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# Whose Habitat Is It Anyway? Role of Natural and Anthropogenic Habitats in Conservation of Charismatic Species

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**Abstract**

Developmental activities have been one of the major drivers of conversion of natural forest areas into mosaics of forest fragments, agriculture, and plantations, threatening the existence of wildlife species in such altered landscapes. Most conservation research and actions are protected area centric and seldom addresses the importance of landscape matrices around these protected areas in providing habitats to a wide range of species. In this article, we bring out the crucial role of natural and anthropogenic habitats for the existence of three charismatic species, namely, Asian elephants, leopard, and lion-tailed macaques. The larger public perception of where the animals should be and where the animals actually are is also discussed. We emphasize that, while habitat generalists often adapt behaviorally and ecologically to modified landscapes, habitat specialists, such as the lion-tailed macaques could find survival harder, with increasing anthropogenic pressures and loss of their habitats.

**Keywords**

anthropogenic habitats, generalists, habitat use, mammals, protected area, specialists

Globally, burgeoning human developmental activities have threatened natural forest areas, resulting in destruction and fragmentation of habitats and in turn restricting wild fauna within islands of forests or pushing them into surrounding human-use areas. Much of the focus on wildlife conservation has been on the *fortresses of conservation*, protected areas (PAs), which focuses on setting aside wildlife sanctuaries and national parks. However, today, wide range of taxa extensively range outside these conventional protected boundaries, into human-use landscapes, and there has been little attention paid to the ecology of such wildlife that uses these modified habitats dominated by commercial and subsistence agriculture or plantations (see Figure 1). It is only in the recent past that conservation of such species outside PAs has gained momentum and is established as an important area of scientific investigation (Graham, Douglas-Hamilton, Adams, & Lee, 2009; Mudappa, Kumar, & Raman, 2014).

Continued persistence of wildlife in human-use areas warrants ecological adaptation in terms of use of diverse habitats and behavioral modifications in species as a response to pressures associated with modified landscapes. Such spillover animal populations, particularly wide-ranging species such as elephants, leopards, primates, and so on, outside forest areas come into frequent contact with people, leading to what is largely referred to as human–wildlife conflict.

India, being one of the largest populated countries with 1.3 billion people, still remains as high biodiversity area, where several taxa thrive in human-dominated areas that surround natural habitats (Sridhar, Raman, & Mudappa, 2008; Chang, Karanth, & Robbins, 2018). In the Western Ghats of India, 25% of forest cover

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loss was estimated between 1973 and 1995, resulting in degradation of forests and increased conversion to agriculture and plantations (Jha, Dutt, & Bawa, 2000). In southern India alone, nearly 10% of available forest area has been reduced due to monoculture plantations such as tea, coffee, *Eucalyptus*, and teak (Santiapillai & Jackson, 1990). Nevertheless, forest remnants among plantations still support wide range of endangered and endemic charismatic species in certain key and important high biodiversity areas in the Western Ghats (Sridhar et al., 2008; Mudappa et al., 2014). Their existence in such altered landscapes is influenced by many factors such as resource availability and distribution, land-use patterns, cultural and religious practices, beliefs of the local communities, and the kind of interactions the species has with people. Semiurban and urban peripheries, off late, provide a unique ecosystem to the species, changing their food habits, distribution, and their physiological processes (Sinha & Vijayakrishnan, 2017).

This article is an attempt to highlight the importance of natural and modified landscapes for the sustenance of three species, namely, the Asian elephant (*Elephas maximus*), leopard (*Panthera pardus*), and the lion-tailed macaque (LTM; *Macaca silenus*). The Asian elephant, a highly endangered species, uses diverse habitats encompassing forested and nonforested production landscapes across its range. India holds the largest Asian elephant population spreading across 13 Indian states. A recent study by Madhusudan et al. (2015) indicates that more than 60% of Asian elephant population distribution lies outside PAs in the southern Indian state of Karnataka alone. Asian elephants are known to use commercial plantations such as tea, coffee, rubber, cardamom, and oil palm plantations, which are often juxtaposed with elephant landscapes. These habitats are extremely important for movement of elephants; and often, they act as refuges, which provide food and shelter in modified landscapes (Kumar, Mudappa, & Shankar Raman, 2010; Srinivasaiah, Anand, Vaidyanathan, & Sinha, 2012). On the other hand, elephants in hard-edge interfaces of forest and farm landscapes tend to depend on crops, leading to intense conflict between people and elephants.

Similarly, leopards (Athreya, Odden, Linnell, Krishnaswamy, & Karanth, 2013; Navya, Athreya,

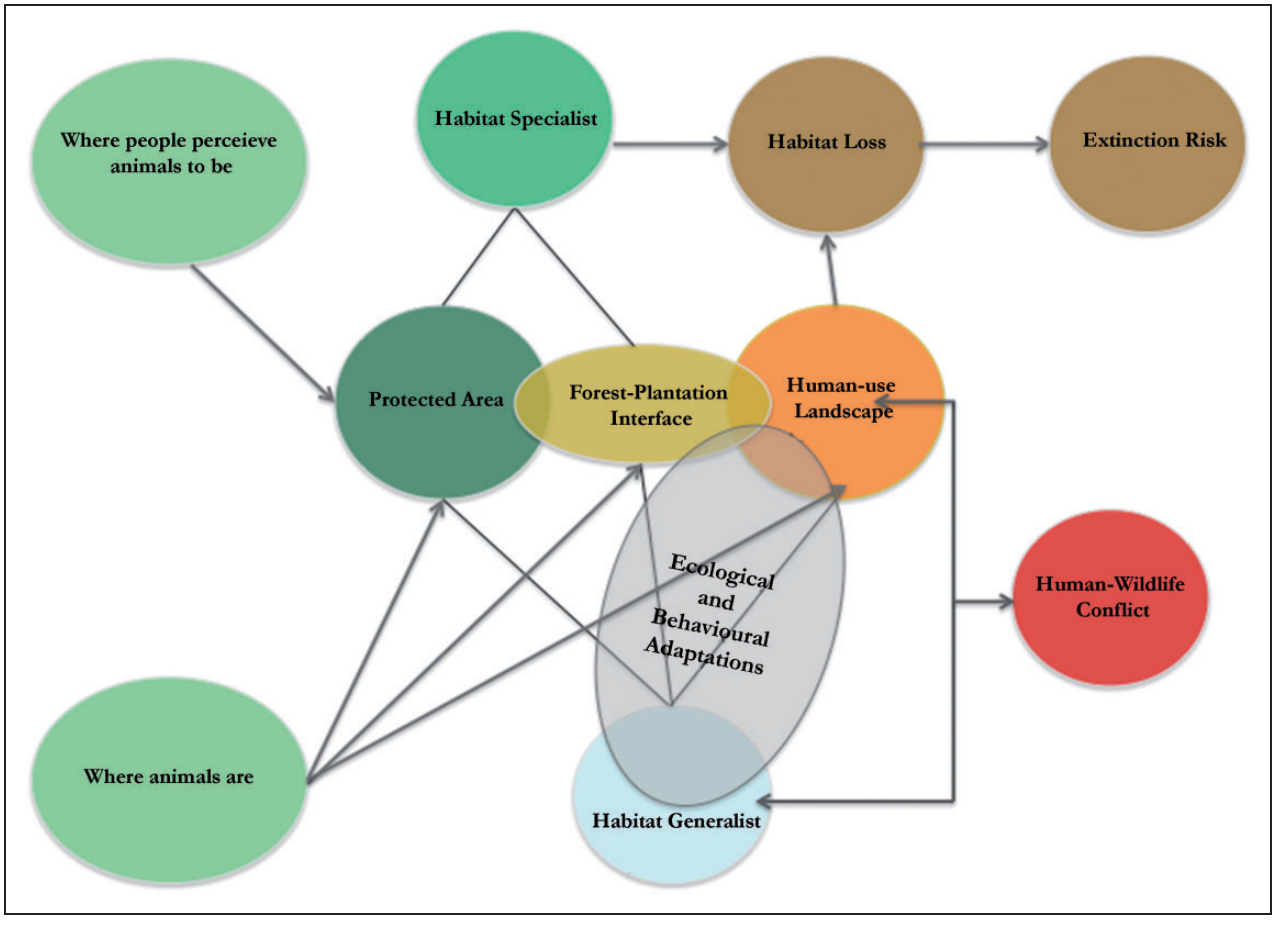


**Figure 1.** Schematic representation of the interrelationship between natural and anthropogenic habitats.

Mudappa, & Raman, 2014; Sidhu, Raman, & Mudappa, 2015; Kshettry, Vaidyanathan, & Athreya, 2017) are known to adapt to human-use landscapes, dominated by tea and coffee plantations, sugarcane fields in villages, and are found even in urbanized spaces, coming into frequent contact with people (see Figure 2). However, these frequent interactions need not necessarily imply incidences of conflict, as indicated by Kshettry et al. (2017), where the authors show that while leopards use ground cover in tea habitats extensively, this is not significantly correlated with conflict occurrence. Abundant wild prey presence in certain modified landscapes such as tea-coffee-forest-fragmented matrix of Valparai plateau in the Anamalai Hills, leopard diet primarily consists of wild prey such as Indian muntjac, Indian spotted chevrotain, sambar deer, Indian porcupine, and so on, as against domestic prey (Sidhu et al., 2015). On the other hand, in large expanse of agricultural habitats with high human density and low wild prey availability, leopards are largely dependent on domestic animals such as dogs, goats, cattle, cats, and so on, which constitute more than 87% of their diet (Athreya et al., 2013). Nevertheless, persistence of large carnivore populations in altered habitats depends on effective conflict avoidance rather than management measures and its enforcement. This also ensures that large carnivore conservation is possible in modified landscapes, thereby enhancing coexistence in such landscapes (Athreya et al., 2013).

On the other hand, species such as LTM, an endangered habitat specialist, listed as Schedule I (highest order of protection in the country) animal under the Indian Wildlife Protection Act, is found only in the narrow strips of rainforests along the Western Ghats of India. Due to exploitation of rainforests to establish commercial plantations such as tea, coffee, rubber, logging, and degradation, many LTM groups are found in fragmented rainforest habitats across its range (Singh, Kaumanns, Sushma, & Molur, 2009; Umapathy, Hussain, & Shivaji, 2011; Kumara et al., 2014) (see Figure 3). Their use and survival in rainforest fragments are influenced by resource quality and certain habitat characteristics such as basal area, tree density, height of the tree, and so on (Umapathy et al., 2011). Moreover, studies have also revealed that LTM populations in fragmented habitats have large group size, high male to female and female to immature ratios due to lack of dispersal spaces, depleted genetic diversity, and reduced home ranges as compared with groups that inhabit contiguous forests, making this species vulnerable in islands of forests surrounded by plantations (Ram et al., 2015; Singh, Kumara, Kumar, & Sharma, 2001; Umapathy et al., 2011; Ram et al., 2015). Unlike other species of the same genus—the Bonnet macaque (*Macaca radiata*) and Rhesus macaque (*Macaca mulatta*)—the LTMs are less adaptable and are vulnerable to extensive changes in their habitats that often threaten their survival. Diversion of rainforests for coffee, rubber, and tea plantations surrounding LTM habitats alters their ranging and

**Figure 3.** Adult lion-tailed macaque in a rainforest fragment in the Anamalai Hills, southern India. Image credits: Ganesh Raghunathan.

**Figure 2.** Leopard in a fuel station amidst plantation-habitation mosaic in the Anamalai Hills, southern India. Image credits: Ganesh Raghunathan.

**Figure 4.** Elephants in a tea plantation in the Anamalai Hills, southern India. Image credits: Sreedhar Vijayakrishnan.

availability of food resources while influencing their behavioral responses (Singh et al., 2001; Erinjery, Kavana, & Singh, 2015), leading to negative interactions with people in some areas.

Often, these human–wildlife interactions are negative in nature leading to loss of life on both sides besides property and livestock damages. This has forced state forest departments to adopt extreme reactive measures such as capture and removal, or translocation, as a way to resolve or mitigate human–wildlife conflict. Such reactive measures neither resolve conflicts nor benefit wildlife conservation in modified landscapes (Athreya, Odden, Linnell, & Karanth, 2011; Fernando, Leimgruber, Prasad, & Pastorini, 2012). In 2012, the Karnataka Elephant Task Force constituted by Karnataka State High Court recommended importance of zonation of habitats or habitations for elephants and people by creating elephant conservation zone, coexistence zone, and elephant removal zone as a way to promote elephant conservation and resolve conflicts. However, such clear zone demarcation is based on extent of forest cover availability, intensity of conflicts, and intensity of land use, supporting livelihood of people in natural and modified elephant landscapes, and often, not based on understanding of elephant movement patterns and considering their ranging behavior outside PAs. From an anthropogenic perspective, such zonation may be helpful in terms of management, often in the form of short-term solutions for human–wildlife interactions. But for wide-ranging species such as elephants or leopards, presence of food resources and cover in altered landscapes may act as suitable habitats.

For example, in the Anamalai Hills, which holds second largest Asian elephant population in India, the 220 $km^2$ of Valparai plateau dominated by tea, coffee, and *Eucalyptus* plantations, interspersed with rainforest fragments, supports around 120 elephants amid 70,000 people. Elephants primarily use these plantations to move across the remnant fragments and the surrounding PAs (see Figure 4). Rainforest fragments, *Eucalyptus* plantations with secondary vegetation, and coffee habitats with abundant grass make the Valparai region an important resource habitat and act as refuges for elephants, while habitats such as tea facilitate movement for elephants at night. While studies show that the proportion of time the elephants spend in human-use areas is fairly high, their physiological parameters, measured in terms of fecal glucocorticoid metabolite concentrations, seem to show signs of adaptation to changing environments (Vijayakrishnan, Kumar, Umapathy, Kumar, & Sinha, 2018).

Our research in coffee-paddy-dominated areas of Hassan region in south India shows that monoculture refuges of *Acacia* and *Eucalyptus*, coffee plantations, and remnant forest habitats provide critical habitats for elephants. Capture and removal of elephants as a measure to mitigate human–elephant conflict in this region have not helped resolve conflicts but resulted in recolonization of the area by elephant herds, and conflicts continue to exist. Similarly, coffee-dominated Coorg region in the state of Karnataka has been intensively used by elephants throughout the year as estates are large in size with native canopy cover and lush green grass availability due to presence of agriculture, ponds or tanks, and presence of *Acacia* and *Eucalyptus* plantations enabling growth of secondary vegetation, thereby acting as feeding and sheltering habitats for elephants (Bal, Nath, Nanaya, Kushalappa, & Garcia, 2011). The presence of crops such as paddy and jackfruit amid coffee habitats attracts elephants, leading to high incidence of conflicts (Bal et al., 2011).

While generalists such as elephants and leopards adapt fairly well to changing environments, the persistence of the LTM, a habitat specialist species, would depend on retention or establishment of canopy connectivity that would connect forest fragments to facilitate movement of males and improve genetic diversity in fragmented populations (Kumar, Singh, Kumara, Sharma, & Bertsch, 2001; Umapathy et al., 2011; Ram et al., 2015). The larger question of inbreeding is yet to be explored in large mammals in fragmented landscapes but facilitating free passage by establishing physical and functional connectivity using tree cover areas of monoculture habitats to nearest forest habitats would enhance their survival in production landscapes.

This article intends to bring out the point that wide-ranging species such as elephants and leopards, which are habitat generalists, can adapt and thrive fairly well in landscape matrices of anthropogenic habitats and in changing environments. While in the case of habitat sensitive and specialist species such as LTMs, further degradation or disappearance of rainforest habitats could potentially lead to local extinction of species.

A major challenge for wildlife conservation outside PAs is that most people are unaware of substantial biodiversity that exists in their own lands. The necessity for increased stewardship of PAs and communicating the beauty and ecological importance of wildlife in production landscapes to combat the thinking of restricting wild animals to forests alone is important. As biologists, we need to bring science and conservation efforts to the general public by getting people involved in conservation by understanding the role of nonforest areas for wildlife conservation. This transparent and integrative approach could help develop an appreciation of the criticality of natural and nonnatural habitats in biodiversity conservation. Through combined efforts among researchers, conservation agencies, policy makers, and citizens, it is not a distant possibility to bring meaningful changes in the idea or perception of what constitutes a habitat and how they are viewed, managed, and appreciated.

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