

UNUSUAL BEHAVIOURAL RESPONSES OF ELEPHANTS: A CHALLENGE FOR MITIGATING MAN – ELEPHANT CONFLICT IN “SHIVALIK ELEPHANT RESERVE”, NORTHWEST INDIA

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Abstract

Drastic changes in the Shivalik landscape and rapid rate of developmental and anthropogenic activities are expected to lead to a severe threat and unusual behavioural changes in elephants. Some unusual behavioural responses of Asian elephants were observed from northwest India, which were rather abnormal and were directly linked with increasing man–elephant conflict. To evaluate ground based data, we used ground surveys to generate database on these behavioural responses and to identify potential impact of developmental projects and anthropogenic activities and for this we made 387 extensive surveys in the crucial elephant’s reserve and on the motor roads, which are running across different habitats during March 2005 to December 2008. All the behaviours studied represents the severe interaction scenario between man and elephant and the prime reason found behind this was human encroachment into the deeper forest regime and shrinking of large migratory corridors. Understanding how animal populations react to such vast adverse activities and their behavioural response is thus essential for addressing future challenges for wildlife management and conservation. There have been little scientific studies available on such type of catastrophic impacts even though such reports are highly required to know the status and our competence in illustrating success and failures of wildlife management besides in conservation of an endangered wildlife. An adaptive management approach will be crucial with corridor connectivity being of paramount importance, as we continue to gain knowledge of wildlife and elephant’s response to such derisive impacts.

Keywords: Asian elephant; unusual behavioural response; man–elephant conflict; Rajaji National Park; conservation; northwest India

Introduction

Traditionally wild animals used to perform different unique behaviours to fulfil their life requirements like social calls, alarming calls, threat calls, greetings, matriarchy & hierarchy, pseudo fights, play, association with others and communication and at the same duration they perform different behaviours along with body contexts. This aspect has remained neglected

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during the past, which is highly required to be documented and will be helpful in management of any wild species. Knowing behaviour of wild animal is a valuable conservation tool, which can help in management and conservation of any threatened species. During our long-term field observations on the ecology and behaviour of elephants in the Rajaji National Park area, some abnormal behavioural responses were perceived, which revealed towards increasing rate of man-elephant conflict and explains about erratic changes in elephant's behaviour.

"Shivalik Elephant Reserve No. 11" lies under sub-tropical moist deciduous forest type and therefore, elephants utilized different forests round the year; additionally, their movements are dependent upon presence of fresh water, favourite fodder species and the place, where they can live safely with their calves. During the last two decade, rapid increasing rate of vehicle traffic on motor roads running across this elephant reserve, increased train traffic in Haridwar-Dehradun railway track, which is passing in between Rajaji National Park, expansion of agricultural lands, human habitation and industrialization has created severe problem for wide ranging elephants. Elephant's frequent movements were restricted in small forest pockets and in some parts their unusual behaviour has been observed, which can further increase man-elephant conflict in this region. The population of wild Asian elephants has a discontinuous distribution in the northern, eastern and southern forest ranges in India. In the past the elephant population of the north used to migrate freely from one end to the other from the river Yamuna to the river Brahmaputra, travelling a maximum distance of approximately 1,300 kilometres as per their requirements in the foothills of Himalayas [1].

During the last two decades, elephant population in north-west India has isolated and found moving in small fragmented habitat. A big example is Rajaji – Corbett wildlife corridor. Only bull elephants used to perform their journeys between these protected areas whereas groups are not observed to inter change this forest primarily due to intense running traffic on Kotdwar–Lansdowne motor road and increasing rate of biotic pressure across the traditional wildlife corridor. The movement of elephants has been restricted across the Rajaji – Corbett corridor as a result of the building of the Kotdwar – Lansdowne road parallel to Koh river. This has resulted in steep edges, which, together with the walls built to prevent landslides, impedes crossing by elephants and this hilly corridor is only used by bulls [2].

Experimental

Study Area

The Rajaji National Park (RNP, Fig. 1) in north-west India (29015'-30031' N, 77052'-78022' E, elevation 250–1100 m above MSL) was created in 1983 to protect Asian elephant's habitat, which presently comes under "Elephant Reserve No. 11". RNP is spread over an area of 820.42 Km² across the Shivalik landscape, which lies in the lesser Himalayas and the upper Gangetic plains and has been designated as a reserved area for the "Project Elephant" by the Ministry of Environment and Forests, Government of India with the sole aim of maintaining the viable population of Asian elephants. Haridwar Forest Division (HFD; 29054.602' N, 78011.982' E, elevation 271.2 meter above sea level) is well connected with RNP and Lansdowne forest division (LFD) and holds a healthy population of wild flora and fauna, which the Rajaji carries. The Shivalik foothills offer the most prominent geomorphic features of this tract. This forest is attached with Lansdowne forest division, which is a corridor for elephant's movement towards Jim Corbett National Park, which embraces one of the healthy sex ratio and good population of elephants in country and on the other hand this forest is attached with Uttar Pradesh forests (Najibabad forest division).

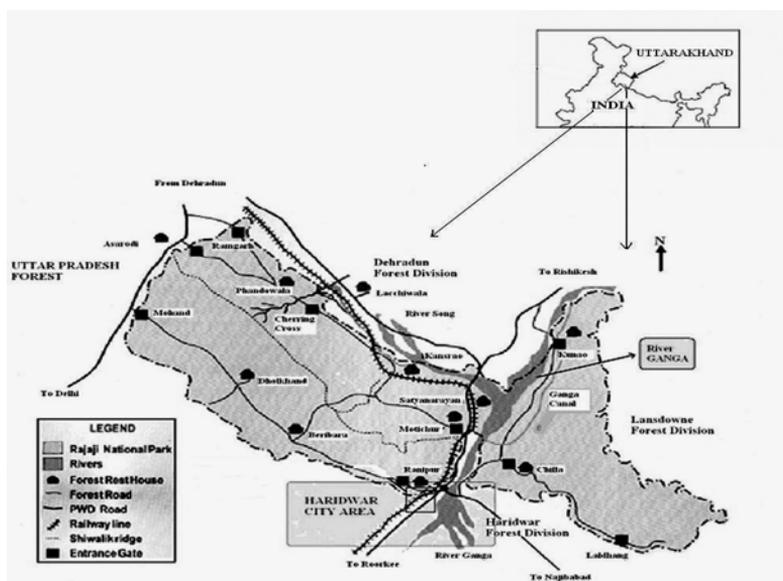


Fig. 1. Map of the study area (Rajaji National Park, $29^{\circ}15'30''$ N, $77^{\circ}52'78''$ E, elevation 250–1100 m above MSL)

Methods

We are working on the behaviour and ecology of Asian elephant in this area since last 13 years and several times observed some unusual behavioural responses of elephants. Noticeably, these behaviours are directly linked with increasing severe human–elephant conflict in this area and looking into this important problem we made a separate in-depth study on these unusual behaviours and documented database on it. On one hand we made observations in problem areas on identified elephant's population to collect ground based data on behavioural aspect and on the other hand sharp reasons behind this were investigated. To evaluate the behavioural responses of elephant and to assess the effect of developmental and anthropogenic activities, study was conducted in Chilla, Gohri, Haridwar and Motichur forest of the RNP and Shyampur and Chiriapur forest of the HFD during March 2005 to December 2008. To evaluate the effects of increasing anthropogenic pressure over to elephant's habitat, we conducted 387 surveys in the affected habitats and in the motor roads, which are running across different crucial forest stretch, during March 2007–June 2010. The distance of transect was finalized based on field conditions and preferences were given to the sites where elephant's movement was frequent during the same period. As the elephants have been known to emerge from the forest predominantly during evenings, therefore, observations were made between 15–19 and 06–10 hours.

The data collected was as part of the animal monitoring activities and the daily record was based on direct sighting of animals, indirect evidences like feeding sign, footprints impression time and fresh dung piles. The direct sighting were noted in duly prepared proforma, recording the group composition, age and sex, if observed in groups and also the place of sighting, time and vegetation type. Besides, villagers of adjoining areas, Gujjars (where available), staff of the forest department, the researchers from various scientific institutions and non-government organizations and other individuals working on this problem, were also interviewed. Behaviour of elephants was monitored especially during onset of summer as this was the time when elephants started movements in lower slopes and in

Gangetic plains. As we are working in this elephant reserve from a long period therefore, it was comfortable for us to draw some conclusion based on the research of our long-term study.

Results and Discussions

Behavioural Responses

Normally, wild elephants are not aggressive in nature but during the recent past fragmentation of wildlife habitats have placed some populations under threat and severe changes have been observed in their behavioural responses. Remarkably, aggressiveness was observed in some recognized groups and bull elephants. Some of the very serious and unusual deaths occurred in this area has promoted us to study these behaviours, which are directly linked with human–elephant conflict and hence survival of elephants. During the recent past various abnormal behaviours of Asian elephants were documented from different elephant range countries, which are highly required to be included in conservation policy making. Solitary movement of a female was observed in Idukki Wildlife Sanctuary, south India [3], which is highly unusual and indicated towards unfavourable environmental conditions. Some very unusual typical behavioural responses of Asian elephants were also documented by us in north India, which surprisingly includes acrobatics in elephants, variations in feeding in a same geographical area and climbing and sliding behaviour [4].

a. Unexpected close encounters with people

Elephant groups generally do not fear for any danger; if they feel and foresee any kind of anthropogenic disturbance, first of all they change the track and if somehow the situation is adverse and when their calves are with them they gather together and attempt the situation. Notably, during the last one decade drastic changes were observed in elephant's behaviour in some parts and these changes are often seen in both males (solitary bulls) and females (in groups). Human encroachment in forests especially in deeper forest regime for collecting fuelwood and fodder is increasing day-by-day, which has enhanced the human casualties inside the forest and opposite to this man–elephant conflict is increasing very rapidly and severely. Additionally, elephant's movements on very outskirts of villages have increased this conflict to two folds.

Encounter between elephants and local villagers inside the forest is causing negative impact besides the fact that traditionally local people are dependent upon forest resources for their livelihood (collection of fuelwood, fodder and brooming sticks) and used to move intensively inside the forest (Fig. 2 and 3). Unawareness about the seasonal movements of elephants is another cause of human casualties and notably maximum deaths occurred during evening hours. Large–scale habitat loss and human encroachment into the deeper forest regime have escalated the instances of man–elephant conflict in northwest India. A serious threat observed here is that adult male elephants (tuskers) are rapidly dying mainly due to unnatural deaths [5]. Since last four years, 32 male elephants died in Rajaji – Corbett National Parks and its adjoining protected habitats. Besides, some female elephants and calves also died at different locations during this period. It was very co-incidental that more than 50 persons also died during the same period through elephant attack at different parts of Rajaji–Corbett wildlife corridor and notably maximum casualties occurred inside the forest.



Fig. 2. Local villagers are carrying fuel wood from the Rajaji National Park.



Fig. 3. Collection of fodder from the park area is another problem, which increases man - elephant conflict

b. Soundless movement in forests

A particular behaviour related to movement of elephants has been also observed during the course of study. Elephants utilize a wide range of slopes as well as higher up routes having uneven topography and variety of vegetations. As this entire elephant reserve falls under sub tropical moist deciduous type therefore, during the autumn heavy bed of fallen leaves can be seen all around the area. The sound of the fallen litter was always noted while we walked through such areas with dry leaves. Even the movement of smaller wild animals makes enough noise, which is supposed to be a good indicator of their movement through forest areas. However, it was observed that while elephants had walked through these areas there was no sound at all. This is very amazing to see such animal of huge body and heavy legs not making any sound while walking through these areas. The movement of elephants has also been noted peacefully and soundless in dry rivers full of stones as also on slopes covered by minor stones. Many human casualties, mainly with woodcutters and grass-cutters, have been occurred in this region due to very silent movement of the elephants. In fact, the victims could not hear any sound of movement of elephants and such casualties had taken place without any chances of self protection or running away by the victims. This aspect of elephant movement needs to be

publicized to the common man so as to caution them about the possibility of presence of elephants nearby them.

Noticeably elephants don't attack immediately on establishing eye to eye contact with the human beings. They first issue warning signals by grumbling and execute different behaviours like stopping up of feeding and ear flapping and upliftment of tail and viewing the object, which takes more than 10 seconds and could be enough to escape from there. Sometimes they also produce loud roaring sounds especially when scared and attempting the situation. Next stage is to make a strategy for attack by making an angle from where they can easily attack and then they start running fast for attack. Under these situations vehicle is the only support for survival or alternately hiding oneself in some bushes to escape from the sights of the elephant and rest depend on God's grace and luck as the elephants have the strong smelling power and can trace human presence.

c. Typical deaths

Normally, the elephants kill human beings by holding in its proboscis and crushing under its legs. However, a heart-breaking scene was observed in Mayapur forest beat of the Haridwar forest range. It was a case during February, 2007 when three women are cutting fuel wood inside the forest and were killed by elephants. The death of one of the women was very unusual and breath-taking. The elephant grabbed the women and broken one of the leg and hand of the women. The broken leg and hand were thrown away at a distance of 20 meter away from the body. Then, the elephant under its leg crushed head of the women. The skull was totally damaged and in this process the brain portion came out of head region and was thrown away at a distance of 10 meter and fell on a stone giving an impression is if it was taken out manually by some one and kept on a stone carefully. The elephant had also pulled the hairs from the head of the women and thrown away. Thereafter, the elephant crushed the chest portion of the women under its leg. The chest and skull portion were so heavily crushed and damaged that the crushed portion of the body had formed a very thin layer on the earth. It was a very heart-breaking incident and normally we do not hear or see such type of killing by an elephant. Normally, elephants just kill the person either by piercing its tusk inside the body or thrashing the person and leave the body. This particular incident indicated highly aggressive and unusual nature of an elephant.

Several other such unusual and dangerous deaths were also observed during the course of investigation in Bilkeshwar and Ranipur (death of a women and a man) forests in which elephant crushed the body brutally and all the body parts were spread within the distance of 10-20 feet and it was impossible to locate and identify the body easily. We have examined all the deaths on spot and it was revealed that elephant took few minutes to accomplish this. A need is felt to study and document such remarkable behaviours of elephants so that they could be included in out-sketching the action plan to condense man-elephant conflict.

Is this an attempt of same group?

Noticeably and astonishingly, most of these abnormal deaths occurred in a same forest stretch and during all casualties, we have observed sharply the incident attestation and examined the encounter situation along with behavioural responses of the elephants. Based on investigations, it was revealed that a single group of six elephants (one adult cow, three sub-adult cows, one juvenile male elephant and one infant) was responsible behind these casualties. All casualties occurred within Haridwar forest range of the RNP especially between Bilkeshwar to Ranipur forest stretch. This stretch could be considered to be a sensitive zone as entirely covered with motor roads and industrial estate on one side and anthropogenic activities were found increasing especially in buffer zones.

Just one decade back elephant movement in this track was very common as this forest comprises of rich fodder and perennial water sources but slowly their movement became

restricted in this part primarily due to increasing rate of anthropogenic activities inside the deeper forest regime, ongoing developmental activities, wildfires and shrinking of perennial water sources [6]. We have correlated this with historical background and found that during 2001, a newly born calf died in train accident at Kharkhari forest and a cow elephant was observed there for about 42 hours, made rescue operation failed and not let anybody near the died infant and even attacked the vehicle several times, which was included in rescue. Expert's team tranquilized her several times but got unsuccessful and after spending more than 40 hours near to died she moved inside the forest. Our documented records revealed that during that duration a total of 13 elephants along with 3 bulls were moving in that stretch, which sometimes found separated in the groups of six and seven respectively.

It is important to mention here that after the isolation of few habitats in Shivalik landscape, the same population of elephants was found to move within a recognized range. Currently elephant's movement is restricted up to Mohand (Uttar Pradesh state forest department), Chillawali, Ramgarh (very rare), Kansrao, Dholkhand, Beribara, Motichur and Haridwar of the RNP and that's why same groups and bulls could be observed moving in different forest compartments round the year, which can be identify easily however, some bulls inter change the long migratory tracks and found moving extensively in different habitats and feeding grounds. Another accident was happened during 2007, when an elephant infant felled through a hillock at Kharkhari forest but this aggressive behaviour could be correlated with 2001 incident. As Haridwar – Dehradun railway track and national highway is running across this habitat, therefore elephants are restricted to move within a recognized pocket, though this belt falls under Chilla – Motichur wildlife corridor, which links the Rajaji – Corbett National Parks.

d. Antagonistic behaviour of bull elephants

Behaviour of Hitler

Since 2005, some behavioural responses of a magnificent bull, which is ruling over to eastern habitat of RNP and adjoining habitats (HFD & LFD) was studied. This bull is recognizable as his right tusk emerged somewhat downward and both the tusks are moderate in size; additionally his right tusk is pointed whereas left is slight wrecked at end and based on his aggressive nature we have given him the name “*Hitler*” (Fig. 4). This bull is aged near about 35 years and his movement is common in Chilla forest of the RNP, Shyampur and Chiriapur forest of the HFD and Laldhang forest of the LFD.



Fig. 4. “Hitler” at Chilla forest. Difference between his right and left tusks could be observed easily (right tusk emerged downward and pointed whereas left is broken at outer end).

His behaviour was always observed to be violent against human beings even for big vehicles like jeeps and to till date five people died during encounter with him inside the forest; during last four years several times he also attacked tourist's jeep inside the RNP but fortunately no causality was highlighted during the recent past. Several times he had also charged us while observing his behaviour with a safe distance. Noticeably, he was found to charge the vehicle whenever any vehicle came in front of him and this is one of the reason, we always informed the concerned forest officers and staff regarding to his movement and tour operators and jeep drivers were always informed about his presence in tourist zone. One favourable feature was that he always found to be cool while moving with older bulls besides the fact that he is a sharp crop raider and performs his journey together with some other older bulls in agriculture fields. Besides, his movement was restricted to different forest areas and on the basis of this, Hitler could not be considered as rogue.

After observing his behavioural responses, we made discussions with locals and Gujjars residing in some parts of the HFD and collected information about his activities during his peripheral movements as their indigenous knowledge always help us in knowing about the behaviour of elephants and sometimes we have used their perceptions about elephant's management in recommending conservation policies. In 2007, a tusker attacked the Gujjar dera (shelter) during night and killed two children at Kotawali forest of the HFD (Fig. 5) and immediately on next day early in the morning we examined whole forest compartment and it was found that this bull was moving there but due to lack of evidences and footprint proofs it was practically impossible to consider Hitler as responsive agent, however it was revealed after examining the ground situation that elephant attacked primarily in search of edible items. Still we are observing his behaviour and making efforts to understand the sharp reasons behind his hostile behaviour.



Fig. 5. Sign of conflict: author is collecting information from an influenced Gujjar family about elephant attack. (In 2007, a tusker has attacked their dera (shelter) during night and killed two children on spot at Kotawali forest, Haridwar forest division)

Behaviour of Ganesh I during pre-mating period

Elephants sometimes show quite aggressive characteristics during mating period. Intense monitoring and research on elephant's behaviour during mating period reveals that elephants also behave quite different when they are in the heat during love play (pre-conception/coitus) period. A recent example confirmed this fact. On 16th of September, 2009,

a female elephant was found dead in the Dholkhand forest (Ganjarvan forest) of the RNP. After carefully examining the carcass, it was found that the elephant had died due to tusk penetration by a bull elephant in aggression of not being able to fulfill its mating needs. The dead female elephant was around 35 years old and as per the information from forest officials and spot evidences it was revealed that both male and female elephants were included in a disparaging fight. Bull elephant had penetrated his tusks at four different spots. Notably this type of serious fight between bull and cow elephant was observed for first time in north-west India specifically the fight which was solely for mating needs and eventually in which a female elephant was brutally killed by bull elephant.

We then for next couple of days searched and frisked the whole adjoined area and observed that in the whole area only one bull elephant having one only tusk (Ganesh) was moving in the area and that was in musth (Fig. 6). Like many other animals elephants also show the phenomenon of love play, which includes mixing of bull elephants in the groups, selecting prospective partner to mate, smelling of genital organs, sniffing the urine and dung, touching the trunk especially temporal gland and discharge of urine. The whole process was observed to happen within 15-20 days but sometimes it also took one month if environmental conditions are unfavourable i.e. scarcity of fodder and water and higher rate of movements [7].



Fig. 6. Bull elephant approaching the cow during musth (Ganesh 1);
(During musth some abnormal behavioural responses of bull elephant could be seen easily)

This incident stresses on the need of having detailed biological information to be collected so that this type of bull elephant's aggressive behaviour can be studied and documented intensely. As per our discussions with local people, it was revealed that the recognized bull elephant is a sharp crop raider and used to move in outskirts of the villages. The Dholkhand forest range lies in southern boundary of the park and is adjoined with number of villages and local people use this area's forest resources (fuel wood and fodder), which is causing devastating behaviour among elephants. Scarcity of natural water is another factor, which has forced the elephants to move outside from protected areas.

e. Do elephants recognize mad and handicapped persons?

The typical behaviour of an adult bull elephant was also observed during our field observations in the Shyampur forest range (Haridwar forest division). We used to observe movement of elephants across the east Ganga canal bridge on Haridwar–Bijnor national

highway. The elephants cross this bridge round the year to visit the Anjani forest beat and the islands present in between river Ganges, where several fodder plant species grow in profusion (*Acacia catechu*, *Dalbergia sissoo*, *Bombax ceiba*, *Saccharum munja*, *Saccharum spontaneum* and *Ficus bengalensis*). On one of the evening (8th July, 2006, 17.23 hour) we were waiting for the elephants to cross the bridge and national highway, suddenly we came across a mad person who was totally naked and was coming towards the bridge. From the side of the Ganga canal parallel to highway at the same time a single tusked bull elephant (commonly called “Ganesh”) came closer to the mad person.

All the people those are watching the incident were sensing the causality causing moment, but surprising thing was that elephant did not attack the mad person rather the elephant was scared of the mad person and ran away from him and re-entered inside the forest area. Just after five minutes again the elephant came towards the bridge and attacked one vehicle. We had seen the hole created in the back side of the vehicle by the elephant by its tusk. Observations indicated that the elephant was disturbed seeing a naked mad person and ran along the highway and attacked the vehicle. Somehow, the occupants of the vehicle were very lucky as the elephant did not cause any major harm to the vehicle as well as to its occupants.

Just four year back, on the evening of July 8th, 2007 as usual, we were waiting at the east Ganga canal bridge at 16.35 hour (Haridwar–Bijnor national highway) for the elephants to cross the bridge as we wanted to follow them towards the Ganga river to trace the traditional route of the elephants and to take photographs of elephants in swimming position. Suddenly a handicapped person in self-hand driven handicapped cycle rickshaw reached the bridge through crossing irrigation canal road. At the same time we saw two adult bull elephants emerging out from the forest and started coming slowly towards the national highway. The handicapped person was just 10 feet away from the elephants. The elephant, which was in front side followed by another elephant saw the handicapped person and was not at all disturbed or furious. The handicapped person also was not scared of the elephants near by him and crossed the bridge comfortably being followed by the elephants. For a moment our heartbeat were increasing as we thought something serious was going to happen. Minute by minute we were sensing danger until the handicapped person and the elephant crossed the bridge and then follow their different directions as if elephant could kill the handicapped person. We were very much relieved to see that no harm was caused to the handicapped person, which was rather-not-anticipated. May be, elephants have the power to sense the physical condition of a person.

Ecological Impact of Developmental Activities

The RNP and its adjoining protected habitats HFD, LFD and Dehradun forest division are an important biological area and have great potential for conservation of Asian elephants [8]. But during the last two decades enhancement of vehicle traffic in various national highways (5 nos.), train traffic in Haridwar – Dehradun railway track, rapid construction of motor roads and expanding rate of high tension electric lines has caused the catastrophic decline in the annual migration rate of elephants within different protected habitats (Fig. 7 and 8). There are also some evidences that elephants and their movement routes are affected by these traffic pressures and presence of small villages on the very outskirts of corridor areas. Despite, crop raiding as the major reason, all of these factors are also responsible for causing man-elephant conflict in this region. Increasing rate of train traffic and rapid expansion of motor roads can make a negative impact on elephant’s habitat and put their long-term survival at risk.

Notably after separation of the Uttarakhand state from the Uttar Pradesh state (2000), Haridwar city became the industrial area of the state, which was named as State Infrastructure and Industrial Development Corporation of Uttarakhand Limited (SIDCUL). Adjoining area (2034 Acres) of the Haridwar forest range was acquired for development of SIDCUL. From 2002 onward rapid expansion of developmental activities nearer to the forest area has caused obstruction in frequent movement of elephants besides other wildlife in adjoining forest beats. Tiger movement was frequently recorded before 2002 but after that tiger movement in these forest tracks has got obstructed. As a result of establishment of more than a dozen of industries, demand for water has been increasing and to meet the demand ground water is being extracted by various stakeholder industries and that has caused the major impact on ground water of adjacent areas.



Fig. 7. Survival for existence: bull elephant on the Haridwar – Bijnor national highway while performing his movement towards Ganges. (Notably, some bull elephants are very habitual of vehicle-traffic and it was found that they sometimes stayed on the road for several minutes in spite of quickly crossing it)

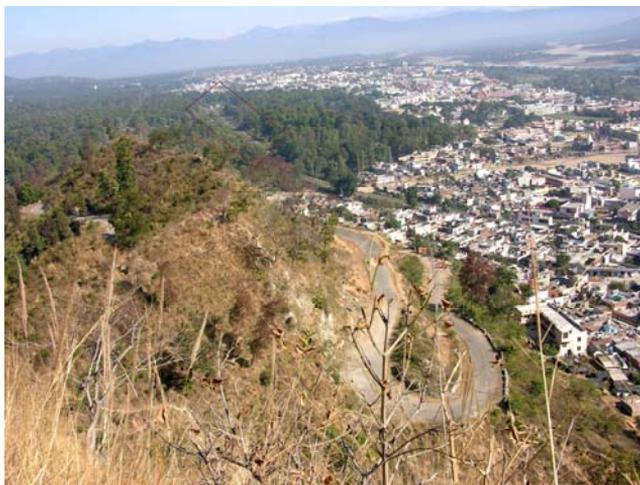


Fig. 8. An overview of Haridwar range; human habitations are clearly visible adjoining to crucial elephant's habitat. (The 110 year old railway track is also clearly visible, which is running across the Rajaji National Park and from Motichur to Kansrao track, 20 elephants have been killed through this railway track since 1987)

Industries are frequently discarding their effluent to the ground because of absence of any appropriate outlet for discharge of waste material. Haridwar forest comprises of many wells those were constructed before the declaration of park area with the aim of maintaining the water availability especially during dry months. Historical evidences suggested that these wells are constructed before 1877 and adjoining to forest roads and raos (seasonal water streams). It was observed that the water level has decreased in all the wells. According to our measurements, about 1.5 meter of the water level has decreased during the last 4 years.

The Haridwar – Dehradun and Haridwar – Bijnor national highway, which are existing in between this critical elephant reserve, Chilla hydro-electric power channel, which is running across this habitat, presence of Raiwala area, Army dump, Khand village and Satyanarayan area are few of the major obstructions, which are present in between elephant's migratory corridors. Similarly, villages those are situated parallel to Laldhang – Kotdwar forest track (*Laldhang, Sigaddi, Nalgaddi, Papidanda, Kham, Chillarkhal, Mandevpur and Kishanpur*), Kotdwar – Lansdowne (15 kilometers long) national highway and Kotdwar - Kalagarh (24 kilometers long) forest road are other major barriers, which impedes the frequent movement of elephants within their home range.

The same populations of male elephants used to perform their movements in Gohri, Chilla, Laldhang, Kotdwar, Shyampur, Chiriapur, Dogadda and Sonanadi forest whereas group movement was almost restricted towards Corbett National Park area as both of the forest zones are disconnected mainly due to huge amount of anthropogenic and developmental activities. Sometimes bulls were observed while crossing the Kotdwar – Lansdowne motor road but group movements were completely restricted in this part. Groups are performing their movements from Gohri and Chilla forest (RNP) to Dogadda forest (LFD), which is well connected zone and after to that steep terrain and heavy vehicle traffic pressure on Kotdwar – Lansdowne motor road doesn't allow them to move towards Corbett Tiger Reserve area. This revealed that only bulls have the chance to use the Sonanadi Wildlife Sanctuary and Kalagarh Tiger Reserve forest for their movements.

Shyampur and its adjoining habitats also consists several rough routes (Siddh shroath rough route, Anjani rough route near to forest depot, Pili rough route, Kotawali rough route, other routes which links different villages with motor roads), which also restricts the movement of elephant and other wildlife. Heavy crowd was observed in these roads during day hours and elephants are not in a position to cross the tracks specially when their calves are with them. Same situation is with other rough roads in other forest ranges of the RNP. Haridwar – Mansadevi – Kharkhari by pass road is 03 kilometers long whereas Bilkeshwar – Ranipur by pass road is 05 kilometers long and Ranipur – Sureshwaridevi temple forest road is 0.5 kilometers long and all of these are running across the potential elephant's habitat. Another critical elephant habitat that falls under "Shivalik Elephant Reserve" is Barkot forest of Dehradun forest division and Haridwar – Dehradun national highway and Rishikesh – Ranipokhri – Dehradun motor roads are running across this habitat, which disrupts the frequent movement of elephant's within their home range. This entire area falls under Motichur – Kansrao – Barkot wildlife corridor (2.5 kilometer long and 2.0 kilometer wide). Tremendous human activities can adversely affect the wildlife and can cause a great change in animal's behaviour. This could also cause a severe change in animal's distribution and migration. Besides, wild animals are very sensitive to human beings and proximity with them makes animal unconscious and furious.

Conclusions

Severe changes in the natural behaviour of elephants and their abnormal behavioural responses could affect our conservation policy and can put the future of a healthy northwest population of Asian elephants at risk. Presently, local people's perceptions towards elephants are unfavourable and notably in some places due to stern crop raiding, cultivators completely bunged farming and opted for some other source of livelihood. On the other hand elephants also die due to electrocution, poisoning and shot dead while moving in cultivated areas adjoining to "Shivalik Elephant Reserve". The results from this study provide a sketch of the extent and likely development of human-elephant conflict in Shivalik landscape in lesser Himalayan zone and major threats. Such reports are largely absent from the literature despite their importance in illustrating success and failures of our wildlife management and conservation efforts. People are also increasingly utilizing these old hamlets and as a result management of these traditional corridors is often uncoordinated and complicated. It is therefore appropriate to develop a scientific based protocol for conducting in depth analysis of these traditional corridors and serious human-elephant conflicts. Managers of protected area must address the impacts of human activities by looking at the effects of those activities on animal population and behaviour. In the future, we will face to a worldwide increase in human population and therefore, dependency of people on local forest resources will increased and anthropogenic disturbance will inevitably increase.

Presently, several communities are living adjoining and inside the protected habitats besides, several villages are also situated on the very outskirts of reserve forests. During the last one decade landscape of Haridwar city has undergone a drastic change primarily due to rapid enhancement of human population and industrialization. More field oriented studies addressing the impact of anthropogenic activities on behaviour of wild animals are needed. Various stakeholders like local people, Gujjars, tour operators, non governmental organizations, government organizations, media persons, researchers from various institutions and universities and protected area managers will have to work together to increase public awareness of the effects of human activities on animal disturbance and act to minimize those effects.

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