



AN OVERVIEW OF ASIAN ELEPHANTS IN THE WESTERN GHATS, SOUTHERN INDIA: IMPLICATIONS FOR THE CONSERVATION OF WESTERN GHATS ECOLOGY

Nagarajan Baskaran

Present address: Department of Zoology & Division of Wildlife Biology, AVC College (Autonomous) Mannampandal, Mayiladuthurai, Tamil Nadu 609305, India
 Asian Nature Conservation Foundation, Centre for Ecological Sciences, Indian Institute of Sciences, Bengaluru, Karnataka 560012, India
 nagarajan.baskaran@gmail.com

Abstract: The Western Ghats region is a global biodiversity hotspot and the source of all the major rivers of peninsular India. The conservation of this region is important for the biodiversity it harbours, and for ecological functions that include climate stability, erosion control, clean water and air, which are essential to safeguard economic growth, social stability and quality of life for the people of peninsular India. Possessing a unique diversity in topography, climate, vegetation, faunal communities, endemism and human communities, the Western Ghats is also known for its spectacular assemblage of larger mammals, including 25% of the global population of Asian Elephants. There are four major landscapes in the Western Ghats: (1) Uttara Kannada, (2) Brahmagiri-Nilgiris, (3) Anamalai-Nelliampathy-High Range, and (4) Periyar-Agasthyamalai, spread across 30,000km², harbouring a minimum 10,000 elephants in six different populations with signs of an increasing trend in some populations. The second landscape (Brahmagiri-Nilgiris) with over 50% of the Ghats' elephant population, along with its contiguity to the Eastern Ghats elephant landscape, forms the single largest global population of Asian Elephants. However, major threats to the long-term conservation of the elephant include further fragmentation of habitat, continued poaching of bulls for ivory, and escalation in human-elephant conflicts resulting in public antagonism toward the species. The goals of management should thus be to: (1) consolidate habitats and preserve corridors to avoid further fragmentation; (2) take steps through integrated land use planning at the landscape level to reduce human-elephant conflicts; and (3) build up a demographically and genetically viable elephant population by protecting the tusked males from ivory poaching. Being a wide-ranging umbrella species, ensuring the long-term conservation of Asian Elephants in the Ghats implies protecting its biodiversity and ecological functions that also safeguard the livelihood of several million people.

Keywords: Asian Elephant, conservation problems, habitat and population, Western Ghats.

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Author details: N. BASKARAN is presently an Assistant Professor at the Department of Zoology, AVC College (Autonomous), Mayiladuthurai and also a Consultant Conservation Scientist in Asian Nature Conservation Foundation, Centre for Ecological Sciences, Indian Institute of Science, Bengaluru. He has over two decades of research experience in studying behavioural ecology of an umbrella species 'the Asian Elephant' across Eastern, and Western Ghats and eastern Himalaya. In addition, he is experienced in assessing biodiversity, habitats and behavioural ecology of mammalian species such as Sloth Bear, Malabar, and Grizzled Giant Squirrels, Four-horned Antelope, Blackbuck.

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INTRODUCTION

The great mountain chain of the Western Ghats, located along the west coast of India, covers 1,80,000km² area, and all the major rivers of peninsular India—Godavari, Tungabhadra, Krishna, Cauvery, Thamirabarni—originate from it. Hence, its ecological health is important to approximately 400 million people living in peninsular India with diverse social, religious, and linguistic backgrounds. The mountain chain, along with its remnant in Sri Lanka, is one of the 34 global biodiversity hotspots (Myers et al. 2000; Mittermeier et al. 2005), harbouring over 30% of Indian plants and animals with a high endemism in less than six percent of the national land area. The Ghats is characterized by a wide altitudinal gradient ranging from as low as 100m on either side to as high as 2694m at Anaimudi Peak, the highest elevation south of the Himalaya. The sharp altitudinal gradient results in a significant variation in the amount of precipitation across the landscape, with the western face and crestline of the hills receiving higher rainfall (mean annual rainfall up to 7000mm), and the eastern rain shadow region receiving lower annual rainfall (mean rainfall of about 800 mm). The rainfall gradient from east to west, along with the complex topography, results in heterogeneous vegetation types: from lowland tropical dry thorn forest mostly on the eastern side, mid-elevation tropical dry and moist deciduous forests, high-elevation tropical semi-evergreen and evergreen forests, to stunted montane forests locally known as 'shola' and grasslands (Subramanyam & Nayar 1974). The landscape, being heterogeneous, supports diverse faunal communities including several endemic fauna, notably limbless amphibians (caecilians), burrowing snakes (uropeltids), and mammals such as Lion-tailed Macaque *Macaca silenus*, Malabar Civet *Viverra megaspila*, Nilgiri Tahr *Nilgiritragus hylocrius*, and Nilgiri Langur *Semnopithecus johnii* (Nameer et al. 2001; Gadgil & Meher-Homji 2003; Kumar et al. 2004a; CEPF 2007).

Besides its high endemism, the region is also known for its spectacular assemblage of larger mammals including a large number of endangered species, and is home to approximately 25% of the global population of Asian Elephants (Sukumar et al. 2006; Baskaran et al. 2011a). Being a wide-ranging megaherbivore, the Asian Elephant is regarded as an umbrella species as it plays a vital role in maintaining the integrity of the ecosystem it inhabits, and its ranges could easily support much of the biodiversity of the landscape. Therefore, the conservation of elephants in the Western Ghats means protecting large tracts of natural habitats in the Ghats,

which are vital to maintain its biodiversity and thus the ecological functions of climate stability, clean water and air, and erosion control that are essential to safeguard economic growth, social stability, and the quality of livelihood of the several million people living in peninsular India. This paper discusses (a) the present status of the Asian Elephant habitats and their populations including conservation issues, considering the status of ecology of the Western Ghats region, and (b) suggests measures including establishment of ecologically sensitive areas to manage the elephant populations in the long run that would also promote the conservation and rejuvenation of the ecology of the Western Ghats.

STATE OF ELEPHANT HABITATS AND THEIR POPULATION IN THE GHATS

The Asian Elephant, presently an Endangered species (Choudhury et al. 2008), had a much wider distribution across Asia during historical times than what it does today. In southern India, before the colonial era (circa 1700), elephant distribution was continuous along the Western and Eastern Ghats including large parts of the plains around them. During the 20th century, their distribution shrank to isolated habitats within the Ghats owing to an increase in human population and its resultant opening of new land (from forested areas) for the expansion of agriculture and the development of industries, hydroelectric projects, irrigation dams, and mining (Sukumar 1989). At present there are four major landscapes in the Western Ghats where elephants are patchily distributed in six populations in the states of Karnataka, Kerala, and Tamil Nadu, and more recently in Maharashtra and Goa by stray herds from Uttara Kannada (Table 1). Of the four landscapes and six populations, two landscapes with two populations are found north of the Palghat Gap and the rest south of the Palghat Gap.

In total, about 10,000 elephants (mean from four Elephant Census: 2002-05-07-10, Table 1) are found in the six areas with the second, third, and fifth areas hosting the bulk (93%) of the elephants, with the Brahmagiri-Nilgiri-Eastern Ghats landscape (Malnad–Mysore-Nilgiris-Wynad-Nilambur) alone accounting for the highest number (5,400 individuals or 57%) of the elephant population in the Western Ghats.

(i) Uttara Kannada Landscape

Elephant habitats: The forest divisions of Haliyal, Dandeli, Sirsi, Yellapur, and Karwar constitute the elephant habitats in the northern hill tracts of Karnataka (Fig. 1). The hills are low, but form a rather wide belt

Table 1. The elephant landscapes and populations in Western Ghats

	Elephant landscape	Elephant population	Elephant habitat (km ²)	Population size*
1	North-Canara	(i) Uttara Kannada-Maharashtra-Goa	5,081	50
2	Brahmagiri, Nilgiri-Eastern Ghats	(ii) Malnad-Crestline-Mysore-Nilgiris-Wynad- Nilambur plateaus	13,058	5,939
3	Anamalai-Nelliampathy-High Range	(iii) Anamalai-Nelliampathy-Palani Hills	5,352	2,257
		(iv) Idukki-Kothamangalam	296	195
4	Periyar-Agasthyamalai	(v) Periyar Plateau-Varushanad-Mehamalai Hills	3,860	1,508
		(vi) Agasthyamalai-Mahendragiri Hills	1758	331
5	Grant total for the Western Ghats		29,400	10,231

(* mean from 2002, 2005, 2007 & 2010 Census)

with precipitation ranging from 6,500mm at the crest to about 1,000mm on the plateau, and the vegetation ranges from evergreen to dry thorn types (Prasad et al. 1974). The natural habitats in this region are fragmented by expanding human population, heavy exploitation of forest for timber and soft wood, mining (iron and manganese), and hydroelectric projects (Prasad et al. 1974; Sukumar 1989). The states of Maharashtra and Goa, including the forest division of Belgaum, were not part of the traditional elephant ranges. However an elephant herd from the Haliyal-Dandeli Forest division made a short foray into Belgaum Forest division in 2001. Subsequently, between 2002 and 2004, the herd further extended its range northward and visited the southern parts of Sindhudurg District in Maharashtra causing damage to crops and properties. Since 2005 the herd has stayed in Maharashtra around the forested area of Sindhudurg and Kolhapur districts, and is in conflict with people. Part of the herd occasionally wanders further westward into Goa State. A few elephants were captured by Maharashtra and the rest continue to range in and around Tillari Reservoir in Maharashtra in considerable conflict with the people of this region. It is likely that their traditional range in Uttara Kannada is subjected to intensive biotic pressure or fragmentation, and being unable to sustain themselves within their traditional home the elephants moved further northward into Belgaum and Maharashtra in search of new areas to settle down, as has been reported elsewhere in Andhra Pradesh and Tamil Nadu (Daniel et al. 1995; Baskaran 1998). Although the natural habitats in Uttara Kannada have tenuous links with the Malnad Plateau on its southern side, elephant movements do not take place anymore, probably due to a higher disturbance from the Bangalore-Shimoga highway and from villages around the Shimoga Forest division.

Vegetation land use: Evergreen forests dominate

(26% or 6,055km²) the natural vegetation in the landscape (Fig. 2), followed by an almost equal (11%) spread of tropical deciduous (2,700km²) and dry-thorn forests (2,525km²). However, at the landscape level, two-thirds of the land cover is occupied by human settlement/cultivation (33% or 7,800km²) (Table 2). In addition the landscape also has commercial plantations like coffee (*Coffea arabica*) and tea (*Camellia sinensis*) over 2500km² (11%) indicating the level of habitat fragmentation.

Elephant population: In this region the elephants are scattered in low density. In 2002 a synchronized census estimated 58 elephants (Elephant Census 2002). However, in 2005 the number declined to 34 (Table 3, Elephant Census 2005), possibly due to the straying of an elephant herd from Belgaum division to Maharashtra. The Dandeli Tiger Reserve is an important elephant habitat in this region supporting the bulk of the population consistently during 2002–07.

Conservation issue: The fragmentation of habitat by (a) expanding human population, (b) extensive exploitation of forest for timber and soft wood in the past, (c) mining (iron and manganese), and (d) Kalinadi hydroelectric project could be the reasons for the straying of elephants from Haliyal Forest division into Belgaum to Maharashtra. The Dandeli Tiger Reserve alone supports the bulk of the elephants of this region. However, no detailed data is available for the elephants in Uttara Kannada, including in new habitats in Maharashtra and Goa. A more objective study is needed to evaluate the habitat conditions, its corridors, population structure and viability, including the present scenario of human-elephant conflict, to make firm conservation recommendations for this population.

(ii) Brahmagiri-Nilgiri-Eastern Ghats Landscape

Elephant habitats: The landscape comprises 31 forest

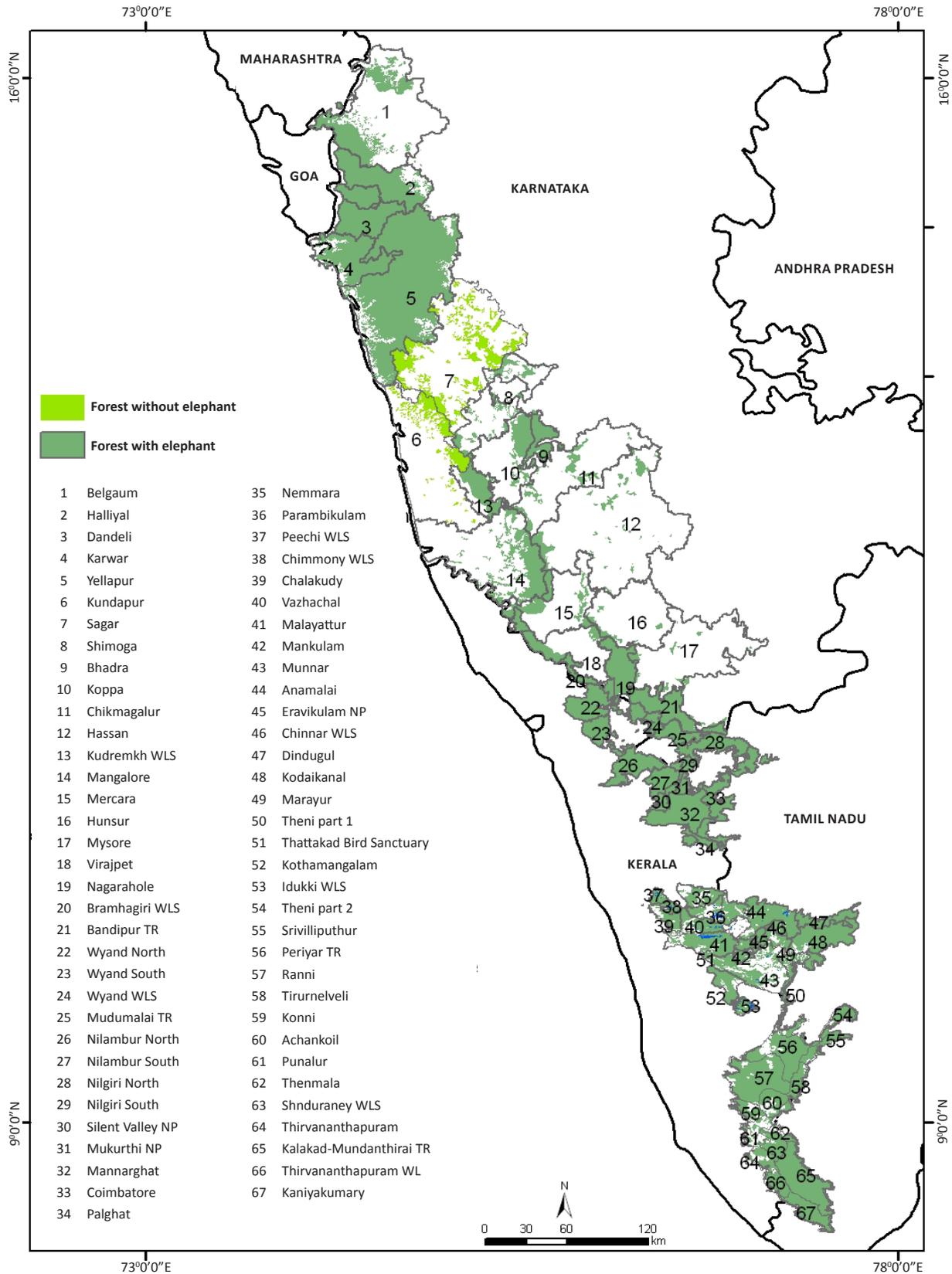


Figure 1. Map showing the distribution of elephants in the Western Ghats under different forest divisions in southern India (excluding Maharashtra and Goa). Note: Forest divisions such as Gudalur in Tamil Nadu, Aralam WLS, Kannore and Calicut in Kerala have elephants but are not shown in the distribution map due to non-availability of SI topographic map. WLS, NP and TR refer to Wildlife Sanctuary, National Park and Tiger Reserve respectively.

Table 2. Vegetation and land-use patterns of the four elephant landscapes (Uttara Kannada landscape areas excluding Maharashtra and Goa elephant habitats)

Land use elements	Elephant landscape (area in km ²)			
	Uttara Kannada-Belgaum	Brahmagiri-Nilgiri-Eastern Ghats	Anamalai-Nelliampathy-High Range	Periyar-Agasthyamalai
Evergreen	6,055	6,251	1,522	3,459
Deciduous	2,702	9,716	1,997	1,463
Dry thorn	2,525	3,099	485	316
Forest plantation	773	866	594	408
Water-bodies	1,131	744	96	150
Commercial plantation	2,691	4,055	779	717
Human set/cultivation	7,776	13,366	382	193
Total	23,653	38,097	5,855	6,705

divisions from the Malnad Plateau and crestline on the northern side to Coorg, Mysore, Wyanad, and Nilgiri plateaus up to the Palghat Gap on the southern side, and the Sigur Plateau on the eastern side, to Kozhikode and Kannur on the western side, spreading contiguously over 13,000km² of forest cover (Fig. 1). The Ghats on the northern part of this region (the crestline of Karnataka) rise much higher and narrower with a rainfall of 6,000-7,000 mm.

The habitats along the crestline of the Ghats and on the western side, with a higher precipitation than the eastern side, have more close canopied tropical evergreen and moist forests. The habitats on the eastern side (slopes and the Malnad-Mysore and Nilgiri plateaus) have more open canopied tropical deciduous forests, with a higher biomass of grass cover. In fact the Mysore-Nilgiri plateaus with extensive tracts of tropical deciduous and dry thorn forests and with relatively less human interference in the deeper forests are potentially the most outstanding elephant habitats anywhere in Asia. They also harbour a wide assemblage of other large mammals like Gaur, Sambar, Chital and langurs in high densities (Karanth & Sunquist 1992; Varman & Sukumar 1995) that support a substantial part of the large carnivorous population in the Ghats.

Vegetation and land-use patterns: The landscape with a geographical area of over 38,000km² has large areas under human settlement/cultivation, most of which is in the Coorg and Malnad plateaus (Fig. 2). However, the landscape has the largest tracts of deciduous forest extending over one fourth of the total landscape (Table 2), which is the major reason for the landscape to support perhaps the world's largest Asian Elephant population. Further, the deciduous secondary forest is supplemented with another 3,000km² of dry

thorn forest, which acts as an optimal habitat for the large herbivores during the north-east monsoon.

Elephant population: The landscape is well known for harbouring the single largest population of Asian Elephants anywhere in Asia. The census estimates reveal that the forested tracts in these parts of the Western Ghats host 5,900 elephants (Elephant Census 2002-05-07-10, Table 3). In addition, the area being contiguous with the Eastern Ghats, the actual population exceeds 8,000 elephants. Except Bhadra Wildlife Sanctuary, the forest divisions on the north of the Mysore plateau such as those in Coorg and Malnad plateaus (Virajpet, Madikeri, Hassan, Chikkamagalur, and Koppa FDs), and those in the crestline region (Mangalore, Brahmagiri, Pushpagiri, and Talacaveri), mostly with evergreen and semi-evergreen habitats, have less than 0.5 elephants/km². While forests in the Mysore, Nilgiri, and southern parts of Wyanad Plateaus (Wyanad Wildlife Sanctuary), with tropical deciduous forest domination, support the highest density of elephants (mean 1.7, range: 1.5–2.5). This region with 2,200km² is estimated to have a mean population of 3,700 elephants (Elephant Census 2002-05-07-10).

Conservation problems

Habitat fragmentation and contiguity: The forest cover in the southern Malnad and Coorg plateaus (forest divisions such as Chikkamagalur, Hassan, Madikere territorial) has been exploited extensively for commercial plantations (mainly coffee), forest-based industries (paper mills), and irrigation and hydroelectric projects (Prasad et al. 1974) resulting in higher fragmentation of traditional elephant habitats along the plateaus. Therefore, the forest contiguity between the Malnad and Coorg plateaus is cut off and bulls can rarely move

Table 3. Elephant population in the Western Ghats, north of Palghat gap

	Elephant landscape/ Forest division	Area* (km ²)	Elephant population size				
			2010	2007	2005	2002	Mean [†]
I	Uttara Kannada-Belgaum-Maharashtra-Goa						
1	Maharashtra	?	-	20?	20?	-	15?
2	Goa	?	-	-	-	-	
3	Belgaum	1,449	-	-	2	22	12
4	Sirsi	1,036	-	-	0	-	0
5	Yellapur	549	-	0	0	0	0
6	Halliyal	598	-	0	0	0	0
7	Karwar	554	-	0	6	17	8
8	Dandeli	895	-	15	26	17	19
	Sub total	5,081	?	37	56	56	50
II	Brahmagiri-Nilgiri-Eastern Ghats						
1	Koppa	1,151	0	0	0	-	0
2	Kudremkh	600	0	-	-	-	0
3	Shimoga	827	-	-	1	-	1
4	Bhadra WLS	492	345	331	534	300	377
5	Chikkamagalur	59	6	7	8	5	6
6	Mangalore	1,128	56	-	-	-	56
7	Madikeri Wildlife (incl. Brahmagiri)	379	189	40	76	167	118
8	Hassan	250	75	23	75	56	57
9	Madikeri	373	37	98	75	86	74
10	Virajpet	337	168	159	297	51	169
11	Nagarahole Tiger Reserve	664	664	600	804	1,170	809
12	Hunsur	71	29	98	16	73	54
13	Mysore	177	71	105	17	68	65
14	Bandipur Tiger Reserve	906	2,175	1,005	1,217	1,975	1,593
15	Wyanad WLS	344	713	604	825	521	666
16	Wyanad North	214	67	25	35	83	53
17	Wyanad South	323	81	104	45	101	83
18	Aralam WLS	55	14	2	17	27	15
19	Kannore	243	30	20	41	0	23
20	Kozhikode	324	81	19	42	38	45
21	Mudumalai Tiger Reserve	321	995	578	294	703	643
22	Nilgiri North	854	427	598	92	557	419
23	Nilgiri South	321	0	14	0	-	5
24	Mukurthi NP	78	-	-	-	-	0
25	Gudalur	411	82	111	-	32	75
26	Nilambur North	325	217	9	46	40	78
27	Nilambur South	100	62	11	50	18	35
28	Silent Valley	90	1	26	12	131	42
29	Mannarkad	665	472	46	200	58	194
30	Coimbatore	738	295	262	119	178	214
31	Palghat	239	66	9	50	11	34
	Sub total	13,058	7,416	4,904	4,987	6,449	5,939

* Approximate elephant habitat, † from 2002, 2005 & 2007 synchronized elephant census block count

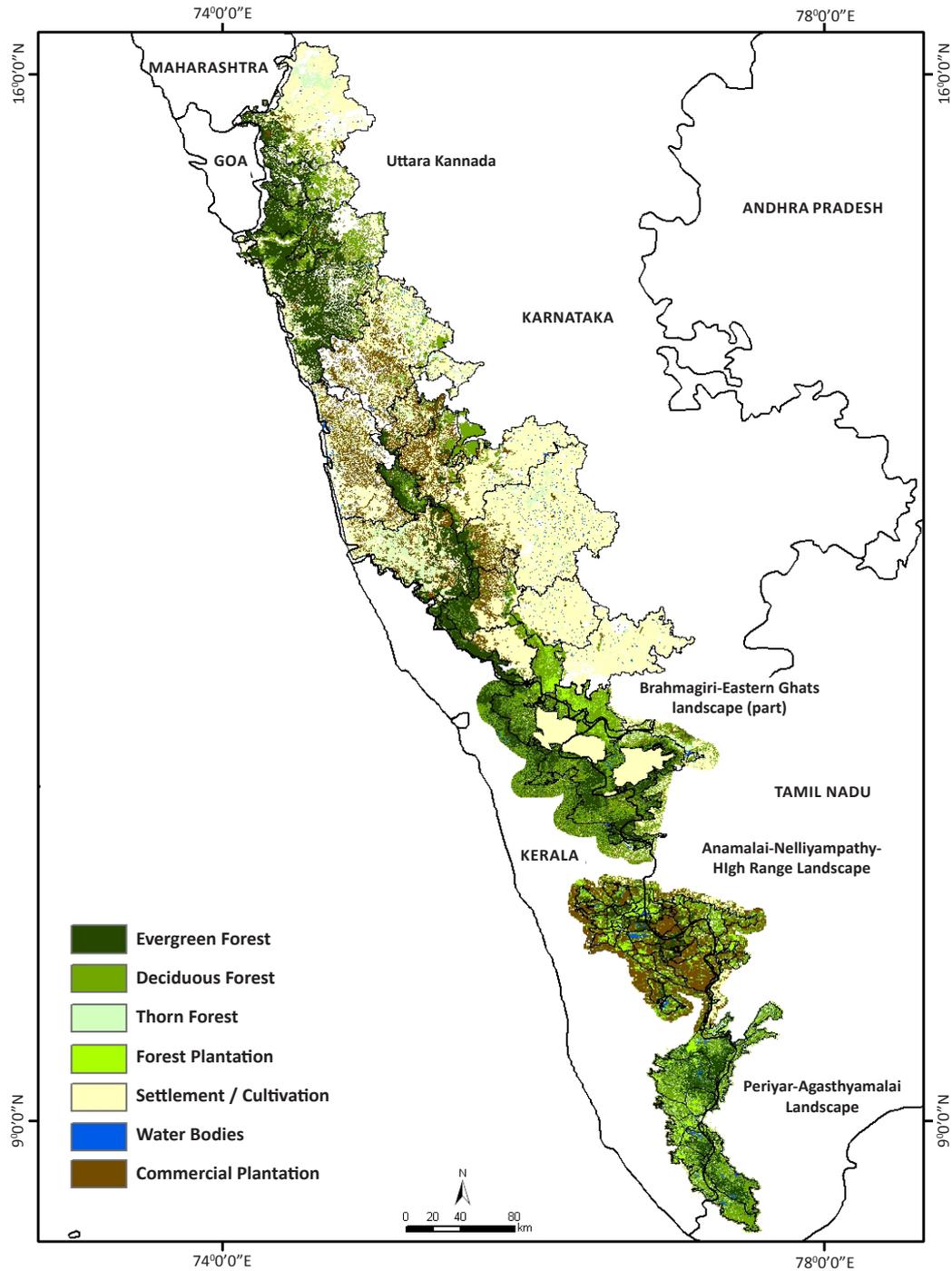


Figure 2. Land use and vegetation of the elephant habitats in the Western Ghats in southern India (excluding Maharashtra and Goa)

along the plateaus from Coorg to Malnad or vice versa using the isolated forest patches available between the coffee plantations and cultivation/settlements. However, the forest habitats in Malnad Plateau (Chikkamagalur Forest Division) with a tenuous link with the crestline of Karnataka are connected with the Mysore Plateau. Although it is not known whether any elephant herd or bulls from the Malnad Plateau range

up to the Mysore plateau or vice versa, the movement of elephants to crestline from Mysore (via Brahmagiri-Pushpagiri) and Malnad plateaus (via Chikkamagalur Forest Division) is known to take place and hence the population is not isolated (Varma 2000). The Hindustan Petroleum Corporation Limited (HPCL) pipeline project, being laid between Mangalore and Bengaluru, which would have broken contiguity between the Malnad

and Mysore plateaus via Pushpagiri-Brahmagiri, has been halted (Varma 2000), but the increasing traffic on the Bengaluru-Mangalore highway could still be a threat in the near future to the elephant movement via Pushpagiri-Brahmagiri between the Malnad and Mysore plateaus.

Similarly, the western parts of the Wyanad plateau have also witnessed a severe habitat fragmentation by developmental activities with most of the low-lying swamps (locally known as 'vayal'), a preferred microhabitat of elephants during the dry season, being taken away for human habitation and cultivation. Besides, large tracts of natural forests have also been converted into monoculture plantations of teak, rubber, and pepper for commercial purposes, which has added to the fragmentation of natural habitats and increased human-elephant conflict.

The construction of a series of hydroelectric projects (Pykara), especially on the eastern side of Mudumalai, brought with them a large influx of human population and infrastructure development, which has created many bottlenecks threatening the habitat contiguity with the Sigur Plateau that in turn connects the Eastern Ghats. Similarly, there were proposals for infrastructure developmental plans for: (i) creation of a highway from Kozhikode to Coimbatore by widening the existing road from Vazhaithottam to Sigur and linking it to Bhavanisagar to bypass the existing Ghats section highway that goes via Nilgiris, and (ii) extending the Mysore-Chamarajanagar railway line to Coimbatore via Bhavanisagar-Sathyamangalam cutting across the Moyar Valley, the connecting link between the Western and Eastern Ghats. Although these proposals have been shelved as of now, they may get revived in the future with pressure by political influence, as has happened several times earlier (Kozhikode-Coimbatore highway, for example). If any of these projects get implemented, it could decimate a large number of wild animals directly through road kills (Boominathan et al. 2008; Baskaran & Boominathan 2010) as well as fragmenting the link between the Western and Eastern Ghats (Baskaran 1998). Additionally, such development would also encourage people to encroach onto the forested revenue patches available in the Sigur Plateau and further aggravate the habitat fragmentation, biotic pressure, and their resultant human-wildlife conflict in the region.

Human-elephant conflict: The extensive loss and fragmentation of habitats in the Malnad-Coorg plateaus, besides decimating much of its wildlife, has also brought a large number of elephants in contact with human settlements/cultivation resulting inevitably in severe

human-elephant conflict, especially in the Coorg Plateau.

Biotic pressure and degradation: The Mysore and Nilgiri plateaus (starting from Nagarahole south to Bandipur and Mudumalai Tiger Reserves), with a moderate rainfall and free of much human habitation deep inside the forest, have retained their habitat integrity. However, the eastern fringes of the Mysore and Nilgiri (Sigur) plateaus experience relatively higher anthropogenic pressure in the form of overgrazing by scrub cattle and firewood collection by people that severely degrade the natural habitats along the fringes on the eastern side (Silori & Mishra 2001; Baskaran et al. 2012). The degradation of natural habitats, besides depleting the food sources available to wild herbivores, alters the animal (Baskaran et al. 2009; Baskaran et al. 2011b) and plant communities and devastates the biodiversity of the region.

Ivory poaching and skewed sex ratio: Illegal ivory poaching during 1984-86 selectively removed a large number of adult males in the population, especially on the southern side of the population in Sigur and the southern side of Mysore and Wynad plateaus (Daniel et al. 1987), leading to a ratio significantly skewed towards females at the adult level (Daniel et al. 1987; Baskaran & Desai 2000; Arivazhagan & Sukumar 2005; Baskaran et al. 2010a). Though the number of adult male poaching incidents has come down in recent years, with decreasing adult males in the population poachers are targeting even sub-adults and juvenile males resulting in a remarkable difference in sex ratio even among the younger population segments (Baskaran & Desai 2000; Baskaran et al. 2010a) indicating that ivory poaching continues with similar intensity as in the past.

Local over-abundance or increase in elephant population: The elephant population estimates over the years show an increasing trend from one elephant/km² in 1987 (Daniel et al. 1987) to nearly three during 2010 in Mudumalai Tiger Reserve (Elephant Census 2010), where long-term population data is available since 1985 from detailed population studies conducted by research institutions like the Bombay Natural History Society (BNHS), the Indian Institute of Science, and the Synchronized Elephant Census. The situation is likely to be similar in the adjoining habitats of Bandipur Tiger Reserve, Nagarahole National Park, and Wynad Wildlife Sanctuary, with similar habitat conditions and elephant density (as shown by recent Synchronized Elephant Census) as in Mudumalai. To some extent the increasing trend in population size could be due to compression of elephant habitats in the adjoining forest divisions. However, to a large extent the population growth may

have also contributed to the present scenario of over-abundance, because the Asian Elephant, unlike other large herbivores, does not face population regulation through a prey-predation mechanism, and the large-scale capture that had checked population growth has been stopped since 1980. Although ivory poaching, as an alternative to capture, has controlled the growth of male segments to some extent, there was no real check on the growth of the female population, which continued growing, as evidenced by a higher proportion of female segments with a higher density of elephants in 1999–2000 as compared to 1985–1987 (for details see Baskaran et al. 2010a). From the time the large scale capture was stopped, a sudden spurt in population growth would be expected; directly through the addition of individuals to the population (first generation) by the reproduction of females that should have been captured, and after 18–20 years time, indirectly with the onset of calving by first-generation cows, which would have been checked by large-scale captures. Due to an over-abundance of elephants in this region, the density of favoured food species of the elephants decreased significantly (Sivaganesan & Sathiyarayanan 1995), and it may become a serious problem in some areas in the near future as it has the potential to degrade the habitats and adversely affect the biodiversity, particularly in areas that are already facing pressure from the surrounding human population (Riddle et al. 2010). Therefore, the growing elephant populations and their impact on the natural habitats need to be addressed appropriately.

(iii) Anamalais-Nelliampathi-High Range Landscape

The elephant landscape is located to the south of the Palghat Gap in the states of Tamil Nadu and Kerala, and extends over 5,600km² across 18 forest divisions (Fig. 1). The population range topographically consists of three major hill ranges—the eastern Palani Hills, central Anamalai Hills, and western Nelliampathi Hills—of the Western Ghats. The elephant population is genetically more diverse than the larger population to the north of the Ghats (Vidya et al. 2005). The landscape also has diverse vegetation types with moist deciduous forest dominating the elephant habitats (Baskaran et al. 2007; Baskaran et al. 2013) and this region is known for its rich biodiversity (Gadgil & Meher-Homji 2003; CEPF 2007). However, the elephant habitat is under threat due to fragmentation by a large number of hydroelectric projects (dams, open canals, penstock pipelines, and powerhouses), commercial plantations (tea, coffee, and cardamom (*Elettaria cardamomum*)), and settlement/cultivation along with the development of major roads

(Sukumar 1989; Baskaran et al. 2007; Baskaran et al. 2013). Due to greater habitat fragmentation in the Munnar Forest division, its contiguity to Theni Forest division is presently cut off by the non-forest commercial plantations. However, elephants continue to move between Munnar and Theni forest divisions and vice versa through commercial plantations (Baskaran et al. 2007; Baskaran et al. 2013). Further, the settlements along with steep terrain in between the southwestern part of Munnar Division and the northeastern part of the Kothamangalam Forest Division act as barriers to elephant movement although forest contiguity exists between these two areas. Therefore, the elephants ranging in Idukki and its adjoining habitats in Kothamangalam and Kottayam forest divisions are isolated from the main population in the landscape. The large-scale conversion of natural habitats, especially on the eastern side of the landscape, has resulted in an increase in human-elephant conflict.

Vegetation and land-use patterns: Of the 5,855km² extent of the landscape, deciduous forests contribute 34% (Table 2), while the non-forest elements such as commercial plantations (of tea, rubber, cardamom) and cultivation/settlements occupy a considerable area (20%) of the landscape (Fig. 2). It is also important to note that the monoculture forest plantations, mostly Teak *Tectona grandis*, and small areas under Wattle *Acacia* sp. and Eucalyptus *Eucalyptus* sp., constitute over 10% of the landscape. The elephants do not use the monoculture plantation area as much as the natural habitats due to a lack of palatable food plants (Sukumar et al. 2003; Baskaran et al. 2007), therefore this is an unconstructive forested area for biodiversity within forest department jurisdiction. The landscape also has 430km² of tropical climax shoal-grassland habitats on the upper reaches of the Ghats, which is an added advantage to the biodiversity of the landscape.

Elephant population: A small part of the population in the landscape is isolated in Idukki, Kothamangalam, and part of Kottayam divisions. The population size estimated using block count method in the years 2002, 2005, 2007, 2010, show respectively, 1,814, 2,148, 2,285, and 2,781 elephants in the major part of the landscape, and 162, 236, 197, 184 in the isolated habitats (Idukki and Kothamangalam). These estimates indicate that this region supports approximately 2,500 elephants (mean from the three estimates). However, population estimates by line transect dung count method, a more realistic method for dense forested habitats (Dawson 1990) of Asian Elephants, works out to 3,850 elephants (Baskaran et al. 2007; Baskaran et

al. in press) for the landscape. Forest divisions such as Malayattur, Vazhachal, Anamalai, and Parambikulam are the important habitats in the landscape holding a high density of elephants.

Conservation problems

Habitat fragmentation and human-elephant conflict: Developmental activities such as extensive commercial plantations, hydroelectric and irrigation projects with cut-open canals, and other forms of infrastructural development have fragmented the once contiguous natural habitats (Sukumar 1989; Easa et al. 1990; Baskaran et al. 2007) and increased human-elephant conflict especially on the eastern side of the landscape (Kumar et al. 2004b; Baskaran et al. 2007; Baskaran et al. 2013).

Such developmental activities, especially across the Valparai Plateau of the Anamalai Tiger Reserve along a north-south axis with topographical features, have split the once contiguous habitat of the plateau into four bottleneck corridors (Sukumar et al. 1998; Baskaran et al. 2007). These are: (i) Monkey Falls-Navamalai, (ii) Attakatti-Upper Aliyar, (iii) Aiyarpadi-Waterfalls, and (iv) Siluvaimedu-Kadamparai located in Anamalai Tiger Reserve. Elephant movements through these corridors are additionally constrained by vehicular traffic on the Pollachi-Valparai highway that cuts across these corridors. Additionally, contiguity between Mattupatti-Mathikettan Shola in the Munnar Division to the Theni Forest Division is presently cut off due to tea and cardamom plantations; further south the landscape has forest contiguity with the Periyar-Agasthyamalai landscape but the elephant movements have stopped between the landscapes due to the penstock pipe of the Periyar Hydroelectric Project since its inception in 1959 (Harikrishnan 1972; Baskaran et al. 2006).

Isolated elephant herds: The elephant habitat of the Idukki Wildlife Sanctuary and parts of the Kothamangalam and Kottayam forest divisions adjoining it are isolated from the main landscape. Human settlements along with steep terrain in between the southwestern part of Munnar Division (Neriyamangalam Range) and the northeastern part of the Kothamangalam Forest Division (Thodupuzha Range) act as barriers to elephant movement although forest contiguity exists between the two areas. Therefore, about 200 elephants ranging in Idukki and the western part of Kothamangalam Forest Division are isolated from the rest of the elephants in the landscape (Baskaran et al. 2013).

Ivory poaching: The elephant population also shows a skewed sex ratio towards females gradually, from

juvenile (1:1.8) to sub-adult (1:2.4) and adult (1:9), indicating a higher mortality of males in the upper age segment of the population that could likely be due to historical poaching for tusks (Baskaran et al. 2007; Baskaran et al. 2013).

Habitat degradation: The illegal clearing of natural habitats for cultivation of Ganja *Cannabis indica* is reported often in the eastern upper reaches of Anamalai Tiger Reserve and some parts of Malayattur Division. However, the extent of this problem is unclear.

(iv) Periyar-Agasthyamalai Landscape

The landscape is located in the states of Tamil Nadu and Kerala and extends over 5,600km² across 16 forest divisions (Fig. 1). The elephant habitat in the landscape comprises the southern part of the Periyar Plateau, and its eastern spur, the Varushnad and Meghamalai hill ranges, the Achankoil Valley, the Agasthyamalai and Mahendragiri hill ranges on the southern side. Like any other landscape in the Western Ghats, the eastern parts of the landscape with low rainfall have more tropical dry deciduous and thorn forests, while the hill ridges and the western sides with high rainfall have more tropical evergreen and moist deciduous forests. The landscape on the northern side is probably the most intact elephant range in southern India. However, developmental activities like human settlements and cultivation and vehicular movements along the Senkotai-Punalur highway have cut off the habitat contiguity to a large extent between the Agasthyamalai-Mahendragiri hill ranges and Periyar Plateau. Therefore, a small number of elephants ranging in the Agasthyamalai-Mahendragiri hill ranges have been isolated from the larger population found on the northern side.

Vegetation and land-use patterns: The landscape, with over 6,000km² of forest elements (circa 80%) outweighing the proportion of non-forest elements (Table 2), represents the most compact elephant landscape in southern India (Fig. 2). The evergreen forests extend over 50% of the landscape dominating all other land use elements, while the secondary forests of deciduous and dry thorn habitats occupy 26% of the landscape. Forest plantations cover a significant area (>5%) in this landscape too. The existence of *Myristica* swamps in parts of Thruvananthapuram Forest Division, which is part of the Agasthyamalai range, is a peculiar vegetation of this landscape.

Elephant population: In total, the landscape is estimated to have 1800 elephants (Elephant Census 2002-05-07-10, see Table 4), of which about 300 are isolated on the southern side in the Agasthyamalai and

Table 4. Elephant population in the Western Ghats, south of Palghat gap

Sno	Elephant landscape / Forest division	Area* (km ²)	Elephant population size				
			2010	2007	2005	2002	Mean [†]
III	Anamalai-Nelliampathy-High Range						
1	Peechi & Chimmony (Thrissur Wildlife)	202	105	39	190	60	98
2	Nemmara	352	19	53	85	80	59
3	Parambikulam Tiger Reserve	274	149	237	219	178	196
4	Chalakudy	477	129	145	79	55	102
5	Vazhachal	414	297	144	262	439	285
6	Thattakad	25	18	8	-	-	13
7	Malayattur	617	653	464	417	155	422
8	Mankulam	93	7	57	7	45	29
9	Munnar	997	74	415	535	116	285
10	Eravikulam & Chinnar (Munnar Wildlife)	187	37	39	61	125	65
11	Anamalai	959	1,151	598	228	480	614
12	Dindugul	394	118	86	65	81	88
13	Kodaikanal	82	-	-	-	-	0
14	Theni part	279	25	0	0	0	6
15	Kothamangalam	166	15	23	13	54	26
16	Idukki	130	169	139	223	143	168
	Sub total	5,648	2,965	2,447	2,384	2,011	2,452
IV	Periyar-Agasthyamalai						
1	Theni part	309	28	33	26	11	24
2	Srivilliputhur WLS	380	114	131	42	114	100
3	Tirunelveli part	200	40	59	34	207	85
4	Periyar	777	422	479	694	1,353	737
5	Kottayam	389	29	125	68	35	64
6	Ranni	1,059	464	413	230	228	334
7	Konni	322	83	51	78	48	65
8	Achankoil	264	84	53	61	68	66
9	Punalur	100	44	18	7	-	23
10	Thenmala part	60	0	0	0	28	7
11	Tirunelveli part	48	10	0	0	0	2
12	Thenmala part	138	0	0	0	0	0
13	Shendurenay WLS	100	90	89	51	40	67
14	Thirvananthapuram	330	147	83	99	53	95
15	Thirvananthapuram Wildlife	181	54	60	29	10	38
16	ABP Special	31	0	7	15	7	7
17	Kalakad-Mundanthurai	528	106	29	25	-	53
18	Kaniyakumary	402	121	30	57	-	69
	Sub total	5,618	1,833	1,659	1,516	2,202	1,802

* Approximate elephant habitat, [†] from 2002, 2005, 2007 & 2010 synchronized elephant census block count

Mahendragiri hill ranges due to developmental activities along Senkotai-Punalur highway. Forest divisions such as Periyar, Ranni, and Srivilliputhur are the important elephant areas among the 16 forest divisions found in the landscape.

Conservation problems

Threat of habitat fragmentation: Developmental activities in the form of settlements, cultivation, and vehicular movement along the Senkotai-Punalur highway have cut off the habitat contiguity to a large extent between the Agasthyamalai-Mahendragiri hill ranges and Periyar Plateau. Therefore, about 300 elephants ranging in the southern part of the landscape are almost isolated from the larger landscape on the northern side.

Habitat degradation: Local people quite often clear natural habitats for illegal Ganja *Cannabis indica* cultivation in parts of Varushnad and Meghamalai region. Similarly, illegal extraction of Cinnamon *Cinnamomum zeylanicum* bark and overgrazing by scrub cattle on the eastern side of the landscape are degrading the natural habitats.

Ivory poaching: The elephant population in the landscape is the most affected one in the country due to ivory poaching. The sex ratio at the adult stage was extremely skewed to the tune of 1:100 (Ramakrishnan et al. 1998), which changed marginally to 1:80 during 2005 (Arivazagan & Sukumar 2005).

Elephant mortality by transmission line: Poor maintenance of high-tension transmission lines crisscrossing the Ranni Forest Division has electrocuted about 20 elephants between 1995 and 2001, and the situation has not improved there.

OTHER CONSERVATION ISSUES IN THE GHATS

In addition to the issues described above specifically for each landscape or population, broader conservation problems pertaining to natural habitats in the Western Ghats and their management measures are described below.

Proliferation of exotic weeds and its impact: Humans impact pristine ecosystem-aided species in crossing ecological barriers and spreading into new environments. Alien invasive species are well known for their aggressiveness in colonization. Their impact on native species and on the naturalness of the ecosystem can be immense, unpredictable, and often irreversible (Sandland et al. 1996). Alien species are recognized as the second largest threat to biological diversity (IUCN 2000). Species such as Lantana *Lantana camara* and Eupatorium *Eupatorium odoratum* are alien invasive

plants in India originating respectively from North America and West Indies. These two species of exotic weeds invaded the natural habitats of the Western Ghats several decades ago, but their impact on native vegetation has been significant, particularly over the last decade. Though the impact of these weeds on native species has not been fully understood, the two species have taken away most of the ground cover (space) available to the local grass species such as *Themeda cymbaria*, *T. triandra* and *Cymbapogon flexuosus* and other native herbs and shrubs including regeneration classes of native tree species. Additionally, the vacant space created along the streams due to natural mortality of old bamboo clumps after flowering has been occupied by Eupatorium first, and subsequently Lantana invaded to replace the Eupatorium. The impact of Lantana is more intense and widespread than Eupatorium. The proliferation of these two species has affected significantly the biomass of grass and browse available to elephants and other large mammals. Such an impact could also result in changes in vegetation dynamics through increased dependency of elephants on browse tree species that could imbalance the ecosystem and its biodiversity. Though the Lantana may provide shelter for nocturnal animals, and may incidentally act as a food source to a few herbivores, its negative impact is enormous and needs some kind of intervention to control its spread (Prasad & Williams 2009; Wilson et al. 2013).

Weed management: Lantana is known to regenerate through seed emergence and by copious growth from roots left over at the subsoil level. Though permanent eradication of species dispersed by birds is quite difficult (as birds would disperse the seeds from adjoining non-forest areas), some effort needs to be made on an experimental basis to control their distribution at periodic intervals. In some places like the tourism zone of Bandipur Tiger Reserve (BTR), Lantana has already achieved a high density and biomass, thus becoming (i) a major barrier for the free movement of large mammals including elephants, along with (ii) reducing the large herbivore food resources, and (iii) intensifying impacts of forest fires (Kodandapani et al. 2004; Prasad & Williams 2009; Wilson et al. 2013).

Forest fire and its impacts: Forest fires in the Ghats are man-made fires mostly set by forest product gatherers (in remote areas), and cattle grazers (along the fringes), and incidentally spread from fire set in agricultural land to destroy crop residue to fragmented forests (Kodandapani et al. 2004). The high accumulation of leaf fall due to the deciduous nature of the forest and the

presence of tall grass in semi dry conditions provide fuel for forest fires. Forest fires are predominantly ground fires that wipe out all the grass cover including the herbs and saplings of tree species. But the Lantana thickets along the dry streams during low rainfall/drought years also catch fire and take the ground fire up to canopy level, burning mature trees. Forest fires have reduced some of the favoured food species of elephants like *Kydia calycina*, *Bosewellia serrata*, etc. (Sivaganesan & Johnsingh 1995). Further, since grass species form the bulk (> 60%) of the annual diet of elephants in the Nilgiri Biosphere region (Baskaran 1998), protecting grass from forest fires is very important, not only for preserving the food resources but also to reduce elephants' impact on browse species as well as on woody tree regeneration and other biodiversity.

Fire management: In protected areas (PAs), management is taking the necessary precautions to reduce forest fire by establishing firebreaks along the roadsides, and by posting additional temporary firewatchers stationed at special camps established for fire control during the dry season. Presently in the PAs, anti-poaching watchers and their widely distributed camping sites with their wireless communication facilities have been managing to control forest fires. But such special efforts are mostly restricted to the PAs network, while territorial divisions with teak- and tall grass-dominated deciduous forests are not protected. Therefore, the efforts need to be spread widely to all fire-prone forest areas, irrespective of type of forest divisions (PA or territorial).

Biotic pressure: Grazing by domestic cattle and firewood collection have become serious habitat threats degrading forest conditions almost all along the eastern sides of the Western Ghats. For example, along the eastern side of Bandipur Tiger Reserve (BTR), there are 213 fringe villages with 1,16,000 scrub cattle (Raju 1995). The residents of these villages mostly collect firewood and graze their cattle in the bordering areas of the Tiger Reserve. The magnitude of biotic pressure along the Ghats can be inferred based on a case study (Sileri & Mishra 2001) that estimated 1800 cubic meters of firewood and 451 cubic meters of cattle dung being collected annually from the forest by just eight villages around the eastern part of the Mudumalai Wildlife Sanctuary/Tiger Reserve. Besides, domestic cattle also spread contagious diseases (Hugh-Jones & de Vos 2002; Priya et al. 2009) such as Haemorrhagic Septicemia, Anthrax, Foot & Mouth to the resident wildlife.

Biotic pressure management: To reduce dependence on firewood, the park management in BTR, with the

help of voluntary agencies, has recently provided LPG connection to about 600 villagers who live along the eastern fringes of BTR. Village-based committees called "Namma Sangha" have been established and are currently managing this scheme with an initial corpus of funding by conservation agencies and individuals. Through similar strategies, local communities need to be motivated and helped to replace the large number of scrub cattle with higher milk-yielding hybrid cows. In doing so, the cattle numbers along the eastern fringes of the Ghats could be reduced to approximately one-third of their present size. Animal husbandry departments, with technical support from agriculture departments, could establish fodder farms at the existing unoccupied revenue land to meet the fodder requirements of stall-fed hybrid cows and establish cooperative milk collection booths so that monetary benefits go directly to the villagers. Partial funding could also be raised through the revenue department under rural development schemes for establishing such facilities. Such a step needs to be taken up in forest divisions, especially along the eastern side of the Ghats, where a large number of families living below the poverty line still cause extensive degradation.

Human-elephant conflict: The human-elephant conflict is largely attributed to fragmentation and degradation of habitat, which often results in elephants resorting to crop raiding, change in movement patterns, and search for new areas to settle down that subsequently lead to human-elephant conflict (Barua & Bist 1995; Balasubramanian et al. 1995). The elephant population in northern West Bengal in northeastern India is an example where the highly fragmented elephant habitats annually experience 50 human deaths, and extensive crop and property damage by about 200 wild elephants (Barua & Bist 1995). The isolated elephant population in the Dhalma Sanctuary in the state of Jharkhand, central India, migrates every year into southern Bengal and Orissa enroute causing severe damage to human life and property (Datye & Bhagwat 1995). Similarly, intensive anthropogenic pressure in terms of cattle grazing, firewood and minor forest produce collection, frequent man-made fires and their resultant weed abundance in elephant habitats, reduces and degrades the quality of fodder available to elephants. The elephants ranging in such suboptimal habitats are unable to meet their fodder requirements and resort to crop raiding either by staying in their traditional ranges or moving into new areas (without or with less elephant occupation) if the new areas are unable to meet their demands (Baskaran 1998; Daniel et al. 2006). As discussed earlier in this paper, the recent straying of elephants from northern Karnataka

Haliyal and Dandeli into adjoining forest divisions in Karnataka (Belgaum FD), Maharashtra, and Goa states could be due to biotic pressure and its impact on their traditional ranges (Koehl 2006). The elephants ranging further south in the Karnataka-Tamil Nadu border (the Nilgiri-Eastern Ghats) also follow a similar pattern. There have been incidences of elephant herds straying out due to degradation and fragmentation of traditional areas of Hosur-Dharmapuri forest division, Tamil Nadu, bordering Bannerghatta National Park, Karnataka, and colonizing the habitats in neighbouring Andhra Pradesh causing extensive damage enroute (Daniel et al. 1995) and in newly colonized places too. A recent study on these newly colonized elephants (Daniel et al. 2006) recommends translocating them, as their new habitats are not viable to support them.

ELEPHANT BEHAVIOUR AND ITS IMPLICATIONS FOR WESTERN GHATS MANAGEMENT

Asian Elephants live in social groups with a strong social bond among females, who live in groups of related females and their dependent offspring of both sexes (Vidya & Sukumar 2005), and are led by a matriarch, the oldest female. Males leave the maternal herd at puberty around the age of 15 years and lead mostly solitary lives and at times join female herds for breeding; alternatively, or when not sexually active, they may join other males to form bachelor herds with weak social bonds (Sukumar 1989; Desai & Johnsingh 1995). Their large body mass and poor digestive ability make them spend as much as 60–70% of the time on feeding/day (Baskaran et al. 2010b) to consume plant matter equal to 5% of their body mass (160–300 kg), and up to 225 L of water every day (Sukumar 2003). Therefore, a matriarchal group needs nearly 700km² of natural habitat in landscape with secondary forest domination to lead a reasonable natural life (Desai 1991; Baskaran et al. 1995; Baskaran 1998).

Besides a wide-ranging nature, elephants have long life spans like human beings and show strong fidelity to their home and seasonal ranges and the corridors within. Thus, they use the same range over several generations (Baskaran et al. 1995; Baskaran 1998). Although elephants, especially herds (clans), overlap extensively in space, the hierarchy and resource defense among clans and its resultant spacing mechanisms do not permit those elephant clans that lost their home to developmental activities to move to adjoining undisturbed habitats already inhabited by a high density of elephants. Therefore, such clans with significant loss of traditional ranges (including their corridors) by

agriculture/settlements will continue to stay in their home ranges conflicting with humans (Balasubramanian et al. 1995; Baskaran 1998). If the traditional ranges turn out to be unsustainable, they will stray out in search of newer habitats to settle down as seen in the cases of elephants straying into Belgaum-Maharashtra-Goa in 2004–05, and from Hosur-Dharmapuri to Andhra Pradesh, (Daniel et al. 1987), and in the absence of newer habitat without elephants, will settle down in areas with very few elephants (as reported in Baskaran 1998). If the newly settled forest is suboptimal, the herd starts sustaining itself partially from agricultural crops available in the adjoining newer habitats (Baskaran 1998; Daniel et al. 2006).

The complex social life, along with large spatial and temporal scales over which elephants live their life and the demand on land for the growing human population imply that the long-term conservation and management of elephant populations requires an integrated and ecologically sound approach among government departments and conservation agencies. Equally essential is a long-term conservation policy for each elephant population.

INTEGRATED LAND USE AND DEVELOPMENTAL PLANNING AT THE LANDSCAPE LEVEL

The Asian Elephant, being a wide-ranging species, is facing continued threats from habitat loss due to the absence of integrated and planned developmental activities that take into account conservation needs. Elephants are now confined to smaller fragmented habitats in the landscapes. The fragmented or isolated populations, often with poor quality of habitats and genetically unsuitable for long-term conservation, are increasingly coming in contact with human beings leading to escalating human-elephant conflict. On the other hand, much of the remaining elephant habitats are surrounded by rural areas where most of the families live below the poverty line and depend on forests for their livelihood, resulting in a degradation of habitat that further leads to an increase in human-elephant conflict and a loss of biodiversity. The existing government management practices at the forest division/park level, with a lack of coordinated management approach within the department among wildlife and territorial divisions of the same state or among states, and a lack of integrated planning with other governmental departments for land use and developmental activities further aggravate the habitat fragmentation and degradation leading to greater human-elephant conflict. Therefore, an integrated land use and developmental planning that

takes into account the conservation needs at landscape level (Sukumar & Baskaran 2007; Gajah 2010), would not only be ecologically sound for the elephant population but would also safeguard biodiversity, economic growth, and the quality of livelihood of the several million people living in and around the Western Ghats.

Establishing a comprehensive database on elephant habitats including the corridors, land use, and vegetation patterns at the landscape level is a basic but vital step. Superimposing other data on elephant population, human-elephant conflict, and other conservation issues like biotic pressure, ivory poaching, etc., along with data on socio-economic status of the people, rainfall, topography, and soil type, etc. on to the elephant distribution map, one could visualize the existing scenario and devise management policies regarding land use and developmental planning at the landscape level, integrating conservation needs of the elephant population and other biodiversity. For such a plan to be practical and successful, it should be drawn up with the involvement of government officials and policy-makers representing forest, revenue, animal husbandry, agriculture, electricity boards, highways and railways, along with experts from elephant ecology, biodiversity, conservation, and sociology.

Since the prospect of restoring connectivity among fragmented patches or consolidating habitat on a large scale is unlikely given the demands of a growing human population, maintaining the integrity of existing habitat and corridors is essential. The corridors are narrow strips of forests connecting two major habitats, which wild animals use traditionally or in recent years owing to the loss of habitats. Such corridors play a vital role in maintaining landscape connectivity by facilitating the movements of organisms between habitat fragments and thus minimize the risk of inbreeding and extinction, thereby increasing local and regional wild animal population persistence (Simberloff 1988). Above all, the Asian Elephant, being a wide ranging species, is highly affected by habitat loss and ivory poaching particularly in southern India. Corridors are thus crucial not only for elephant survival, but also to minimize their conflict with people and their negative effect on natural ecosystems and thereby on biodiversity. Although a majority of the corridors are within the reserved forests (see Menon et al. 2005), either under Territorial forest divisions or protected areas network (wildlife sanctuaries, national parks, and tiger reserves), a few of them are under the revenue and private lands and need to be preserved legally from the threats of developmental activities to maintain the integrity of the Western Ghats elephant

landscapes and their biodiversity. Detailed guidelines to maintain the integrity of elephant landscapes and to protect elephant corridors legally through various legislations including declaring them as "Ecological Sensitive Areas" are suggested by the Elephant Task Force (Gajah 2010), a committee consisting of wildlife experts from India and Project Elephant Director (Government of India) which was set up recently by Project Elephant, Ministry of Environment & Forests, to strengthen the conservation of the species and to secure the future for elephants in India.

CONCLUSIONS

Overall the southern Indian states are fortunate to have the Western Ghats, which is one among the 34 global biodiversity hotspots with high endemism and a spectacular assemblage of large mammals including a large number of endangered species like the Asian Elephant. Indeed, the largest global populations of the Asian Elephant are distributed along the Western Ghats in the states of Karnataka, Kerala, and Tamil Nadu (and more recently in Maharashtra and Goa). The Ghats has nearly 10,000 elephants in four major landscapes, with signs of an increasing trend in some populations over the past two decades; elephant population numbers per se are not an issue, as far as the region is concerned. The major threats to the long-term conservation of the elephant in the Western Ghats include further fragmentation of habitat from developmental activities, continued poaching of bulls for ivory, and the escalation of human-elephant conflicts resulting in public antagonism toward the species. Therefore, the goals of management should be to consolidate the habitats and preserve the corridors to avoid further fragmentation, take steps through integrated land use planning at a landscape level to reduce and, eventually, eliminate human-elephant conflicts in a phased manner, and build up a demographically and genetically vibrant elephant population by protecting the tusked males from ivory poaching and corridors from developmental threats. As stated earlier in this paper, ensuring the long-term conservation of Asian Elephants in the Western Ghats implies that protecting large tracts of natural habitats in the Ghats, which are vital to maintain its biodiversity, ecological functions of climate stability, clean water and air, and erosion control, is essential to safeguard economic growth, social stability, and the quality of livelihood of the several million people living in peninsular India.

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An elephant herd in Theni Forest Division

