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# Western Ghats Biodiversity Hotspot-Species Distribution and Recent Threats with special reference to Mollem National Park

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**ABSTRACT:** The 'Western Ghats' is a mega biodiversity region as well as a biodiversity hotspot with varied flora, fauna, and landscapes. The distribution and magnitude of the biodiversity that exists today is a product of over 3.5 billion years of evolution, involving speciation, migration, extinction, and more recently, human influence. This study mainly focused on the diversity of plant life as an essential underpinning of most of the tropical ecosystem and the certain faunal components, particularly in the wet zones of the region. The existing information on species richness and endemism of taxa shows the environmental, ecological, and biogeographical importance of this region. The natural ecosystems of this hotspot are under threat by the increasingly adverse effects of human impacts on the environment and urgent conservation action is needed, especially in augmenting the protected area network. Unless actions are taken to protect biodiversity, the opportunity of reaping its full potential benefit to mankind will be lost forever. This necessitates balanced exploitation and conservation of the nation's resources, especially plant and animal resources. There is also the need for increasing the level of scientific collaboration in biodiversity studies in the 'Western Ghats' region.

**KEYWORDS:** Biological diversity, Biodiversity Hotspot, Endemism, Endemics, Flora, Fauna, Threatened species.

## I. INTRODUCTION

The term 'Biodiversity' means the variety of all life on earth. 'Biological diversity' or biodiversity is a part of Mother Nature which includes the gene differences among the individuals of a species. The variety and richness mean all the species (plant or animal) at different scales in space (local, regional, country, or world), and various types of ecosystems (terrestrial, marine, or any other aquatic), within a defined area. It is identified as the variability among living organisms from all sources including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems.

Biological diversity deals with the degree of variability of nature in the biosphere. This variability can be observed at three levels. A) Genetic variability: The variability of individual species B) Species variability: The variability of species within a community in a present region; and C) Ecosystem variability: The organization of species within an area into the distinctive plant and animal communities constitutes ecosystem diversity.

Another term 'Biodiversity Hotspot' refers to a large biogeographic region with a significant reservoir of both exceptional concentrations of plant and animal species as well as endemism and experienced by serious levels of habitat loss, which is under threat from humans. This is a method to identify those regions of the world where attention is needed to address biodiversity loss and to guide investments in conservation. The term 'Biodiversity Hotspot' was first coined by 'Norman Myers' in 1988 to identify tropical forest 'hotspots' characterized both by exceptional levels of plant endemism and serious habitat loss, which he then expanded to a more global scope. He identified eighteen geographical regions that need to conserve because they contained large numbers of endemic species and facing significant threats of habitat loss. A hotspot must contain at least 1,500 species of vascular plants as endemics, and it has to have lost at least 70 percent of its original habitat. Conservation International adopted Myers' hotspots as its institutional blueprint in 1989, and in 1999, the organization undertook an extensive global review that introduced quantitative thresholds for the designation of biodiversity hotspots. Currently, 35 biodiversity hotspots have been identified, most of which occur in tropical forests. They represent just 2.3% of Earth's land surface, but between them, they contain around 50% of the world's endemic plant species and 42% of all terrestrial vertebrates.

Overall, Hotspots have lost around 86% of their original habitat and additionally are considered to be significantly threatened by extinctions induced by climate change.

## II. OBJECTIVES

The precise and direct objectives related to this study are mentioned below:

- To protect and conserve the biodiversity for obtaining resources
- To preserve the diversity of species (all varieties of old and new flora, fauna, and microbes) and sustainable utilization of ecosystem for maintaining the ecological balance
- To protect natural habitats and critically endangered, and rare species
- To maintain the life-supporting systems and essential ecological processes
- To reduce pollution and utilization of the natural resources in a sustainable way
- To implement strict restrictions on the export of rare plants and animals
- To increase public awareness through media, government agencies, NGOs, etc.

## III. DESCRIPTION OF THE STUDY AREA

The Western Ghats, of south-western India, is locally known as the Sahyadri Hills, are formed by the Malabar Plains and the chain of mountains running parallel to India's western coast. The mountain range stretches over a distance of 1500- 1600 km with an average elevation of more than 600 m about 30 to 50 km inland and traverses through six states viz. Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu cover an area of about 160,000 km<sup>2</sup> from Tapi river in the north to the country's southern tip Kanyakumari, interrupted only by the 30 km Palakkad Gap, a 30-km wide break in the Western Ghats that separates the south from the more northern stretch.

The northern portion of the narrow coastal plain between the Western Ghats and the Arabian Sea is known as the Konkan Coast or simply Konkan, the central portion is called Kanara and the southern portion is called the Malabar region or the Malabar Coast. The foothill region east of the Ghats in Maharashtra is known as Desh, while the eastern foothills of the central Karnataka state are known as Malenadu. The largest city within the mountains is the city of Pune (Poona), in the Desh region on the eastern edge of the range. The landscape of Western Ghats is unique in terms of biology, ecology, geology, and geomorphology coupled with high rainfall makes the Western Ghats as a majestic-magnificent mountain range and one of the most ecologically diversified landscapes.

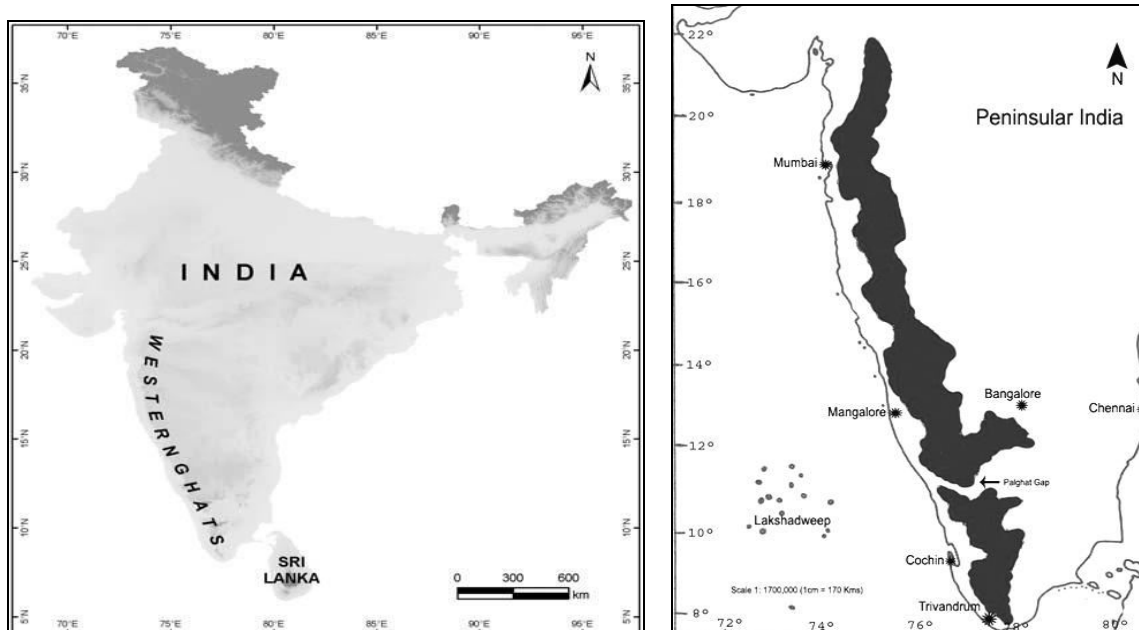


Figure 1: Location of the study area (Source: Institut Français de Pondichéry)

## IV. SPECIES DIVERSITY

The Western Ghats region is considered one of the most important biogeographic treasures of India, as it consists of a high degree of endemism (11% to 78%) with scenic beauty. Due to unimaginable topography and micro-climatic regimes, some areas within the region are considered to be active zones of speciation. The tropical climate complimented by heavy precipitation by intercepting the south-west monsoon and favorable edaphic factors creates an ideal condition for the luxuriant growth of plant life, which can be seen only in few parts of the world. The western slopes of the mountains experience heavy annual rainfall (with 80 % of it falling during the southwest monsoon from June to September), while the eastern slopes are drier; rainfall also decreases from south to north. With its rainfall regime, the wide variation of rainfall patterns in the Western Ghats, coupled with the region's complex geology and geomorphology, produces a great variety of vegetation types. The western slopes of the Western Ghats have a natural cover of evergreen forest, which changes moist to dry deciduous type as one comes to the eastern slopes and then scrub forests in the low-lying rain shadow areas and the plains. The vegetation reaches its highest development towards the southern tip in Kerala with rich tropical rain forests, and in the northern part, a unique type of mosaic mountain forests and rolling grasslands found above 1,500 m.

The Western Ghats presents a whole range of gradients, both altitudinal as well as latitudinal in climatic factors, such as total annual rainfall, maximum temperatures. This tremendous environmental heterogeneity found across the Western Ghats, of topography, soils, rainfall, number of dry months per year, and temperature, makes for an extremely environmentally heterogeneous biogeographic area, with a tremendous amount of diversity, both plants, and animals.

The region has 490 arborescence taxa, of which as many as 308 are endemics this endemism of tree species shows a distinct trend, being the highest (43%) in 8N-10°30'N location and declining to 11% in 16N - 16°30'N location. About 1500 endemic species of dicotyledonous plants are reported from the Western Ghats. 245 species of orchids belonging to 75 genera are found here, of which 112 species in 10 genera are endemic to the region. As regards the fauna, as many as 315 species of vertebrates belonging to 22 genera are endemic, these include 140 species of mammals, 458 species of birds, 267 species of reptiles, 178 species of amphibians, and 191 species of fish.

The extent of endemism is high in amphibians and reptiles. There occur 117 species of amphibians in the region, of which 89 species (76%) are endemics. 165 species of reptiles found in the Western Ghats, of which 88 (53%) species are endemics. Many of the endemics and other species are listed as threatened, nearly 235 species of endemics flowering plants are considered as endangered and some rare fauna found in this region are Lion Tailed Macaque, Nilgiri Langur, Nilgiri Tahr, Flying Squirrel, and Malabar Gray Hornbill.

**Table: 1;** Species Diversity and Endemism\*

| Taxonomic Group   | Species | Endemic Species | Endemism (%) |
|-------------------|---------|-----------------|--------------|
| Plants            | 5916    | 3049            | 51.5         |
| Mammals           | 140     | 18              | 12.9         |
| Birds             | 458     | 35              | 7.6          |
| Reptiles          | 267     | 174             | 65.2         |
| Amphibians        | 178     | 130             | 73.0         |
| Freshwater fishes | 191     | 139             | 72.8         |
| Land snails       | 269     | 204             | 75.8         |
| Freshwater snails | 77      | 28              | 36.3         |
| Butterflies       | 332     | 37              | 11.1         |
| Odonata           | 174     | 69              | 39.6         |
| Ants              | 350     | 70              | 20.0         |

\*Source: Article in Current Science; December 2017, Research Gate

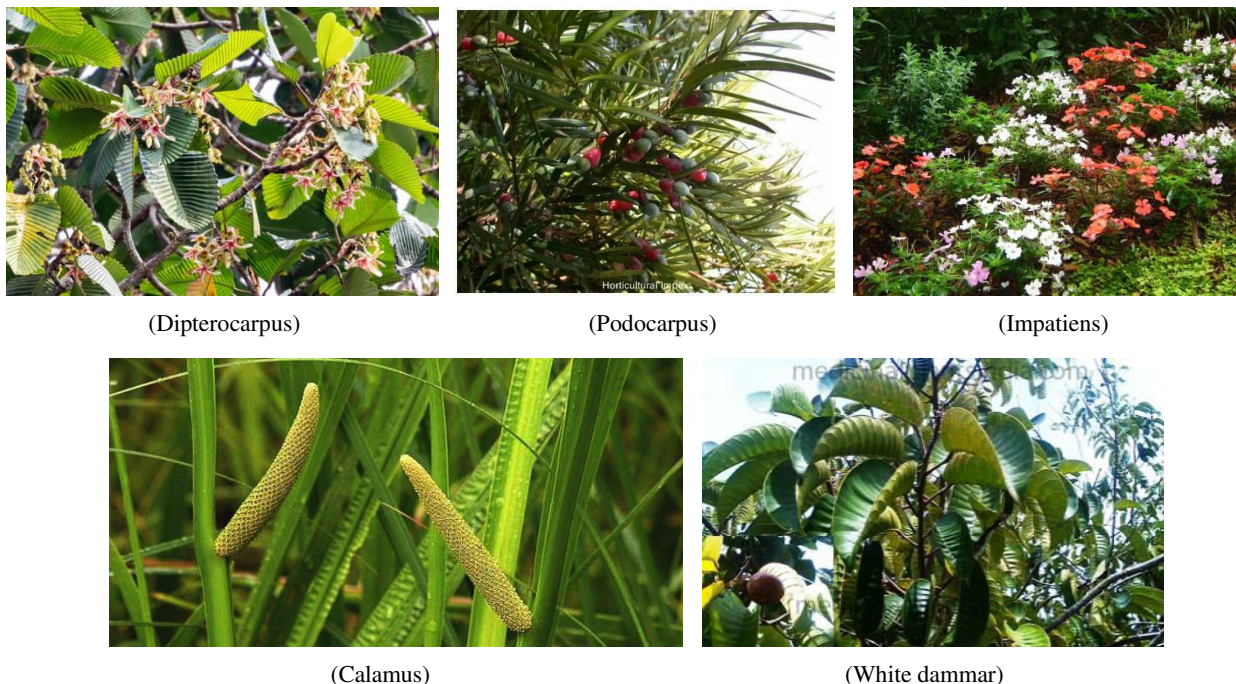
**Flora:**

Plant diversity in the Western Ghats is correlated with seasonal variation, with higher levels of alpha diversity towards the south; similarly, plant endemism is also higher towards the southern region. Over 5,000 different plants are found in the Western Ghats and 1,700 of these are found nowhere else in the world. This includes the wild relatives of many economically important species, such as grains, fruits, and spices, as well as numerous medicinal plants, such as the highly-threatened White dammar (*Vateria indica*). The fragrant resin and seed oil of this large evergreen tree can be used in medicines, as well as in soap and candle manufacturing. Other notable plants that occur in the Western Ghats include Wight’s sago palm (*Arenga wightii*) which Starch and Sap (*Palm wine*) provide an alternate source of food and drink for the local Muthuvans tribes. The grassland ecosystems of the higher elevation of the Western Ghats have been fairly well studied and shown to be primary and not of anthropogenic origin. The disjunct distribution of the genus *Eriochrysis* (*Eriochrysis cayennensis*) further indicates the relict nature of some of the floral elements. The recently rediscovered from the Red Data Book of Indian plants; *Eriochrysis rangacharii* is an endemic swamp grass used extensively by the Toda ethnic group, inhabitants of the grasslands.

The Western Ghats has approximately 6,000 species of vascular plants belonging to nearly 2,200 genera; about 1,700 species (34%) are endemics. There are also 58 endemics plant genera, and, while some are remarkably speciose (like *Nilgiantus*, which has 20 species); nearly three-quarters of the endemics genera have only a single species.

Evergreen tree endemism is about 56% along the Western Ghats with tree communities tending to vary with the local topography within the wet zones. 490 evergreen tree species are found in low and mid-elevation forests, of which 308 species are endemics. Some prominent genera and families are represented by large numbers of endemic species, such as *Impatiens* (*Touch-me-not plants*) with 76 endemic species, *Dipterocarpus* (*Flowering plants*) with 12 endemic species, and *Calamus* (*Sweet flag*) with 23 endemic species. *Podocarpus* (*Plum pine*) *wallichianus* is the only gymnosperm (*Seed-producing plants*) tree; there are also 267 species of orchids, of which 130 are endemics.

In the Western Ghats, the Agasthyamalai Hills in the extreme south are believed to harbor the highest levels of plant diversity and endemism at the species level. Among the flowering plants in the Western Ghats, about 10% are under the IUCN ‘threatened’ category, and nearly 87% of flowering plants of these regions are found in the southern part of the Palakkad Gap; 37% of plants species being exclusive to this sub-region; these figures decrease to about 60% and 5%, respectively, in the Nilgiri Hills.



**Figure 2:** Some floral species of Western Ghats

**Fauna:**

**Mammals:** Around 120 mammal species have been recorded in the Western Ghats. Most notably, they are home to both the world's largest population of Asian elephants (*Elephas maximus*) and ten percent of the world's Tigers (*Panthera tigris*). Prominent endemic mammals include the Nilgiri tahr (*Hemitragus hylocrius*), which can be observed on the cliffs and high, grassy plateaus, and the Lion-tailed macaque (*Macaca silenus*) which inhabits the evergreen forest, and Malabar civet (*Viverra civettina*). Nearly 50 of the mammal species found in the Western Ghats are Bats. This includes Salim Ali's fruit bat (*Latidens salimalii*), remarkable for being the only species in its genus. Endemism is quite low among the species when compared to other taxa with only 18 endemics in this region, though 14 of them are in the IUCN 'vulnerable' and 'endangered' categories.

**Birds:** A great diversity of birds with species richness and endemism has been recorded in the Western Ghats region, imposing from great Indian vulture (*Gyps indicus*) to tiny blue Nilgiri flycatcher (*Eumyias albicaudatus*), Nilgiri pipit, (*Anthus nilghiriensis*); White-bellied shortwing (*Brachypteryx major*) and the stunning Indian peafowl (*Pavo cristatus*). Around 500 bird species are found in the Western Ghats, of which 22 species are found nowhere else in the world. From the bird species, many of these are endemic species, such as the Nilgiri wood pigeon (*Columba elphinstonii*) and Nilgiri blue robin (*Myiomela major*). Changes in the land use throughout the Western Ghats have triggered the decline in endemic species among bird diversity and seven of the 22 endemic bird species are globally threatened and listed as IUCN 'vulnerable' and 'endangered' species.

**Reptiles and amphibians:** Reptiles and amphibians have the highest level of endemism among vertebrates in the Western Ghats region. There are 225 species of reptiles recorded in the Western Ghats includes some fascinating and unique animals, such as the endemic Cochin forest cane turtle (*Vijayachelys silvatica*), the wonderfully named mugger (*Crocodylus palustris*), and the infamous king cobra (*Ophiophagus hannah*). A family of primitive burrowing snakes (*Uropeltidae*) is also restricted to these regions. This region having over 50% endemic species and a number of these endemic species being in the IUCN 'threatened' category.

There are also 117 amphibian species found in the Western Ghats, of which 89 are endemics. The amphibian diversity of the wet zone is remarkable; it has the highest species density (approx. 3.9 species per 1000 sq. km) compared to eight other 'mega diversity' countries in the world. The studies indicate that many of the ancient amphibian lineages are confined to the Western Ghats. The family Ranidae (*true frogs*) has the highest number of species in this region (42% of total species) followed by Rhacophoridae (25%). The two genera Nyctibatrachus (11 species) and Micrixalus (7 species) are known to be endemic to the Western Ghats. Recently a peculiar-looking purple frog (*Nasikabatrachus sahyadrensis*) was discovered in the southern part of Western Ghats and represents an entirely new genus.

**Fish and invertebrates:** The numerous rivers and streams originate from the Western Ghats are home to a remarkable variety of fishes. An analysis of distributional patterns shows that the southern Western Ghats are more species-rich than the northern and central regions. There are 288 freshwater species recorded in this region, of which 118 (41%) are endemics. This includes the Denison barb (*Puntius denisonii*), a pretty, stream-dwelling fish that is popular in the ornamental fish trade. During the past ten years, nine new species have been discovered in this area, which incidentally, is also the most heavily populated region of the country. Loss of freshwater habitats, the introduction of exotic species and pollution of water bodies poses the most serious threats to fish populations.

The available information indicates that the Western Ghats has an abundance of diverse invertebrates, many of which are believed to be endemics. For example, of nearly 140 tiger beetle species known from the Western Ghats, more than 100 are found nowhere else. About 269 species belonging to 56 genera of land-snails have been recorded from the Western Ghats, of which 76% were endemics. 140 species of ants in 32 genera from 12 localities are found in the Western Ghats. The Odonata fauna of the Western Ghats includes 223 species representing two sub-orders; dragonflies and damselflies. About 52% of the species belonging to these sub-orders are endemic. The families Gomphidae and Platystictidae have high levels of endemism within the region.

Among the insects, an incredible 330 butterfly species have been recorded in the Western Ghats, of which 290 species are found in Nilgiris. One of these species, the Travancore evening brown (*Parantirrhoea marshalli*), can only be found in a small area of mid-elevation forest in the Western Ghats, where it flutters around reed patches at twilight.

Butterfly endemism is about 10% in this region, which is much lower compared to other groups and many widespread species in the Indian subcontinent.



(Lion-tailed Macaque)



(Nilgiri Flycatcher)



(Micrixalus)



(Denison barb)

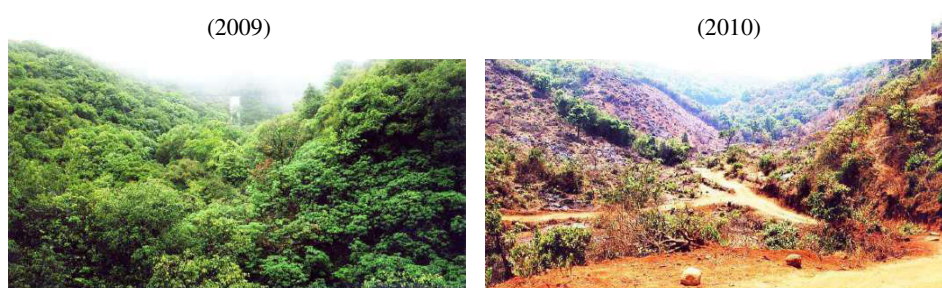


(Platystictidae)

**Figure 3:** Some faunal species of Western Ghats

#### V. THREATS

The Western Ghats faced tremendous population pressure; the forests of the Western Ghats have been dramatically impacted by the demands for timber and agricultural land and the remaining forests of the Western Ghats are heavily fragmented. Population levels are also applying increased stress on the fringes of protected areas where many farms, loggers, and poachers use the resources illegally. Likely, no more than about 25% of the extent of original native vegetation remains in relatively pristine condition today. The forests of the Western Ghats have been selectively logged and highly fragmented throughout their entire range. Forests have been converted to agricultural land for monoculture plantations of tea, coffee, rubber, oil palm, teak, eucalyptus, and wattle, and are also cleared for building reservoirs, roads, and railways. Encroachment into protected areas further reduces the extent of forests. Grazing by cattle and goats within and near protected areas causes severe erosion on previously forested slopes. Much of the remaining forest cover consists of timber plantations or disturbed secondary growth. Today, approximately 20% of the original forest cover remains in a more or less pristine state, with forest blocks larger than 200 sq. km found in the Agasthyamalai Hills, Cardamom Hills, Silent Valley- New Amarambalam Forests, and southern parts of the South Kannada District in Karnataka State. Remaining forest patches are subject to intense hunting pressure and the extraction of fuel-wood and non-timber forest products. Uncontrolled tourism and forest fires are additional concerns. The growth of populations around protected areas and other forests has led to increasing human-wildlife conflict by raiding elephants cause crop loss and leopards kill livestock. Compensation for farmers is generally inadequate, and wild animals are often killed or injured in an attempt to reduce further damage.



**Figure 4:** Landscape alteration of a part of Western Ghats before 2009 and after 2010

#### ***Recent threats of Mollem National Park:***

Mollem National Park spread over 240 sq km in the Western Ghats, located in Sanguem taluk in Goa close to the border with Karnataka. The reserve also has several temples dating back to the Kadamba Dynasty. The national park is located near the town of Mollem, 60 km southeast of Panaji, (the capital city of Goa). The NH4A and Mormugao–Londa railway line also passes amidst the thick jungles of the national park. The park was earlier known as Mollem game sanctuary. It was declared a wildlife sanctuary in 1969 and renamed Bhagwan Mahaveer Sanctuary. The core area of the sanctuary spread over 107 sq km was named Mollem National Park in 1978. Since then the national park is called Bhagwan Mahaveer Sanctuary and Mollem National Park. Several species of snakes including the King Cobra, Hump-nosed pit viper, Indian rock python, and Malabar pit viper are found in the park.

The main issue in this national park is the extension of NH4A by 4 lanes and double-tracking of the Mormugao–Londa railway line. These are the two main projects out of the 30; that has been cleared by the Ministry for Environment, Forests and Climate Change (MoEF&CC) during the lockdown of the Global pandemic of Covid-19. The clearances were discussed and granted virtually, without proper scrutiny, assessment, appraisal, and deliberation, in a clear violation of a meaningful engagement with the procedure established by law. Along with the laying of a 400kV electricity transmission line, the road and railway project could lead to one lakh trees being cut, of which 60,000 in Goa. The projects are likely to cause a loss of 170 hectares of protected forest land in Bhagwan Mahavir Sanctuary and Mollem National Park. The process for granting environmental clearances in India is dependent upon the nature of the project and accordingly referred to the National Board for Wildlife, the Forest Advisory Committee, and the Expert Appraisal Committee. Further, there has been no cumulative environmental impact assessment of all three projects in this region. A fragmented assessment does not give the real picture of the impact that the region is going to take, and is mere lip service to the process of environmental impact assessment (EIA).

The government and its concerned ministries have blatantly ignored the growing concerns regarding these projects passing through Goa's sensitive protected regions and the inevitable damage that will be caused by them. They have gone as far as alleging that the protestors are 'outsiders' or being misled for political reasons. The projects are touted as being in the best interest of Goa, while the harsh reality is that neither are these projects by the government of Goa, nor the residents of Goa. The projects are merely to facilitate vehicles of corporates to convert Goa into a coal transportation hub. Environmentalists, activists, and various social media users are now highly concerned about the disruption of Goa's biodiversity. Many locals feel that the cost to be paid in exchange for making Goa a commercial coal hub is not justifiable.

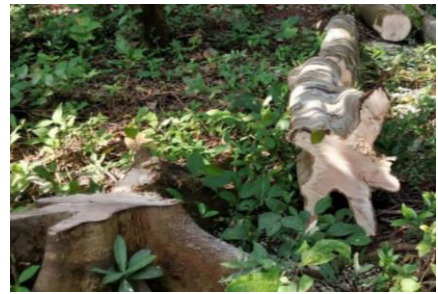




(A view of the Mollem National Park)



(Bhagwan Mahaveer Sanctuary)



(Destruction of trees)



(Protesters opposing projects which will cut across Mollem)



(Bird's eye view of the felling area in Mollem)

**Figure 5:** Recent threats of Mollem National Park

## VI. CONCLUSION

The ecological diversity of Western Ghats supports a wide range of forest types ranging from tropical wet evergreen forests to grasslands. It is also the home of about 4000 species of flowering plants with a high degree of endemism and rich fauna with endemism ranging from 11% to 78% among different groups. Trees, bryophytes, odonates, land snails, reptiles, and amphibians show higher levels of endemism than butterflies, birds, and mammals. Therefore dispersal ability and habitat specialization could be related to levels of endemism among taxa. Consequently, Western Ghats constitutes not only one of the hotspots of biodiversity in the world, but also one among the world's eight hottest hotspots. The Western Ghats is the home for about 50 million people belonging to the Six States of the Country. It is the source of water for the entire Peninsular India and also influences the monsoons. The life-supporting and biodiversity-rich ecosystems of Western Ghats are threatened today due to habitat pressures.

In this present century, this unique eco-system has been threatened by continuously increasing habitat pressures and declared as one of the world's hottest hotspots of biodiversity. Realizing the need to protect and rejuvenate the ecology of and for sustainable development in the Western Ghats, the Ministry for Environment, Forests and Climate Change (MoEF&CC) constituted a Western Ghats Ecology Expert Panel (WGEEP). The mandate of WGEEP was to demarcate ecologically sensitive zones and suggest measures to conserve protect and rejuvenate the ecology of the Western Ghats region. Taking into account the comments and suggestions made by different stakeholders including State Governments and Central Ministries on WGEEP Report, the MoEF&CC constituted a High-Level Working Group (HLWG) to suggest an all-round and holistic approach for sustainable and equitable development while keeping in focus the preservation and conservation of ecological systems in Western Ghats.

## REFERENCES

- [1] Nihara R. Gunawardene, A brief overview of the Western Ghats –Sri Lanka biodiversity hotspot, CURRENT SCIENCE, vol. 93, no. 11, 10 December 2007, pp. 1567-1572.
- [2] C. Radhakrishnan and Rajmohana, K. Fauna of Ecosystems of India Western Ghats, Zoological survey of India, special publication, September 2012.
- [3] Fred Van Dyke, Biodiversity Hotspots: Concepts, applications and challenges, Chapter January 2014. [https://www.researchgate.net/profile/Fred\\_Dyke/publication/262143113\\_Biodiversity\\_hotspots](https://www.researchgate.net/profile/Fred_Dyke/publication/262143113_Biodiversity_hotspots)



- [4] Claude Garcia, Geographical Indications and Biodiversity in the Western Ghats, India Source: Mountain Research and Development, vol. 27, no. 3, Aug 2007: 206–210. Published By: International Mountain Society, DOI: 10.1659/mrd.0922, URL: <http://www.bioone.org/doi/full/10.1659/mrd.0922>.
- [5] Blanford, W. T., The distribution of vertebrate animals in India, Ceylon, and Burma. Philos. Trans. R. Soc. B, Containing Papers of a Biological Character, 1901, 194, 335–436.
- [6] Bhat, G. K., Caecilian diversity of Western Ghats. In Biodiversity of the Western Ghats Complex of Karnataka – Resource Potential and Sustainable Utilization (eds Husaain, S. A. and Achar, K. P.), Biodiversity Initiative Trust, India, 1999, pp. 259.
- [7] Daniels, R. J. R., Geographical distribution patterns of amphibians in the Western Ghats, India. J. Biogeogr., 1992, 19, 521–529.
- [8] Dahanukar, N., Raut, R. and Bhat, A., Distribution, endemism and threat status of freshwater fishes in the Western Ghats of India. J. Biogeogr., 2004, 31, 123–136.
- [9] Sahyadri E-News: Issue XII, Sahyadri: Western Ghats Biodiversity Information System, ENVIS\_@\_CES, Indian Institute of Science; Bangalore.
- [10] Daniels, R. J. R., A Field Guide to the Birds of South-western India, Oxford University Press, New Delhi, 1997.
- [11] Walter V. Reid, Biodiversity hotspots, Elsevier Science Ltd. TREE vol. 13, no. 7 July 1998
- [12] India: State of the Environment, 2001, Chapter 9: Biodiversity, pp. 77-95
- [13] Conservation International, Western Ghats: 2007; <http://web.biodiversityhotspots.org/xp/Hotspots/ghats>
- [14] Environmental Studies for Undergraduate Courses, Unit 4: Biodiversity, pp. 82-108
- [15] Sahyadri : Western Ghats Biodiversity Information System, <http://ces.iisc.ernet.in/biodiversity>
- [16] Conservation International: [www.conservation.org](http://www.conservation.org); [www.cepf.net](http://www.cepf.net)
- [17] Critical Ecosystem Partnership Fund; CEPF, Western Ghats region, 2007; [www.cepf.net](http://www.cepf.net)



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