

Western Ghats

Western Ghats also known as **Sahyadri** (Benevolent Mountains) is a mountain range that runs parallel to the western coast of the Indian peninsula, located entirely in India. It is a UNESCO World Heritage Site and is one of the eight "hottest hot-spots" of biological diversity in the world.^{[1][2]} It is sometimes called the Great Escarpment of India.^[3] The range runs north to south along the western edge of the Deccan Plateau, and separates the plateau from a narrow coastal plain, called Konkan, along the Arabian Sea. A total of thirty-nine properties including national parks, wildlife sanctuaries and reserve forests were designated as world heritage sites - twenty in Kerala, ten in Karnataka, five in Tamil Nadu and four in Maharashtra.^{[4][5]}

The range starts near the border of Gujarat and Maharashtra, south of the Tapi river, and runs approximately 1,600 km (990 mi) through the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu ending at Swamithoppe, near Kanyakumari, at the southern tip of India. These hills cover 160,000 km² (62,000 sq mi) and form the catchment area for complex riverine drainage systems that drain almost 40% of India. The Western Ghats block southwest monsoon winds from reaching the Deccan Plateau.^[6] The average elevation is around 1,200 m (3,900 ft).^[7]

The area is one of the world's ten " Hottest biodiversity hotspots" and has over 7,402 species of flowering plants, 1,814 species of non-flowering plants, 139 mammal species, 508 bird species, 179 amphibian species, 6,000 insects species and 290 freshwater fish species; it is likely that many undiscovered species live in the Western Ghats. At least 325 globally threatened species occur in the Western Ghats.^{[8][9][10]}

Contents

Geology
Geography
Peaks
Water bodies
Climate
Ecoregions
Biodiversity protection
Fauna
Mammals
Reptiles
Amphibians
Fish
Birds
Insects

Western Ghats	
Sahyadri	
	
Western Ghats as seen from Gobichettipalayam, Tamil Nadu	
Highest point	
Peak	Anamudi, Kerala (Eravikulam National Park)
Elevation	2,695 m (8,842 ft)
Coordinates	10°10′N 77°04′E﻿ / ﻿
Dimensions	
Length	1,600 km (990 mi) N–S
Width	100 km (62 mi) E–W
Area	160,000 km ² (62,000 sq mi)
Geography	
Country	 India
States	List
Regions	Western India and Southern India
Settlements	List
Biome	Tropical and subtropical moist broadleaf forests
Geology	
Age of rock	Cenozoic
Type of rock	Basalt, Laterite and Limestone
UNESCO World Heritage Site	
Criteria	Natural: ix, x
Reference	1342
Inscription	2012 (36th Session)
Area	795,315 ha

Molluscs

Flora

Notes

References

External links

Geology

The Western Ghats are the mountainous faulted and eroded edge of the Deccan Plateau. Geologic evidence indicates that they were formed during the break-up of the supercontinent of Gondwana some 150 million years ago. Geophysical evidence indicates that the west coast of India came into being somewhere around 100 to 80 mya after it broke away from Madagascar. After the break-up, the western coast of India would have appeared as an abrupt cliff some 1,000 m (3,300 ft) in elevation.^[11] Basalt is the predominant rock found in the hills reaching a thickness of 3 km (2 mi). Other rock types found are charnokites, granite gneiss, khondalites, leptynites, metamorphic gneisses with detached occurrences of crystalline limestone, iron ore, dolerites and anorthosites. Residual laterite and bauxite ores are also found in the southern hills.

Geography

The Western Ghats extend from the Satpura Range in the north, stretching from Gujarat to Tamil Nadu. It traverses south past the states of Maharashtra, Goa, Karnataka and Kerala. Major gaps in the range are the Goa Gap, between the Maharashtra and Karnataka sections, and the Palghat Gap on the Tamil Nadu and Kerala border between the Nilgiri Hills and the Anaimalai Hills. The mountains intercept the rain-bearing westerly monsoon winds, and are consequently an area of high rainfall, particularly on their western side. The dense forests also contribute to the precipitation of the area by acting as a substrate for condensation of moist rising orographic winds from the sea, and releasing much of the moisture back into the air via transpiration, allowing it to later condense and fall again as rain.

The northern portion of the narrow coastal plain between the Western Ghats and the Arabian Sea is known as the Konkan, the central portion is called Kanara and the southern portion is called Malabar. The foothill region east of the Ghats in Maharashtra is known as Desh, while the eastern foothills of the central Karnataka state is known as Malenadu.^[12] The range is known as *Sahyadri* (सहाद्री) in Maharashtra and Karnataka. The Western Ghats meets the Eastern Ghats at Nilgiris in northwestern Tamil Nadu. Nilgiris connects Biligiriranga Hills in southeastern Karnataka with the Shevaroys and Tirumala hills. South of the Palghat Gap are the Anamala Hills, located in western Tamil Nadu and Kerala with smaller ranges further south, including the Cardamom Hills, then Aryankavu pass, Aralvaimozhi pass near Kanyakumari. The range is known as *Sehion* (സെഹിയോൻ) in Kerala. In the southern part of the range is Anamudi (2,695 metres (8,842 ft)), the highest peak in Western Ghats.



Topography- Western Ghats (southern part)

Peaks

Western Ghats has many peaks that rise above 2,000 meters with Anamudi (2,695 m (8,842 ft)) being the highest peak.

Water bodies

The Western Ghats form one of the four watersheds of India, feeding the perennial rivers of India. The major river systems originating in the Western Ghats are Godavari, Kaveri, Krishna, Thamiraparani and Tungabhadra. The majority of streams draining the Western Ghats join these rivers, and carry large volume of water during the monsoon months. These rivers flow to the east due to the gradient of the land and drain out into the Bay of Bengal. Major tributaries include Kali, Bhadra, Bhavani, Bhima, Malaprabha,

Ghataprabha, Hemavathi and Kabini. The Periyar, Bharathappuzha, Pamba, Netravati, Sharavathi, Mandovi and Zuari rivers flow westwards towards the Western Ghats, draining into the Arabian Sea and are fast-moving, owing to the steeper gradient.



Jog Falls in Karnataka, one of the most spectacular waterfalls in India

The rivers have been dammed for hydroelectric and irrigation purposes with major reservoirs spread across the states. The reservoirs are important for their commercial and sport fisheries of rainbow trout, mahseer and common carp.^[13] There are about 50 major dams along the length of the Western Ghats.^[14] Most notable of these projects are the Koyna in Maharashtra, Linganmakki and Shivanasamudra in Karnataka, Mettur and Pykara in Tamil Nadu, Parambikulam, Malampuzha and Idukki in Kerala^{[12][15][16]}

During the monsoon season, numerous streams fed by incessant rain drain off the mountain sides leading to numerous waterfalls. Major waterfalls include Dudhsagar, Unchalli, Sathodi, Magod, Hogenakkal, Jog, Kunchikal, Shivanasamudra, Meenmutty Falls, Athirappilly Falls Talakaveri is the source of the river Kaveri and the Kuduremukha range is the source of the Tungabhadra. Western Ghats have several man-made lakes and reservoirs with major lakes at Ooty (34 hectares (84 acres)) in Nilgiris, Kodaikanal (26 hectares (64 acres)) and Berijam in Palani Hills, Pookode lake, Karlad Lake in Wayanad, Devikulam (6 hectares (15 acres)) and Letchmi (2 hectares (4.9 acres)) in Idukki, Kerala.



View from Varandha Pass showing the numerous waterfalls



Banasura Sagar Dam

Climate

Climate in the Western Ghats varies with altitudinal gradation and distance from the equator. The climate is humid and tropical in the lower reaches tempered by the proximity to the sea. Elevations of 1,500 m (4,921 ft) and above in the north and 2,000 m (6,562 ft) and above in the south have a more temperate climate. Average annual temperature is around 15 °C (59 °F). In some parts frost is common, and temperatures touch the freezing point during the winter months. Mean temperature range from 20 °C (68 °F) in the south to 24 °C (75 °F) in the north. It has also been observed that the coldest periods in the South Western Ghats coincide with the wettest.^[17]

During the monsoon season between June and September, the unbroken Western Ghats chain acts as a barrier to the moisture laden clouds. The heavy, eastward-moving rain-bearing clouds are forced to rise and in the process deposit most of their rain on the windward side. Rainfall in this region averages 300 centimetres (120 in) to 400 centimetres (160 in) with localised extremes touching 900 centimetres (350 in). The eastern region of the Western Ghats which lie in the rain shadow, receive far less rainfall of about 100 centimetres (39 in) resulting in an average rainfall of 250 centimetres (98 in) across regions. The total amount of rain does not depend on the spread of the area with areas in northern Maharashtra receiving heavy rainfall followed by long dry spells, while regions closer to the equator receive less annual rainfall and have rain spells lasting several months in a year^[17]

Ecoregions

The Western Ghats are home to four tropical and subtropical moist broadleaf forest ecoregions – the North Western Ghats moist deciduous forests, North Western Ghats montane rain forests, South Western Ghats moist deciduous forests and South Western Ghats montane rain forests. The northern portion of the range is generally drier than the southern portion, and at lower elevations makes up the North Western Ghats moist deciduous forests ecoregion, with mostly deciduous forests made up predominantly of teak. Above

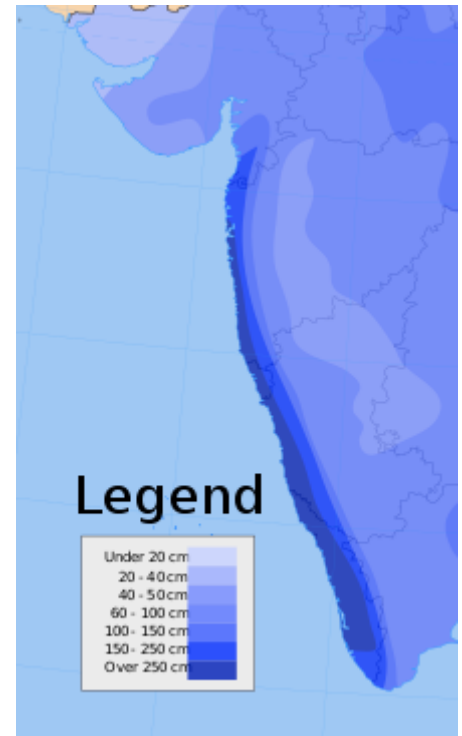


Sholas, part of the rain forests

1,000 meters elevation are the cooler and wetter North Western Ghats montane rain forests, whose evergreen forests are characterised by trees of family Lauraceae.

The evergreen forests in Wayanad mark the transition zone between the northern and southern ecologic regions of the Western Ghats. The southern ecologic regions are generally wetter and more species-

rich. At lower elevations are the South Western Ghats moist deciduous forests, with Cullenia the characteristic tree genus, accompanied by teak, dipterocarps and other trees. The moist forests transition to the drier South Deccan Plateau dry deciduous forests, which lie in its rain shadow to the east. Above 1,000 meters are the South Western Ghats montane rain forests, also cooler and wetter than the surrounding lowland forests, and dominated by evergreen trees, although some montane grasslands and stunted forests can be found at the highest elevations. The South Western Ghats montane rain forests are the most species-rich ecologic region in peninsular India; eighty percent of the flowering plant species of the entire Western Ghats range are found in this ecologic region.



Annual rainfall along the Western Ghat region

Biodiversity protection

Historically the Western Ghats were well-covered in dense forests that provided wild foods and natural habitats for native tribal people. Its inaccessibility made it difficult for people from the plains to cultivate the land and build settlements. After the arrival of the British in the area, large swathes of territory were cleared for agricultural plantations and timber. The forest in the Western Ghats has been severely fragmented due to human activities, especially clear felling for tea, coffee, and teak plantations during 1860 to 1950. Species that are rare, endemic and habitat specialists are more adversely affected and tend to be lost faster than other species. Complex and species rich habitats like the tropical rainforest are much more adversely affected than other habitats^[18]

The area is ecologically sensitive to development and was declared an ecological hotspot in 1988 through the efforts of ecologist Norman Myers. The area covers five percent of India's land with 27% of all species of higher plants in India (4,000 of 15,000 species) are found here and 1,800 of these are endemic to the region. The range is home to at least 84 amphibian species, 16 bird species, seven mammals, and 1,600 flowering plants which are not found elsewhere in the world. The Government of India established many protected areas including 2 biosphere reserves, 13 National parks to restrict human access, several wildlife sanctuaries to protect specific endangered species and many Reserve Forests, which are all managed by the forest departments of their respective state to preserve some of the ecoregions still undeveloped. The Nilgiri Biosphere Reserve comprising 5,500 square kilometres (2,100 sq mi) of the evergreen forests of Nagarahole and deciduous



Dense rain forests cover Western Ghats



Western Ghats is a UNESCO heritage site

forests of Bandipur in Karnataka, adjoining regions of Wayanad-Mukurthi in Kerala and Mudumalai National Park-Sathyamangalam in Tamil Nadu forms the largest contiguous protected area in the Western Ghats.^[19] Silent Valley in Kerala is among the last tracts of virgin tropical evergreen forest in India.^{[20][21]}

In August 2011, the Western Ghats Ecology Expert Panel (WGEEP) designated the entire Western Ghats as an Ecologically Sensitive Area (ESA) and assigned three levels of Ecological Sensitivity to its different regions.^[22] The Western Ghats Ecology Expert Panel, headed by ecologist Madhav Gadgil, was a committee appointed by the Union Ministry of Environment and Forests to assess the biodiversity and environmental issues of the Western Ghats.^[23] Gadgil Committee and its successor Kasturirangan Committee recommended suggestions to protect the Western Ghats. Gadgil report was criticized as being too environment-friendly and Kasturirangan report was labelled as being anti-environmental.^{[24][25][26]}

In 2006, India applied to the UNESCO MAB for the Western Ghats to be listed as a protected World Heritage Site.^[27] In 2012, the following places are declared as World Heritage Sites.^{[28][29]}

- Indira Gandhi Wildlife Sanctuary and National Park
- Kalakkad Mundanthurai Tiger Reserve
- Thattekad Bird Sanctuary
- Mudumalai Tiger Reserve
- Shendurney Wildlife Sanctuary
- Neyyar Wildlife Sanctuary
- Peppara Wildlife Sanctuary
- Periyar Tiger Reserve
- Srivilliputtur Wildlife Sanctuary
- Eravikulam National Park
- Grass Hills National Park
- Karian Shola National Park
- Sathyamangalam Wildlife Sanctuary
- Chinnar Wildlife Sanctuary
- Silent Valley National Park
- New Amarambalam Reserved Forest
- Mukurthi National Park
- Pushpagiri Wildlife Sanctuary
- Brahmagiri Wildlife Sanctuary
- Talakaveri Wildlife Sanctuary
- Aralam Wildlife Sanctuary
- Kudremukh National Park
- Someshwara Wildlife Sanctuary
- Kaas Plateau
- Koyna Wildlife Sanctuary
- Chandoli National Park
- Radhanagari Wildlife Sanctuary
- Parambikulam Wildlife Sanctuary
- Pambadum Shola National Park
- Anamudi Shola National Park
- Chimmony Wildlife Sanctuary
- Peechi-Vazhani Wildlife Sanctuary
- Wayanad Wildlife Sanctuary
- Mathikettan Shola National Park
- Kurinjimala Sanctuary
- Karimpuzha National Park
- Idukki Wildlife Sanctuary
- Ranipuram National Park

Fauna

The Western Ghats are home to thousands of animal species including at least 325 globally threatened species^[30]

Mammals

There are at least 139 mammal species. Of the 16 endemic mammals, 13 are threatened and amongst the 32 threatened species include the critically endangered Malabar large-spotted civet, the endangered lion-tailed macaque, Nilgiri tahr, Bengal tiger and Indian elephants, the vulnerable Indian leopard, Nilgiri langur and gaur.^{[31][32][33]}

These hill ranges serve as important wildlife corridors and forms an important part of Project Elephant and Project Tiger reserves. The largest population of tigers outside the Sundarbans is in the Western Ghats where there are seven populations with an estimated population size of 336 to 487 individuals occupying 21,435 km² (8,276 sq mi) forest in three major landscape units spread across Karnataka, Tamil Nadu and Kerala.^[34] The Western Ghats eco-region has the largest Indian elephant population in the wild with an estimated 11,000 individuals across eight distinct populations.^{[35][36]} The endemic Nilgiri tahr which was on the brink of extinction has recovered and has an estimated 3,122 individuals in the wild.^[37] The Critically Endangered endemic Malabar large-spotted civet is estimated to number fewer than 250 mature individuals, with no sub-population greater than 50 individuals.^[38] About 3500 lion-tailed macaques live scattered over several areas in the Western Ghats.^[39]



Western Ghats has the largest tiger population outside Sunderbans



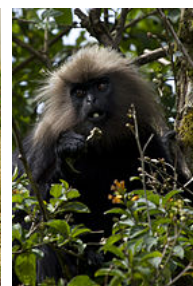
Endangered Lion-tailed macaque is endemic to Western Ghats



Western Ghats region has the largest Indian elephant population in India



Only 100 individuals of Nilgiri tahr were left in 2001 but has recovered to 3,300 by 2010



The endemic Nilgiri langur is endangered

Reptiles

The major population of snake family Uropeltidae of the reptile class is restricted to the region.^[40] The region has significant population of vulnerable Mugger crocodiles.^[41]

Amphibians

The amphibians of the Western Ghats are diverse and unique, with more than 80% of the 179 amphibian species being endemic to the rainforests of the mountains.^[42] The endangered purple frog was discovered in 2003.^[43] Four new species of frogs belonging to the genera Rhacophorus, Polypedates, Philautus and Bufo were described from the Western Ghats in 2005.^[44] The region is also home to many caecilian species



The region has significant population of vulnerable Mugger crocodile



Purple frog (Nasikabatrachus sahyadrensis) was discovered in 2003



Malabar gliding frog is endemic to Western Ghats



Pipe snakes are found only in South India and Sri Lanka



Denison's barb is threatened from habitat loss and is now bred in captivity

Fish

As of 2004, 288 freshwater fish species are listed for the Western Ghats, including 35 also known from brackish or marine water.^[10] Several new species have been described from the region since then (e.g., Dario urops and S. sharavathiensis).^{[45][46]} There are 118 endemic species, including 12 genera entirely restricted to the Western Ghats (Betadevario, Dayella, Horabagrus, Horabiosia, Hypselobarbus, Indoreonectes, Lepidopygopsis, Longischistura, Mesonoemacheilus, Parapsilorhynchus, Rohtee and Travancoria).^[47]

There is a higher fish richness in the southern part of the Western Ghats than in the northern,^[47] and the highest is in the Chalakudy River, which alone holds 98 species.^[48] Other rivers with high species numbers include the Periyar, Bharatapuzha, Pamba and Chaliyar, as well as upstream tributaries of the Kaveri, Pambar, Bhavani and Krishna rivers.^[47] The most species rich families are the Cyprinids (72 species), hillstream loaches (34 species; including stone loaches, now regarded a separate family), Bagrid catfishes (19 species) and Sisorid catfishes (12 species).^{[10][47][48]} The region is home to several brilliantly colored ornamental fishes like Denison's (or red line torpedo barb),^[49] several species of Dawkinsia barbs, zebra loach, Horabagrus catfish, dwarf pufferfish and

dwarf Malabar pufferfish.^[50] The rivers are also home to *Osteobrama bakeri* and larger species such as the Malabar snakehead and Malabar mahseer.^{[51][52]} A few are adapted to an underground life, including some *Monopterus* swampeels,^[53] and the catfish *Horaglanis* and *Kryptoglanis*.^[54]

According to the IUCN, 97 freshwater fish species from the Western Ghats were considered threatened in 2011, including 12 critically endangered, 54 endangered and 31 vulnerable.^[47] All but one (*Tor khudree*) of these are endemic to the Western Ghats. An additional 26 species from the region are considered data deficient (their status is unclear at present). The primary threats are from habitat loss, but also from overexploitation and introduced species.^[47]

Birds

There are at least 508 bird species. Most of Karnataka's five hundred species of birds are from the Western Ghats region.^{[55][56]} There are at least 16 species of birds endemic to the Western Ghats including the endangered rufous-breasted laughingthrush, the vulnerable Nilgiri wood-pigeon, white-bellied shortwing and broad-tailed grassbird, the near threatened grey-breasted laughingthrush, black-and-rufous flycatcher, Nilgiri flycatcher, and Nilgiri pipit, and the least concern Malabar (blue-winged) parakeet, Malabar grey hornbill, white-bellied treepie, grey-headed bulbul, rufous babbler, Wynaad laughingthrush, white-bellied blue-flycatcher and the crimson-backed sunbird.^[57]



Nilgiri wood-pigeon



Great hornbill



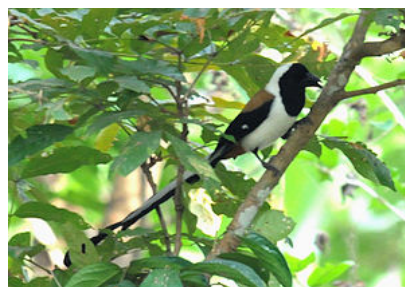
Malabar barbet



Malabar (blue-winged) parakeet



Nilgiri pipit



White-bellied treepie

Insects

There are roughly 6,000 insect species.^[58] Of 334 Western Ghats butterfly species, 316 species have been reported from the Nilgiri Biosphere Reserve.^[59] The Western Ghats is home to 174 species of odonates (107 dragonflies and 67 damselflies), including 69 endemics.^[47] Most of the endemic odonate are closely associated with rivers and streams, while the non-endemics typically are generalists.^[47] There are several species of fleeces found all along the Western Ghats.^[60]



The Malabar tree nymph is endemic to the Western Ghats



Tamil Lacewings are found only in South Asia



The Western Ghats has 67 species of damselflies



The endemic land snail Indrella ampulla



Phallus indusiatus found in the Western Ghats

Molluscs

Seasonal rainfall patterns of the Western Ghats necessitate a period of dormancy for its land snails, resulting in their high abundance and diversity including at least 258 species of gastropods from 57 genera and 24 families.^[61] A total of 77 species of freshwater molluscs (52 gastropods and 25 bivalves) have been recorded from the Western Ghats, but the actual number is likely higher.^[47] This include 28 endemics. Among the threatened freshwater molluscs are the mussels Pseudomulleria dalyi which is a Gondwanan relict, and the snail Cremnoconchus, which is restricted to the spray zone of waterfalls.^[47] According to the IUCN, 4 species of freshwater molluscs are considered endangered and 3 are vulnerable. An additional 19 species are considered data deficient.^[47]

Flora

Of the 7,402 species of flowering plants occurring in the Western Ghats, 5,588 species are native or indigenous and 376 are exotics naturalised and 1,438 species are cultivated or planted as ornamentals. Among the indigenous species, 2,253 species are endemic to India and of them, 1,273 species are exclusively confined to the Western Ghats. Apart from 593 confirmed subspecies and varieties; 66 species, 5 subspecies and 14 varieties of doubtful occurrence are also reported and therefore amounting 8,080 taxa of flowering plants.^[62]

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