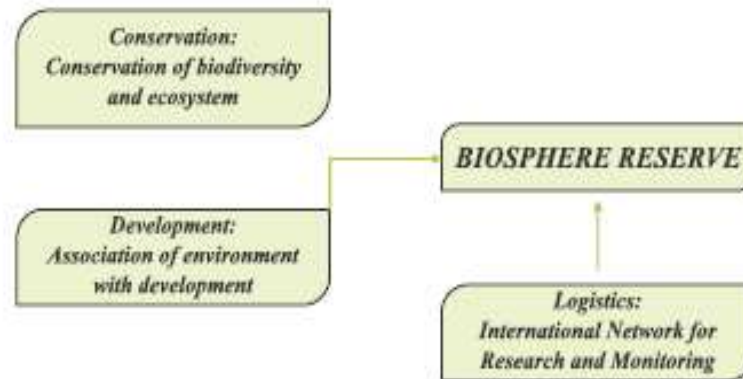


Figure 1. Objectives of Biosphere (Kumari, 2015)

1.2 Geography

The NBR lies at the tri-junction of the three southern States of India – Kerala, Tamil Nadu and Karnataka, stretches from Coorg-Wynaad Plateau just east of Brahmagiri, south to Attapadi-Bolampatti Hills at the northern edge of the Palghat Gap and eastwards into the Talamalai-Hasanur Plateau of the Eastern Ghats. The total area (5,670 km²) of NBR is spread in three states viz., Tamil Nadu (2537.6 km²), Kerala (1455.4 km²) and Karnataka (1527.4 km²). It forms an almost complete ring around the Nilgiri Plateau. The sites are characterised by both conical and flat topped hills interspersed with valleys and spurs. As the Western Ghats extends southwards, the NBR appears as a contiguous unit of dense forests and wide-ranging landscape. Encompassing high hills, wide plateaus and undulating features, NBR includes the towering Nilgiri hills that extend into the north and south with a number of off shoot ranges. The south-west slopes are steep, while on the eastern side, the slopes are relatively gentle. The northern parts of the reserve extend into the Mysore plateau and the southern tail form relatively smaller hills in the west of the Coimbatore plains. The highest elevations of the NBR are over 2600 metres Above Mean Sea Level (AMSL) and the lowest is below 80 metres AMSL. The NBR is biogeographically part of the Indo-Malayan realm and an appropriate representative of the topographic and climatic complexity of the Western Ghats – biodiversity 'hot-spot' in India (Editor - Director, 2001).

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The NBR area included within Tamil Nadu consisting of Nilgiri-Wynad, upper Nilgiri plateau, Nilgiri south eastern slopes, Nilgiri eastern slopes and Sigur plateau extends to 2537 km². Mudumalai wild life sanctuary having an area of about 300 km² and Nilgiri Tehr sanctuary (now called Mukurthi National Park) are the prime wild life conservation areas in the Tamil Nadu part of NBR. Benne reserve forest within Nilgiri-Wynad has very good semi-ever green forest. The reservoirs on Pykara river formed in the upper Nilgiri Plateau includes Parthimund Parson's valley reservoir, Mukurthi lake and Pykara lake. The southern edge of Nilgiris descends abruptly to the Attapadi plateau near the confluence of Kunda and Bhawani rivers. The Pillur reservoir is situated below the confluence of Kunda with Bhavani. On the eastern slopes of Nilgiri the Bhavani river has been dammed near its confluence with Moyar river resulting in the formation of Bhavanisagar with a water spread of 80 km².

The eastern slopes of Nilgiri and a portion of Talamala reserve forest immediately opposite to it beyond Moyar and the Moyar reserve forest of Sigur plateau constitute a very rich area having biota of the driest tracts within the biosphere reserve. This area is being treated as core zone for preservation of dry scrub forest biota of peninsular India. The Sigur plateau stretches all along the northern boundary of Nilgiris from near Markandurai bella in Theppakadu area, where the Nilgiri-Wynad and Kerala Wynad meet and its passes through Masinagudi, Anaikatti and Tenkamarda villages and ends near Gaza lathi where the Talamalai - Billigiri Rangan hills, Satyamangalam plateau and Coimbatore plains meet. Sigur plateau is a dry rain shadow area with extensive scrub jungle. The slope forests are dominated by xerophytic scrubs gradually changing through dry deciduous forest to semi-evergreen and stunted sholas on the crest. The absence of road links and scattered human settlements have encouraged concentration of wild life on the Sigur plateau.

Nilgiri Biosphere Reserve area included within Kerala State is around 1455.4 km² and comprises broadly forests of Kerala Wynad, Nilambur vested forests, new Amarambalam reserve forests, Silent valley, Attapaddi valley reserve forest, Attapaddi plateau and Siruvani hills. Kerala Wynad is an extensive table land containing Wynad wild life sanctuary. The northern half of Wynad wild life sanctuary contains Begur, Kudrekode, Edakode and Kattikulam reserve forests, separated from the southern half by Pulpalli encroachments. The southern half of the sanctuary includes Kurchiyat, Kuppadi, Rampur and Noolpuzha reserve forests. This forest belt is along the inter-state boundary and forms a valuable buffer area for the Bandipur tiger reserve and Mudumalai wild life sanctuary.

The floral complex stretching from Nilgiri slopes to Kerala plains on the one hand and the Mysore plateau on the other, used to provide optimal habitat conditions for all wild life species, especially elephants. The natural vegetation exists only upto the Gudalur Taluka boundary towards the north western corner of Nilambur forests along the Chalipuzha drainage. New Amarambalam reserve forests are the slope forests drained by Punnapuzha, Talipuzha, Karimpuzha and Cherupuzha, all tributaries of Challyar. The evergreen and semi-evergreen areas of new Amarambalam are undisturbed while moist deciduous portions have been brought under monoculture of teak. The Silent valley National park having an area of about 90 Km² is mostly covered by west coast tropical evergreen forest and hold all the basic attributes

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required of a biosphere reserve. The southern limits of Kerala State part of Nilgiri biosphere include the tropical evergreen forests of Muthikulam reserve forest and moist deciduous Chenat Nayar reserve forest.

1.2.1 Location

The NBR is located in the Western Ghats between 76° to 77°15' East longitude and 11°15' to 12°15' North latitude. The NBR region is divided into 13 forest divisions, viz., Coimbatore Division, Nilgiri South Division, Erode Division, Nilgiri North Division, Satyamangalam Division, Nilambur Division, Mudumalai Sanctuary, Wynad Division, Palghat Division, Chamrajnagar Division, Project Tiger Bandipur, Mysore Division and Hunsur Division. The protected areas that lie within this reserve include the following: Mudumalai Wildlife Sanctuary, Wayanad Wildlife Sanctuary, Bandipur National Park, Nagarhole National Park (Rajiv Gandhi National Park), Mukurthi National Park and Silent Valley National Park.

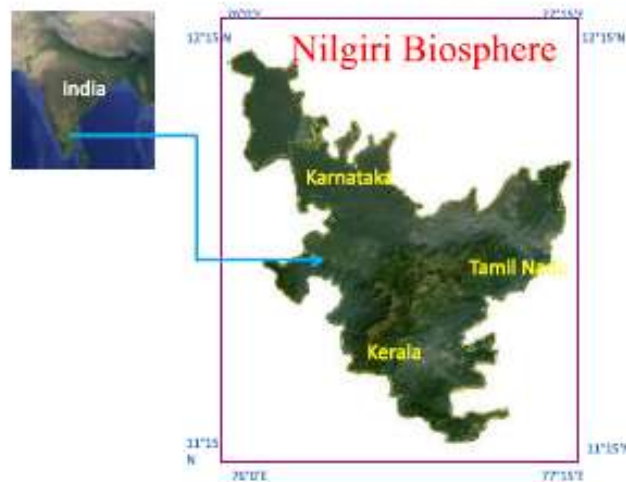


Figure 2. Location of NBR

1.2.2 Topography and Climate of NBR

The NBR has a remarkable topographic diversity varying from as low as 80 m (Nilambur plains) to over 2600 m (Nilgiri plateau) AMSL. The Palghat Gap separates NBR from the southern western ghats that touches the southern extremity of Kanyakumari in Tamil Nadu. It is at Kanyakumari that these ranges, alternatively called the Sahyadris, Nilgiris, Anaimalais and Agastyamalai, end almost upon the sea front, completing its journey of more than 1600 km from the Tapi river in Gujarat to the sea front of the Indian ocean.

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The NBR falls under the biogeographic region of the Malabar rain forest and Deccan thorn forest. The rainfall is generally heavier in the western side averaging 5000 mm. The wet season is June – September though there are summer and occasional winter rains locally within the NBR. The length of the dry season varies from about a month in the western hills to over six months in the eastern plateau. Ground temperature below 0 °C (frost) is frequent during December-January and April-May are the hottest months with 41 °C in the higher hills of Nilgiris.

Climatically NBR presents varieties of climate types. The higher region of NBR under Tamil Nadu has a temperate montane climate with low temperature due to high altitude but at lower elevation it has typical tropical monsoonic climate. The Tamil Nadu portion towards south-west, where monsoon is more pronounced gets more than 7620 mm annual rainfall but towards north east, it is merely 1777 mm/annum and similar is the condition of temperature here. In rain shadow zone, it goes upto 40°C or more in summer, whereas, in grassy meadows frost is a regular phenomenon during winter. The Karnataka portion receives an average rainfall in between 900 mm to 1778 mm/annum and temperate varies from 12°C to 32°C.

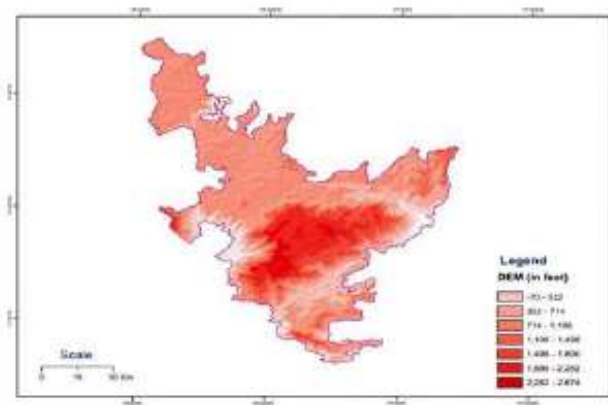


Figure 3. DEM of NBR

1.3 Biodiversity of NBR

The NBR is known for its rich bio-diversity and identified as being representative of the bio-geographical zone of the Western Ghats and the setting up of the reserve aimed at conserving large tracts, rich in bio-diversity and to promote sustainable use of resources. There are 3238 species of *angiosperms*, 71 species of *gymnosperms*, 134 species of *pteridophytes*, 300 species of butterflies and 684 species of vertebrates hitherto reported from this area. Of the 285 species of vertebrates endemic to the western ghats, 156 occur within the NBR (Daniel, 1992).

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Several species of lower organisms are yet to be discovered and described.

The NBR completely encircles the massive Nilgiri Plateau and extends over wide and diverse ecological, geological, cultural, climatic and geographic zonation. Due to enormous diversity, there have thrived distinctive forest types and numerous endemic species. The reserve includes within its area parts of two of the twelve bio-geographical zones of India (The Malabar rainforest and Deccan Thorn forest) and as a result encompasses within it a wide spectrum of spectacular species and ecosystems.

1.3.1 Vegetation in NBR

The altitude and climatic gradients support and nourish different types of vegetation in NBR. The NBR embraces all the important forest types that are found in South India such as tropical thorn forest, tropical dry deciduous forests, tropical moist deciduous forests, tropical semi evergreen forests, sub tropical broad leaved forests, tropical wet evergreen forests, southern montane wet temperate forests, southern montane wet grasslands and subtropical hill savannas.

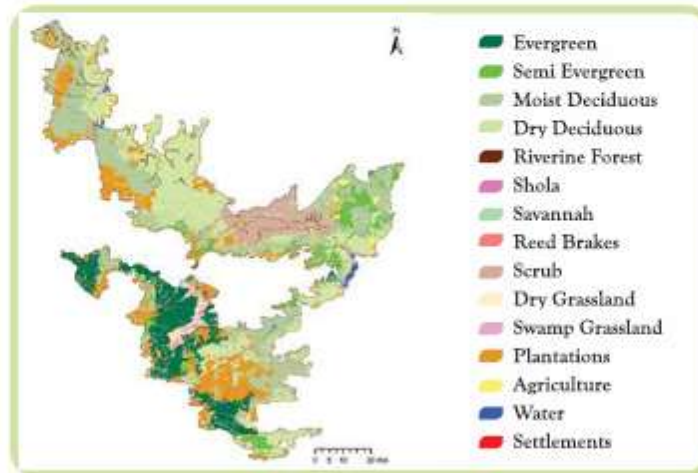


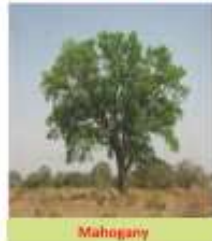
Figure 4. Vegetation Types of NBR

Table 1. Types of Vegetation in the NBR

Sl.No.	Forest Type	Nature of Vegetation	Area of occurrence
1.	Moist evergreen	Dense, moist and multi storeyed forest with gigantic trees	In the narrow valleys of Silent Valley
2.	Semi evergreen	Moist, Deciduous	Nilambur and Palghat division
3.	Thorn	Dense	North east part of the Nilgiri district
4.	Savannah woodland	Trees scattered amid woodland	Mudumalai and Bandipur
5.	Sholas & Grasslands	High elevated evergreen with grasslands	South and Western catchment area, Mukurthi national park



Rosewood Tree



Mahogany



Ebony Tree

Natural vegetation

Tropical Evergreen and Semi Evergreen Forests: These forests are found in the western slope of the Western Ghats; they are found in warm and humid areas with an annual precipitation of over 2000 mm and mean annual temperature above 22°C. Tropical evergreen forests are well stratified, with layers closer to the ground and are covered with shrubs and creepers, with short structured trees followed by tall variety of trees. In these forests, trees reach great heights up to 60 m or above. There is no definite time for trees to shed their leaves, flowering and fruition. As such these forests appear green all the year round. Species found in these forests include rosewood, mahogany, aini, ebony, etc. The semi evergreen forests are found in the less rainy parts of these regions. Such forests have a mixture of evergreen and moist deciduous trees. The undergrowing climbers provide an evergreen character to these forests. Main species are white cedar, hollock and kail.

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Sandal Wood



Sal Tree



Kusum Tree

Tropical Deciduous Forests: These are the most widespread forests in India. They are also called the monsoon forests. They spread over regions which receive rainfall between 700-2000 mm. On the basis of the availability of water, these forests are further divided into moist and dry deciduous. The moist deciduous forests are more pronounced in the regions which record rainfall between 1000-2000 mm. These forests are found in the northeastern states along the foot hills of Himalayas, Eastern slopes of the Western Ghats. Teak, sal, shisham, hurra, mahua, amla, semul, kusum and sandalwood etc., are the main species of these forests.

The Sholas and Grasslands: They play a very important role in retaining water and supplying it to these streams. A drastic decline in the sholas and grasslands is one of the reasons for the recent water scarcity in the NBR.

Plantations: Variety of exotic and native tree plantations cover the landscape of the NBR. The distribution of these artificial vegetation within the reserve is given in Table 2.



Bluegum



Cardamom



Arecanut

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Table 2. Artificial Vegetation

Sl.No.	Location	Vegetation type	Nature of plantation	Area(KM ²)
1.	Coorg Wynaad (Tittimati Arakeri Hotgot Nalkeri)	Moist deciduous	Teak	350
2.	Kerala Wynaad (Begur Kudrekode Kattikulam Edakode Kurchiyat)	Moist deciduous	Teak	325
3.	Nilgiri Wynaad (Mudmnalai Kumbarkolli)	Moist deciduous	Teak	195
4.	Nilambur vested forests (Gwalior Rayon plantations)	Semi-evergreen	Blue gum	100
5.	New Amarambalam	Moist deciduous	Teak	10
6.	Silent Valley	Wet evergreen	-	0
7.	Upper Nilgiri Plateau	Shola-grassland	Wattle Blue gum	60
8.	Attapadi valley Rain Forest	Wet evergreen	Teak, Fruit trees	10
9.	Attapadi Plateau	Scrub forest, Wet evergreen	Coffee, Cardamom, Pepper, Arecanut	200
10.	Siruvani hills (Muthikulam Chenatnayar Bolampatti)	Wet evergreen	Teak, Blue gum	280
11.	Nilgiri south-eastern slopes (Gopanari Pillur slopes Melur slopes Jakkanare RF)	Scrub forest Dry deciduous	Blue gum	220
12.	Nilgiri eastern slope	Scrub forest	-	0
13.	Sigur plateau (Avarhalla Sigur)	Scrub forest Semi-evergreen Dry deciduous Wet evergreen	Blue gum	260
14.	Mysore plateau south	Scrub forest Dry deciduous Moist deciduous	-	0
15.	Mysore plateau north (Kakankote, Mettukuppem, Veeranahosahalli, Kachuvanahalli)	Moist deciduous	Teak	280

Source: (Anon, 1980)

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1.3.2 Flora

The NBR is very rich in plant diversity. About 3,300 species of flowering plants can be seen here. Of the 3,300 species 132 are endemic to the NBR. The genus *Baeolepis* is exclusively endemic to the Nilgiris. Some of the plants entirely restricted to the NBR include species of *Adenoon*, *Calacanthus*, *Baeolepis*, *Frerea*, *Jaradina*, *Wagatea*, *Poeciloneuron*, etc.

Table 3. Plant Types in NBR

Sl.No	Plant Type	No of Species
1.	Angiosperms	3238
2.	Gymnosperms	71
3.	Pteridophytes	134

Angiosperms: Angiosperms are flowering plants that reproduce through seeds that are contained in fruit. The flower of a plant can contain male anatomy, female anatomy and sterile structures. A plant that contains both male and female anatomy is known as a perfect flower. A flower that only contains male or only female anatomy is called an imperfect flower. There are two classes of angiosperms, phylum *Anthophyta*: the *Monocotyledonae*, or **monocots** (about 65,000 species) and the *Dicotyledonae*, or **dicots** (about 175,000 species). Dicots are the more primitive of the two classes, with monocots apparently having derived from early dicots. Included in the dicots are the great majority of familiar Angiosperms - almost all kinds of trees and shrubs, snapdragons, mints, peas, sunflowers and other plants. Monocots include the lilies, grasses, cattails, palms, agaves, yuccas, pondweeds, orchids and irises.

Gymnosperms: There are four groups of living gymnosperms (Conifers, Cycads, Gnetophytes, and *Ginkgo*), none of which is directly related to one another, but all of which lack the flowers and fruits of angiosperms. In all of them the ovule, which becomes a seed, rests exposed on a scale (modified leaf) and is not completely enclosed by sporophyte tissues at the time of pollination. The most familiar gymnosperms are conifers (phylum: *Coniferophyta*), which include pines, spruces, firs, cedars, hemlocks, yews, larches, cypresses and others.

Pteridophytes: Ferns are vascular plants that do not produce seeds. Sexual reproduction is accomplished by the release of spores, which develop in special structures called sporangia (singular: sporangium). The sporangia usually occur in clusters called sori (singular: sorus), found on the underside of "fertile" leaves. Fern leaves, often called fronds, usually arise from underground stems (rhizomes). The primary divisions of compound leaves are referred to as pinnae (singular: pinna) and further divisions of pinnae are known as pinnules.

The sholas of the NBR are a treasure house of rare plant species, of the 175 species of orchids found in the NBR, 8 are endemic to the NBR. These include endemic and endangered species of *Vanda*, *Liparis*, *Bulbophyllum*, *Spiranthes* and *Thrixspermum*.

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Flora of the various forest types in the NBR have been studied by several authors; Subramanyam, 1959; Subramanian, 1966, (Bolampatti); Naithani, 1966 (Bandipur); Sharma et al., 1978; Stephen, 1994 (Mudumalai); Vajravelu, 1992 (Palghat) and Manilla, 1988 (Silent Valley).

Endemic flora: According to Nayar (1983) there are 141 genera endemic to India, out of which 50 spread over 25 families are endemic to the western ghats, 11 genera occurring in the Nilgiris. At the species level, out of the estimated 2100 species of flowering plants are endemic to peninsular India, 818 are to be found in the Nilgiris and adjoining areas (Mohanan and Balakrishnan, 1991). One hundred and thirty two species and 13 varieties of flowering plants are endemic to the NBR which amounts to 4.0 per cent of its total *angiosperm* flora (Ahmedullah and Nayar, 1986). Of these, 28 are exclusive to the Kundah range in the Nilgiris district (Nair and Daniel, 1986). The genus *Baeolepis* with a single species *nervosa* (*Periplacaceae*) is restricted to the Nilgiris (Ahmedullah and Nayar, 1986). Endemism is marked in the families *Acanthaceae*, *Balsaminaceae*, *Poaceae* and *Orchidaceae* within the NBR.

*Baeolepis nervosa**Odontanema cuspidatum**Phalaenopsis*

Threatened flora: Of the 168 species of flowering plants of Tamil Nadu listed as endangered in the Red Data books, 25 (15%) are exclusive to the Nilgiris. Some of the threatened orchids of this region are *Bulbophyllum acutiflorum*, *B. nodosum*, *Habenaria denticulata*, *H. polyodon*, *Liparis biloba*, *Spiranthes sinensis*, *Thrixspennum musciflorum* and *Vanda wightii* (Mohanan and Balakrishnan, 1991).

*B. nodosum**Spiranthes sinensis**Thrixspennum musciflorum*

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Economically Important Flora: Sanjappa (1991) recorded 80 species of legumes from western ghats and a majority of these are from the NBR and adjacent areas. A large number of medicinal plants also occur in the NBR. About 200 species of medicinal plants have been reported from the NBR of which 24 species are commercially exploited. Due to over exploitation certain species such as *Rauvolfia serpentina* and *Saraca asoca* have become rare.



Rauvolfia serpentina



Saraca asoca

New Taxa: In addition, Nilgiris is an important centre of specification and many plants new to science have been discovered and described from the region making it the type locality for a number of species. *Silentvalleya* (Poaceae) and Kanjaram (*Acanthaceae*) are two genera recently discovered from this region. *Curcuma silentvalleyi*, *Eriatiagii*, *Hedyotis silentvalleyensis*, *Hydnocarpus pendulus*, *Liparis indiraii*, *Oberonia bisaccata*, *Porpax chandrasekharanii*, *Robiquetia josephiana*, *Sauropus saksenianus* and *Silentvalleya nairii* are newly described species.



Robiquetia josephiana



Porpax chandrasekharanii



Hydnocarpus pendulus

1.3.3 Fauna

The fauna of the NBR includes over 100 species of mammals, 350 species of birds, 80 species of reptiles and amphibians, 300 species of butterflies and innumerable invertebrates. 39 species of fish, 31 amphibians and 60 species of reptiles endemic to the western ghats also occur in the NBR. Fresh water fish such as *Danio neilgherensis*, *Hypselo barbisdubuis* and *Puntius bovanicus* are restricted to the NBR. The Nilgiri tahr, Nilgiri langur, slender loris, black buck, tiger, gaur, Indian elephant and marten are some of the animals found here.

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Garrulax cachinnans



Nilgiri Langur



Nilgiri Tahr

We know very little about the invertebrates of the NBR except butterflies. Almost all the butterfly species endemic to the western ghats also occur within the reserve (Daniel, 1992). The best known animals are however the vertebrates, especially the larger mammals. There are already efforts made towards the protection of endangered and endemic mammals such as the Asian elephant (*Elephas maximus*), Tiger (*Panthera tigris*), Nilgiri tahr (*Hemitragus hylocricus*), Nilgiri langur (*Presbytis johnii*) and lion tailed macaque (*Macaca silenus*) within the biosphere reserve. A number of little known bats (*Chiroptera*) and smaller mammals including the Clawless otter (*Aonyx cinerea*), Nilgiri marten (*Martes gwatkinsi*), Civets (*Viverra* sp.) and the lesser Cats (*Fezix* sp.) exist within the reserve. There is however very little information on their current range and status in the western ghats itself. Twelve species of mammals endemic to the western ghats are also found here; *Mus famulus* a rodent being exclusive to this reserve (Daniel, 1992).

Over 300 species of birds are known from the NBR and of this 15 species are endemic to the western ghats, except the white breasted laughing thrush (*Garrulax jerdoni*), all species are found in the biosphere reserve (Daniels, 1992). Of the 14 species, the Nilgiri laughing thrush (*Garrulax cachinnans*) is exclusive to the higher hills of the Nilgiris. The Nilgiri wood pigeon (*Columba elphinstonii*) listed as globally endangered is found frequently within the reserve. Some of the uncommon migratory birds that visit the western ghats during winter from the Himalayas such as the woodcock (*Scolopax rusticola*), blue chat (*Erithacus brunneus*) and brown breasted flycatcher (*Muscicapa muttui*) are found most often within the NBR.

Amongst the lower vertebrates a number of little known amphibians, reptiles and fish exist in the NBR. 39 species of fish, 31 species of amphibians and 60 species of reptiles endemic to the western ghats also occur within the biosphere reserve. Of these, 24 are hitherto known only from the NBR.

There are at least 300 marsh crocodiles (*Crocodylus palustris*) distributed in the major water courses of the reserve. Of these the Moyar river has the most substantial population. It must also be emphasized that this is the largest intact naturally breeding population of crocodiles anywhere in south India. Other endangered reptiles viz., the Indian rock python (*Python molurus*) and king cobra (*Ophiophagus hannah*) are frequently sighted within the NBR.

Management Zones of NBR

The Nilgiri Biosphere reserve is split into four major zones viz. Core Zone, Manipulation forestry Zone, Tourism Zone and Restoration Zone. Core Zone occupies 1240.3 km² (22.5%), Manipulation Forestry Zone has 3238.7 km² (58.6%), Tourism Zone has 335.0 km² (6.1%) and Restoration Zone is about 706.4 km² (12.8%) (Daniel, 1996). Presently, the management of the Nilgiri Biosphere is under the respective jurisdiction of the State Governments and the classifications of core, manipulation and restoration also under their management (Prabhakar, 1994).

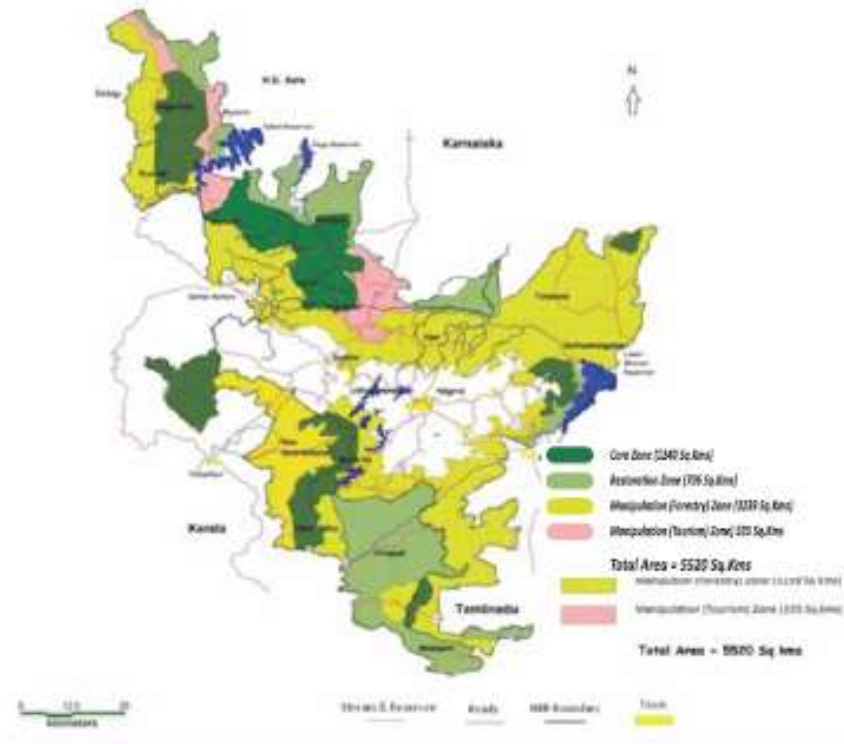


Figure 5. Management Zones of NBR

The core zone largely comprises of the most protected parts of the six protected areas and parts of the Nilgiri eastern ghats and Minchkuli region of Sathyamanagalam forests. A large part of the reserve is classified as manipulation zones that is a threat if logging operations are allowed in future. The restoration zones is mostly restricted to the Attapady forests that have suffered the relentless on slaughter of man in the previous decades.

Management Zones of NBR

Table 4. Area Under the Various Zones of the NBR

Sl.No.	State	Total area (KM ²)	Core area (KM ²)	Manipulation Forestry Zone (KM ²)	Tourism Zone (KM ²)	Restoration Zone (KM ²)
1.	Tamil Nadu	2537.6	274.0	2081.5	65.8	116.3
2.	Kerala	1455.4	264.5	945.0	0.0	245.9
3.	Karnataka	1527.4	701.8	212.2	269.2	344.2
	Total	5520.4	1240.3	3238.7	335.0	706.4

Core Zone: The core zone must contain suitable habitat for numerous plant and animal species, including higher order predators and may contain centres of endemism. Core areas often conserve the wild relatives of economic species and also represent important genetic reservoirs having exceptional scientific interest. Core area(s) comprises strictly protected ecosystem that contributes to the conservation of landscapes, ecosystems, species and genetic variation. A core zone being National park or Sanctuary/ Protected/ Regulated mostly under the Wildlife (Protection) Act, 1972. Whilst realizing that perturbation is an ingredient of ecosystem functioning, the core zone is to be kept free from human pressures external to the system.

Buffer Zone: The buffer zone adjoins or surrounds core zone, uses and activities are managed in this area in the ways that help in protection of core zone in its natural condition. These uses and activities include restoration, demonstration sites for enhancing value addition to the resources, limited recreation, tourism, fishing, grazing, etc., which are permitted to reduce its effect on core zone. Research and educational activities are to be encouraged.

Transition Zone: The transition area is the outer most part of a biosphere reserve, includes settlements, crop lands, managed forests and area for intensive recreation and other economic uses characteristics of the region. It is the part of the reserve where the greatest activity is allowed, fostering economic and human development that is socio-culturally and ecologically sustainable.

Rivers in NBR

The Nilgiri Biosphere Reserve is one of the critical catchment areas of peninsular India. Many of the major tributaries of the river Cauvery like the Bhavani, Moyar, Kabini and other rivers like Chaliyar, Punampuzha, etc., have their source and catchment areas within the reserve boundary. Many hydro-electric power projects are present in the Kundah, Bhavani and Moyar basins.

All the rivers in the Nilgiri Biosphere Reserve start their journey from mountain sholas, grasslands or wetlands. The sholas and grasslands play a very important role in retaining water and supplying it to these streams. A drastic decline in the sholas and grasslands is one of the reasons for the recent water scarcity in the NBR. Fairly good rainfall in the region accounts for the countless small streams that run for some distance but get absorbed by the top soil of the slopes, before they gain enough strength to flow further. These streams become rivers and provide drinking water, nourish agriculture and support many endangered species.



Figure 6. Rivers within NBR

Pykara is the largest river in the Nilgiri district, Tamil Nadu State, India. It is considered as a very sacred by the Todas. It is situated about 21 km from Ooty. It is well protected and fenced with sholas, todas settlement, undisturbed grass meadows and also have a good wild life habitat. Pykara river originates in the Mukurthi peak and passes through a hilly tract, generally keeping to the north and turns to the west after reaching the Nilgiri plateau's edge. It has number of water falls in its course and important one is Pykara falls (61 m). After reaching Wayanad, this river turns westward and has a fall near Theppakadu, off the Gudalur-Mysore road. From here, this river is known as the Moyar river, continues its journey towards the east, where it joins the Bhavani river at Denkanickottai and finally drains into Bhavanisagar dam.

Rivers in NBR

In the Pykara dam, electricity is generated with the help of power plant. After generating electricity the water from the dam flows in to Pykara river. Then the river receives domestic and agricultural wastes and is polluted. Sandynalla is a tributary of Pykara river.

Sigur river springs up from the Udthagamandalam slopes. Two streams, the Malkod from Pykara Hill and the Billikallu halla from Billikal betta join to form this river. After a point, it is joined by Sandy Nallah stream, flowing towards Kalhatti, which is about 9 km north-west of Udthagamandalam. Here it drops 52 m and forms a beautiful water falls (Kalhatti water falls), after which it flows along the Sigur ghat and finally joins the Moyar river.

Bhavani river rises in the Upper Nilgiri plateau, drains the Attapadi valley in Kerala, collects the waters of the Kundah river and flowing past Mettupalayam joins Moyar river at Bhavanisagar. Further on, it reaches Cauveri river at Bhavani town after a 217 km flow. About 90 per cent of the river's water is used for agriculture.

Pandiar river originates in the grasslands on the northern slopes of the Mukurthi National Park and joins with the **Punnapuzha river**, a tributary of Karimpuzha. This is one of the last free flowing rivers of South India, which has not been dammed. **Karimpuzha River** originates from the western slopes of the NBR, near the Mukurthi Peak. **Cherupuzha river**, which joins the Karimpuzha near Karulai, originates from the forests to the north-west of Upper Bhavani reservoir. This river is the largest tributary of the Chaliyar. The Karimpuzha joins the Chaliyar at Chaliyar mukku, near Nilambur town in Kerala and flows west to join the Arabian sea. This river is famous for its freshwater fish species diversity. Important endemic fish, such as the *Tor malabaricus* and *Glyptothorax annandalei* are found in this river.

Siruvani river originates from the Siruvani hills and is one of the tributaries of the Bhavani. The Siruvani waterfalls and the dam named after it are located 37 km to the west of Coimbatore. Water from the Siruvani river is renowned for its taste and mineral properties and is one of the main domestic water sources for Coimbatore city.

Coonoor river originates from the south eastern slopes of Doddabetta range and collecting waters from streams in and around Wellington, flows through Coonoor ghats to feed the Bhavani river at Nellithorai near Mettupalayam. The **Kallar river** collecting waters from the Catherine Falls (76 m) below Kotagiri on its westward flow meets at the same confluence.

Kabini river is a confluence of the Panamaram river (originating from Lakkidi Hills, Kerala) and Mananthavady river (originating from Tondarmudi hills, Kerala). After flowing through Mananthavady town, the Mananthavady river joins the Panamaram river near Payyampally. Two kilometers from Payyampally, the Kabani river forms an island called Kuruva Island, spreading over 950 acres containing diverse and unique flora and fauna. Downstream from the island, another tributary of the Kabini river, called the Kalindi, joins. The Kabani flows through Kerala only for a stretch of 8 km and turns eastward to join the Cauvery river at Tirumakudal in Narasipur, Karnataka. The Cauvery finally empties into the Bay of Bengal.

Protected Areas in NBR

Mudumalai Wild Life Sanctuary and National Park (321 km²), Wayanad Wildlife Sanctuary (344 km²), Bandipur National Park (874 km²), Nagarhole National Park (643 km²), Nugu Wildlife Sanctuary (30 km²), Mukurthi National Park (78 km²) and Silent Valley National Park (89.52 km²) are protected areas within the NBR,

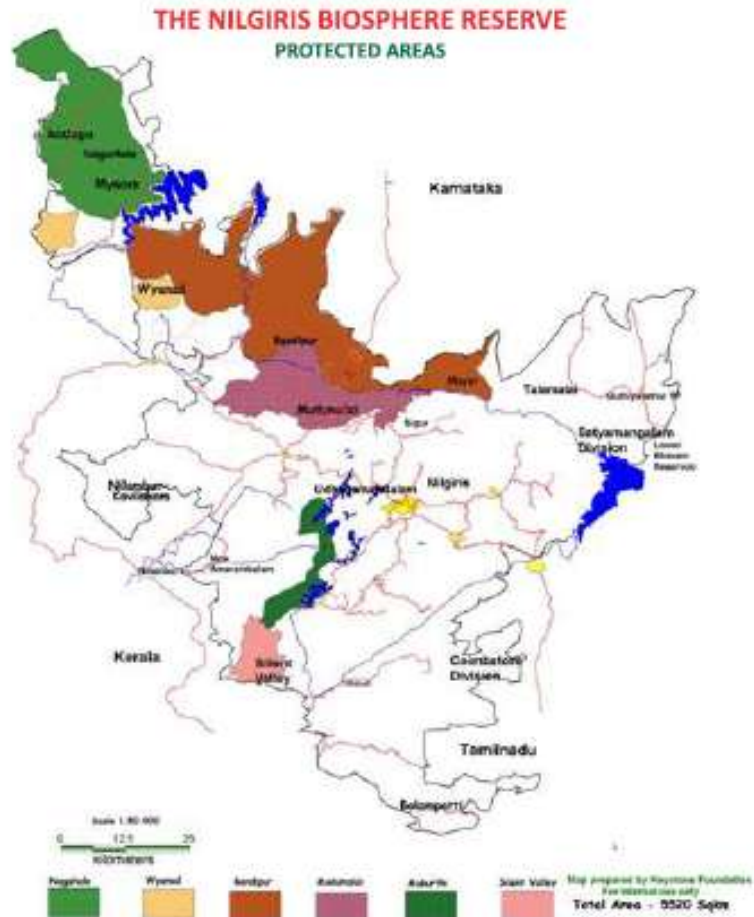


Figure 7. Protected Areas in NBR

4.1 Mudumalai Wildlife Sanctuary

The Mudumalai National Park or Wildlife Sanctuary was the first sanctuary in South India established in 1940. It covers an area of 321 km². It resides on the Northwestern side of the Nilgiri Hills (Blue Mountains), in Nilgiri District, at the tri-junction of the three southern States of Tamil Nadu, Kerala and Karnataka. It is an important wildlife habitat due to its strategic position as a wildlife corridor between several other protected areas making an essential part of the NBR. Its north is being crusted with Bandipur National Park and Nagarhole National Park, its west is the Wayanad Wildlife Sanctuary and along the south corner is flourished with Mukurthi National Park and Silent Valley National Park. It has an elevation of 800 to 1000 m AMSL and is divided into 5 ranges – Masinagudi, Thepakadu, Mudumalai, Kargudi and Nellakota.

Flora: Madumalai Reserve is accosted with three major types of forest in the sanctuary: tropical moist deciduous to be found in the western Benne block, where rainfall is higher than in the other blocks with annual rainfall exceeding 2000 mm. Tropical dry deciduous forest in its middle and southern tropical dry thorn forests in the east. Additionally, there are patches of tropical semi evergreen forest in the southwest and western part of Mudumalai. Tree species in this habitat include *Litsea mysorensis*, *Casseria ovoides*, *Cinnamomum malabratrum* and *Olea dioica*.

Climbers including Sneezewort (*Watakaka volubilis*), *Gnetum ula* and *Entada scandens* are also found in these semi evergreen forests. Moist Bamboo brakes can be found among dry deciduous, moist deciduous and semi-evergreen forests and along the fringes of riparian forests and swamps. There are two species of bamboo found in Mudumalai, the giant clumping bamboos: *Bambusa* (arundinacea) and *Dendrocalamus strictus*. In such types of forest, a green strip of riparian forest can also be seen along the shore of dry seasonal and perennial streams. This type of forest remains green throughout the seasons. The plant species found here includes: *Mangifera indica*, *Terminalia arjuna*, *Pongamia glabra*, Indian rosewood *Dalbergia latifolia*, *Syzygium cumini* and the bamboo.

Fauna: NBR is an ideal home to several endangered and vulnerable species nesting viz., Indian elephant, Bengal tiger, gaur and Indian leopard. There is a high diversity of animal life in the sanctuary with about 50 species of fishes, 21 species of amphibians, 34 species of reptiles, 227 species of birds and 55 species of mammals. Mammal diversity is higher in the dry deciduous and dry thorn forests than in the other habitats and 13 per cent of all mammal species in India are present in Mudumalai wildlife sanctuary. There are at least 266 species of birds in the sanctuary, including critically endangered Indian White-rumped vulture and long-billed vulture. Around 8 per cent of the bird species in India can be found in Mudumalai Wildlife Sanctuary. Among the counts of 227 bird species in the area, 110 species are insectivores, 62 are carnivores, 23 species are fishivores, 12 species are omnivores and 20 species are grainivores. The Mudumalai Sanctuary is also being termed as Madumalai Tiger Reserve due to the presence of around 48 tigers in the Nilgiri Reserve across which tigers are free to roam.

Protected Areas in NBR

Wildlife of Muthumalai

Mudumalai forest can be found among the picturesque surroundings of Tamil Nadu. Nilgiri Hills is a part of the Mudumalai National Park which, in turn, is a component of the greater Nilgiri Biosphere Reserve. The wildlife in the Mudumalai National Park can be divided into the following categories:

The Mammals: The major wildlife in the Mudumalai National Park include, the Asian elephant, tiger, leopard, gaur, hyena, jackal, sloth bear, sambar, chital, muntjac, mouse deer, wild boar, stripe-necked mongoose, Nilgiri tahr (adjoining areas), porcupine, giant flying squirrel, bonner macaque, barking deer, four-horned antelope, otter and langurs.

The Birds: The Mudumalai National Park is known for its avian population. The park is home to over 200 species of birds belonging to 48 families, enough to attract thousands of ornithologists and bird lovers to the park. The major birds found in the Mudumalai National Park include, crested hawk eagles, crested serpent eagle, malabar trogon, malabar whistling thrush, large racket-tailed drongos, spotted babbler, green pigeons, brown dove, malabar grey hornbill, parakeets, bulbuls, cuckoos, hornbills, scops owl, tiny-eared owl, black woodpecker, mynas, barbets, buzzards, harriers, falcons and king vulture.

The Reptiles: The reptile population in the Mudumalai National Park mainly consists of the Crocodiles and Pythons. Common Krait and Bamboo Pit Snake are the other major reptiles in the park.

Others: The park also supports a variety of turtles, frogs and amphibians.



Mukurthi Peak - Elevation : 2554 M

4.2 Mukurthi National Park

Location: Mukurthi National Park is a 78.46 km² protected area located in the western corner of the Nilgiris Plateau west of Ootacamundhill station in the northwest corner of Tamil Nadu State in the Western Ghats mountain range of South India. On the Nilgiri Plateau, the Kundah range of the Nilgiri hills is a ridge on the south-western side of Mukurthi National Park bordering Kerala.

Park elevation varies from 1500 m to 2629 m AMSL, with Kollaribetta 2,629 m, Mukurthi 2,554 m, and Nilgiri 2,476 m AMSL being the highest peaks. With elevations greater than the general level of the plateau. The park generally slopes towards the east and south receiving water from the Billithadahalla,

Protected Areas in NBR



Nilgiri Tahr in Montane Grassland

Pykara and Kundah rivers and the Upper Bhavani and Mukurthi reservoirs which flow through the park. Also several perennial streams originate in the park, most of which drain into the Bhavani Puzha. The park has a harsh environment with annual rainfall varying from 2010 mm to 6330 mm, night temperature sometimes below freezing in the winter and wind speeds ranging up to 120 kmph.

Mukurthi National park is characterised by montane grasslands and shrublands interspersed with sholas in a high altitude area of high rainfall, near-freezing temperatures and high winds. It is home to an array of endangered wildlife, including royal Bengal tiger and Asian elephant, but its main mammal attraction is the Nilgiri tahr. The park was previously known as Nilgiri Tahr National park.

Flora: The area is home to numerous endemic plants particularly of the scapigerous annual *Impatiens* plants. *Alchemilla indica* and *Hedyotis verticillaris* are found only within or on the fringes of this park. *Rhododendron arboreum* are seen throughout the grasslands and very large specimens are conspicuous around many sholas. Other common shola trees and shrubs include: *Syzygium calophyllifolium*, *Daphniphyllum neilgherrense*, *Cinnamomum wightii*, *Vaccinium leschenaulti*, *Mahonia leschenaulti*, *Litsea sp.*, *Lasianthes sp.*, *Psychotria sp.* and *Michelia nilagirica*.

The orchids *Eria abliflora*, *Oberonia santapaul*, *Aerides ringens*, *Aerides crista* and *Coelogyne odoratissima* are found on the high west edge of the park. Among the grasslands are a plethora of *Brachycorithis iantha*, *Satyrium nepalense*, *Habenaria cephalotes*, *Seidenfia densiflora*, *Spiranthes sinensis* and *Liparis atropurpurea*.



Rhododendron Tree in Shola



Wild Yellow Raspberries in Sholas

Protected Areas in NBR



Aerides



Oberonia



Eria

Several threatened mammal species including Nilgiri tahr, Indian elephant, Bengal tiger, Nilgiri marten, Nilgiri langur and Bonhote's mouse. There are also leopard, bonnet macaque, sambar deer, barking deer, mouse deer, otter, jungle cat, small Indian civet, wild dog, jackal, black-naped hare, shrew, Malabar spiny dormouse and soft-furred rat live here.

Avi fauna consists mostly of hill birds including the threatened laughing thrush, whistling thrush, woodcock, wood pigeon, black and orange flycatcher, Nilgiri flycatcher, grey headed flycatcher, black bulbul, white eye, Nilgiri pipit. The predatory black-winged kite, kestrel and black eagle may be seen in the grasslands.

The area is home to many species of point-endemics among reptiles such as the geckos dwarf gecko spp., Nilgiri salea (*Salea horsfieldii*) and the skink (*Kaestlea bilineata*) the snakes horseshoe pit viper, Checkered keelback, *Ptyas mucosa* (rat snake), *Oligodon venustus*, bronze-headed vine snake and several shieldtails of which Perronet's shieldtail is the most common. Like reptiles, almost all species of amphibians here are endemic only to this region, except the widespread common Indian toad (*Duttaphrynus melanostictus*); main species include *Bufo microtympanum* and many species of tree frogs including *Raorchestes tinniens*, *Raorchestes signatus*, *Raorchestes ravii*, *Raorchestes thodai*, *Raorchestes primarrumpfi*, *Ghatixalus variabilis* and the dancing frog *Micrixalus phyllophilus* and aquatic ones like *Nyctibatrachus indraneili* and *Fejervarya nilagirica*. Butterflies with Himalayan affinity like the blue Admiral, Indian red admiral, Indian fritillary, Indian cabbage white and hedge blues are seen here.



Nilgiri Langur



Whistling Thrush



Indian Red Admiral

Protected Areas in NBR

4.3 Bandipur National Park

The Bandipur National Park was brought under Project Tiger in 1973 and is situated in Mysore (Nanjangud and H.D.Kote taluks) and Chamarajanagar (Gundlupet taluk) districts of Karnataka state, at the confluence of western and eastern ghats, serving as a central link in the seasonal migration of elephants from Mudumalai sanctuary and Satyamangalam forest division in the east and south east to Nagarahole National park and Wynad sanctuary in the west and northwest.



Flora: The forests of the Tiger reserve are varied and rich. To the eastern most portions lie the scrub forests of Moyar. While the vegetation in the central portion of the Tiger reserve viz., Kaniyanapura, Bandipur part of Beerambadi is dry deciduous, the vegetation in the western part of the reserve viz., Ainurmarigudi, Begur and Beerambadi is moist deciduous. The vegetation, therefore, changes from scrub type to moist deciduous type from east to west. These forests are classified as the scrub type, southern tropical dry and deciduous type and south tropical moist deciduous type.

Fauna: Predator found here is tiger (*Panthera tigris*), Co-predators are panthers (*Panthera pardus*), the Indian wild dog (*Cuon alpinus*), the jungle cat (*Felis chaus*), python (*Python molurus*) and other associates are Indian elephant (*Elephas maximus*) and sloth bear (*Melurus ursinus*). Prey animals include, the spotted or chital (*Axis axis*), sambar (*Cervus unicolor*), four horned antelopes or chowsingha (*Tetracerus quadricornis*), barking deer or muntjac (*Muntiacus muntjak*), gaur (*Bos gaurus*), Indian wild boar (*Sus scrofa*), mouse deer (*Tragulus meminna*), Indian porcupine (*Hystrix indica*), Indian hare (*Lepus nigricollis*), common langur (*Presbytis entellus*), bonnet macaque (*Macaca radlat*). Other animals found in the NBR are the Indian giant squirrel (*Ratuba indica*), three striped palm squirrel (*Funambulus palmarum*), the flying squirrel (*Petaurista petaurista*), the porcupine (*Hystrix indica*) and black naped hare (*Lepus nigricollis*). Due to the varied habitat, Bandipur is rich in reptiles. From the huge Indian python (*Python molurus*), Indian cobra (*Naja naja*), vine snake (*Anaetulla nastus*), common krait (*Bangarus caeruleus*), wolf snake (*Lycodon anlicus*), green keelback (*Macropisthodon plumbicolas*), rat snake (*Ptyas mucosus*), bamboo pit viper (*Trimeresurus gramineus*) and russel's viper (*Vipera russelli*). Some snakes like green pit viper and cat snakes are more likely to be seen in the moist forest towards the western parts of the reserve.



Cuon alpinus



Petaurista petaurista



Lepus nigricollis

Protected Areas in NBR



Stone Curlews



Malabar Trogon



Bluewing Parakeet

Bird life found here are quails, partridges and stone curlews, malabar trogon, malabar grey hornbill, bluewing parakeet and whitebellied minivet which are exclusively found in the western ghats and nowhere else on earth. Drongo and yellow browed bulbul, drongos, white headed babblers are also seen here.

4.4 Nagarhole National Park

Nagarhole National Park (also known as Rajiv Gandhi National Park) is located in Kodagu district and Mysore district in Karnataka state in South India. The park ranges the foothills of the western ghats spreading down the Brahmagiri hills and south towards Kerala state. This park was declared the thirty seventh Project Tiger Reserve in 1999. The park has rich forest cover, small streams, hills, valleys and waterfalls. The park has a healthy tiger-predator ratio, with many tigers, Indian bison and elephants.

The park receives an annual rainfall of 1440 mm. Its water sources include the Lakshmantirtha river, Sarati Hole, Nagar Hole, Balle Halla, Kabini River, four perennial streams, 47 seasonal streams, four small perennial lakes, 41 artificial tanks, several swamps, Taraka dam and the Kabini reservoir.

Flora: The vegetation here consists mainly of north western ghats moist deciduous forests with teak and rosewood predominating in the southern parts. There is central deccan plateau dry deciduous forests with Pala indigo and thorny wattle towards the east. There are some sub-montane valley swamp forests with several species of the Eugenia genus.

*Python molurus**Naja naja**Macropisthodon plumbicolor*

Protected Areas in NBR

The main trees found in Nagarhole National Park are the commercially important like rosewood, teak, sandalwood and silver oak. Species of trees of the dry deciduous forest include crocodile bark, *Lagerstroemia lanceolata* (crepe myrtle), Indian kino tree, *Grewia tilaefolia*, rosewood and axlewood. Other tree species that are seen in the forests are *Lagerstroemia microcarpa* (crepe myrtle), kadam, cotton tree, *Schleichera trijuga* and some species of ficus. In the understorey, species found growing include *Kydia calycina*, Indian gooseberry and beechwood. Shrubs like horse nettles, tick clover, *Helicteres* species and invasive species like lantana and bonesets are found in abundance. These forests have some conspicuous tree species such as golden shower tree, flame of the forest and clumping bamboo.



Lagerstroemia lanceolata



Grewia tilaefolia



Schleichera trijuga

Fauna: The important predators and carnivores in Nagarhole National park are the Bengal tiger, Indian leopard, Ussuri dhole (*Cuon alpinus*), sloth bear and the striped hyena (*Hyaena*). The herbivores are chital, sambar deer, barking deer, four-horned antelope (*Tetracerus quadricornis*), gaur (*Bos gaurus*), wild boar (*Sus scrofa*) and Indian elephant. Other mammals includes the gray langur (*Presbytes entellus*), bonnet macaque (*Macaca radiata*), jungle cat, slender loris (*Loris tadigradus*), leopard cat (*Felis bengalensis*), civet (*Viverricula indica* and *Paradoxurus hermaphroditus*), mongoose (*Herpestes fuscus* and *Herpestes vitticollis*), European otter (*Lutra lutra*), Indian giant flying squirrel (*Petaurista*), Indian giant squirrel (*Ratufa indica*), porcupine, golden jackal, chevrotain (*Traguluseminna*), hare and pangolin (*Manis crassicaudata*).

Over 250 species of birds are found at Nagarhole National Park. Besides the enormous variety of woodland birds, there are large congregations of waterfowl in the Kabini river. Birds range from blue bearded bee eater, scarlet minivet and Malabar whistling thrush to the more common ospreys, herons and ducks. Important birds found are oriental white-backed vulture (*Gyps bengalensis*), greater spotted eagle (*Aquila chrysaetos*), Nilgiri wood-pigeon (*Columba elphinstonii*), darters (*Anhinga melanogaster*), oriental white ibis (*Threskiornis melanocephalus*), greater grey headed fish eagle (*Ichthyophaga ichthyophaga*) and red headed vulture (*Sarcogyps calvus*), blue winged parakeet (*Psittacula columboides*), Malabar grey hornbill (*Ocyroceros griseus*), white bellied treepie (*Dendrocitta leucogastra*), painted bush quail (*Pendicula erythrorhyncha*), Sirkeer malkhoa (*Phaenicophaeusles chenaultia*), ashy prinia (*Prinia socialis*), Indian robin (*Saxicoloides fulicata*), Indian peafowl (*Pavo cristatus*) and yellow legged green pigeon (*Treron phoenicoptera*).

Protected Areas in NBR



Golden Shower Tree



Clumping Bamboo

Reptiles commonly found here are mugger (*Crocodylus palustris*), common vine snake (*Ahaetullanasutus*), common wolf snake (*Lycodonaulicus*), rat snake (*Ptyas mucosus*), bamboo pit viper (*Trimeresurus gramineus*), Russell's viper (*Daboia russellii*), common krait (*Bangarus caeruleus*), Indian rock python (*Python molurus*), Indian monitor lizard (*Varanus bengalensis*) and the common toad (*Bufo melanostictus*).

*Gyps bengalensis**Pesticula erythrorhyncho**Treron phoenicoptera**Crocodylus palustris**Ahaetullanasutus**Varanus bengalensis*

Protected Areas in NBR

The insect biodiversity of this park includes over 96 species of dung beetles and 60 species of ants. Unusual species of ants that have been identified include the jumping ants such as *Harpegnathos saltator*, which are known to jump up to a metre high.



Harpegnathos saltator

4.5 Wayanad Wildlife Sanctuary

Wayanad wildlife sanctuary was formed in 1973 and was brought under the Project Elephant in 1991-'92. It is located 16 km east of Sulthan Bathery in the state of Kerala, occupies an area of 345 km². It is the second largest one in the State of Kerala. The sanctuary is separated into two disconnected parts known as the Upper Wayanad wildlife sanctuary in the north and Lower Wayanad wildlife sanctuary in the south. The area in between the two parts was originally a forest region, though it is now occupied majorly by plantations.

Wayanad climate is salubrious. Average rainfall in this district is 2322 mm. Annual rainfall in these high rain fall areas ranges from 3000 to 4000 mm. High velocity winds are common during the south west monsoon and dry winds blow during March and April. High altitude regions experience severe cold. This place experiences a high relative humidity which goes even up to 95 per cent during the south west monsoon period.

Flora: It is part of the Wayanad plateau and the vegetation is predominantly of the south Indian moist deciduous teak forests. Also, the sanctuary has pastures of the west-coast semi-evergreen trees. Moist deciduous forest consists of maruthi, karimaruthi, rosewood, ventek, vengai, chadachi, mazhukanjiram, bamboos, semi-evergreen patches comprises *Veteria indica*, *Lagerstroemia*, *Terminalia*.



Chadachi

Fauna: The wildlife sanctuary comes under protect elephant and one can spot herd of elephants roaming in the area. A variety of large wild animals such as Indian bison, elephant, deer and tiger, panthers, jungle cats, civet cats, monkeys, wild dogs, bisons, deer, bears, monitor lizards and a variety of snakes are seen. There are also quite a few unusual birds in the sanctuary. In particular, peafowl, peacocks, babblers, cuckoos, owls, woodpeckers, jungle fowls are a few of the various types of birds seen here.



Terminalia

Protected Areas in NBR



Civet Cat

4.6 Silent Valley National Park

Silent Valley National Park is located in the Nilgiri hills spread in Palakkad district of Kerala. The British named the area silent valley because of a perceived absence of noisy cicadas. The total extent of silent valley National park is 8952 hectares (89.5 km²) with about 20 per cent of the area falling under grassland and the rest under woodland. The entire area is roughly a rectangular plateau closed on all sides by the high mountains of the western ghats, thus shielding the vegetation of the plateau from extremes of climate, which in turn creates a special micro-climate in the plateau.



Babbler

Flora: Flora and Fauna at silent valley national park areas fall under tropical and subtropical moist broadleaf forests eco-region. Flora of the valley include about a 1000 species of flowering plants, 108 species of orchids, 100 ferns and fern allies, 200 liverworts, 75 lichens and about 200 algae. Majority of the plants in the park are endemic to the western ghats (FAO, 2010). Hilly areas of the park of above 1000 m are in a south western ghats mountain rain forests region. Above 1500 m, the evergreen forests begin to give way to stunted forests, called sholas. The forest area covered in the silent valley national park found important to naturalists, biologists and other researchers because of the rich biodiversity in the park that has never been disturbed by human settlements. Several threatened species are endemic and several new plants along with new animal species are often discovered in this park.



Woodpecker

The reserve extends from the tropical moist forests of the windward western slopes of the ghats to the tropical dry forests on the leeward east slopes. Rainfall ranges from 500 mm to 7000 mm per year. The reserve encompasses three ecoregions, the south western ghats moist deciduous forests, south western ghats mountain rain forests and south deccan plateau dry deciduous forests. The habitat types include montane rain forest, semi-evergreen moist forest, thorn forest and scrub, mountain grassland and high-elevation Shola forests.



Monitor Lizard

Fauna at silent valley National park includes different species of mammals, butterflies, and insects. There are at least 34 species of mammals at silent valley including the threatened lion-tailed macaque, Nilgiri langur, Malabar giant squirrel, Nilgiri tahr, Peshwa's bat (*Myotis peshwa*) and hairy-winged bat. There are

Protected Areas in NBR



White-bellied Blue Flycatcher

nine species of bats, rats and mice. Fourteen troops of lion-tailed macaque, eighty five troops of Nilgiri langur, fifteen troops of bonnet macaque and seven troops of Hanuman langur were also observed. Of these, the Nilgiri langur was randomly distributed, whereas, the lion-tailed macaque troops confined to the southern sector of the Park. Bonnet macaques and Hanuman langurs were occasional visitors. The silent valley forest remains one of the most undisturbed viable habitats left for the endemic and endangered primates lion-tailed macaque and Nilgiri langur.

Avifauna at silent valley National park: It is home for different species of wild animals, birds, butterflies, insects and plants. Ornithologists recorded occurrence of 16 bird species in silent valley, designated as threatened or restricted. List of threatened bird species include Nilgiri wood-pigeon, Malabar parakeet, Malabar grey hornbill, white-bellied treepie, grey-headed bulbul, broad-tailed grassbird, rufous babbler, Wynaad laughing thrush, Nilgiri laughing thrush, Nilgiri blue robin, black and rufous flycatcher, Nilgiri flycatcher, white-bellied blue-flycatcher, crimson-backed sunbird and Nilgiri pipit. Rare bird species found in the silent valley National park include the Ceylon frogmouth and great Indian hornbill, long-legged buzzard, a new species of raptor at Sispara, the park's highest peak. The researchers found 10 endangered species recorded in the International Union for Conservation of Nature (IUCN) Red List including the red winged crested cuckoo, Malabar pied hornbill and pale harrier in the silent valley National park. The area covered in the silent valley is home to 15 endemic species including the black and orange flycatcher. It recorded 138 species of birds including 17 species that were newly observed in the silent valley area. The most abundant bird was the black bulbul in this National park.



Nilgiri Wood Pigeon



Ceylon Frogmouth

Insects at silent valley National park: There are 70 species of insects found in the park. The largest number of species belongs to the orders Lepidoptera and Coleoptera. Other insects found in the park include 33 species of crickets and grasshoppers of which one was new along with 41 species of true bugs (eight new), 128 species of beetles including 10 new species recorded in this park.

Butterflies at silent valley National park: Researchers found 128 species of butterflies and 400 species of moths in the park. Studies conducted in the year 1993 indicated butterflies belonging to 9 families in this park. The families *Nymphalidae* and *Papilionidae* contained the largest number of species. 13 species were endemic to south India,

Protected Areas in NBR

Including 5 species having protected status. Seven species of butterflies observed migrating in a mixed swarm of thousands of butterflies towards the silent valley National park. At least 500 species of earthworms and leeches have also been identified in the park.

**Lion Tailed Macaque****Nilgiri Wood Pigeon****Female Southern Birdwing****Tailed Jay**

Flora of the various forest types in the NBR have been studied by several authors (Subramanyam, 1959; Subramanian, 1966; Naithani, 1966; Sharma et al., 1978; Manilal & KS, 1988; Vajravelu, 1992; Stephen, 1994).

5.1 Endemic Flora

According to Nayar (1983), there are 141 genera endemic to India, out of which 50 spread over 25 families are endemic to the Western Ghats, 11 genera occurring in the NBR. At the species level, out of the estimated 2100 species of flowering plants endemic to peninsular India, 818 are to be found in the Nilgiris and adjoining areas (Mohanan and Balakrishnan, 1991).

One hundred and thirty two species and 13 varieties of flowering plants are endemic to the NBR which amounts to 4 per cent of its total angiosperm flora (Ahmedullah and Nayar, 1986). Of these, 28 are exclusive to the Kundah range in the Nilgiris district (Nair and Daniel, 1986). The genus *Baeolepis* with a single species *nervosa* (*Periplocaceae*) is restricted to the Nilgiris (Ahmedullah and Nayar, 1986). Endemism is marked in the families *Acanthaceae*, *Balsaminaceae*, *Poaceae* and *Orchidaceae* within the NBR.

Table 5. Endemic Flora of NBR

Family	Plant Species	Family	Plant Species
ANNONACEAE	<i>Goniothalamus wynaaden</i>	MIMOSACEAE	<i>Acacia hoheneckeri</i>
RANUNCULACEAE	<i>Clematis theobromina</i>	URTICACEAE	<i>Pouzolzia wightii</i> f. var.
AMARANTHACEAE	<i>Achyranthes aspera</i> var.	SAPOTACEAE	<i>Isonandra perrottetiana</i>
SYMPLOCACEAE	<i>Symplocos microphylla</i>	MYRSINACEAE	<i>Embelia gardneriana</i>
LAURACEAE	<i>Actinodaphne lanata</i> <i>A. lawsonii</i> <i>A. salicina</i> <i>Litsea stocksii</i> f. var.	FABACEAE	<i>Crotalaria bidei</i> <i>c. formosa</i> <i>C. abtecta</i> <i>Dalbergia gardneriana</i>
MYRTACEAE	<i>Eugenia argentea</i> <i>Meteoramyrtus wynaadensis</i> <i>Syzigium malabaricum</i> <i>Melastomataceae</i> <i>Memeclylon flavescens</i> <i>M. lawsonii</i> <i>M. sisparensis</i> <i>Sonerila versicolor</i> var. <i>axillaris</i> <i>s. wynaadensis</i>	LABIATAE	<i>Anisochilus dysophylloides</i> var. <i>purpureus</i> <i>Leucas pubescens</i> <i>L. rasmariifolia</i> <i>Pogostemon nilagiricus</i> <i>P. paludatus</i> <i>Teucrium wightii</i>
UMBELLIFERAE	<i>Bupleurum plantaginifolium</i> <i>Heracleum hookerianum</i>	ASCLEPIADIACEAE	<i>Brachystegna maculatum</i> <i>Caralluma nilagiriana</i>

Contd..

GENTIANACEAE	<i>Swertia lawn</i>	PERIPLOCEAE	<i>Baeolepis nervosa</i>
CONVOLVULACEAE	<i>Argyreia coanaorensis</i>	VISACEAE	<i>Viscum orbiculatum</i>
ACANTHACEAE	<i>Andrographis lobeloides</i> <i>A. stehriata</i> <i>Leptacanthus amabilis</i> <i>Mackenzia homatropa</i> <i>M. violacea</i> <i>Nilgiranthus papillosus</i> <i>N. wighteanus</i> <i>Phlebophyllum lanatum</i> <i>Plecaulis sessilis</i> <i>Rhinacanthus nasutus</i> var. <i>montanus</i> <i>Thelepaeopale bicolor</i>	RUBIACEAE	<i>Hedyotis hirsutissima</i> <i>Lasianthus cillatus</i> <i>Oldenandia hirsutissima</i> <i>O. sisparensis</i> <i>Ophiorrhiza brunois</i> var. <i>brunois</i> <i>O. pykarensis</i> <i>Pavetta brunois</i> <i>P. hohenackeri</i> <i>P. wightii</i> Loranthaceae <i>Dendrophthoe</i> <i>memecylifolia</i> <i>D. neelgherensis</i> var. <i>clarkii</i> <i>Loranthus recurvus</i>
CELASTRACEAE	<i>Microtropis de&flora</i>	EUPHORBIACEAE	<i>Dalechampia velutina</i> <i>Glochidion sisparensis</i> <i>Mallotus subramanyamii</i> <i>Reidia timbriata</i>
ORCHIDACEAE	<i>Aerides elatoir</i> <i>Bulbophyllum</i> <i>acutiflorum</i> <i>B. aureum</i> <i>B. fusco-purpureum</i> <i>B. katiense</i> <i>B. nodosum</i>	ARECACEAE	<i>Calamus gambleri</i> var. <i>sphaerocarpa</i> <i>Anisaema auriculatum</i> <i>A. pulchrum</i> <i>A. transiucens</i> <i>A. tuberculatum</i> <i>A. tylopharum</i>
CARIFOLIACEAE	<i>Viburnum hebanthum</i>	APIACEAE	<i>Bunium nothum</i>
ASTERACEAE	<i>Anaphalis neelgeiriana</i> <i>A. notariana</i> <i>Melichrysium wightii</i> <i>Senecio kundaicus</i> <i>S. lawsonii</i> <i>S. lessigianus</i> <i>s. polycephalus</i> <i>Vernonia saligna</i> var. <i>nilgherensis</i> <i>Yaulgia nilgiriensis</i>	BALSAMINACEAE	<i>Impatiens clavicomus</i> <i>I. debilis</i> <i>I. denisonii</i> <i>I. laticornis</i> <i>I. levengei</i> <i>I. munronii</i> <i>I. neo-barnesii</i> <i>I. nilagrica</i> <i>I. archioides</i>
COMMELINACEAE	<i>Commelina tricolor</i>	RUTACEAE	<i>Melicope indica</i> Oxalidaceae <i>Biophytum polyphyllum</i>

Contd..

POACEAE	<i>Andropogon longipes</i> <i>A. polytychus</i> <i>-dinella purpurea</i> <i>A. setosa</i> var <i>nilgiriana</i> <i>Brachiaria semundulata</i> <i>Eriochrysis rangachari</i> <i>Garnottia schmidii</i> <i>Isachne deccanensis</i> <i>I. oreades</i> <i>I. nilagiricum</i> <i>Ochlandra beddomei</i> <i>O. setigera</i> <i>Panicum fischeri</i> <i>Poa gamble</i>	ERIOCAULACEAE	<i>Eriocaulon christopheri</i> <i>E. gamblei</i> <i>E. pectinatum</i> <i>E. robustum</i> <i>C. pseudo-asperata</i> <i>C. vicinalis</i> <i>C. curvibracteatus</i> <i>Fimbristylis</i> <i>latinighunjera</i> <i>F. latinucifera</i> <i>F. rectifolia</i>
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Source: Ahmedullah and Nayar, 1986

*Goniolobum swynaadensis**Clematis theobromina**Acacia tohenackeri*

5.2 Threatened Flora

Of the 168 species of flowering plants of Tamil Nadu listed as endangered in the Red Data Books, 25 (15%) are exclusive to the Nilgiris. Some of the threatened orchids of this region are *Bulbophyllum acutiflorum*, *Bulbophyllum nodosum*, *Habenaria denticulata*, *Habenaria polyodon*, *Liparis biloba*, *Spiranthes sinensis*, *Thrixspennum musciflorum* and *Vanda wightii* (Mohanan and Balakrishnan, 1991).

*Bulbophyllum acutiflorum**Spiranthes sinensis**Vanda wightii*

5.3 Economically Important Flora

Sanjappa (1991) recorded 80 species of legumes from western ghats and a majority of these are from the NBR and adjacent areas. A large number of medicinal plants also occur in the NBR. About 200 species of medicinal plants have been reported from the NBR of which 24 species are commercially exploited. Due to over exploitation certain species such as *Rauvolfia serpentina* and *Saraca asoca* have become rare. A list of over-exploited medicinal plants of NBR is given in Table 6.

Table 6. Rare Medicinal Plants in Nilgiri Biosphere Reserve

Family	Plant Species	Location
Araceae	<i>Acorus calamus</i>	Nilgiris
Menispermaceae	<i>Caccinium fenestratum</i>	Silent valley
Zinziberaceae	<i>Curcuma zeaoria</i>	Nilgiris
DroseraCeeae	<i>Drosera peltata</i>	Nilgiris
Liliaceae	<i>Gloriosa superba</i>	Nilgiris
Ophioglossaceae	<i>Helminthostachys zeylanica</i>	Nilambur
Asclepidaiaaceae	<i>Hemilakmus indicus</i>	Nilgiris, Attapadi
Apiaceae	<i>Heracleum candolkanum</i>	Nilgiris
Lamiaceae	<i>Plectranthus barbatus</i>	Nilgiris
Apocynaceae	<i>Rauvolfia serpentina</i>	Palghat
Caesalpiniaaceae	<i>Saracaasoca</i>	Palghat



Acorus calamus



Curcuma zeaoria



Hemilakmus indicus

5.4 New Taxa

In addition, Nilgiris is an important centre of specification and many plants new to science have been discovered and described from the region making it the type locality for a number of species. *Silentvalleya* (Poaceae) and *Kanjaram* (Acanthaceae) are two genera recently discovered from this region. *Curcuma silentvalleyi*, *Eria flagii*, *Hedyotis silentvalleyensis*, *Hydnocarpus pendulus*, *Liparis Indrail*, *Oberonia bisaccata*, *Porpax chandrasekharanii*, *Robiquetia josephiana*, *Sauropus saksenianus* and *Silentvalleya nairii* are newly described species.

Fauna of NBR

The Indian Peninsula which in the geological past was part of the Gondwana mass per se is biogeographically India vera (true India), the largest and oldest region of differentiation of the original flora and fauna of India. The northward movement of the peninsula resulting in the Himalayan uplift brought about block fracturing of the western parts of the peninsula and marine subsidence of the fragments in the Arabian sea, giving rise to the scraps of the western ghats of which the NBR is a part. The faunal complex of the reserve as also the whole of the Peninsula arose from the ancient stock of Lemuria and the still older Gondwana faunas (Mani, 1974).

*Ezephos maximus**Mus famulus*

The present day fauna of the NBR, as also that of the Indian Peninsula, is at present characterized by its remarkable wealth of phylogenetic (Gondwana) and geographical (Asiatic) relicts. Pleistocene relicts of the Himalaya, endemics, ancient and phylogenetically older groups and by the presence of ecologically anomalous (Habitat-fermede forms) groups (Khajuria, 1924). The fauna is on the whole at present remarkable for its greatly impoverished remnants that are also rapidly vanishing. Some of the fauna of the peninsula exposed

to extensive regression, degradation, impoverishment and the resultant extinction are still preserved in this Reserve in the 'refugial pockets'.

General observations on the present day fauna of NBR

The best known animals are however the vertebrates, especially the larger mammals. There are already efforts made towards the protection of endangered and endemic mammals such as the Asian elephant (*Ezephos maximus*), tiger (*Panthera tigris*), Nilgiri tahr (*Hemitragus hylocrius*), Nilgiri langur (*Presbytis johnii*) and lion tailed macaque (*Macacasilenus*) within the biosphere reserve. A number of little known bats (Chiroptera) and smaller mammals including the clawless otter (*Aonyx cinerea*), Nilgiri marten (*Martes gwatkinsi*), civets (*Viverra sp.*) and the lesser cats (*Fezils sp.*) exist within the reserve. There is however very little information on their current range and status in the western ghats itself. Twelve species of mammals endemic to the western ghats are also found here; *Mus famulus* a rodent being exclusive to this reserve (Daniel, 1992).

Over 300 species of birds are known from the NBR and of the 15 species endemic to the western ghats, except the white breasted laughing thrush (*Garruzax jerdoni*), all species are found in the biosphere reserve (Daniel, 1992). And of the 14 species, the Nilgiri laughing thrush (*Garrulax cachinnans*) is exclusive to the higher hills of the Nilgiris. The Nilgiri wood pigeon (*Columba elphinstonii*) listed as globally endangered is found frequently within the reserve. Some of the uncommon migratory birds that visit the western ghats during winter from the

Fauna of NBR

Himalayas such as the wood cock (*Scolopax rusticola*), bluechat (*Erithacus brunneus*) and brown breasted fly catcher (*Muscicapa muttui*) are found most often within the NBR.



Scolopax rusticola

Very little is known about the invertebrates of the NBR except butterflies. Almost all the butterfly species endemic to the western ghats also occur within the reserve (Daniel, 1992). Amongst the lower vertebrates, a number of little known amphibians, reptiles and fish exist in the NBR. 39 species of fish, 31 species of amphibians and 60 species of reptiles endemic to the western ghats also occur within the biosphere reserve. Of these, 24 are hitherto known only from the NBR.



Muscicapa muttui

There are at least 300 marsh crocodiles (*Crocodylus palustris*) distributed in the major water courses of the reserve. Of these the Moyar river has the most substantial population. It must also be emphasized that this is the largest intact naturally breeding population of crocodiles anywhere in south India.

Table 7. Fauna of NBR

FISH	AMPHIBIANS	REPTILES
<i>Danio neilghiriensis</i>	<i>Ichthyophis longicephalus</i>	<i>Cnemaspis wynadensis</i>
<i>Hypseobarbus dubius</i>	<i>Ansonia rubigina</i>	<i>Cnemaspis sisporensis</i>
<i>Puntius javanicus</i>	<i>Bufo silentvalleyensis</i>	<i>Scincella bilineatus</i>
<i>Puntius melanostigma</i>	<i>Ikiicrixalus thampii</i>	<i>Triphops tindalli</i>
<i>Neolissochilus wynadensis</i>		<i>Rhabdops olivaceus</i>
<i>Garra maclellendi</i>		<i>Melanophidium</i>
<i>Nemacheilus sinuatus</i>		<i>bilineatum Plecturus</i>
<i>Nemacheilus striatus</i>		<i>guentheri</i>
<i>Mystus punctatus</i>		
<i>Silurus wynoaknsis</i>		
<i>Clarks dayi</i>		
<i>Glyptothorax anandalei</i>		

A comprehensive picture of the present day fauna of NBR may emerge only on the completion of studies on various groups of invertebrates yet to be initiated. The NBR mainly under the 'Malabar forest' and is extremely rich in its faunal resources as evidenced by the faunal diversity of the silent valley which is an important component of this reserve (Pillai, 1981). According to a recent publication, the fauna of the reserve is said to contain 100 species of mammals, 550 species of birds, 80 species of reptiles and amphibians and an unknown number of invertebrates.

Fauna of NBR

*Mystus punctatus**Ichthyophis longicephalus**Cnemaspis wynadenis*

As mentioned earlier, the 'refugial pockets' in the NBR today are home for many and unique forms which originally inhabited vast stretches of the peninsula but have disappeared from many areas due to development pressure, over exploitation, market failure and intervention failure.

A. Invertebrate Fauna

On the basis of fairly detailed information available on the vertebrate groups represented by more than 602 species in NBR and the diversity of the fauna of selected groups of lower forms studied, it is reasonable to presume that the invertebrate fauna in this reserve may comprise more than a quarter million species.

A species diverse habitat performs valuable ecological processes because of the interactions between species and environment (WRI, 1989). Ecological processes include biogeochemical recycling, the maintenance of soil fertility, water quality and climatic regulations. Besides, large scale deforestation carried out for raising mono culture plantations have driven out many species, especially insects, to the plains turning them into pests. Hence for any successful biological control programme of crop pests in Peninsular India, one has to seek the natural enemies in the forest ecosystems of western ghats, especially of the NBR which is home for many of the rare species. Because of their small sizes and modest needs, most of the invertebrates occupy ecological niches that are more numerous and smaller in all dimensions (space, time and so on) and therefore more sensitive than those of vertebrates. Furthermore, the needs of invertebrates do not always coincide with those of vertebrates. So it is not safe to assume that protection of large areas for vertebrates will automatically safeguard the diversity of lower forms also. For every species of higher form of life disappearing, there are thousands of invertebrates that travel the road to extinction. We ignore them at our peril. Hence concerted efforts at revealing the faunal diversity of all the groups of invertebrates of NBR is called for.

The invertebrate groups studied are the following : Protozoa, Rotifera, Ostracoda, Chilopoda, Diplopoda, Scorpionida, Orthoptera, Odonata and some families of Hemiptera, Lepidoptera, Diptera and Hymenoptera.

One hundred and eleven species of protozoans have been reported from the NBR of which 69 are rare. A few of the species are hitherto known only from the NBR, which include two species of *Gregarina* from the insect *Lepisma saccharina* Linn., some ciliates inhabiting the stomach of ruminants and the caecum of Indian elephant. Very little is so far known about the

Fauna of NBR

groups Rotifera and Ostracoda of NBR. All the 13 species of the former and 6 of the latter studied from the area enjoy very wide distribution and none is endemic to the area. Cladocerans are represented by 31 species of which *Alona inreticulata* is known only from NBR in India while *Simocephalus exspinosus* and *Pleuroxus aduncus* have their range of distribution confined only to this reserve in southern India. The rest of the species are widely distributed. Though the 16 species of Centipedes and most of the 41 species of Millipedes recorded from NBR are rather widely distributed, yet 9 of the latter group are endemic to NBR. Only 13 species of Scorpions are so far known from this reserve of which 2, *Heterometrus (Chersonesometrus) collinus* Pocock and *Heterometrus (Heterometrus) keralensis* Tikader & Bastawade are NBR endemics. The insect fauna of NBR is rather little known.

There is no consolidated account available on many of the species orders and families. One can easily visualise the richness of this group by the diversity of the few groups incorporated in this inventory. Only 82 species of Orthoptera including Grylloidea are so far known from the reserve which may represent only a fraction of the diversity of the group. Most of the species recorded are widely distributed beyond the limits of this reserve. Because of the many reservoirs, streams and other water bodies, NBR harbours a large donate fauna. 71 species of this group have been recorded from this reserve, some of which are endemic to the western ghats including a few confined only to NBR. 106 species of leaf hoppers included in this inventory represents 70 per cent of the fauna of this group reported from India. 37 species representing 35.5 per cent of those recorded are endemic to NBR which accounts for the Indian fauna so far known.

NBR is very rich in its aquatic and semi-aquatic Heterophteron fauna. 74 off these 262 species (21.3%) known from India are available in this reserve and 11 species accounting for about 15 per cent of the total are endemic to this reserve.

The reserve harbours a rich fauna of Scarabid beetles, only a few of which are restricted in their distribution to areas of NBR. Western ghats is endowed with a rich and diverse fauna of butterflies. Many of these are endemic to the ghats. 300 species have been recorded from this reserve of which some belong to the various threatened IUCN categories.

There is a paucity of consolidated information on the distribution of many of the Dipteran families. Study of a few selected groups reveals that Dipteran fauna is very rich in this biosphere. While a few of the Gall midges known from this reserve are confined to NBR and only 1 of the 16 species of *Agromyzidae* is endemic to the area, 53 per cent will be genera and 11.4 per cent of reptile species of the family recorded from India are represented here. As for another *Acalypterate* family *Chloropidae*, 63 species representing more than 25 per cent of the species known from India and 3 per cent reported from the world are distributed here, which include 15 species endemic to NBR, accounting for 6.25 per cent of the Indian fauna so far known. Besides 32 genera and all the five subfamilies of *Chloropidae* are represented in this reserve. Of the 187 species of Family *Tephritidae* known from India 35 species are present in this reserve which include many Indian endemics of which 4 are confined in their distribution to NBR.

Fauna of NBR

The study of super families *Chalcidoidea* and *Proctotrupeoidea* representing mostly parasitic *Hymenoptera* of the reserve revealed the occurrence of 130 species of the former and 15 of the latter group. Many of the Chalcidoidea studied are endemic to India. 12 species, accounting for 17 per cent of those recorded from NBR are endemic to the reserve. Though *Proctotrupeoidea* is a large group, only 15 species could be recorded from this biosphere of which 5 are endemic to NBR.

Vertebrate Fauna**Fishes:**

Fishes are a dominant group in NBR. Of the 446 species of primary fresh water fishes known from India, 239 species, including 127 endemics are represented in the western ghats. The NBR comprises 116 species under 46 genera and 20 families of which 12 are endemic and 4 are exotics.

Amphibia:

NBR harbours a rich amphibian fauna. 55 species representing 27 per cent of the Indian species are represented here. Of these 38 are endemic to India, 9 are found in India and Sri Lanka and the remaining 8 are widely distributed. Five of the Indian endemics are strictly restricted to NBR.

Reptiles:

Much is yet to be known about the reptiles of NBR. Based on a small collection it is seen that 21 species are distributed in this reserve. Though none of the species recorded is endemic to NBR, 10 of the Indian endemics, including 7 having their range of distribution restricted to the western ghats are represented here. Five others are common to India and Sri Lanka while 6 have a wider distribution.

Birds:

On the basis of the published records and recent observations, 313 species of birds are known to be distributed in NBR. Of these 183 species are distributed in other areas of the sub continent which include 104 species found also in Sri Lanka and 40 limited to the political boundaries of India and Sri Lanka.

All the rest of the 130 species are endemic to India of which 32 are widely distributed, 39 are restricted to the peninsula and 59 are found only in the western ghats. Among the western ghats endemics, 13 species / subspecies have a range limited to NBR and adjoining hills.

Mammals:

As in almost all other groups, mammalian diversity in NBR is very rich. 97 species, representing 26 per cent of the 373 species of mammals known from India are distributed here. These include about 30 species belonging to the various threatened / endangered IUCN categories. 20 of these species are Indian endemics.

People of NBR

The Biosphere has a large number of indigenous communities, most of them forest dwellers and hunter gatherers. These distinct ethnic groups have small populations and live in geographical concentrations. Approximately, 19,70,000 tribal populations within the NBR is distributed as follows: Kerala part of NBR, especially the Wynaad district gives shelter to the maximum number of tribes both scheduled and unscheduled (1,500,000) followed by Tamil Nadu (300,000) and Karnataka (170,000).

A variety of human cultural diversity can be found in the NBR. The increase in population is attributed to migration from surrounding areas rather than the population growth of indigenous people. It forms home to several adivasi communities, including the only surviving hunter gatherers of the Indian Sub-continent – the Cholanalkans in the new Amarambalam area. Apart from the Todas – a well known pastoral group in the upper Nilgiris, other groups include the Paniyas, Irulas, Kurumbas, Kuruchiyans, Mullukurumbas, Adiyans, Alyars, Jenukurumbas, Kadu Kurumbas, Betta Kurumbas, Urali Kurumbas, Edanadan Chettis, Wynaadan Chettis, Mandatan Chettis, Kurichyans, Karimpalans, Kaders, Pathiyans, Kanaladis, Kattunayakans, Aranadans, Mudugas, Sholagas, Kotas, Panjari Yeravas, Pani Yeravas, hulas and Alars (Anon., 1987; Anon., 1989). Except for Cholanalkans who live exclusively on food gathering, hunting and fishing, all the other tribal groups are involved in their traditional occupation of agriculture.

According to Prabhakar and Gadgil (1994), the pastoral Todas immigrated into the Nilgiris during the 2nd century BC. Along with them probably came the first domestic cattle and buffaloes. During the 8th century AD, hunter gatherers and shifting cultivators including Kotas, Kurumbas and Irulas entered the biosphere reserves. However, the most important event of human immigration that has had a permanent bearing on the landscape of the Nilgiris is that of the Badagas during the 15th century AD. Further infiltration of humans from the plains of Coimbatore and Mysore have added to the population of the biosphere reserve.

Betta Kurumbas

They live in northern parts of Gudalur, extending into the Mysore district in the north. These people live in large settlements of 60-80 households. Most have no land and depend on wage labour and NTFP collection for a large part of the year. With the rapid change to tea cultivation in Gudalur area, these adivasis have become daily wage workers. Many of them have found employment with the Forest Department as watchers and elephant mahouts. Some of them are skilled bamboo workers. Today, the Betta Kurumbas have access to government schemes and help from other agencies. During the season, they go into the forest to mainly collect shikakai (*Acacia concinna*), kodampuli (*Garcinia gummitutta*) and some medicinal plants. They are not good honey collectors and like the Irulas, cover a wide area and collect small volumes; the more specialized/skilled collection of herbs and honey is left for the Kattunalkans.

Jenu Kurumba

Living in the northern part of the reserve, they are named such due to their skill in honey collection – jenu means honey. These



TODA HUT

People of NBR

communities are concentrated in the Mysore and Kodagu districts in the Karnataka part of the NBR. Cultivable land has been given to these communities, though they are traditionally hunter gatherers. Some of the people undertake seasonal agriculture or else depend on wage labour. They collect forest produce, mainly honey, during the season and travel sometimes across the forest to Kerala to sell it. They are socially organized into groups and sangams in different zones. There are approximately 40,000 Jenu Kurumbas in the NBR.

Irulas

Anthropologists do not consider them original inhabitants of hills. They have moved up to the mountains either for wage labour or while doing slash and burn agriculture. Usually, the Irulas have very little link to the other adivasis in the region, except with the Kurumbas. They have a more plains-ward movement and associate with agricultural and trading communities in the adjacent plains around the hills. Hunting, food gathering and agriculture form a distinctive way of making a living, which they now carry out, mainly for commerce. They usually go in groups into the forest and collect items for sale to traders. Till now, the hunting for small game and eating of roots from the forest is common. They collect honey from the Rock Bee from trees and from the combs of the smaller bee – *Apis cerana*. They have a more widespread foraging strategy, collecting more volume for trade by covering vast areas. They too have knowledge of various medicinal plants, which they use. However, they hold the Kurumbas in awe for their skill in sorcery and medicine.

Todas

Though very few in number, approximately 1500 people, this community is well known for their distinct features and traditions. They are scattered over 40 settlements in the Nilgiris. They are pastoralists, breeding buffaloes for both custom and livelihood. Their traditional huts, like igloos, are made of different products from the forest. Due to the nature of their activities, they traditionally commanded large stretches of land for grazing. These were mainly in the upper areas of the Nilgiris, with grasslands and shola vegetation. After the advent of the British and the introduction of exotic plantations of acacia and eucalyptus, their pastures are lost and many of their traditional landmarks become meaningless.

Cholanaickens

The Cholanaickens live in the Karulai forest range of Nilambur in Kerala, forming part of the western NBR. They are the most primitive indigenous community, still in the pre-agricultural level of development. The people live in temporary shelters alongside rivers and shift to caves in the monsoons. Their lives are closely linked to the semi evergreen and moist deciduous forests around that area. They collect NTFPs and sell them to the co-operative society of Nilambur. They collect honey, black dammer, mosses, nutmeg, shikakai from the forest and take back rice, tobacco, salt, oil and other necessities from the Society. Now, they number approximately 426 and continue their lifestyle, though slowly being drawn into modern market economies. Very few development programmes address this community and since they are so few in number, they also marry into other communities, especially the Padinaickens.

People of NBR

Malasars

They are found both in the district of Coimbatore and in the adjoining parts of Kerala. These people are a forest community, living on marginal cultivation (slash & burn), and collection of NTFPs. A large part of their diet also consists of wild yam (*Dioscorea* spp.). The Malasars live in low elevations and almost down to the plains. Some of the villages have good access and infrastructure facilities. Most of the younger generation is getting educated and some are working on regular jobs. A vast difference is found in the economic status of the adivasis in different settlements. Some of the Malasars practice settled agriculture, whereas most earn their livelihood through daily wage jobs.

Kurumbas

Mostly residing in the southern and eastern belts of the Nilgiris, this group was historically known for their sorcery powers and providing medicine from the forest. They were the people of the jungle and lived in caves inside thick forests. Kurumbas collected myrobalans, barks and roots, both for personal use and exchange for grain and salt. They also practiced slash and burn cultivation with millet, chillies and pumpkin. Today, these Kurumbas are settled in villages, adjacent to forests, eking out their living, partly by working on their own lands, working for wages in nearby estates or from collections from the forest. These people are today becoming part of the world around them – e.g. the adivasis of Joghi Kombel have shifted from their remote village of Erukul Kombel. The homesteads are often unkept, close to large rocks which they use for various chores like drying, cleaning, washing sharpening tools, cutting firewood, etc. Some of the Kurumbas villages have house made by the government – in rows with flat drying yards in the front. The settlement size varies from 3-60 households, with an average of 14 households and a population of 40 people. These are usually dispersed settlements.

Kurumbas Kuruchiar

They live in the forested Wyanad region of the NBR. This is a matriarchal society and the women participate in agricultural operations, fishing, animal husbandry, fuel collection, etc. Most land is owned by lineages, whereas there are a few individual owners now. Traditionally, they were shifting cultivators and hunters but now they mostly farm or are farm labourers. Some Kuruchians are also in government jobs and in the defence. Government schemes and programmes have reached out to these communities.



Kattunaickens

The Kattunaicken get their name from the words 'kadu' (forests) & nayakan (leader/chief) and live in parts of Gudalur. They live as a nuclear family and follow patriarchy. However, land ownership is not common. The primary occupation of this community is based on hunting and gathering, especially honey. The Kattunaikans, now live near or inside estates or are settled just outside the Mudumalai and Wyanad Sanctuaries. Their settlement sizes are very small, with an average of 5-8 households; sometimes just 1-2 families can be found living together. Some Naickens, especially those living inside the Mudumalai Sanctuary and in Wyanad, have special affiliations with the Mandan Chettis and Mappilas, working in their paddy

fields and supplying with forest produce, including firewood. Till today, these Naickens live with very few assets in small bamboo huts and are extremely shy in meeting outsiders. Around their houses, they grow a little ginger, coffee, pepper, tapioca and yam but are generally not cultivators. They collect NTFP during the season, but not in large quantities. Honey is the main collection item, other items being forest pepper, cinnamon and nutmeg. Like the Alu Kurumbas, they have a strategy of less volume, high value collection. They have demarcated boundaries within which they forage, often the husband and wife leaving together. Now, they also work in Coorg, where there is seasonal demand for labour in coffee estates.

Mullu Kurumbas

The Mullu Kurumbas are concentrated in the Wyanad region, including parts of Gudalur. Known more for their hunting and bird catching traditions, they now practise agriculture in the vyls of Wyanad. The women engage in fishing traditionally. Today, most of the people are educated and hold jobs. They take advantage of government schemes and their special status. A lot of the culture is now borrowed from the Nayars of Kerala, though they have an animistic form of worship.

Kasavas

The Kasavas live in the northern part of the Nilgiri district and have large settlements, averaging 80 households. Their houses are small and neat. Presently, they are mainly built with the support of the Panchayat or the Forest Department. Living close to a wildlife rich area, these adivasis are adept in the forest. They are good NTFP collectors and have a high economic dependence on this activity. Most of the adivasis have land, which is left barren due to lack of water facilities. Since the land is rocky, it is seasonally planted with millet and vegetables. Crop destruction from wild animals is also a constant threat to them. They too, like the Irulas, collect NTFP in bulk and sell it to traders. They collect honey from trees and small rocks. They also hunt small game. The Kasavas are also herdsmen, looking after herds of cows, owned by the Badaga community from whom they get wages. However, this has created an extensive overgrazing pressure in the area. The whole area in which the Kasavas live, is under consideration for being declared a protected area.

Chetties

Small but significant populations of Chettis are found in the region. These are both Wyanad Chettis and the Mandhadan Chettis. The latter live in the Gudalur region around the Mudumalai Sanctuary. They practice paddy cultivation and have links with other communities of the region.

Paniyas

This community is significant in the Wyanad region. They number approximately 6000 and many of them were (are) bonded labourers to landlords in Wyanad. They have now been rehabilitated but a large number do not have land and go back as labourers. In recent times, protests in the Muthanga area of Wyanad were related to access to land and included the Paniya community, amongst other adivasis. Access to land and work, living conditions are the major issues facing this community.

People of NBR

Kadukuruba

This community mainly lives in the Mysore district of the NBR, just north of the area where most Betta Kurumbas are located. It is difficult to distinguish between the two communities as they are very similar in their lifestyle. However, detailed studies of kinship reveal different communities. These people also depend on different means of wage work, forest collection and mixed agriculture. They are good bamboo basket makers and are also skilled in forest labour work including the trapping of wild elephants. Their approximate population is 15,000.

Sholigas

These hunter-gatherers are mainly located in the Karnataka part of the NBR, bordering towards Biligiri Rangan Betta. This area is covered with forests, which is their largest resource base for livelihood and sustenance. They also practice shifting cultivation but are now settled in villages, where they undertake seasonal agriculture. They are good honey collectors from trees and undertake basket weaving.

Badagas

The largest single ethnic minority in the Nilgiri district of the NBR, this community numbers approximately 2,00,000. Principally tillers and herdsmen, now the community members are in all walks of life. They are supposed to have come to the Nilgiris, after the break up of the Vijaynagar Empire in 1565 and settled here. After the British came to Nilgiris, it was the Badagas who took to change and modernity. However, even today, they maintain their ethnic distinction which is reflected in language, settlements and costume. The Badagas play an important role in the cultural landscape of the area. They are not classified as 'tribe' by the government, but as 'backward class'.

Kotas

The Kotas are the artisanal adivasis of the Nilgiris. There are 7 Kota Villages in the hills. They are skilled as blacksmiths, silversmiths and carpenters. The women practice pottery. The Kotas also cultivated their own lands and were known to be good musicians. During earlier times, this community supplied tools, pots and other artisanal services mainly to Badagas and Todas. Now these occupations are not followed, as modern equipments have taken over. Some pottery is still done for ritualistic purposes. This community is now mostly educated and can be seen holding government jobs, owning tea gardens or running small businesses. They now number approximately 1900 people only.

Muduvars

The Muduvars are a small population in the NBR, close to the Boluvampatty Area. This community is considered to be at the top in the hierarchy of adivasis in this area and are believed to come from the Madurai area during the Pandiyian times. They practice agriculture and have control over large areas of land for both cash and food crops. Most of their villages are in the upper plateau areas, adjacent to tropical evergreen forests. Most of the Muduvars grow beans, pepper and cardamom and also have vayal areas in the valley for paddy cultivation. These people are self-sufficient and well off. They also have good knowledge of the forest for medicinal plants and collect large amounts of *Canarium strictum* for their rituals and for sale.

Issues in NBR

The entire land area in the NBR stretches across more than eight revenue districts and forms the largest contiguous patch of protected forest in the nation. These forests though rich and diverse are also irrevocably transforming into a protected island. These large forests, if transformed into an island are likely to suffer immensely because of the complete stoppage of flow of biodiversity between different types and locations of forests.

The NBR has been enduring human interference for a very long time through development projects such as hydroelectric power projects, agriculture, horticulture, etc., which have brought about substantial change in the ecology of the area. Many environmental problems are noticed in different parts of the NBR. Human pressures from all sides, be it in Tamil nadu, Karnataka or Kerala are pushing the forest and animals deeper inside these protected zones.

Intrinsic threats include the growing resident human and cattle populations and the subsequent demand on land for settlement, agriculture and pasture. Associated with the rise in human and cattle population are hazards such as spread of diseases, exotic species, fire, erosion, siltation, poaching, fodder, food and fuel gathering within the reserve. A large number of estates, factories and small industries which functioned within the NBR before it was declared a biosphere reserve, continue to exist and operate causing considerable ecosystem damage largely through inorganic pollution to air, soil and water. Major industries such as a Needle Factory, Hindustan Photo Films and Cordite (explosives) Factory in the Nilgiris district are permanent threats to the NBR (Anon, 1990).

8.1. Human Population

The three hill towns viz., Uthagamandalam, Coonoor and Kotagiri are located in the Nilgiris plateau, have a human population of around 704,827 at a density of 900 people per km². Of these not less than 70 per cent are immigrants from the plains of Coimbatore and Mysore. Prabhakar (1994) reported that, in the Nilgiris, during 1891 the native immigrant ratio was unity, in 1981 it is about a third. Human activities in the Nilgiri plateau comprising the Nilgiris district has the most impact on the biosphere reserve. Due to their situation up on the hills any adverse impact to the ecosystem that they may create locally, spreads over a considerable distance downhill (Daniel, 1992).

8.2. Intensive Felling

The increase in influx of population from the surrounding areas has led to deforestation and consequent habitat destruction. Between 1990 - '96 there has been a decrease in the dense forest area. 28.96 sq. km. of dense forests have become open forest and 22.67 sq. km. of dense forests have changed into non-forest areas. Intensive felling has led to multiple problems like destruction, depletion and degradation of the environment and its natural resources. Indiscriminate clearing of forests is destroying the habitat of the several species of animals and birds of the Nilgiris. Some of them like the Nilgiri wood pigeon, Nilgiri pipet and Nilgiri langur

that are endemic to this region have become highly endangered. Animals like the elephant, tiger and leopard are moving closer to human settlements owing to the shrinking of forest areas.

8.3. Faulty Land Use

The steep terrain of the NBR has been unscientifically utilized for cultivating exotic vegetables including potatoes, cabbage, carrot, etc. One of the major impacts on the Nilgiris ecosystem was caused by the Indo-German potato farming project. Growing potatoes extensively on the steep slopes has led to a number of permanent disasters such as landslides and siltation of the existing water bodies. Hundreds of hectares of forest land was cleared for tea plantations to employ the Srilankan repatriates by the government sponsored TANTEA corporation. Several small tea growers, especially amongst the Badagas, have continually encroached forest and revenue lands for the cultivation of tea. The precipitous topography and the added high rainfall coupled with the faulty land use have resulted in severe land slides year after year; the significant being the one that happened during the monsoons of 1993 between Coonoor and Udthagamandalam, which was about a kilometer wide and over nearly five km distance downhill.

8.4. Plantations (Monoculture)

The Nilgiris, which support a variety of tree species, are threatened by monoculture. The sholas are being destroyed for plantations. Monoculture of eucalyptus, wattle, blue gum, cash crops like tea, coffee, cardamom and food crops like potato have degraded the soil quality along with excessive use of fertilizers. The tea bushes require frequent application of fertilizer, which has made the soil porous. During heavy rain, these slopes are easily washed away resulting in a landslide.

Table 8. Change in Comparison of the Different Types of Vegetation in the NBR Between 1849 and 2000

Sl.No	Total Area	1849 (Area in ha)	2000 (Area in ha)	Change in area (ha)
1.	Sholas	8,600	4,225	(-)4,375
2.	Grasslands	29,875	4,700	(-)25,175
3.	Cultivation	10,875	12,400	1,525
4.	Tea	0	11,475	11,475
5.	Wattle	0	9,775	9,775
6.	Eucalyptus	0	5,150	5,150

(http://www.fire.uni-freiburg.de/iffn/country/in/in_7.htm)

Deforestation in the biosphere reserves, which are key Protected Areas, has negative impacts on biodiversity, climate, carbon fluxes and livelihoods. Studies have indicated that Restoration zone has undergone 38.9 per cent of forest cover loss followed by Manipulation-Forestry zone (27.3%), Manipulation- Tourism zone (15.3%) and Core zone (6%). The reserve has accorded high degree of protection in Core zone, Manipulation zone as well as Restoration zones after declaration as biosphere reserve (Satish *et al.*, 2014). A study reported about the mapped figure of forests from earliest available topographical maps and multi-temporal satellite data spanning from 1920 - 2012 period (Satish *et al.*, 2014). The total forest area of biosphere reserve was found to be 5,806.5 km² (93.8% of total geographical area) in 1920. Overall loss of forest cover was estimated as 1,423.6 km² (24.5% of the total forest) with reference to 1920. The deforestation in Nilgiri Biosphere Reserve is mainly attributed to conversion of forests to plantations and agriculture along with submergence due to construction of dams during 1920 to 1989. The loss of forest cover in Nagarhole and Bandipur is mainly due to construction of dams and agricultural expansion. There was large scale deforestation before the declaration of area as biosphere reserve in 1986; however, the deforestation has drastically reduced after the declaration due to high degree of protection, thus indicating the secure future of reserve in the long term under the current forest management practices (Schmitt, 2009 and Satish *et al.*, 2014).

8.5. Grazing

The sholas were used for grazing cattle. The livestock population inside the NBR is very low but the population in the periphery is very high. Destruction of the sholas has led to disappearance of perennial streams, causing soil erosion and microclimatic changes. Overgrazing has led to degradation of low and high level grasslands, which harbour a large number of endemic species.

A case study in Masinagudi indicated that, the main stay of cattle has about 15,000 humans and an equal number of cattle. Ten thousand tonnes of cow dung is removed from this area every year for commercial purposes (Anon, 1992). These cattle freely graze within the protected areas often competing with the native herbivores such as gaur, sambar and deer. A crude estimate suggests that the daily removal of natural biomass by these cattle would amount to about 100 tonnes or 12 lorry loads, considering that an average bovine consumes at least 5 kg food per day (Anon, 1990).

8.6. Forest Fire

Forest fires are more common in the sholas and dry deciduous forests. They are both accidental as well as deliberate. The annual fire set off during the summer months for a better pasture in the ensuing monsoon is another manmade threat to the biological diversity.

8.7. Development and Construction Activity

The host of infrastructure projects like building new roads, rail lines, Special Economic Zone, widening the existing highways in the forests, location of heavy industries in the region is

bound to cause damage to the existing natural resources. Due to developmental activities, large areas of forests have been cleared in and around the NBR. More human habitation has resulted in large scale road laying that connects even remote forest areas to the nearest urban centre. Construction activities like road building have unleashed widespread landslides and slope destabilization. Construction of the Kabini reservoir has submerged the valley between Nagarhole and Bandipur.

8.8. Horticulture and Agriculture Practices

Extension of agriculture and use of lands unsuited for agriculture have accelerated soil erosion. Human settlements on the uplands have destroyed the sholas. Soil erosion is severe in the east and southwest areas of the Nilgiris where the monsoons are heavy. In the Mysore plateau region, the extension of irrigation canals from reservoirs has led to a large scale shift in land practices.

8.9. Tourism

The Nilgiris is an important tourist centre in South India and attract a large number of tourists. A large number of hotels, clubs, resorts, gardens and roads have emerged rapidly and degrading the natural vegetation. Extensive pollution and water scarcity are the result affecting the entire ecology of NBR.

8.10. Threatened Tribal Livelihood

The forest dwelling tribes in Western Ghats represent a unique diversity of cultures that co-habit within forest ecosystems. Their resource base of natural forests is shrinking at a faster rate, affecting the livelihood opportunities like collection of Non Timber Forest Produce. In order to provide livelihood security, the Forest Right Act 2006 needs to be effectively implemented. Community control over forest resources, in addition to rights over land, can guarantee livelihood security with the added benefit of forest and diversity conservation.

8.11. Hydel Power Projects

Many river valley projects in NBR, like Upper Bhavani, Kundha, Pykara have not only affected the river and stream flow but also submerged vast stretches of forests. The grasslands of Silent valley, habitat of many rare and interesting plants other than important grasses were considered insignificant by the supporters of the hydro electric project in this area. The submergible area of the Silent valley is found to harbour 84 species, which are not present anywhere else in the region. This includes 23 rare/new species also, which would have been lost completely by the flooding waters of the dam. The rediscovery of the ground orchid *Ipsea malabarica* after 135 years shed light on the importance of the above area. The elimination of species like *Eriochrysis rangacharii* (Poaceae) and *Ophiorrhiza pykarensis* (Rubiaceae) from Pykara are largely due to dam construction.

A major threat to the important elephant corridors is the Pykara Ultimate Stage Power Project, the formal clearance for which has been made by the government. It is even feared that human influx brought about by the project would be creating pressure on the existing scrub jungle on the Sigur plateau for firewood. Some estimates have put the existing demand as 2-3 tonnes per day.

8.12. Man-Animal Conflict

Forests are the sole and rapidly shrinking habitat of wildlife and any forest encroachment accelerates man-animal conflict. Forest conservation and wildlife protection go hand in hand but erroneous perception is that priority to wildlife triggers such conflicts. Both are complementary to each other and the need of the hour is to instill confidence among the forest dwelling tribes that their livelihood is secured through conservation of wild animals and habitats. This enhances the natural capital as well as provides ecological security for the human beings and wildlife. There should be no resettlement of villages from the National Park or Sanctuary. Indigenous people and tribes be given access to Non Timber Forest Produce.

8.13. Diverting Rivers

There are numerous attempts to link and divert rivers flowing in the west to be linked to the east flowing rivers. This kind of engineering of the rivers, diverting their natural course is bound to create Irreparable ecological, social and economic impacts on the downstream including loss of 'ecological flows' in rivers, causing hardship to people and forests.

8.14. Invasive Species

Estimates in 1938 found that the Nilgiri plateau was 80 per cent grasslands and 20 per cent sholas. Black wattle and pine were planted in the grasslands to meet the fuel wood requirements of human settlements as well as the industrial needs. Many generations of farmers, gardeners and foresters have introduced the temperate and ornamental plants from other parts of the world into Nilgiris. Spread of exotics such as *Eupatorium odoratum*, *Sorathomnus scoparius*, *Lantana camara*, *Ulex europeus* and *Parthenium hysterophorus* is extensive even currently. Invasive alien species are plants that are not endemic to a place. For instance, a croton variety found in Kalakkadu Mundanthurai Tiger Reserve in Tirunelveli district in 1991 was found to have come from the jungles of Vavuniya along with the Tamil militants who used the forests for training in the '80s, says a forest officer.

8.15. Pollution

Bhavani River rises in the Upper Nilgiri plateau, drains the Attapadi valley in Kerala, collects the waters of the Kundah river and flowing past Mettupalayam joins Moyar river at Bhavanisagar. Further on it reaches Cauveri river at Bhavani town after a 217 km flow. About 90% of the river's water is used for agriculture. Pesticides from the tea estates of the Nilgiris District seep into the Bhavani. It is estimated that tea estates and coffee pulp houses add about 1.5 million litres per day (MLD) of effluents to the river every day.

Summary and way forward

The Nilgiri Biosphere Reserve (NBR) was identified as representative of the Western Ghats under Man and Biosphere Programme (MAB) by UNESCO during 1970s to conserve *in-situ* genetic diversity of species, to restore degraded ecosystems to their natural conditions, to provide baseline data for ecological and environmental research and education and to function as an alternate model for sustainable development. The NBR has four major zones viz. Core Zone (1240.3 km²), Manipulation forestry Zone (3238.7 km²), Tourism Zone (335.0 km²) and Restoration Zone (706.4 km²). The NBR is one of the critical catchment areas of peninsular India. Many of the major tributaries of the river Cauvery like the Bhavani, Moyar, Kabini and other rivers like Chaliyar, Punampuzha, etc., have their source and catchment areas within the reserve boundary. Mudumalai Wild Life Sanctuary and National Park (321 km²), Wayanad Wildlife Sanctuary (344 km²), Bandipur National Park (874 km²), Nagarhole National Park (643 km²), Nugu Wildlife Sanctuary (30 km²), Mukurthi National Park (78 km²) and Silent Valley National Park (89.52 km²) are protected areas within the NBR.

The NBR is known for its rich biodiversity and identified as being representative of the biogeographical zone of the Western Ghats and the setting up of the reserve aimed at conserving large tracts, rich in biodiversity and to promote sustainable use of resources. There are 3238 species of *Angiosperms*, 71 species of *Gymnosperms*, 134 species of *Pteridophytes*, 300 species of butterflies and 684 species of Vertebrates hitherto reported from this area. Of the 285 species of vertebrates endemic to the western ghats, 156 occur within the NBR. Several species of lower organisms are yet to be discovered and described.

The NBR embraces all the important forest types that are found in South India such as tropical thorn forest, tropical dry deciduous forests, tropical moist deciduous forests, tropical semi evergreen forests, sub tropical broad leaved forests, tropical wet evergreen forests, southern montane wet temperate forests, southern montane wet grasslands and subtropical hill savannas. The NBR is very rich in plant diversity. About 3,300 species of flowering plants can be seen here. Of the 3,300 species 132 are endemic to the NBR. The fauna of the NBR includes over 100 species of mammals, 350 species of birds, 80 species of reptiles and amphibians, 300 species of butterflies and innumerable invertebrates.

The Biosphere has a large number of indigenous communities, most of them forest dwellers hunter and gatherers. Approximately, two million tribal populations are distributed within the NBR. Todas, Paniyas, Irulas, Kurumbas, Kuruchiyans, Mullukurumbas, Adiyans, Alyars, Jenukurumbas, Kadu Kurumbas, Betta Kurumbas, Urali Kurumbas, Edanadan Chettis, Wynaadan Chettis, Mandatan Chettis, Kurichyans, Karimpalans, Kaders, Pathiyans, Kanaladis, Kattunayakans, Aranadans, Mudugas, Sholagas, Kotas, Panjari Yeravas, Pani Yeravas, Iulas and Alars are the major tribal groups for in NBR. Except for Cholanaickens who live exclusively on food gathering, hunting and fishing, all the other tribal groups are involved in their traditional occupation of agriculture.

The NBR has been enduring human interference for a very long time through development projects such as hydroelectric power projects, agriculture, horticulture, etc., which have brought about substantial change in the ecology of the area. Many environmental problems are noticed in different parts of the Nilgiri Biosphere Reserve. Human pressures from all sides, be it in Tamil Nadu, Karnataka or Kerala are pushing the forest and animals deeper inside these protected zones.

The NBR must be kept undisturbed in future from all activities of human for its natural resilience over years in future.

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