

Wanderers of Rajaji: are elephants learning new lessons in the changing environment?

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Factors which influence learning of behaviour in wild animal populations are important for understanding the responses of species to changing environments and for their conservation¹. An important and often neglected aspect of behavioural ecology concerns the ability of animal populations and individuals to respond to changes in their immediate environment, both on long- and short-term basis². Asian elephant (*Elephas maximus*) is one of the flagship species in the Indian forests, which requires large landscapes for movement, feeding, etc. Connectivity of large migratory corridors helps the elephant to move across larger landscapes and breed conveniently, ensuring its long-term survival. However, the population of this giant animal remains fragmented and restricted to the foothills-dominant areas, mainly because of the conversion of natural habitats in the fertile river valleys to agricultural fields, industrial areas and human settlements³. It is now widely acknowledged that the elephants are intelligent and learning to adapt to their changing natural environments⁴⁻⁶. They possess higher levels of intelligence and cognitive abilities, and thus are capable of exhibiting novel behavioural responses to a changing environment⁷.

The Rajaji National Park (RNP; 29°15'–30°31'N, 77°52'–78°22'E; Figure 1) is one of the crucial wildlife habitats in the northwestern Shivalik landscape in Uttarakhand, forming the northwestern limit of the range of elephants in India. It falls within the Gangetic Plains biogeographic zone and upper Gangetic Plains province⁸; and a major portion of the area is dominated by tropical moist deciduous forest. RNP is spread at an elevation of 302–1000 m and has been considered as the northwestern limit of distribution of many endangered species like the Asian elephant, tiger, great-pied hornbill and king cobra^{9,10}.

Isolation of large migratory corridors and increasing anthropogenic and developmental activities have been some of the causes threatening the survival of elephants in the area. One of the studies

carried out on the status of elephant corridors in India revealed that the presence of traffic on the road, construction of steep retaining walls and human population along the entire Rajaji–Corbett wildlife corridor area have almost restricted the migration of elephants between the Rajaji and Corbett National Parks¹¹. The northwestern elephant population in India once had a continuous range, from Katarniaghat Wildlife Sanctuary in the east, to the Yamuna river in the west; however, over the time this continuity has been broken, and now the whole population occurs in six isolated sub-populations^{12,13}. Though RNP has been recently notified as the Rajaji Tiger Reserve to enhance conservation activities, providing a natural connectivity for frequent movement of elephants has been one of the major challenges. RNP has been maintaining a stable population of elephants for the last one and half decades, with an average of 394.5 ± 71.90 (range 302–469) individuals¹⁴.

Various aspects of social organization have been intensively studied in African savannah elephant (*Loxodonta africana africana*), compared to the African forest elephant (*Loxodonta africana cyclotis*)

and the Asian elephant¹⁵. However, only few studies have been conducted on the social organization of Asian elephants throughout their range. Future studies should focus on a better understanding of the social organizations of Asian elephants. Despite the fact that RNP is one of the crucial and biologically rich protected areas, little has been done on the behaviour of Asian elephants. In contrast, several studies have been conducted on the movement and status of ecological corridors of the elephants, which revealed their movement pattern in the entire Rajaji–Corbett National Parks^{11,16,17}. While studying elephants in the northwestern Shivalik landscape for about a decade, the present article observed a few of their behavioural responses, which revealed that the elephants were learning to adapt themselves to fulfil their requirements, according to the changing environment.

Elephants live in a matriarchal society, where the oldest female usually leads the group. In contrast, bull elephants prefer to lead a solitary life, especially after attaining the pubertal stage. Male elephants are known to use a wide range of



Figure 1. Location map of the Rajaji National Park, Uttarakhand, India indicating important wildlife corridors and crop-raiding areas.

habitats, and travel more distances compared to the family groups. They are known to enter agricultural fields to feed on cultivated crops and return to the forest unharmed. While studying the behaviour of elephants in RNP, it was observed that the bull elephants arrive and assemble in the forest adjacent to the agricultural fields in the afternoon and stay there till dusk; they enter the fields by forming groups and return to the forest before dawn. As observed, the timings of their movements entirely depend on the distances which have to be covered. However, sometimes they also get trapped in the villages when they stay in the fields for longer duration up to dawn or when they travel long distances during night and are not able to return from the fields. In such situations, bull elephants stay in any of the small forest patches (islands) located in the River Ganges and sometimes in the agricultural fields.

It was observed during several occasions that the older bull elephants were getting used to facing the crowds and vehicular traffic pressure. The bull elephants, especially older ones, while crossing the national highways/motor roads, were observed to show no fear of any objects, whether vehicular traffic or the crowds (Figure 2). Sometimes, elephants spent a few minutes standing on the road and facing the vehicular traffic and exhibiting mock charges to threaten the crowds standing there. A study carried out on the life history of male African elephants suggested that older males were more likely to be raiders than young males, when their closest associates were also raiders and when their second closest associates were raiders older than them¹. Another study carried out in the northwestern Shivalik landscape on the social bonding of male elephants indicated that the bull elephants in the area have a year round association, mainly during their movements outside the boundaries of protected habitats and during raiding of crops¹⁸. Individual adult and sub-adult male elephants are known to show a higher propensity of occurrence in high-disturbance areas when forming groups, whereas solitary elephants are suggested to exhibit the least propensity in such areas².

Generally the movement of elephants occurs across the higher ridges of the Park during monsoon and is confined to lowlands during winter and summer. In RNP, the movement of elephants was

recorded ranging from ~300 to 700 m. However, above this elevation, their movement was found to be rare and seasonal. During monsoon, on several occasions, the present author recorded the movement of male elephants at an elevation of ~980 m on the outskirts of villages, situated along the boundary of the park, mainly to feed upon palatable crops in these villages. A few of the villages, where the movement of elephants was recorded include Talla Banas (29°58'384"N, 78°19'930"E; 943 m), Kasaan (29°58'810"N, 78°17'10"E; 983 m) and Garakot (29°54'29.7"N, 78°22'19.4"E; 970 m). A number of villages situated along the eastern boundary of the Park grow various cash crops like paddy, wheat, maize, etc. It was also observed during the study that elephants prefer to move across higher ridges during monsoon, as all the natural water sources located across the hilly terrain are filled with rainwater during monsoon, and several species of grasses like *Neyraudia arundinacea* (Madagascar grass), *Desmostachya bipinnata* (sacrificial grass) and *Dendrocalamus strictus* (bamboo) grow in abundance in the high ridges of the Park.

Electric fences have been considered as one of the effective barriers to restrict elephants from entering crop fields¹⁹⁻²¹. During 2006–2011, on a few occasions, observations were made from areas adjacent to the Shyampur and Chiriapur forests of Haridwar Forest Division, Uttarakhand, that some of the bull ele-

phants were familiar with these fences. Elephants use twigs or branches of trees on the fences and/or bend the iron pillars of the fences causing the electric current to trip due to wet ground vegetation. They would then bend the iron pillars with their forefoot and cross the fence. Similar observations were made from the southern Indian elephant ranges from where they were reported to use their tusks, soles of forefeet and trees to cross the fence²². A study carried out by a team from World Wildlife Fund indicated that in parts of South Asia, some elephants eventually adapted to prolonged exposure to these fences. Elephants have been reported to break electric fences using their tusks, which are considered to be non-conductive; and few elephants appeared to have learnt that an electric shock does not harm them and simply barged through the wires²³. Recently, similar reports from the southern Indian elephant ranges showed that the elephants were short-circuiting the electric fences using logs²⁴. A study in Africa also indicated a similar observation, wherein the elephants were reported to have short-circuited the electric fences in order to gain access to crops or water installation. This study observed that the elephants had learnt to protect themselves against electric shock while breaking an electrified fence using a tusk or even holding a rock to the forehead or throwing a tree into the fence²⁵. Another study in Sri Lanka reported that the electric fence could not prevent the elephants

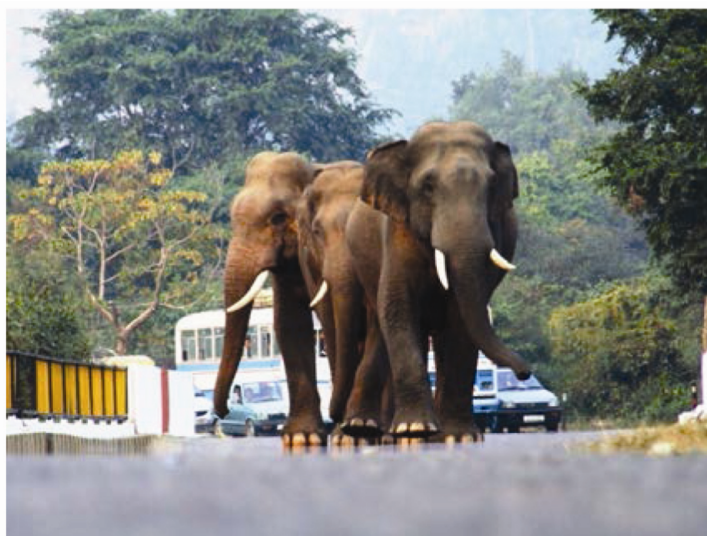


Figure 2. Bull elephants crossing the Haridwar–Bijnor national highway, across the Rajaji Tiger Reserve.

from entering the agriculture fields, since they had learnt to break these fences²⁶.

It was observed during the study period that the feeding requirements of the elephants have undergone changes over the last decade. Like human beings, elephants also have feeding preferences; they take interest in exploring new species to feed upon. In RNP, elephants were reported to feed on 50 species, out of which 37 (74%) are trees and 13 (26%) are shrubs, grasses and climbers species²⁷. Interestingly, the elephants were reported feeding on *Tectona grandis* (sagaun/teak) and *Haplophragma adenophylla* (kut-sagaun) in 2006 in Chilla forest of RNP. The bark of teak is frequently consumed by the elephants in southern India, but rarely observed in the northern part of the country²². Similarly, in 2007, elephants were reported feeding on *Eucalyptus obliqua* (eucalyptus)²⁸. In 1990s, elephants were first reported using the bark of eucalyptus tree in elephant ranges of the southern India²². During the same year, elephants were also reported feeding on quite a few tree species for the first time, which included *Cordia obliqua* (clammy cherry), *Holarhena antidysenterica* (Tellicherry) and *Mitragyna parvifolia* (kaim). In 2009, elephants were reported to have started consuming the *Careya arborea* (wild guava) in the Park area. The sporadic feeding among elephants and their exploration of new plant species, which could have a greater influence in the regeneration of vegetation, need to be further studied. A recent study in Nepal indicated that the rapidly growing elephant population may modify the composition of the forest by increasing its preferred food species²⁹.

Four crucial wildlife corridors exist across the RNP, which connect it with the Corbett Tiger Reserve, namely Motichur–Kansrao–Barkot (2.5 km long × 2 km wide), Chilla–Motichur (3.5 km long × 1 km wide), Rawasan–Sonanadi (10 km long × 5 km wide) and Motichur–Gohri (4 km long × 1 km wide). During the study of about a decade, I observed that the movement of wildlife, especially elephants was restricted in these corridors, mainly because of the presence of two national highways (Dehradun–Haridwar and Haridwar–Bijnor) and a railway track (Dehradun–Haridwar), which exist in RNP. Some elephant populations were rarely reported using the Chilla–Motichur and Motichur–Kansrao–Barkot cor-

ridors. Whereas elephants were reported using the Rawasan–Sonanadi corridor on a regular basis. Elephant movement was not observed in the Motichur–Gohri corridor for about half a decade, before 2010, when they were first observed moving across this corridor. In 2010, a recognized bull elephant was observed using this corridor for nearly a month; whether he entered the eastern part of the Park (Gohri forest) or not, is unknown. All these observations may indicate that the elephants in the northwestern Shivalik landscape are adapting to the changing environment. It is important to note that elephants are attempting to find new ways to move across their traditional home-ranges, which were not accessible about two to three decades ago. Further study is required to investigate how the elephants, especially older bulls, are exploring new areas and previously inaccessible traditional home-ranges, which would help in understanding the use of changing landscapes by elephants, for better management of human–elephant co-existence.

During 1999–2000, movements of a few of the identified groups of elephants were recorded across Jageetpur village, which had arrived from the Rawli/Ranipur forest of RNP (southwestern part of the Park). The elephants used to cross Roshnabad, Ravli–Mehdood, Subhash Nagar and Pandowala villages, and the Bharat Heavy Electricals Limited and Ranipur Jhal areas, which at that time had less human population. This traditional track was earlier a connecting corridor for elephant movements between the southwestern and eastern parts of RNP, and had facilitated movement between RNP and Corbett Tiger Reserve. Elephants used this tract frequently before 1990, as part of their traditional home-range. However, after 2001, such movements were entirely restricted, mainly because of establishment of the State Industrial Development Corporation of Uttarakhand Limited along the boundary of RNP.

RNP is one of the crucial elephant habitats in the northwestern Shivalik landscape. However, fragmentation of large forests has converted the larger family units of elephants into smaller ones. A study carried out on the mortality of tuskers in RNP and adjoining habitats revealed that wide-ranging tuskers in this landscape were pocketed in small areas and were facing confrontation with

human beings³⁰. During 1970s, after the establishment of Chilla Hydroelectric Power Station, RNP was divided into two major parts – the eastern part and the western part. Also, after the establishment of Uttarakhand State in 2000, increased rate of vehicular traffic pressure the Haridwar–Dehradun national highway and railway track across RNP, and establishment of SIDCUL along the southwestern boundary of the Park had restricted frequent movements of the elephant. This had also affected the elephant movement between Rajaji and Corbett National Parks. Nearly 14,100 vehicles were recorded passing across this highway everyday, except for 3 h at night³¹.

The widening of the Haridwar–Dehradun national highway to four lanes could affect the movement of elephants across various wildlife corridors. Keeping in view the importance of biodiversity and animal movement across these corridors, efforts are being made to facilitate such movements by constructing a natural connectivity across various corridors. Four flyovers are being constructed (each ~0.5 km long) in different animal-crossing areas, which lie within the Motichur–Kansrao and Motichur–Chilla corridors.

Today, the Asian elephant is listed under Schedule I of the Indian Wildlife (Protection) Act 1972, Appendix I of the CITES and as Endangered in IUCN Red List of Threatened Species. Increasing developmental and anthropogenic activities across the boundaries of the Park, shrinkage of natural water sources inside the protected areas, expansion of road networks existing across long fragments of protected habitats, and poor awareness of the local communities about the ecological role of species were observed to be some of the conservation threats to elephants and wildlife in general. RNP is now experiencing advocacy of development and conservation together. To scientifically address all the conservation issues would be a challenging task. It is, however, important to document and observe in the next few years, how the wide-ranging elephants adapt themselves to the changing environment and how development of the area would help the locals without affecting conservation.

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