

Diversity and conservation of selected biota of the Megamalai landscape, Western Ghats, India

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Data on the diversity of selected faunal groups of Megamalai landscape, southern Western Ghats, India, based on a field study from March 2006 to January 2009 and published information were collated and analysed. Greater species richness of tree species (157 species), amphibians (34), reptiles (87), birds (211) and mammals (62) and endemism in the area appear to be due to the availability of various vegetation types and greater elevational gradient (200–1800 m msl). High proportion of endemic species with respect to sampled taxa was observed in wet zones (> 800 m). Annexing area with various vegetation types and elevation gradients to the recently declared Megamalai Wildlife Sanctuary is critical for biodiversity conservation in the region.

Keywords: Biodiversity, highway mountains, protected areas, Western Ghats.

THE Megamalai landscape, encompassing Varusanad Hills, Cumbam Valley, Highway mountains, part of the Theni Forest Division¹, and a portion of the northern slopes of the landscape together with Madurai Forest Division has recently been declared as the Megamalai Wildlife Sanctuary², considering the conservation significance of the hill chain in having several endemic and threatened flora and fauna. Further, large-scale conversion of wet forests to raise a few economic crops during the colonial period³ and intense anthropogenic pressure during the last few decades had put tremendous pressure on natural forests⁴, although the area has been considered for world heritage site (Periyar sub-cluster)⁵. Nevertheless, the landscape still holds few remnant patches of wet forests in the upper reaches (Cardamom Hills) and forms a catchment area for rivers like the Vaigai, Vaippar and Suruliar¹. The area is known for a few range-restricted and threatened species such as Hutton's pit viper,

Tropedolaemus huttoni, Blue-bellied skink, *Dasia subcaeruleum* and Salim Ali fruit bat, *Latidens salimalii*^{6,7}. In addition, it is also one of the few landscapes in southern Western Ghats with five species of primates, and two each of giant squirrels and flying squirrels⁶. In this context, barring a few short surveys and collections^{6–13}, the Megamalai and the adjacent forests have been poorly studied for their biodiversity wealth. In this article, we update the available information on the selected biota of this landscape, and highlight its importance for long-term conservation of biodiversity.

Study area

The Megamalai (9°31'–9°51'N and 77°10'–77°30'E), popularly known as Highway Mountains, a part of the Western Ghats biodiversity hotspot¹⁴, is located along the border of Tamil Nadu and Kerala States (Figure 1). The Megamalai landscape is bounded by the Periyar Plateau (Periyar Tiger Reserve) on the south, Srivilliputtur Grizzled Squirrel Sanctuary on the south and southeast, Cumbam floodplains on the north and northeast, and alluvial plains of Theni–Periyakulam on the northeast. This area forms a part of the South Sahyadris and Tamil Nadu Uplands. Most parts of the Megamalai are under the administrative jurisdiction of the Theni Forest Division, Tamil Nadu¹. The general area is rugged and forms a catchment for rivers such as Vaigai, Vaippar and Suruliar. A major portion of forests in this area remains unexplored for its biodiversity. The higher elevation of Megamalai was opened up for various commercial plantations during mid 1940s (ref. 3).

Forests of this area have been reported as an important wildlife habitat¹⁵ and recently a part of this forest (269.11 sq. km) has been declared as Megamalai Wildlife Sanctuary. This landscape also forms a buffer to the existing protected areas such as Srivilliputhur Grizzled Squirrel Sanctuary (Varusanad) on the east and the Periyar Tiger Reserve on the south⁴.

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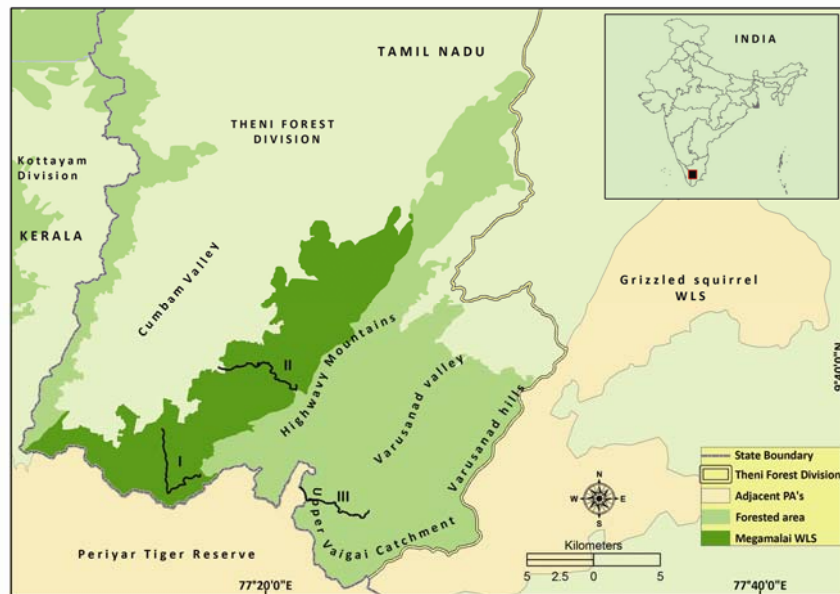


Figure 1. Map of Megamalai landscape, Western Ghats, southwestern India.

Field methods

The following data collection procedures were adopted to assess the diversity of selected taxa in the Megamalai landscape. Primary dataset was based on a study from March 2006 to January 2009 (ref. 4).

Landscape

Landscape features and distribution pattern of amphibians, reptiles and tree species were studied along three belt-transects (with 1000 m width), namely Suruli (Transect I), Mavadi (Transect II) and Vellimalai (Transect III) placed along the elevation gradient from the hill bottom to the plateau (Figure 1). These transects, measured 6.86, 8.0 and 6.31 km respectively in straight line. Each transect was stratified at 200 m and area availability in each elevation category was estimated using GIS tools. ASTER Global Digital Elevation Model (GDEM; <http://www.gdem.aster.ersdac.or.jp/index.jsp>) was used to find out the area available in various elevation categories of the general landscape.

Tree species

One-time tree sampling (i.e. post-monsoon, during November 2008) was done using point centred quarter (PCQ)¹⁶ at every 50 m along the midline of each transect. Plants with girth at breast height > 20 cm were considered as trees. Forest type¹⁷ at a point was assigned based on tree species present in the quarter. The number of quarters (points) sampled in each elevation category (i.e. 200–400 m, 400–600 m, etc.) was based on the length of each along the transect line.

Herpetofauna

Amphibians and reptiles were sampled following area (quadrates) and time-constrained (visual encounter) survey protocol¹⁸ on seasonal basis along three (belt) transects for two years (i.e. December 2006 to November 2008). Sampling intensity was 300 man-hours of visual encounter survey/transect/season (300 h × 3 transects × 4 seasons = 3600 man-hours). Hundred quadrates (10 × 10 m) were examined along each belt transect (1 ha × 3 transects × 4 seasons = 12 ha). The whole year was divided into wet (May–October) and dry (November–April) seasons. Intensity of sampling in each elevation category was based on area availability. In addition, herpetofauna were recorded opportunistically from March 2006 to January 2009.

Birds and mammals

These were recorded opportunistically while traversing the area. Both direct and indirect (pellets, scats) observations were considered for preparing the species lists. No attempt was made to study smaller mammals, especially rats and bats.

Published information on the fauna (reptiles^{3,6,19,20}, birds^{8–10,21–23}, mammals^{7,24}) of the Megamalai landscape, including Varusanad and Kumuly was collated from the literature and compared with the results of the present study.

Results

Landscape

Digital elevation model (DEM) of the general area (490 sq. km) of the Megamalai landscape had an eleva-

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tion range of 200–2010 m msl. However, area above 1400 m msl was minimal (Figure 2). Lower elevation (<800 m) contributed the highest proportion with respect to geographical extent (44%), followed by medium elevation (800–1400 m). The contribution by higher elevation (>1400 m) was only 18% (Figure 2). Area available in different altitudinal categories (along the three transects, 21.17 sq. km) studied was not statistically different from that of the estimated area in various elevation categories based on DEM using 490 sq. km window of this landscape.

Vegetation type

Several vegetation types were recognized along the transects studied: tropical dry deciduous, moist deciduous and evergreen forests, and shola–grasslands. Considerable portion of the area had riverine forests and patches of open rock with grass, especially in the mid elevation. Besides these, teak plantation and certain economic crops (tea, cardamom and coffee) cultivated during the colonial period were also found in patches, which were not quantified in this study. The tropical dry deciduous forest had the highest elevational width and area occupied (Table 1). The shola grasslands had the lowest elevational width (1400–1800 m msl) and the riverine forest had minimal area.

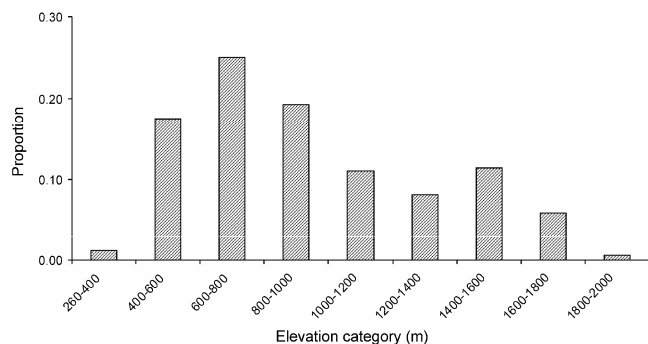


Figure 2. Area representation by various elevation categories in the Megamalai landscape, based on ASTER Global Digital Elevation Model (GDEM; <http://www.gdem.aster.ersdac.or.jp/index.jsp>).

Table 1. Distribution of various vegetation types (broader level) and their relative area in Megamalai landscape, Western Ghats, as estimated along three transects studied

Vegetation type	Elevation width (m)	Extent of area (%)
Tropical dry deciduous forest	400–1200	43.84
Riverine forest	600–1000	8.77
Tropical moist deciduous forest	600–1200	9.04
Open rock with grass	1000–1600	18.08
Tropical evergreen forest	1200–1600	10.68
Montane shola grasslands	1400–1800	9.59

Tree species

We examined 419 points for trees using PCQ along three transects (total length 21.17 km). Among them, only 276 points had trees. A total of 1107 trees belonging to 157 species of 45 families were observed, including 43 species (27.39%) endemic to the Peninsular India and the Western Ghats. *Syzygium zeylanicum* var. *megamalanum* is endemic to Megamalai.

The highest of 70 species of trees was observed in the tropical dry deciduous forest and the lowest (35) in riverine forest followed by shola grasslands. No tree was observed in open rocky stretches along transects sampled (Table 2). The highest number of endemic tree species was found in shola grasslands (25/36 species) followed by evergreen forests (16/41). The lowest number of endemic species was recorded in riverine forests followed by tropical dry deciduous forests (Table 2). Tree species richness was relatively high both in low (<800 m) and high (>1400 m) elevations, and the lowest species richness was observed between 1200 and 1400 m. This stretch was characterized by open rocks with steep slopes. Greater proportion of endemics was found in high hills (maximum along 1600–1800 m msl; Table 3).

Fauna

Thirty-four species of amphibians belonging to eight families, including 21 (61.8%) endemics were observed. A little known species, the Malabar false tree frog *Rhacophorus pseudomalabaricus* was observed during this study. Amphibian richness ranged from 10 (1000–1200 m) to 16 (800–1000 m) species across 400–1800 m elevation of the sampled area (Table 3). The proportion of amphibian species endemic to the Western Ghats increased with elevation in this landscape. The highest of 15 species was observed in the tropical evergreen forest and the lowest (5) in the tropical moist deciduous forest. Higher proportion of endemic species was found in relatively wetter forests (Table 2).

Seventy-two species of reptiles belonging to 16 families, including 23 endemics, were observed in this study. The highest number of 30 species was observed along the 600–800 m elevation category followed by 28 in 400–600 m. The lowest (5) was recorded in the 1600–1800 m elevation category. However, the proportion of endemic species increased with elevation. Only fewer endemic reptiles were found in each elevation category compared to amphibians (Table 3). The highest number of 37 species was recorded in the tropical dry deciduous forests and the least (5) in shola grasslands. All reptile species found in shola grasslands and 61.5% in tropical evergreen forests were endemic to the Western Ghats (Table 2). The drier forests had relatively fewer species of endemic reptiles.

Richness of selected taxa based on both literature survey and the present study is given in Table 4. The data indicate the occurrence of higher species diversity with several endemics. Considerable information is available for three taxa, namely reptiles, mammals and birds of the area due to extensive surveys by Angus F. Hutton (1946–1948) and E. G. Nichols (1944–1945) respectively. A comparison of the past data (prior to 2005) with that of the present study (2006–2009) showed that several species reported by earlier workers were not sighted and many species were added to the records during the present study (Table 5).

Discussion

DEM analysis showed that the lower elevation (< 800 m) contributed the highest proportion with respect to area (44%) and the geographical area showed declining trend with altitude. At a broader level, several vegetation types were recognized along the transects studied. This included tropical dry deciduous, moist deciduous and evergreen forests, and shola grasslands¹⁷. A recent analysis showed the occurrence of 11 forest types in the mountainous Highway landscape.

We examined 419 points for trees along three transects (total length 21.17 km). The record of 157 species, including 43 of endemic trees to the Peninsular India and Western Ghats²⁵ is worth noting and the distribution of *S. zeylanicum* var. *megamalanum* is restricted to the

Megamalai Hills²⁶. Greater proportion of endemics was found in high hills (highest along 1600–1800 m; Table 3). Distribution of relatively greater number of endemic plants in higher hills has been reported for the Western Ghats^{27,28}. Some descriptions on the forests, mosses and flora of the Highway Mountains based on surveys during 1917 and 1929 by E. Blatter are available^{29–31}.

Data on the fish fauna of Megamalai landscape is scanty and the same was not studied during this study. The available data on this taxon showed that ten out of 18 species are endemic to the Western Ghats. *Puntius ophicephalus*, a rare barb, has restricted distribution in the rivers originating/flowing through this landscape^{12,13,32–34}. The record of 34 (21.7%) out of 157 species of amphibians known from the Western Ghats³⁵ in 21.17 sq. km showed the richness of the landscape with respect to this taxon. Distribution of relatively low proportion (61.8%) of endemics and lack of Caecilians in the area could be due to the dry nature of these hills, as they largely fall under the rain-shadow area³⁶. The Megamalai is one of the two known localities for the Malabar false tree frog, *Rhacophorus pseudomalabaricus*^{37–39}. This indicates our poor understanding on the distribution of amphibians and the importance of this area for their conservation.

In all, 87 species of reptiles have been reported from this landscape, which included 57 species of snakes, 29 lizards and one turtle^{3,4,6,19,20}. This is 52.7% ($n = 165$) of the reptile fauna (and 31% endemic species) reported for the whole of Western Ghats⁴⁰. A compilation of snake species reported from the collections made during 1946–48 by Angus Hutton with that of the recent study (2007–09) by the Salim Ali Centre for Ornithology and Natural History, Coimbatore showed the occurrence of 57 snake species in the area^{3,4,6}. This included 23 species common to both studies, 14 only to the earlier and 20 to the latter. The Hutton's pit viper, *Tropedolaemus (Trimeresurus) huttoni* and Blue-bellied skink, *Dasia subcaeruleum* reported from these hills during 1949 (refs 19 and 20) have not been observed for over 60 years, despite serious attempts to locate them, including the present study.

Table 2. Distribution of tree species and herpetofauna in various vegetation types in Megamalai landscape

Vegetation type	Tree species	Amphibians	Reptiles
Tropical dry deciduous forest	70(6)	10(6)	37(8)
Riverine forest	35(2)	11(9)	18(2)
Tropical moist deciduous forest	46(9)	5(2)	18(6)
Open rock with grass	0(0)	12(10)	25(6)
Tropical evergreen forest	41(16)	15(12)	13(8)
Montane shola grasslands	36(25)	10(8)	5(5)
Overall total	157(43)	34(21)	72(23)

Table 3. Distribution of tree species and herpetofauna along various elevation categories in Megamalai landscape

Elevation category	Tree species	Amphibians	Reptiles
400–600	51(3)	15(2)	28(2)
600–800	65(6)	11(6)	30(5)
800–1000	51(6)	16(10)	23(4)
1000–1200	19(2)	10(7)	22(2)
1200–1400	20(11)	12(9)	21(7)
1400–1600	37(19)	14(12)	15(6)
1600–1800	37(23)	11(9)	5(4)
Total	157(43)	34(21)	72(23)

Table 4. Richness of selected taxa in the Megamalai landscape, based on various studies

Taxon/group	Family	Species	Endemic to Western Ghats	References
Tree	45	157	43(27.4)	Present study
Fish	4	18	10(55.6)	13 and 34
Amphibian	8	34	21(61.8)	Present study
Reptile	16	87	27(31)	Present study, ref. 3
Bird	48	211	11(5.2)	Present study, 8, 10 and 21
Mammal	24	62	14(22.6)	Present study, 6 and 24

Numbers in parenthesis are percentage.

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Both the species are endemic to the Megamalai landscape and it is not clear, whether these species have become extinct in the area. A big difference was observed, especially with respect to the number of snake species reported between the past^{3,6} (1946–48) and the present⁴ (2007–2009) reports.

A total of 211 species of birds have been reported from this area^{4,8–10}. Surveys on birds specific to Megamalai are not available. A collation of birds of the erstwhile Madura District by E. G. Nichols^{8–10} and subsequent workers had reported about 70 species indicating Megamalai and its environs such as Highway Mountains, Kumuly and Varusanad Valley. The present study, recorded 160 species, including 11 endemic to the Western Ghats. The only sighted record of the Red-faced malkoha, *Phoenicophaeus pyrrhocephalus* in India is from Megamalai²¹. Due to non-availability of specimens in the museum and lack of records for over 50 years, distribution of this species within India is considered spurious, and it is currently reported as endemic to Sri Lanka^{22,23}.

Sixty-two species of mammals have been reported from the Megamalai landscape, including 14 (22.6%) endemics^{4,7,24,41,42}. Among them, only 39 species could be recorded opportunistically during the present study, which includes two additional records. Megamalai is an important area for the conservation of rare and endemic Sálím Ali fruit bat, *Latidens salimalii*, which is restricted to this and a few other hills of the southern Western Ghats⁴¹. Several species such as the Indian fox, *Vulpes bengalensis* and Malabar civet, *Viverra civettina* were reportedly common according to earlier report⁷, but were not observed subsequently, including the present study. The Malabar civet is a critically endangered species, which has not been observed in the wild for about three decades^{43,44}.

Analysis showed vast difference in the number of species reported in earlier studies compared to that of the present study (Table 5). This could be due to various factors such as: (i) shortcomings in the methodologies adopted, (ii) unequal sampling intensity, (iii) focus on single taxon or group, (iv) land-cover and land-use changes, (v) hunting pressure during the intervening period and (vi) reduction of population size or local extinction of species. However, the present compilation clearly highlights the vertebrate diversity of this landscape.

Table 5. Richness of selected taxa in the Megamalai landscape; in parenthesis, number of species recorded only during the particular study

Taxon/ group	Number of species			Recorded in both studies
	Total	Past records	Present study	
Reptile	87	38(15)	72(49)	23
Bird	211	70(51)	160(141)	19
Mammal	62	60(23)	39(2)	37

A portion (269.11 sq. km) of Megamalai forests has been declared as a wildlife sanctuary during 2009 (ref. 2). The present study showed that the richness of different taxa varied across vegetation types and elevation gradients (Tables 2 and 3). Protection of a forest patch/small landscape in isolation may be beneficial for one or two taxa. In the whole of Western Ghats, there are about 50 Protected Areas (PAs)⁴⁵ and most of them are isolated with little or no connectivity. PAs in India have historically been established on an ad hoc basis with little attention to the conservation value of an area^{46,47}. A review of existing PAs in the Western Ghats, especially the newly declared Megamalai Wildlife Sanctuary, with respect to the representation of various vegetation and elevation categories is suggested. The area also forms part of the corridors for several large mammals, especially the Asiatic elephant, *Elephas maximus* and Gaur *Bos gaurus*. This landscape also holds considerable population of the endangered Lion-tailed macaques, *Macaca silenus*⁴⁸ and Nilgiri tahr, *Nilgiritragus hylocrius*⁴⁹. Ecorestoration focusing on the conservation of these species is required.

Awareness campaign to the local stakeholders regarding conservation significance of biodiversity and natural resources is required. Regular man–wildlife conflict along the foothills has resulted in the killing of wild animals, although this is currently under control. The existing PA (Megamalai Wildlife Sanctuary) is not sufficient for restoring and conserving the entire biodiversity wealth of the landscape. Hence PA needs to be redefined considering the biodiversity wealth of the adjoining areas.

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ACKNOWLEDGEMENTS. This paper is an outcome of a research work funded by the Ministry of Environment and Forests (MoEF), Government of India. We are grateful to G. V. Subramanian and Naseem Ahmad (MoEF) for financial support; R. Sundararaju and Srinivas R. Reddy (Tamil Nadu Forest Department) for permission to work in the forest area and logistic support, and P. A. Azeez, P. Balasubramanian and other colleagues at the Salim Ali Centre for Ornithology and Natural History, Coimbatore, for encouragement and support at various levels. We thank Yesudoss, Kumar and Munusamy for assisting us in the field. We also thank an anonymous reviewer for various suggestions, which improved the quality of this paper.

Received 17 February 2011; revised accepted 4 January 2012