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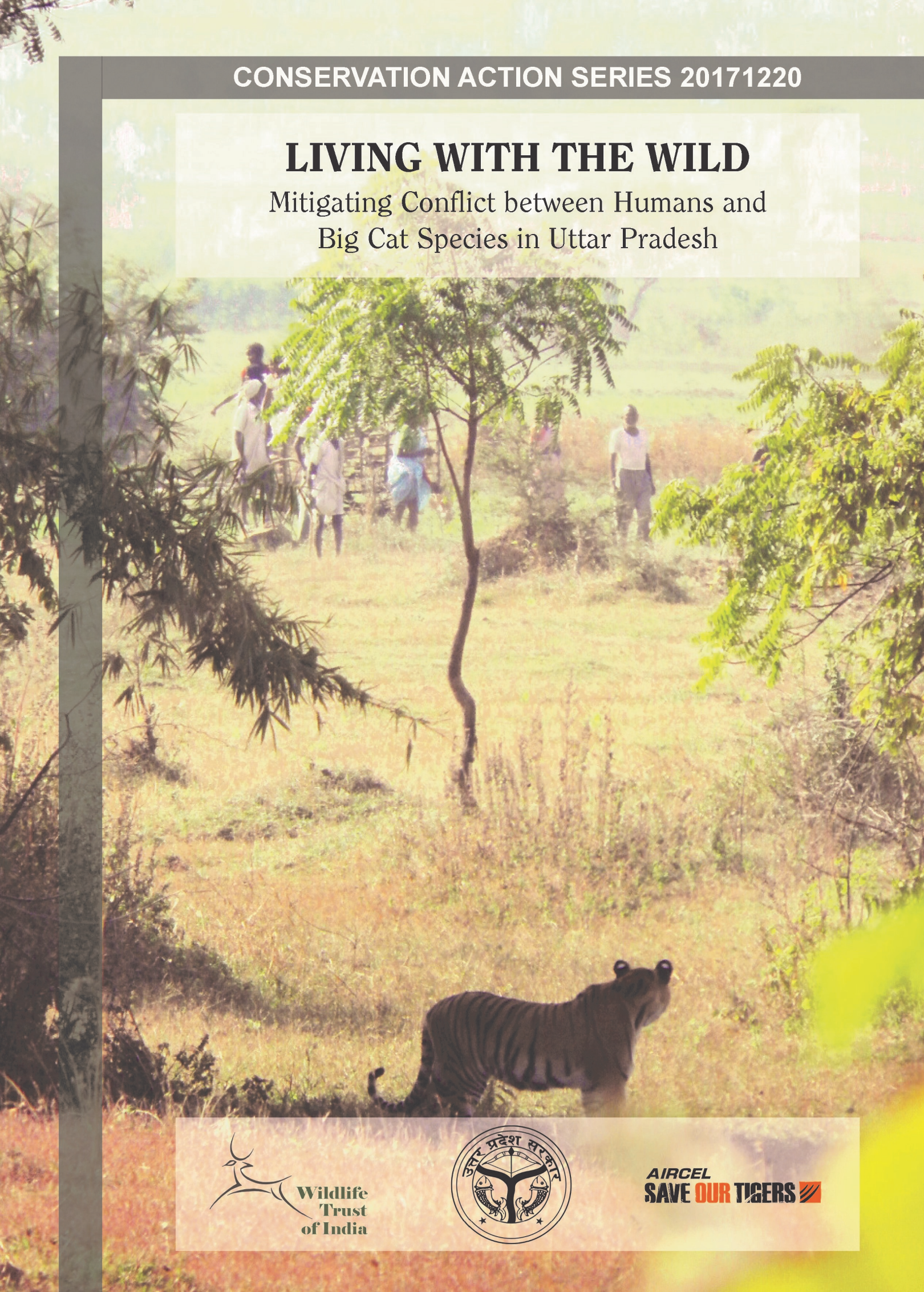
LIVING WITH THE WILD

Mitigating Conflict between Humans and Big Cat Species in Uttar Pradesh



Wildlife Trust of India

उत्तर प्रदेश सरकार

AIRCEL SAVE OUR TIGERS

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Mitigating Conflict between Humans and Big Cat Species in Uttar Pradesh

Mayukh Chatterjee, Krishnendu Basak, Prem Chandra Pandey,
Saurabh Kr Singhai, NVK Ashraf and Rahul Kaul

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Wildlife Trust of India (WTI) is a leading Indian nature conservation organisation committed to the service of nature. Its mission is to conserve wildlife and its habitat and to work for the welfare of individual wild animals, in partnership with communities and governments. WTI's team of 150 dedicated professionals work towards achieving its vision of a secure natural heritage of India, in six priority landscapes, knit holistically together by nine key strategies or Big Ideas.

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FOREWORD

राष्ट्रीय व्याघ्र संरक्षण प्राधिकरण
NATIONAL TIGER CONSERVATION AUTHORITY
(पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के अन्तर्गत सांविधिक निकाय)
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CONFLICT BETWEEN people and large carnivores is an escalating issue worldwide. The reasons for this are manifold: human population growth and the attendant anthropogenic pressures on forest lands and resources; shrinking habitats for big cat species, which typically require large areas to thrive; the depletion of prey populations resulting in more frequent opportunistic killings of livestock – all of these intertwined factors have fostered a growing friction between large carnivores and communities living on the fringes of forest areas.

These factors are lent a sharper edge in the Indian context, given our country's burgeoning population, its rapidly increasing resource needs and the consequent pressures on its wild habitats. Attacks on humans, predation of livestock and retaliatory killings of big cats now occur with regularity around the country. The National Tiger Conservation Authority in this regard has promulgated a three-pronged strategy to manage negative tiger-human interactions, ranging from short-term measures such as providing financial assistance for logistics, instituting standing operating procedures to manage dispersing tigers and handling livestock depredation, as well as long-term measures like altering habitat interventions based on tiger carrying capacity.

It is important to emphasise that while the imperatives of human development and those of wildlife conservation can appear irreconcilable, there are practical, scalable and replicable solutions available, if we only know where to look.

This report outlines one such field-tested approach to mitigating human-large carnivore conflict. It is no accident that it emerges from a project on tiger and leopard conservation run by Wildlife Trust of India (WTI) and the Uttar Pradesh Forest Department, for there can be no conservation of these big cats in the long-term if issues related to conflict are not addressed today. The landscape that the project operates in – Dudhwa and Pilibhit Tiger Reserves, Katerniaghat and Kishanpur Wildlife Sanctuaries, and the villages located on their margins – is also very significant. Given that

Uttar Pradesh is India's most populous state, has the second-highest incidence of leopard-related human fatalities as well as tiger attacks on humans, and sees a large number of livestock kills, this is a region of great interest with respect to conflict between humans and large predators.

It is noticeable that the demonstrable successes of this project, as evidenced in the declining trend of attacks on humans by leopards and tigers from 2010 to 2015, occurred once a more holistic approach encompassing the ecological, sociological and veterinary aspects of conflict was taken. Among the most important initiatives in this regard was the sustained sensitisation of local communities and their active integration in the management and resolution of conflict situations.

I congratulate WTI and the Uttar Pradesh Forest Department for this project and recommend that all individuals and organisations involved with conservation read this project report. It shows us that even in areas where interactions between humans and wildlife are at their most fraught, it is a concerted process of engagement with communities, paired with technical expertise and effective enforcement, which is proven to have the most potent impact.

(Dr Debabrata Swain)

PREFACE

A wild cat requires four things to flourish: food, water, a suitable mate – and secure habitat in which to find the former three. Ironically, in India, the two big cats that share most of the country with its burgeoning human populace are not finding one or the other. Ironic, as both the tiger and leopard are considered threatened animals and in the popular imagination there should be enough nourishment for such depleting species. But the tiger and leopard are currently paying a price for their resilience. Both are showing an upward trend in their population, triggering the need for dispersal among sub-adult cats. Only in moving out from the ranges that they are born in do they have sufficient chances to find mates as well as enough food to eat. Unfortunately, at the boundaries of their existence that other large predator, *Homo sapiens*, is also increasing in numbers. In most circumstances humans are also moving inwards into earlier sacrosanct wild cat habitat, causing face-offs. As a result, the country is seeing conflict from the Himalayas to central India, from upper Assam to Mumbai, at a scale never seen before.

In Dudhwa, Kishanpur, Katerniaghat and now Pilibhit, fertile bhabhar and terai forests of Uttar Pradesh, Wildlife Trust of India has been running a project for over eight years. When we entered the area at the behest of the local forest department, 81 cases of human death or injury had occurred at the paws of wild cats in little under a decade (2000-2009). Tigers had moved prodigiously from the forests all the way to near Lucknow in three separate incidents, the longest perhaps a distance of 400 km, provoking a panicked forest department to kick-start the project. Since then, the project has had many successes.

Human injuries and deaths have considerably reduced, falling from 12 cases per year (136 in the eleven years preceding 2013) to just about four cases per year (11 from 2013 to 2015). Meanwhile, since the project started, eight tigers and four leopards have been captured with four of them released back into the wild. Capture is the last resort and the project has provided safe passage from conflict to two tigers and eight leopards during this period, without human or animal casualty. Even more remarkable, in three cases of human interest leopards have taken young children away and the Primary Response Teams have swung into action and rescued the children. Rescuing kids from the jaws of a predator is unheard of and the fact that the children have survived is amazing. This is the biggest success of the project.

However, more lasting than the instant stories of success is the conflict resolution model that has been demonstrated by us to mitigate human-wildlife conflict in India. There are two pillars on

which this model rests. One, the deployment of a biologist, social scientist and veterinarian as a triumvirate to combat conflict. The biologist tracks animals *pre*-conflict, the sociologist warms up to people *pre*-conflict and the veterinarian assists in immunisation and treating people's livestock *pre*-conflict. This ground work results in some support from local human populations when a big cat enters their area, as opposed to resentment and anger. The second pillar is forming these local people, moulded by their own need for security and newfound friendship with the team, into Primary Response Teams or PRTs. It is these 'village response teams', trained and equipped under the project, which are solving many cases without the expert Rapid Response Teams even having to react. Being formed due to necessity and not the lure of money, they are successful in defusing conflict situations in most instances.

This report is one from which there is much to learn. But the take-home message is to understand the reasons for conflict in every local situation and to build up local capacity to deal with the issue. It is not through mega projects full of technological prowess and cash-rich kitties that human-wildlife conflict can be resolved. It is by understanding people, animals and the needs of the twain, and by devising a local settlement of these needs, that the single largest threat to wild animals and people can find resolution.

This model can be used with case-specific tweaking to conflict with other species such as elephants and bears, as also in other landscapes such as central India and Wayanad in Kerala. WTI will test its applicability and feasibility in such areas for different species and then recommend it more broadly throughout the country. Meanwhile, we invite all other NGOs and governments to try out these strategies across various landscape and species compositions through India.

Vivek Menon
Executive Director & CEO

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We sincerely thank the Uttar Pradesh Forest Department for partnering with Wildlife Trust of India (WTI) in an effort to reduce human-big cat conflict in the state. In particular, we are extremely grateful to Shri IK Patnaik, (former) Principal Chief Conservator of Forests (Wildlife), who first invited WTI to address the issue of human-big cat conflict in 2009. We are also thankful to him for initiating the formulation of a long-term Memorandum of Understanding (MoU) with WTI to further these efforts in a systematic manner. The project team and WTI are also highly indebted to Shri (Dr) Rupak De for officially launching the project in its new phase in 2012, and for providing the requisite permissions to conduct a varied nature of activities in Dudhwa and Pilibhit Tiger Reserves under the new project framework, aimed at reducing human-big cat conflict on the ground.

We are also sincerely thankful to Shri Sailesh Prasad (IFS), former Field Director, Dudhwa Tiger Reserve; Shri Sanjaya Singh (IFS), former Field Director, Dudhwa Tiger Reserve; and Shri Sunil Chaudhary (IFS), Field Director, Dudhwa Tiger Reserve, for providing accommodation and office facilities at the Dudhwa forest campus to the project team, thus giving the project a much needed operational base.

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We also sincerely thank the National Tiger Conservation Authority (NTCA) for its active support of the project team during conflict situations, in particular Shri Sanjay Kumar (IFS), Deputy Inspector General, NTCA (former Deputy Director, Dudhwa Tiger Reserve) and Shri Nishant Verma (IFS), Deputy Inspector General, NTCA, for actively acknowledging WTI's expertise in conflict mitigation and assigning the Rapid Response Team as the NTCA representative in several human-big cat conflict situations in Uttar Pradesh.

1. EXECUTIVE SUMMARY

The north Indian state of Uttar Pradesh is at a crossroads in terms of wildlife conservation. Once famous for its healthy populations of Royal Bengal tigers, Asian elephants and greater one-horned rhinoceroses, it now only has about a couple of thousand square kilometres of stringently protected habitat for the last remnants of these species in the state. Further, being the most populous state in the country, Uttar Pradesh has begun facing an escalation of human-wildlife conflict in the last two decades or so. Among the various dimensions of human-wildlife conflict, conflict between humans and big cat species such as the tiger and leopard is largely centred on injuries to and deaths of humans, as well as depredation of livestock. A large proportion of these conflicts are concentrated around the sole remaining protected habitats for tigers and leopards in the state: Dudhwa and Pilibhit Tiger Reserves.

Between 2000 and 2013, 151 human-wildlife conflict cases that resulted in human deaths and injuries were recorded by the Uttar Pradesh Forest Department in this landscape, 90.1% of which involved leopards and tigers. A large number of these cases were recorded between 2006 and 2012. An additional 474 cases involving leopards and tigers, which directly resulted in the death of livestock, were recorded between 2003 and 2012. Tigers were responsible for 58.6% of cattle depredation cases while leopards accounted for 41.4% of the cases recorded. In 2009, in response to the escalating levels of conflict between humans and big cat species in the landscape, Wildlife Trust of India began a long-term project to address the situation in collaboration with the Uttar Pradesh Forest Department.

Launched in 2009, the Uttar Pradesh Big Cat Conflict Mitigation Project marks one of the first concentrated efforts towards mitigating conflict between humans and big cat species in the state of Uttar Pradesh. This report elucidates the project's findings and activities for the period 2009-2015.

Beginning with a **Mobile Veterinary Service** to rescue leopards and tigers from conflict situations, the project had by 2012 evolved a more 'proactive' approach, employing a holistic model of conflict mitigation to address human-big cat conflict in the Dudhwa-Pilibhit landscape. This novel approach addresses conflict from three different angles: First, it strives to understand the natural drivers of conflict, assessing every conflict situation independently to determine the ecological factors behind it, which may range from a shortage of wild prey species, to debilitating injuries or the age of the individual big cat involved, to the fragmentation of dispersal habitats. Second (and perhaps most important), the project aims through various means to integrate local communities in the successful resolution of conflict situations. Finally, it aims

at addressing complex conflict situations through rescue-rehabilitation/release of the animal involved. There is thus an ecological, a sociological and a veterinary aspect to the project.

Characterising Conflict

In its initial phases the project sought to assess the actual quantum of conflict and the primary factors that could be potentially driving the increase in incidences of conflict between humans and big cats. Extensive data collection from secondary accounts, besides primary data collection on various ecological factors such as prey availability and general habitat health, revealed interesting facets.

The pattern of human-big cat conflict was found to be highly variable both temporally and spatially. Cases involving leopards peaked in the early spring and summer months of March to June, while tiger attacks peaked in the winter months (October to February). Spatially as well, Katerniaghat Wildlife Sanctuary (WLS) was found to face more leopard related conflict while Pilibhit Tiger Reserve (TR) and Kishanpur WLS experienced more tiger related conflict.

Men were predominantly the victims of both tiger and leopard attacks, and leopards were more prone to attacking children below 10 years of age, who being young were also more prone to succumbing to their injuries. The majority of attacks by tigers occurred during the day, and largely within forests or at their periphery. Leopards on the other hand primarily attacked humans in the late evenings or at night, and largely within villages or at village peripheries, where ample cover was available. The number of cases recorded to have occurred within villages or sometimes even within individual homes or homesteads were much higher for leopards, relative to only a few such cases involving tigers.

Big Cat Distribution and Prey Availability

It is a well-established fact that the distribution of big cat species such as leopards and tigers is heavily dependent upon the distribution of their principal prey species, in both space and time (Sunquist & Sunquist, 1989). Leopards do tend to be much more flexible than tigers in accruing alternative sources of food such as livestock, stray dogs and various other commensal species. Nonetheless, in order to ascertain the nature of conflict it is important that the actual distribution of the species involved and an assessment of the availability of their respective principal prey species is carried out. The project therefore undertook surveys to determine these systematically and thoroughly, with over 500 km being covered across various jungle trails in the main regions of the landscape: Dudhwa NP, Katerniaghat WLS, Kishanpur WLS and parts of Pilibhit Forest Division (FD).

The survey results indicated that tigers were more uniformly distributed in Dudhwa NP, Pilibhit FD and Kishanpur WLS, while leopards were more prevalent across Katerniaghat WLS. It is interesting to note here that irrespective of the relative differences in the abundance of leopards and tigers, leopards were largely distributed around forest fringes, compared to tigers.

All the areas surveyed also revealed the presence of various prey species, ranging from the large-bodied nilgai (*Boselaphus tragocamelus*) and sambar deer (*Rusa unicolor*), to smaller ungulates such as barking deer (*Muntiacus vaginalis*) and wild pig (*Sus scrofa*). Although the results indicated an overall decrease when compared to earlier studies in the same landscape with a similar sampling effort (Johnsingh *et al.*, 2004), the distribution of prey species was highly variable across the landscape. While the spotted deer (*Axis axis*) was found to be the most abundant prey species across most of the landscape (relative frequency of occurrence, Dudhwa = 50.40; Katerniaghat = 48.2; Kishanpur = 46.26; Pilibhit = 33.95), the wild pig dominated the landscape of Pilibhit FD (relative frequency of occurrence, Dudhwa = 14.5; Katerniaghat = 13.1; Kishanpur = 16.4; Pilibhit = 36.52). Similarly, the nilgai was found to be present in the entire landscape with a higher relative abundance in Pilibhit FD and Kishanpur WLS, but was virtually non-existent in Dudhwa NP (relative frequency of occurrence, Dudhwa = 2.9; Katerniaghat = 28.97; Kishanpur = 31.46; Pilibhit = 22.1). The swamp deer (*Rucervus d. duvaucelii*) was the most spatially clustered species among the ungulates, with its only conspicuous aggregate being detected in Dudhwa

NP besides a small population in Kishanpur WLS (relative frequency of occurrence, Dudhwa = 6.52; Katerniaghat = 0.0; Kishanpur = 1.33; Pilibhit = 0.0). Similarly, the sambar deer was not detected in Katerniaghat WLS (relative frequency of occurrence, Dudhwa = 2.79; Katerniaghat = 0.0; Kishanpur = 1.46; Pilibhit = 1.01), which could explain the lower abundance of tigers here.

In addition to the transect sampling, 225 scat samples of tigers were also collected and analysed to understand the prey selection patterns of tigers in these regions. The results revealed that when the availability of large sized prey was low, tigers tended to include large bodied domestic species such as cattle in their diet to a considerable extent (3.8% - 21.9%). However, tigers tended to have different dietary preferences in different regions. In Pilibhit for instance, livestock constituted almost 21.9% of tiger diet and was being preferred next to large sized wild prey – i.e. tigers did not seem to select medium to small sized wild prey in the absence of large prey species, but instead preferred livestock. However in Katerniaghat WLS, Dudhwa NP and Kishanpur WLS, tigers preferred large bodied livestock only third to large and medium sized wild prey species, i.e. as a last resort.

Garnering Community Participation for Conflict Resolution

Conflict between humans and wild animals, especially big cat species like tigers and leopards, has a major human angle. In a majority of the cases conflict ensues from the very moment a big cat is spotted in the vicinity of human habitations, even if the individual has not attacked any human or livestock. It was understood during the initial course of the project that a large number of human injuries as well as deaths of individual animals involved in conflict could have been avoided if local people had remained passive but alert about the animals' whereabouts. Avoiding crowding around a wild leopard or tiger and taking certain simple precautions can go a long way in reducing the adversities that arise out of such situations. Keeping this in mind, the project began steering a large number of initiatives to not only make local people aware about these aspects, but also to gradually integrate some of them in actively dealing with conflict situations on the ground.

Through scores of consultative meetings with villagers in the region, by the end of 2012 the project had managed to establish nine **Primary Response Teams (PRTs)** in different parts of the landscape. These teams mainly comprise local volunteers and influential people such as village elders and forest department staff, and are trained to manage conflict situations on the ground. The teams function by assessing the location of the leopard or tiger, cautioning people in its vicinity and relaying information to the relevant authorities. In some cases they also inhibit the formation of crowds, conduct drives to impel the animal back to the forest, and attend to any human injuries.

The PRTs have thus far been functioning in the landscape as envisaged, and have in recent times set examples wherein conflict situations have been successfully resolved without the need for captures or more serious interventions. These teams are trained from time to time and provided with basic equipment such as flashlights, first-aid kits, pamphlets, utility vests, mobile phones etc, to enable them to carry out their work efficiently.

To increase people's participation and to develop a populace that is more accepting of 'proactive' conflict mitigation measures, various awareness programmes have also been organised periodically. Between 2012 and 2015 alone, 53 awareness meetings were held in 48 different villages, sensitising nearly 4000 people. Additionally, 19 signboards listing precautionary measures to be taken during conflict situations have been installed in various villages, to enable a wider mass of people to be informed about the same.

Additionally, the project has also initiated children's awareness programmes in several schools of the region. The aim is to sensitise the younger generation, increasing awareness and willingness to conserve nature and wildlife. Sixty-five programmes have been conducted from 2010 to 2015, ranging from classroom sessions to interactive and educative competitions to field based activities, through which 7615 school

children have been sensitised. Results from the pre- and post-sensitisation questionnaires show a statistically significant increase in knowledge gained (c.a. 30% increase) about the wildlife of the region and its conservation value. In 2014, this initiative was further enhanced through the development of novel awareness packs in the form of an illustrated comic book with an engaging storyline that aims to educate children about wildlife, with a focus on human-wildlife conflict and how it can be handled.

The Rapid Response Team

Besides these public interface initiatives, the project also established a **Rapid Response Team (RRT)** to provide an expert emergency response to human-big cat conflict situations. This team comprises a trained wildlife biologist, a wildlife veterinarian and a sociologist, and is provided with the requisite equipment and a vehicle. At the scene of a conflict situation the RRT strives to control crowds (usually with the support of the PRTs) and intervene if required to capture and translocate the big cat involved. Since its establishment in 2011-12, the RRT has directly intervened in 17 cases of human-big cat conflict, saving the lives of five tigers and six leopards. In nine of these 17 cases the RRT was summoned outside the project region by the state forest department, to address and resolve conflict situations on the ground.

Veterinary Interventions

Apart from providing treatement to big cats injured in conflict situations, the project also initiated certain measures to safeguard the big cat population in the larger landscape. Two such key activities were: 1) Treating prey species in distress situations and conducting post-mortem investigations of various animals found deceased, and 2) conducting livestock immunisation camps to create a disease-free belt around protected forests.

Between 2009 and 2015, 39 post-mortem investigations were conducted and the deceased animals were screened for communicable diseases. Another 32 cases of animal distress were resolved through different levels of veterinary support. The project team also began conducting livestock immunisation camps in 2013 and till date has conducted eight camps in different parts of the landscape, immunising over 1000 heads of cattle against common diseases that are communicable to wildlife, such as Foot-and-Mouth Disease, Haemorrhagic Septicaemia and Black Quarter.

Strengthening the Ground Force for Conflict Mitigation

One of the main thrust areas of the project has been to develop the capacity of frontline forest staff across various Forest Divisions of Uttar Pradesh to resolve human-wildlife conflict situations expeditiously. Capacity building workshops are organised to give frontline staff a more complete understanding of conflict situations and their underlying causes, and of the various ways they can be resolved, including the different technological innovations developed across the world to mitigate such situations.

The trainees are imparted first-hand experience in handling various trapping and tranquilising equipment, taught about disease control measures and instructed in the nuances of bridging the gap between the forest department and local communities. Between 2011 and 2015 the project team conducted over 16 training workshops, training some 580 frontline forest personnel.

2. INTRODUCTION

(i) What is Human-Large Carnivore Conflict?

Worldwide, among wild megafauna, large carnivores pose an immense problem in terms of conflict with humans (Woodroffe *et al.,* 2005; Treves and Karanth, 2003). Human population growth and the consequent demand for land as well as forest resources have isolated many large carnivore populations (Treves and Karanth, 2003; Dinerstein *et al.,* 2007; Ranganathan *et al.,* 2008). Loss of habitat of large carnivores due to expanding agricultural practices and human encroachment has thus intensified friction between human and wildlife populations (Tilson *et al.,* 2001; Goodrich *et al.,* 2008). Though most large carnivore populations exist within Protected Areas, they often cannot be contained within park boundaries as they usually require large spaces to thrive. New population recruits wander beyond Protected Area boundaries onto human inhabited lands in search of competition-free areas. Reports of large carnivores ranging on adjoining unprotected lands and coming into conflict with humans are fairly widespread (Woodroffe *et al.,* 2005; Gurung *et al.,* 2008).

Most large carnivores are also invariably adapted to hunt wild ungulates of various sizes and therefore many individuals may resort to killing domesticated ungulates opportunistically (Karanth and Stith, 1999). For instance, tigers and leopards in Asia are well known for killing livestock (Karanth and Madhusudhan, 2002). Even highly elusive snow leopards are known in some areas of their distribution to prey on domesticated sheep and goats (Mishra *et al.,* 2003).

Under some circumstances, large carnivores may also attack humans, causing grievous injuries and/or fatalities (Rajpurohit and Krausman, 2000; Karanth and Madhusudhan, 2002). Attacks on both humans and livestock many a time lead to retaliatory killings of the animals involved in conflict, and sometimes of several other individuals of the species involved. For instance, a single case of a sloth bear mauling and killing eight people in the east Indian state of Odisha in 2014 led to the retaliatory killing of several sloth bears across various regions of the state over the forthcoming months (WTI unpublished data).

There has been little concentrated effort made to mitigate human-wildlife conflict situations using holistic approaches that employ both long-term and short-term mitigation measures.

Worldwide, the issue of human-large carnivore conflict has been primarily addressed using one of three main approaches: total elimination, controlled extermination or harvesting, and

preservation (Woodroffe *et al.,* 2005). While extermination has been a historical practice and is now rarely employed, controlled harvesting of large carnivores is still practiced in several parts of the American and African continents. Nonetheless, preservationist approaches are today gaining importance, and in many parts of the world where controlled harvesting was once the norm, creation and maintenance of Protected Areas and the absolute protection of the concerned species within them is a more prevalent trend. In India, for instance, total extermination was the predominant strategy until the mid-1900s, claiming the lives of over 80,000 individual tigers (Rangarajan, 2001). Over the past few decades this has been replaced by total protection, rendering the killing of tigers for any cause as illegal (Karanth and Gopal, 2005). Societal objectives, values and ethics have tended to play a larger role in conservation in India than even the use of science, and the prevalent ethics therefore have dictated preservationist policies (Menon and Lavigne, 2006; Menon, 2013).

India, in this sense, has long been a bastion of preservationist nature conservation and has been exemplary in constituting laws that prevent the killing of large carnivores (and other threatened species) that are in conflict with human populations. Controlled extermination and illicit killing of threatened species are regarded as illegal, and the laws protecting these species are reasonably enforced both inside and outside Protected Area networks. Given the context of high population pressures, such policies have ensured that wild habitats and species profit. India thus has 60% of the world's tiger population, over 50% of the Asian elephant population, 80% of the greater one-horned rhino population and 100% of the Asiatic lion population. Nonetheless, such preservationist approaches to conservation entail high costs. They require a larger number of personnel for the enforcement of relevant laws, monitoring of populations, verification of damages, disbursement of relief claims, and engagement with primary stakeholders.

A number of countries consider preservationist approaches to managing human-large carnivore conflict expensive and untenable, compared to less tolerant measures such as controlled harvesting. For instance, the issuing of game tickets to hunting enthusiasts generates large revenues in a number of national parks, including the famous Yellowstone National Park in north America.

Preservationist approaches have also led to the exclusion of local communities from protected natural ecosystems, creating in certain cases an atmosphere of alienation (Rangarajan and Shahabuddin, 2006; West *et al.,* 2006). Preservationist stands such as absolute protection thus suffer the risk of proving detrimental to conservation efforts in the long run, especially if protection measures are subsequently relaxed. It is because of this that most wildlife conservation strategies today encompass community integration or community led measures.

As human populations increase, even Protected Areas in India are threatened by habitat fragmentation and degradation. Communities living around these areas are not only gradually encroaching on adjoining forest lands through the expansion of agricultural lands, a large number of families in such communities also depend upon the forest for various reasons.

Grazing of livestock is one predominant dependence factor that directly impinges on food availability for forest dwelling herbivores, besides causing disturbance. It also increases the chances of attacks on livestock by large carnivores. Similarly, collection of firewood and other Non Timber Forest Products (NTFP), as well as illicit extraction of timber for livelihood dependencies, exposes local people to large carnivore attacks while also directly impacting the ecosystem by causing degradation and disturbance.

Further, natural phenomena such as natal or breeding dispersal, shortage of prey, defending territories against conspecifics and impairment from hunting may drive large carnivores to seek easier prey such as livestock near human habitations. Human and livestock presence inside a forest or on its fringes further aggravates the degree of conflict, by increasing chances of fatal attacks on humans and/or livestock.

Like many other nations with large carnivores, India abounds with recorded instances of human-large carnivore conflict – especially involving leopards and tigers, probably because of the widespread distribution of these two species across the subcontinent. Interestingly, India also has a record number of cases of man-eating leopards and tigers. These cases have been well documented since the 1900s, with some individual tigers and leopards in the early records having been known to have killed over 400 humans before themselves being killed. The historical accounts of acclaimed hunters such as Sir Jim Corbett suggest an 'infirmity theory' to explain such cases (Patterson *et al.,* 2003). In these accounts, most man-eating leopards and tigers are shown to be highly incapable of hunting natural prey, either due to impairing injuries or old age. Despite the attention that man-eaters generate, however, instances of man-eating animals are extremely rare and the majority of conflict cases do not involve man-eating leopards or tigers, even when human fatalities do result.

Within the distribution range of tigers and leopards in India, the state of Uttar Pradesh emerges as a region of great interest with respect to conflict between humans and wild predators. Uttar Pradesh is second only to Sundarbans Tiger Reserve in the state of West Bengal in terms of the number of attacks by tigers on humans (De and Singh, 2001). The state is also second only to Uttarakhand (the erstwhile hill portion of Uttar Pradesh) in fatal attacks on humans by leopards. Leopards and tigers in Uttar Pradesh also attack and kill a large number of livestock, thus elevating the overall quantum of human-tiger/ leopard conflict. For example, in Katerniaghat Wildlife Sanctuary (WLS) alone, 21 humans and 288 heads of livestock were reported to have been killed by leopards and tigers between 2000 and 2007 (Sethy, 2013). These are isolated figures, however, and there remains a dearth of comprehensive data pertaining to human-large carnivore conflict in almost all parts of India. Uttar Pradesh fares no better in this regard with much of the data coming from opportunistic records from the forest department and a few short-term studies.

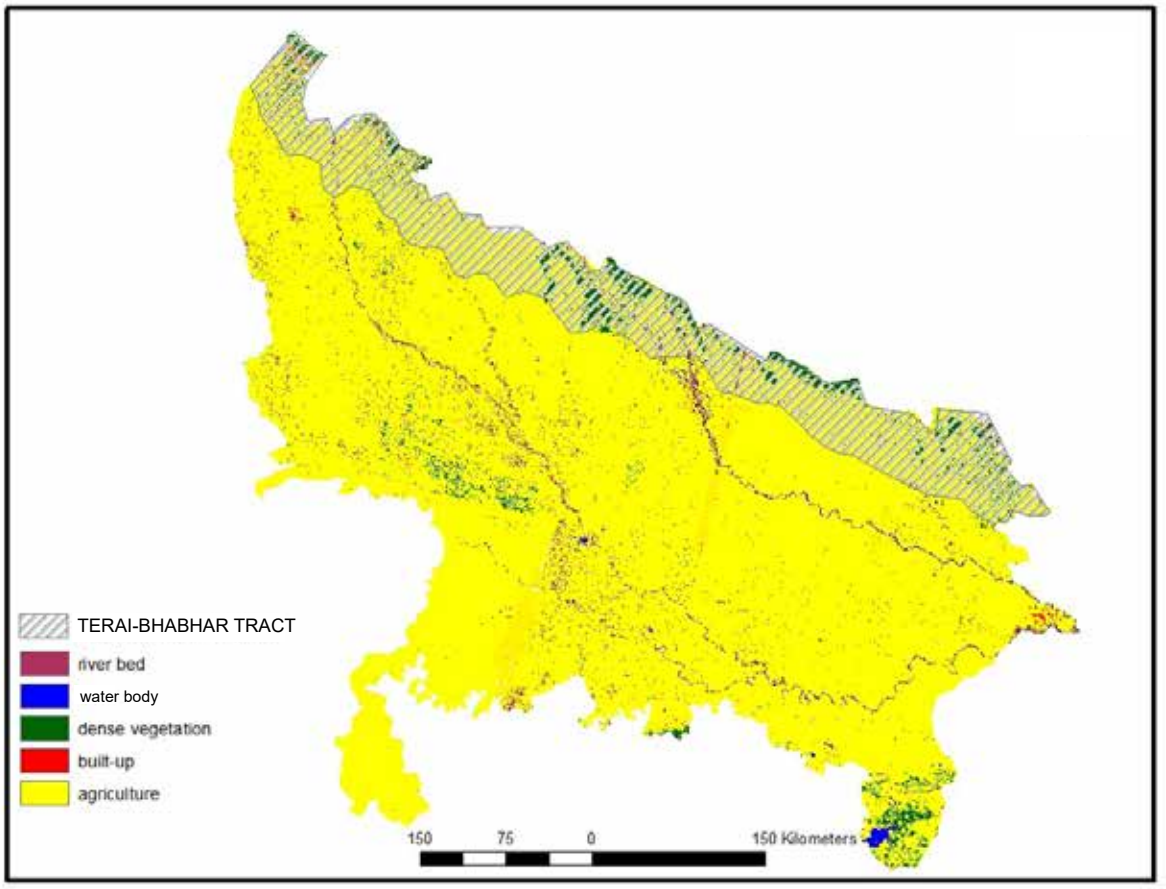
As much as there is a lack of data, there has also been little concentrated effort made to mitigate human-wildlife conflict situations using holistic approaches that employ both long-term and short-term mitigation measures. This report elucidates one such effort in Uttar Pradesh.

Map 1: Location of Uttar Pradesh, India

(ii) Uttar Pradesh - The Landscape and its Wilderness

The north Indian state of Uttar Pradesh is flanked by Rajasthan to the west, Haryana and Delhi to the northwest, Uttarakhand to the north, Bihar to the east, Jharkhand to the southeast, Chhattisgarh to the south and Madhya Pradesh to the southwest. It also shares an international boundary with Nepal to the northeast (*Map 1*). With a human population of over 200 million (20 crore) spread across 243,290 sq km of the country's landmass, it is the most populous state in India (16.6% of India's population), and with an average human density of about 829 per sq km, the most populated country subdivision in the world. A large part (40.9%) of this population lives below the poverty line and about 30% is below the national average literacy rate. Agriculture is one of the primary drivers of Uttar Pradesh's economy and the state is the largest producer of sugarcane (and by extension refined sugar) in the country.

The state's landmass is bounded by a portion of the Himalayas in the north and the Vindhya range in the south, and comprises major portions of the fertile Gangetic plains region, which includes



Map 2: Land use / land cover of Uttar Pradesh, showing the Terai-Bhabhar tract

the Ganga-Yamuna Doab, the Ghaghara plains, the Ganga plains, and the Terai-Bhabar tract running almost the entire length of the state. The most pristine natural landscapes including the important Protected Areas, are situated primarily in the Terai-Bhabhar regions (*Map 2*).

The vast alluvial plains are almost all agricultural tracts, spread across 14 districts. Interestingly, these 14 districts have the highest human population density in the state, despite being understood as scarcity prone arid areas that are subject to periodic floods and droughts. The state is fed by over 32 large and small rivers with the Ganga, Yamuna, Saraswati, Betwa and Ghaghara being the largest.

Despite being the most populated state in India, Uttar Pradesh harbours rich biodiversity resources. It has over 14,461 sq km of forested area (6% of geographic area; *Map 2*), and its forests and grasslands teem with a variety of fauna and flora. Several species of trees, medicinal plants, mammals, reptiles and insects are found across the state's natural ecosystems (India State of Forest Report, 2015).

Specifically in terms of wildlife, therefore, the state constitutes an important landscape in northern India. It has 23 wildlife sanctuaries across 27 districts covering over (c.a.) 5000 sq km, and one national park (NP) with an additional 490 sq km (*Table 1*).

Uttar Pradesh also has two tiger reserves (including one national park, two wildlife sanctuaries and additional reserve forest divisions) spanning four districts and covering over 2933 sq km of pristine wildlife habitat. The tiger reserves are not only home to the majestic

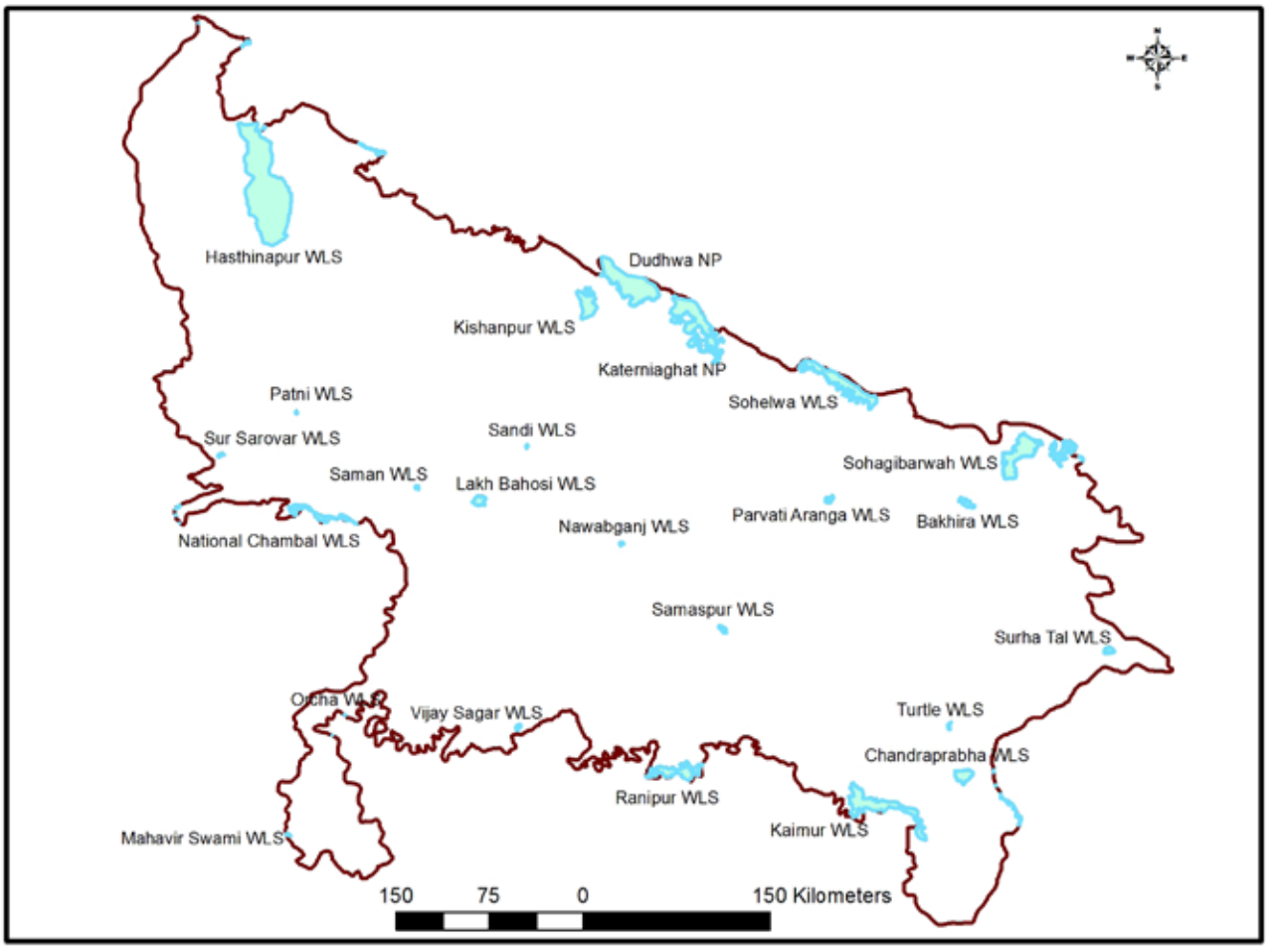
Table 1: List of Protected Areas (PAs) of Uttar Pradesh

Sl.	Protected Area	Year of establishment	Area (sq km)	District(s)
1	Dudhwa NP	1977	490.00	Lakhimpur Kheri
2	Bakhira WLS	1990	28.94	Sant Kabir Nagar (Basti)
3	Chandraprabha WLS	1957	78.00	Chandauli
4	Hastinapur WLS	1986	2073.00	Muzzafarnagar, Meerut
5	Kaimur WLS	1982	500.73	Mirzapur, Sonbhadra
6	Katerniaghat WLS	1976	400.09	Bahraich
7	Kishanpur WLS	1972	227.00	Lakhimpur Kheri
8	Lakh Bahosi WLS	1988	80.24	Farrukhabad
9	Mahavir Swami WLS	1977	5.41	Laltipur
10	National Chambal WLS	1979	635.00	Agra, Etawah
11	Nawabganj WLS	1984	2.25	Unnao, Lucknow
12	Okhla WLS	1990	4.00	Ghaziabad
13	Parvati Aranga WLS	1990	10.84	Gonda
14	Patna WLS	1990	1.09	Etah
15	Ranipur WLS	1977	230.31	Banda, Chitrakoot
16	Saman Bird WLS	1990	5.26	Mainpuri
17	Samaspur WLS	1987	7.99	Rae Bareily
18	Sandi WLS	1990	3.09	Hardoi
19	Sohagibarwa WLS	1987	428.20	Maharajganj
20	Sohelwa WLS	1988	452.47	Shravasti Balrampur
21	Sur Sarovar WLS	1991	4.03	Agra
22	Surha Tal WLS	1991	34.32	Ballia
23	Turtle WLS	1989	7.00	Varanasi
24	Vijai Sagar WLS	1990	2.62	Mahoba
25	Pilibhit FD/TR	2014	726.89	Pilibhit

Royal Bengal tiger (*Panthera tigris tigris*) but also to the endangered Asian elephant (*Elephas maximus*), the vulnerable greater one-horned rhinoceros (*Rhinoceros unicornis*), and the northern subspecies of swamp deer (*Rucervus duvaucelii duvaucelii*), besides several other important mammalian, avian, amphibian, reptilian and insect species. It is believed that some species like the tiger and the swamp deer (also the swamp francolin, *Francolinus gularis*) in this landscape constitute the last remnants or ecotypes adapted to the Terai-Bhabar ecosystems.

(a) Dudhwa Tiger Reserve (DTR)

Situated in the northwest of Uttar Pradesh (*Map 3 and 4*), Dudhwa Tiger Reserve has diverse ecosystems like grasslands, forests and wetlands that represent an extensive habitat for large carnivores and herbivores alike, spread across three districts of the state: Lakhimpur Kheri, Bahraich and Shahjahanpur. It comprises 490 sq km of Dudhwa National Park, 204 sq km of Kishanpur Wildlife Sanctuary and 400 sq km of Katerniaghat Wildlife Sanctuary (*Map 4*), constituting the largest source habitat for all the charismatic large mammals of the state,



Map 3: Map showing location of various PAs in the state of Uttar Pradesh

including tigers, greater one-horned rhinos and Asian elephants. The 2010-11 estimation of tigers revealed around 111 tigers, and DTR is considered to hold the potential for at least 200 breeding individuals (Ranganathan *et al.,* 2008).

The tiger reserve largely represents what remains intact of the natural Terai-Bhabar landscape at the foothills of the Himalayas, with sal (*Shorea robusta*) dominated forests interspersed with tall and short grasslands and numerous swamps that are fed by several rivers, rivulets and streams.

Over 150 years of forest management through social forestry initiatives, besides migrant settlement, expansion of agricultural practices and other associated developmental activities, have resulted in severe degradation and fragmentation of this landscape, such that only four intact clusters (including the Pilibhit Forest Division) with adjoining fragmented patches remain in this landscape amidst an overwhelmingly human dominated landscape.

The wildlife habitats of this landscape range from moist deciduous forests to tropical swamps and low alluvial savannah woodlands, with vegetation being classified into six distinct types, namely, sal forests, mixed forests, riparian forests, tall wet grasslands, upland grasslands, and moist savannah grasslands (De and Singh, 2001).

A total of 47 mammalian species are reported, among which the tiger, leopard (*Panthera pardus*), Asian elephant, leopard cat (*Prionailurus bengalensis*), fishing cat (*Prionailurus viverrinus*), sloth bear (*Melursus ursinus*), swamp deer, Indian pangolin (*Manis crassicaudata*), Indian giant flying squirrel (*Petaurista phillipensis*) and the smooth-coated otter (*Lutrogale perspicillata*) are listed under Schedule I of the Wild Life (Protection) Act of 1972.

Dudhwa is also home to the vulnerable (IUCN Red List, 2012) greater one-horned rhinoceros. This species, thought to have gone locally extinct due to extensive poaching, today thrives following sustained reintroduction measures. Further, among the several deer species found in India, five occur in this area, including the only viable population of the northern subspecies of the swamp deer. The natural habitats of this tiger reserve are also home to some critically endangered fauna such as the hispid hare (*Caprolagus hispidus*); the Bengal florican (*Hubaropsis bengalensis*) and nearly 450 species of birds; all major classes of reptiles including the Indian marsh crocodile (*Crocodylus palustris*) or the mugger, the critically endangered gharial (*Gavialis gangeticus*), eight species of turtles and 16 identified species of snakes; and an untold number of insect species including 43 identified species of butterflies (De and Singh, 2001).

Despite its rich faunal and floral assemblage and the uniqueness of the landscape, like most other protected forests Dudhwa TR faces immense pressures from the burgeoning human population that surrounds its extents. The tiger reserve is among the most populous in the country, supporting over 20 lakh people and a proportionally large population of livestock, harboured in more than a hundred villages situated in and around its forest patches.

Most people living inside and in the proximity of Dudhwa TR depend on its forests and grasslands chiefly for fodder, fuelwood and timber. Rampant cattle grazing and extraction of NTFP escalate conflict between humans and wildlife – interestingly, of the two Protected Areas in India from which intermittent cases of man-eating tigers are reported, Dudhwa TR is one (Chauhan *et al.,* 1995) – while also resulting in the degradation and fragmentation of natural ecosystems. Apart from these direct impacts, the predominance of agriculture around this landscape has resulted in the draining of several swamps, which have been converted into paddy or sugarcane fields.

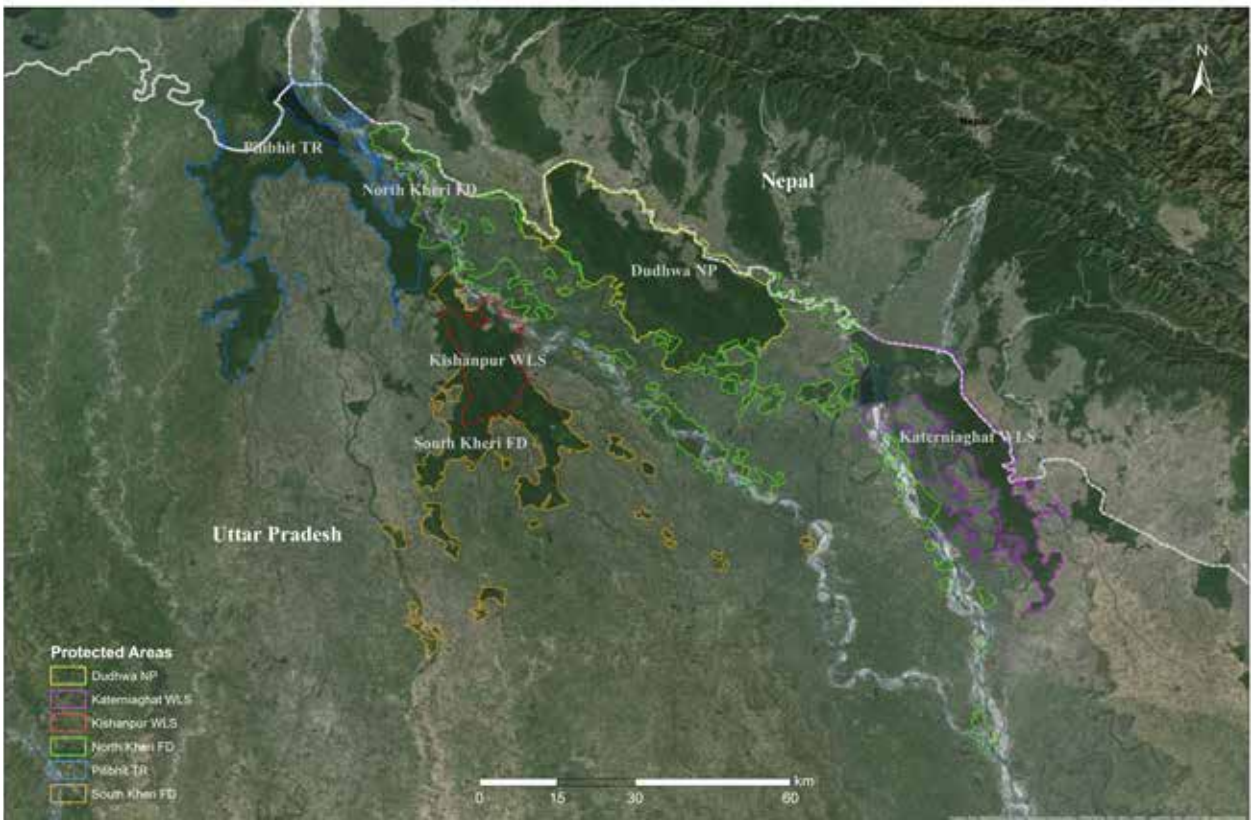
Further, the porous boundaries of the landscape with Nepal have led to decimation of several wildlife species in this region – the local extermination of rhinos in the late 1970s is one clear example. These unguarded boundaries have also contributed to smuggling of timber and other natural produce, as well as several species that are in demand in the illegal international trade in wildlife and its derivatives, such as the Indian pangolin.

(b) Pilibhit Tiger Reserve

Notified in June 2014 as a distinct tiger reserve, Pilibhit was a standalone reserve forest division situated in northern Uttar Pradesh. Pilibhit TR constitutes almost 23 percent of the area of Pilibhit district and comprises almost all of its large intact natural vegetation tracts. It spans part of the Upper Gangetic Plains of the Terai landscape, covering over 730.25 sq km with a mix of sal forests, swamps and grasslands. The reserve is managed under five forest ranges, namely Barahi, Haripur, Deoria, Mala and Mahof, comprising 52 forest management units or beats. Pilibhit TR is not only important for its landscape and the flora and fauna therein but also because it constitutes a connectivity with Kishanpur WLS through the Lagga-Bagga forest tracts and the Haripur Forest Range (*Map 4*). It also connects to the Royal Shukla Phanta Wildlife Reserve in Nepal through its forested tracts in the northeast. These forested tracts are fed by numerous small rivers such as the Sharda, Mala, Khannot and Chuka, as well as the Gomti, which originates from the reserve.

Like Dudhwa TR, the vegetation in Pilibhit is a mosaic of dry and moist deciduous forests, scrub, and alluvial grassland patches, together constituting habitat for over 127 terrestial animal species (including reptiles and amphibians), 556 bird species and 2100 flowering plants. The densest forested patches comprise sal dominated mixed forests interspersed with alluvial and tall grasslands and water bodies. The most common large mammalian species found in the reserve are the Bengal tiger, greater one-horned rhinoceros, Asian elephant, sambar deer (*Rusa unicolor*), spotted deer (*Axis axis*), and hog deer (*Axis porcinus*), besides a small population of blackbuck (*Antilope cervicapra*) and several other species common to this landscape.

Like other PAs in India, Pilibhit TR also provides



Map 4: Satellite image showing the Dudhwa-Pilibhit TR landscape and the individual component PAs

for the varied livelihood dependencies of over six million people living in and around it. Like Dudhwa, it also faces serious management challenges arising mainly from the human population that lives within and on the fringes of its area. Livestock grazing, NTFP collection and timber extraction all combine into the major quantum of threats this tiger reserve faces. Pilibhit's direct connectivity to Nepal also poses serious threats to its wildlife and their habitats due to unchecked poaching and smuggling. Adding to these pressures is the increase in human-wildlife conflict, which constitutes a major threat today, especially to certain key taxa including the national flagship, the tiger.

(iii) The Uttar Pradesh Big Cat Conflict Mitigation Project

Launched in 2009, the Uttar Pradesh Big Cat Conflict Mitigation Project marks one of the first concentrated efforts towards mitigating conflict between humans and big cat species, i.e. tigers and leopards, in the state of Uttar Pradesh. Wildlife Trust of India (WTI) began this hallmark project at the request of the state forest department, following an increase in the frequency of conflict between big cats and humans in the state in 2008-2009 and subsequently through 2010 as well.

Following a traditional approach, WTI first established a Mobile Veterinary Service (MVS) unit comprising a trained wildlife veterinarian equipped with a four-wheel-drive vehicle and necessary equipment to capture big cats involved in conflict. The unit sought to intervene directly to rescue leopards or tigers involved in conflict situations and, if successful, treat and release the animals back into the wild. However, it soon became apparent that though direct interventions could save the lives of a few animals, a greater number were being killed as a result of retaliation by local communities (animals involved in conflict, especially big cats, are often poisoned or even lynched by angry mobs).

The MVS approach is useful only where the incidence of conflict cases is relatively rare, or if the intention is to rescue a wide range of animals from distress situations (if no better alternative is available). One major lacuna in this approach is that it does not consider conflict to be a largely anthropogenic phenomenon. 'Being rescued' may

also result in the death of the animals involved, either due to the high stress of capture or due to improper upkeep during treatment. Many 'rescued' animals are also displaced haphazardly as they are released in new locations far away from the conflict site and can potentially come into conflict with other human populations. Ones that are released close to conflict sites, on the other hand, are often able to return to their original home ranges (Odden and Wegge, 2015; Athreya *et al.,* 2013).

The MVS approach to conflict mitigation also leads to a large number of wild animals being retained in lifetime care centres, which is unrequired and unsustainable as such facilities are scarce and mostly overcrowded. This approach was therefore deemed a short-term, 'reactive' mitigation strategy (*Figure 1*). WTI's project was driven to adopt a more holistic and pragmatic approach: a 'proactive' model of conflict mitigation that could ensure a long-term reduction in both the frequency of conflict and in the severity of the consequences of conflict, whenever it did occur. This proactive model attempts to address human-big cat conflict on three fronts: Providing veterinary interventions, engaging and integrating local communities, and understanding conflict from a biological perspective. A combination of these three approaches is expected to, in the long run, reduce the adversities caused by conflict situations and therefore impact the intensity of human-big cat conflict rather than addressing individual conflict situations.

This model (*Figure 2*) addresses big cat related conflict in a more pragmatic way as it acknowledges that human-wildlife conflict, especially pertaining to big cats, is an inevitable consequence of the complex matrix of wildlife and human habitats. It focuses largely on understanding the ecology of large carnivores in a region and the possible underpinnings of conflict as a phenomenon, and on spreading awareness and sensitising local communities as well as engaging them actively in conflict mitigation.

Direct interventions involving the capture of big cats from conflict situations are also furthered through this model, but largely as a last resort in situations that are not conducive to alternate mitigation measures.

To make the project's goals more realisable given the constraints of resources and manpower, efforts were concentrated in the two source tiger habitats, i.e. Dudhwa and Pilibhit Tiger Reserves. The project's strategic framework was addressed towards first understanding and documenting the intensity and patterns of conflict in the project region and assessing various aspects of large carnivore ecology. This was followed by a prioritisation of areas, mostly comprising village clusters across the fringes of the two tiger reserves, in terms of conflict intensity for a more focussed implementation of activities related to community integration and awareness.

The project concurrently aimed at saving the lives of individual animals involved in conflict through physical interventions, when necessitated, and to develop safeguards against potential stochastic drivers of human-large carnivore conflict such as disease outbreaks. Lastly, the project also aimed to develop the capacity of local forest department staff to address conflict situations, by providing comprehensive training on various aspects of conflict mitigation including chemical and tactical methods of animal capture.

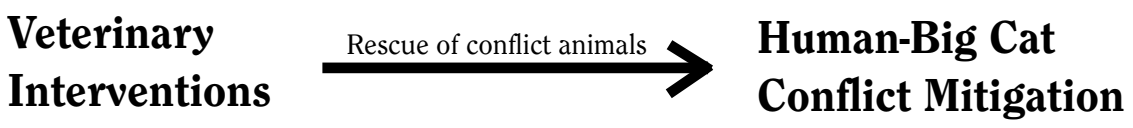


Figure 1: Reactive model of conflict mitigation

(iv) Project Objectives

With the above-mentioned model for human-big cat conflict mitigation in mind, the project pursued certain specific objectives, namely:

(a) Biological and Socio-economic Studies

- Assess the quantum and intensity of conflict between humans and big cats in the Dudhwa-Pilibhit TR landscape.
- Gauge the dependence patterns of local communities living in and around Dudhwa and Pilibhit TRs and their understanding and attitudes towards wildlife.

(b) Social Interventions

- Reduce adverse impacts of human-big cat conflicts through active integration and engagement of affected local communities.
- Develop the capacity of frontline forest staff to make them self-sufficient in resolving conflict situations.
- Conduct programmes to sensitise and motivate local communities, especially local children and youth, to enable them to understand the dynamics of human-big cat conflict and garner greater support for the conservation of tigers and leopards in the future.

(c) Veterinary Interventions

- Facilitate the chemical or tactical capture of tigers and leopards involved in conflict in the Dudhwa-Pilibhit TR landscape when required, as well as their treatment, release and post-release monitoring.
- Identify and implement important disease control measures to prevent disease outbreaks among wild fauna of the Protected Areas in focus.

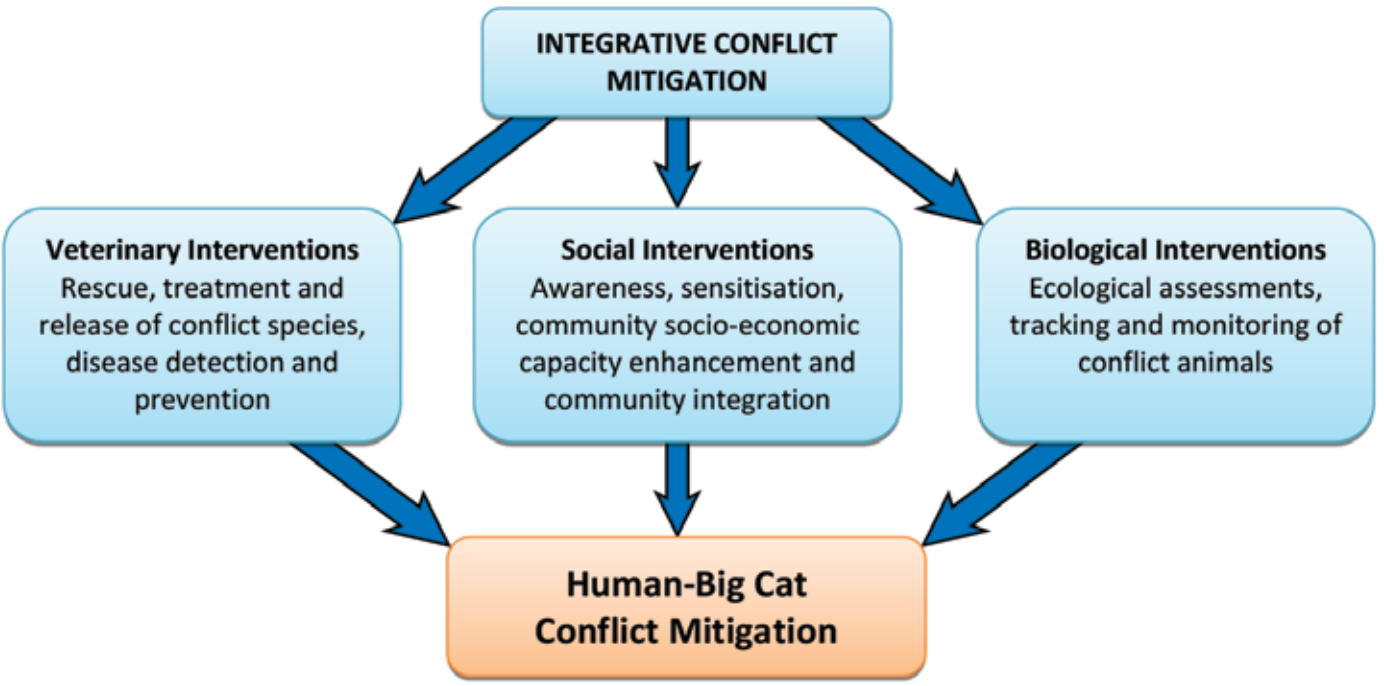


Figure 2: Proactive model of conflict mitigation

3. METHODS

(i) Conflict Research

(a) Status of human-big cat conflict in the Dudhwa-Pilibhit TR landscape

Data on tiger and leopard attacks on humans, and on the predation of livestock, in Dudhwa National Park and the neighbouring Katerniaghat and Kishanpur Wildlife Sanctuaries was collected by the project team between 2000 and 2013 from first-hand accounts, cases attended, and the records of the relevant forest range and divisional offices.

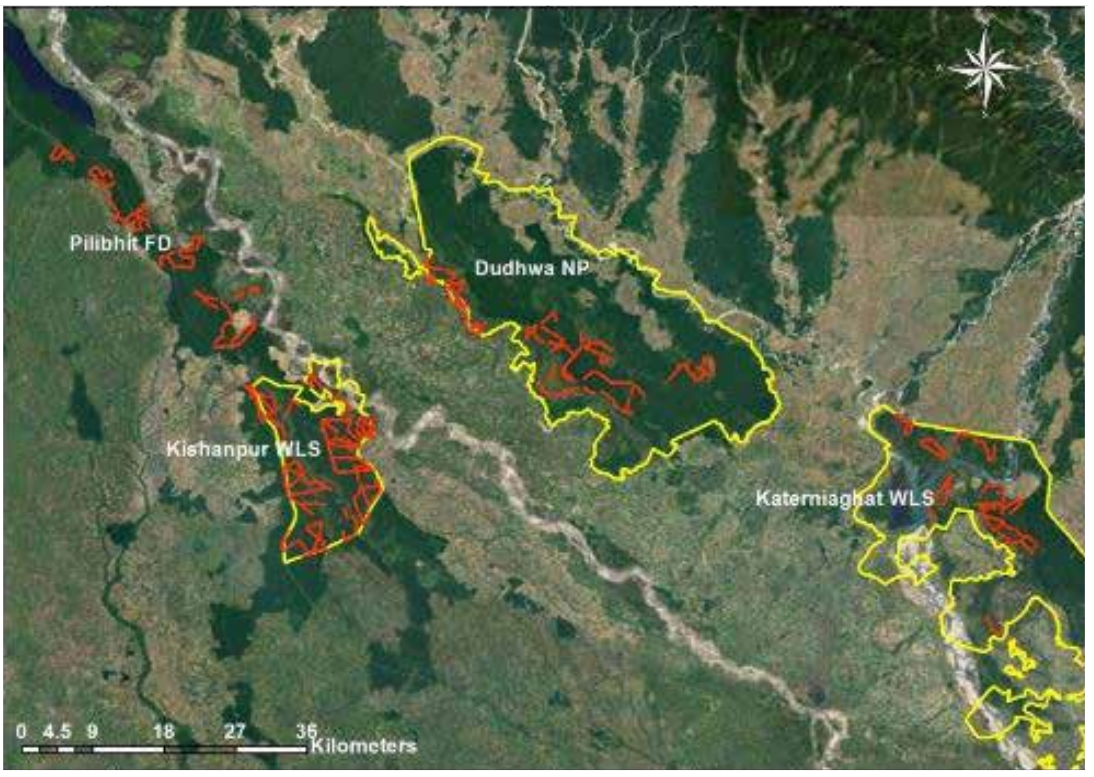
The project team also visited various sites where human-big cat conflict situations had arisen in the past. A reconnaissance of the areas around these sites was conducted to gather complementary data such as village location with respect to forests, nearest roads, hospitals, police stations, and the presence of basic amenities such as lighting, toilets etc. Wherever possible, victims of attacks were also interviewed to ascertain the nature of their injuries and the precise circumstances of the incident. Causality profiles were created to understand the scale and the spatial, temporal and social characteristics of conflict in these areas. This data was also used to prioritise villages or village clusters according to intensity of conflict for further action. Data gathered until 2013 was analysed, even though data on human-big cat conflict incidents continues to be collected.

Consultative meetings are organised on a regular basis in villages that have experienced conflict. These meetings provide a platform for local community members to speak about their experiences of and learnings from conflict situations, and articulate what according to them are possible reasons and solutions.

(b) Big cat ecology

Intensive surveys were conducted in Dudhwa and Pilibhit Tiger Reserves between 2012 and 2013, to understand the broad ecological parameters that were driving individual big cats into conflict with humans, such as prey depletion and specific consumption patterns vis-à-vis the relative abundance of leopards and tigers in different regions of the landscape. Data on habitat characteristics was also collected using standardised methods within a uniform grid framework (5x5 km). These grid cells were surveyed along natural trails to document various habitat characteristics including human disturbance (Nichols and Karanth, 2005).

Data was collected by trained field biologists and field assistants, accompanied by forest staff who were thus simultaneously trained in data collection methods. All data was recorded in structured data sheets. Trails from three to 13.5 km long were



Map 5: Trails surveyed (red lines) in the four PAs in the Dudhwa-Pilibhit TR landscape

walked within the grid layout. A total of 83 trails were walked (*Map 5*), covering about 410.5 km in total. Each trail was also divided *post-hoc* into 250 m segments to ascertain the relative abundance of tigers and leopards across each 250 m replicate segment (Nichols and Karanth, 2005). Indirect signs of animal presence such as pugmarks, scats and scrape signs were recorded in each trail and quantified with respect to individual segments of the trail.

This data was utilised to generate indices of relative abundance of these two carnivore species. Intensity of area use was established based on frequency of occurrence of signs in the surveyed segments (i.e. number of segments with carnivore signs / total number of segments surveyed). Simultaneously, data on prey species (through direct sighting, pellet group count and track signs) was collected on the same segments to determine their frequency of occurrence in the surveyed area.

To understand the dietary patterns of tigers and leopards, scats found along forest trails were opportunistically collected during surveys. Collected scats were stored in plastic bags labelled with date, GPS location and associated secondary signs of animal presence. Collected scat samples were then soaked in tap water and hand-washed, passed through three sieves of decreasing pore sizes, washed with Xylene and sun dried. Components of each sample (including hair, bones, teeth, feathers, scales, claws, hooves and vegetation remains) were then separated and stored in individual plastic bags, labelled appropriately. For hair samples, permanent slides were prepared using the DPX mounting medium. Prey species were identified based on microscopic hair analysis and presence of bone fragments, teeth, nails and other hard parts. Whole mount (medulla) and scale patterns (cuticular) were observed under a standard (400x) magnification microscope (Leica) (*Plates 1&2*). Scat samples were analysed at the laboratories of the Wildlife

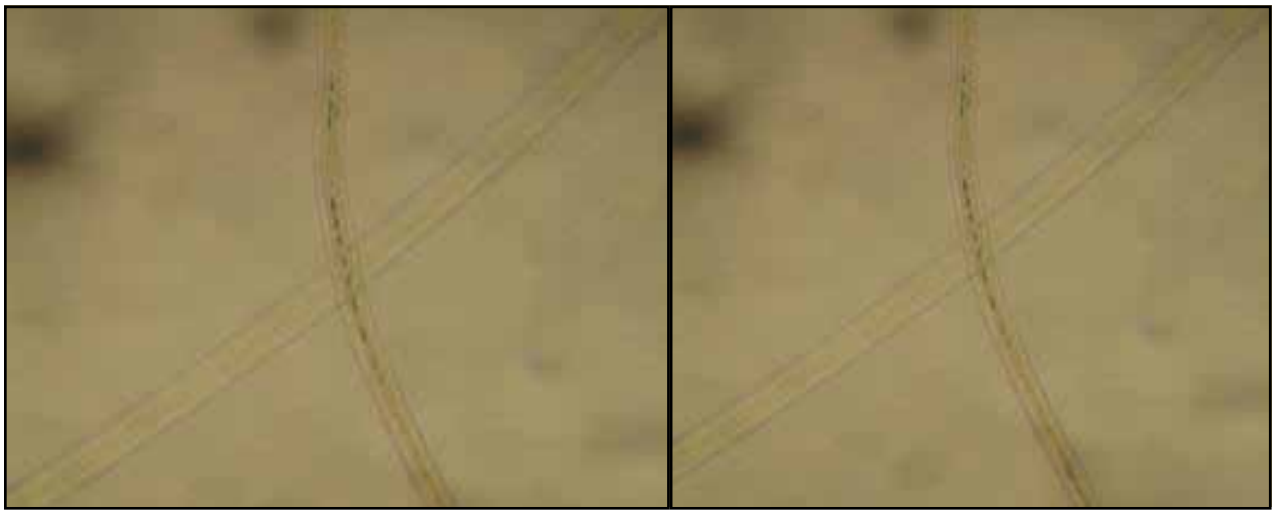


Plate 1: Medulla patterns of wild pig (left) and Hanuman langur (right) hair

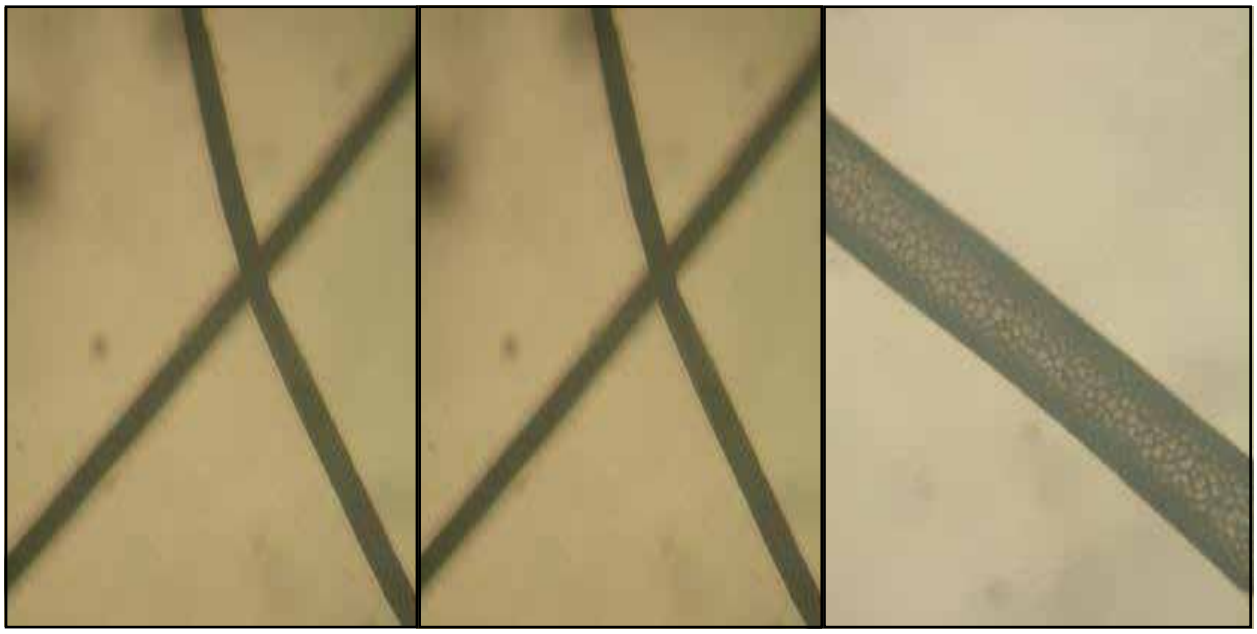


Plate 2: Medulla patterns of spotted deer (left), sambar deer (middle) and domestic buffalo (right) hair

Institute of India, Dehradun, and the National Zoological Park, New Delhi (Basak *et al.*, 2016).

(c) Socio-economics and perceptions of conflict
To understand the patterns of dependence of local communities on forests, as well as their subsistence patterns and their perceptions of conflict with wild animals, a total of eight prioritised villages (based on intensity of conflict recorded over a nine to ten year period) were intensively surveyed. Interviews were conducted using pre-formatted questionnaires to collect data on various aspects of people's livelihood status such as primary occupation, cropping patterns, factors for which they depended upon forests, availability of toilets and electricity, modes of communication etc. Additionally, data on landholdings, problems associated with proximity to wildlife habitats and other issues faced by people were also recorded. A total of 355 people from different households were interviewed across the eight villages identified as conflict hotspots; on average, ten percent of households of each village were covered in the survey.

***(ii) Resolving Human-Big Cat Conflict* In Situ**

(a) The Rapid Response Team and community integration through Primary Response Teams
The project endeavours to rescue big cats (and at times, other animals) from conflict scenarios if circumstances do not permit any alternative measure to resolve such situations. To facilitate this, the expertise of a qualified wildlife veterinarian and that of a wildlife biologist is leveraged.

The wildlife biologist plays a crucial role in tracking, locating and identifying wildlife species in conflict situations, strategising the best mitigation measures applicable to a particular situation, planning possible capture strategies if required, assessing and identifying potential release sites based on the species captured, and monitoring conflict animals before and after release using camera traps and/or radio-telemetry. The biologist is also responsible for collecting circumstantial information (including relevant ecological data if available) in conflict situations, in order to develop detailed case files of each case.

The veterinarian employs his/her expertise in the chemical immobilisation of animals involved in conflict situations, either through remote delivery of tranquilisation darts or using tactical methods such as trap cages. The veterinarian also treats captured animals for injuries, ensures their recovery and evaluates their fitness for release back into the wild.

In addition, a trained sociologist or social worker is recruited into the project team to work with local communities, educating people on basic precautionary measures to be taken during conflict situations and particularly to prevent the formation of crowds that could potentially escalate such situations. The sociologist or social worker develops a rapport with community members in conflict hotspot villages and engages them in the management of conflict situations so as to reduce the incidences of attacks on humans and the chances of retaliation against the animal involved, thus addressing human-big cat conflict in the long-term as well.

These three subject experts are provided with the requisite equipment, including nets, handheld GPS units, automatic trap cages, camera traps, cameras, flashlights, binoculars, tranquilisation equipment and the necessary drugs, first-aid kits, public announcement systems, and a modified four-wheel-drive vehicle that can transport crates and cages.

Together, the three specialists and their equipment constitute the project's **Rapid Response Team (RRT).**

The RRT, however, cannot function effectively without the support and participation of local communities. It is crucial that communities which experience conflict on a regular basis know the importance of the RRT and how it functions. This is achieved through regular awareness meetings as well as the constitution of **Primary Response Teams (PRTs)** comprising community members who work alongside the RRT to resolve ongoing

conflict situations (Choudhury *et al.*, 2008). PRTs are constituted in villages that experience a high frequency of conflict with big cats or other wildlife. They usually comprise village elders, eminent members of the community, enthusiastic youth who are willing to partake in conflict mitigation, one or two deputed forest guards and, where possible, one police constable.

PRTs perform the following main duties:

1. Notifying the local forest department office and the closest RRT unit about conflict situations.
2. Spreading awareness in targeted villages about conflict, precautionary measures to be taken etc.
3. Inhibiting the formation of crowds and mobs.
4. Delivering first-aid care to people injured by big cats or other wildlife species.
5. Patrolling village boundaries and adjacent areas to detect animal movement.
6. Liasing to facilitate filing of compensation claims and ensuring their disbursement on time.

PRTs are constituted through a consultative process and are provided support in the form of basic equipment such as flashlights, mobile phones, utility vests, as well as signboards and brochures listing precautionary measures. They are also supported through regular capacity enhancement trainings and workshops: interactive sessions are held to understand their perspectives and ideas, information is shared on new ways of managing conflict, and knowledge is imparted on how wild animals behave, their importance etc. The PRTs are apprised, supported and mobilised by the RRT's sociologist / social worker.

The project's strategy for *in situ* mitigation of conflict situations with respect to big cat species is elaborated in *Figure 3*. Largely, it entails an assessment of the situation by the RRT to determine if the animal involved is a repeat offender (ritually killing livestock or attacking/ killing humans) or simply an animal that is passing through. Simultaneously, the closest PRT is mobilised and consultative meetings are held with key community members in order to inhibit the formation of crowds and minimise the chances of human injury or death due to unnecessary confrontation with the animal.

In situations where the animal involved is a dispersing individual that is only passing through or appears to be lost, it is either left alone until it returns to the forest on its own, or is actively driven back into the forest. In cases where the animal is stranded (for instance if it has accidentally fallen into a well or is trapped in a house) the RRT rescues it (employing the best applicable technique) and subsequently releases it in the nearest forest area depending on its overall condition. In other cases where the animal has localised itself and is repeatedly killing livestock for food, it is captured using the best technique applicable to the situation, and may be released

Plate 3: Indirect signs of animal presence such as pugmarks were recorded and quantified under the project. The data was utilised to generate indices of relative abundance of tigers and leopards.

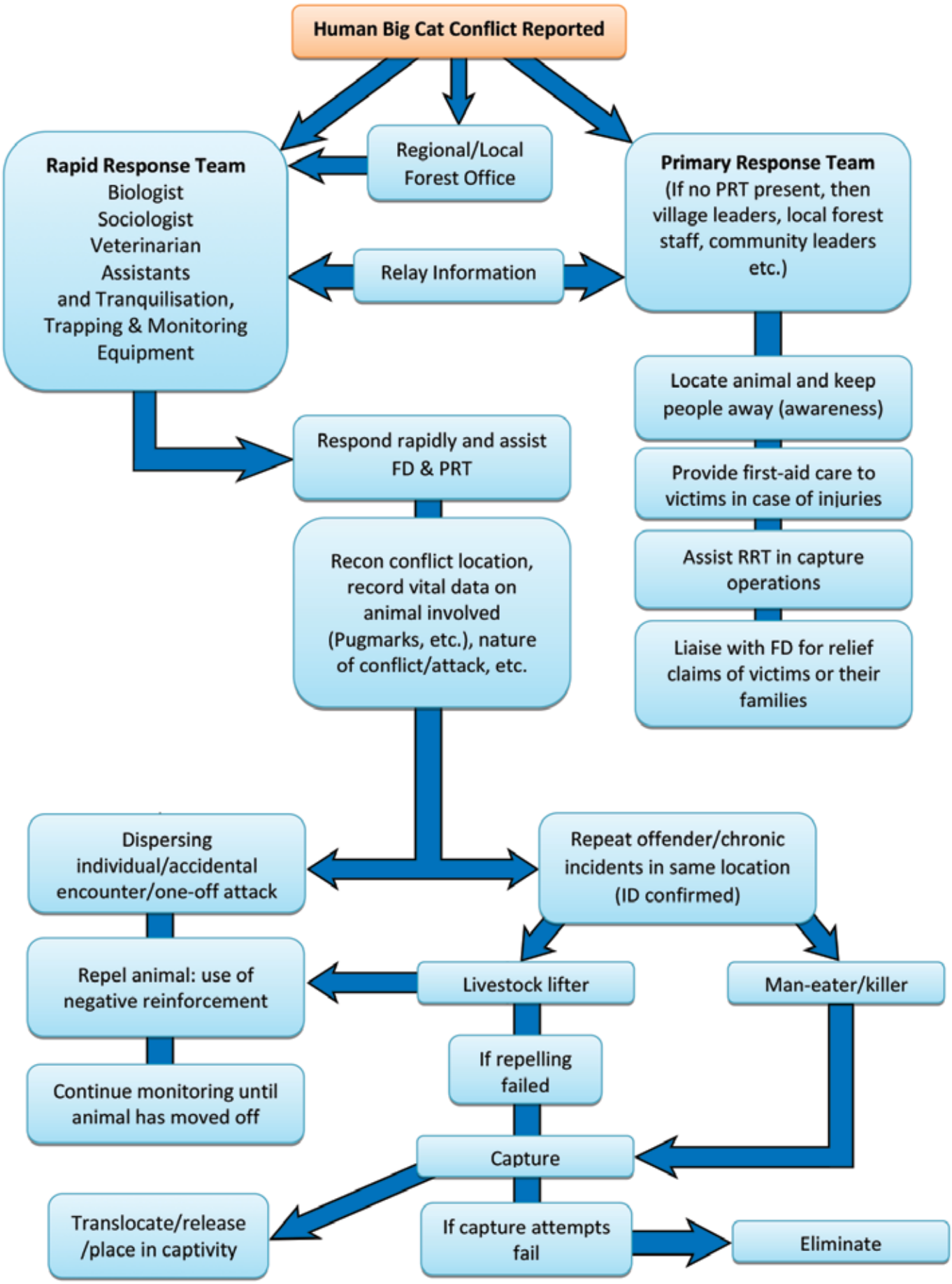


Figure 3: The project's strategy for *in situ* mitigation of conflict situations involving big cat species

into a natural habitat with sufficient natural prey base, provided it is not physically impaired and is deemed fit to hunt and fend for itself. In all cases where conflict animals are released back to the wild, the RRT's biologist is required to monitor the released animal till the time it becomes evident that it has settled into the natural environment and is in a healthy condition.

(b) Tracking and monitoring big cats in conflict situations

Being large sized cats, both leopards and tigers leave behind tracks that can be easily identified. Secondary signs such as pugmarks, scrape marks, scat depositions etc. (*Plates 3 & 4*), are not only indicators of the presence of these species but also allow for their relative size, and therefore age, to be determined. It is important that all such signs are photographed (with a relative measure alongside), geo-tagged and catalogued for future reference (see *Annexure*).

However, while such signs can provide crucial first-hand information to specialists, they often result in ambiguous interpretations, especially regarding gender differentiation of the animals involved (Singh *et al.*, 2014). New age tools such as camera traps prove more fruitful in not just identifying conflict animals but also tracking them over time, across large landscapes. Both leopards and tigers are adorned with distinctly patterned coats that are akin to human fingerprints, with each individual having a unique variant pattern of rosettes (leopards) or stripes (tigers). Camera traps are automated cameras that are triggered by movement (*Plate 5*). Placed appropriately along paths regularly used by these animals, camera traps provide pictures of big cats (as well as many other elusive species) that can be used for future reference, for instance after translocation into a new habitat (O'Connel *et al.,* 2010).

Plate 4: The pugmark of a tiger (left), scat of a tiger (centre) and pugmark of a leopard (right)

Plate 5: A camera trap mounted on a tuft of elephant grass (left) and a camera trap picture of a tigress in Dudhwa TR (right)

Used strategically, camera traps can prove to be vital tools for monitoring the movement of conflict animals across vast areas. All captured photographs of a conflict animal can be sequenced based on time stamps, and along with associated evidence such as pugmarks can be used to develop movement and area utilisation maps to understand movement patterns of the animal and how it traverses a vast landscape (Karanth, 1995; O'Connel *et al.,* 2010). Such information is vital for any capture operation and therefore needs to be a mandatory precursory exercise during conflict situations.

(c) Capturing big cats in conflict situations

Both leopards and tigers are large sized cats, highly elusive in nature, but dangerous to humans when provoked. When these species move into human dominated landscapes, which are foreign and unfamiliar to them, they are often under great stress. However, in most cases, both tigers and leopards will avoid confrontation with humans if left alone.

Sometimes however, accidental as well as imposed encounters (when people attempt to mob or catch a glimpse of the animal) do occur. A big cat may also get into a situation wherein it is unable to evade confrontation with humans, such as if it falls into a well, gets stuck in a house or homestead, or falls victim to a trap set for other animals. In a few cases, leopards and tigers may resort to chronic hunting of livestock and (very rarely) of humans as well. While in cases involving chronic man-eaters the animals responsible are often killed or caught and placed under lifetime care, ones that indulge in regular livestock depredation are required to be captured and released in appropriate natural habitats depending upon their health status and age.

This is important because new recruits to natural populations are many a time forced to travel out of source habitats in search of new territories. In such circumstances leopards and tigers often venture into human habitations, as the major interconnectivities across natural habitats have been encroached upon by humans. It is necessary, therefore, to assess the situation and identify the animal (species, relative age and sex) prior to determining the most feasible mitigation method. In all such cases the active intervention of the RRT is required.

In cases where the animal needs to be captured (whether for translocation or for placement in lifetime care) two main techniques, **tactical** and **chemical capture**, are commonly employed. The former involves trapping the animal in conventional or improvised traps while the latter mainly involves the use of immobilisation drugs that are remotely delivered into the animal to sedate it.

Traditional trapping methods involve the use of trap cages and pitfall traps. Trapping box

Plate 6: A collapsible leopard trap cage with detachable bait compartment (left) and a camouflaged tiger trap cage placed to capture a conflict tiger (right)

cages come in a variety of shapes and sizes (Ver Cauteren *et al.,* 1999), but are commonly made of heavy gauge steel or iron, with a trapping mechanism that is triggered either by pressure (weight of the animal) or by motion (movement of a trigger lever by the animal). Box traps, used particularly for carnivores, often consist of an additional compartment to allow placement of a live/dead bait to lure the animal into the cage (*Plate 6*).

Trapping cages are required to be well camouflaged within the habitat that the animal is present in (*Plate 6*), and both the trap cage and the bait are required to be placed side by side, sometimes for several days, to habituate the animal to the bait's presence before it is placed inside the cage (see *Chapter 6* for more details).

Improvised pitfall traps can also sometimes be used to strategically capture big cats in conflict situations. A pitfall trap comprises a deep pit underneath camouflaged material such as bamboo strips covered with soil or foliage (*Plate 7*), through which the animal drops into the pit due to its sheer weight. The pit is required to be dug in a manner that prevents the animal from jumping out and escaping. The depth should ideally be not less than 15 feet, the side walls smooth and vertical, and the dimensions at the top and bottom about 12x12 feet. Care must be taken to ensure that water does not accumulate at the bottom of such pits. The camouflaged covering can further be improvised to allow for live bait to be tethered on it. This has to be planned and devised carefully to keep the bait from disturbing the camouflaged cover of the pit. Alternatively, partially eaten kills can also be dragged and placed on top of the pit as bait (see *Chapter 6* for more details).

Another, albeit less used tactical capture method involves restraining the conflict animal using netting. Netting is more apt in situations where the animal is hiding in a small agricultural patch. Thick nylon nets not less than six to seven feet high and with pore sizes no larger than four to five inches are placed strategically on one side of such a patch, while the remaining sides can be blocked with makeshift bamboo or wooden barricades, or even cloth stretched between wooden or bamboo poles, acting as a visual barrier (*Plate 8*). Such methods have been tried, successfully or near successfully, in isolated capture operations involving tigers. While this method is relevant in the case of both leopards and tigers, the pitfall trap method is suitable only for tigers.

As most big cats (or other wild animals for that matter) do not perceive nets as barriers they are likely to attempt jumping through the netting, thereby entangling themselves. Although captures


Plate 7: A freshly dug pitfall trap (left), and a pitfall trap being prepared with a camouflaged cover and a bait platform in the centre (right)


Plate 8: Nets placed along a sugarcane patch to capture a leopard (left), and white cloth used on other sides of the same patch to create a visual barrier

using nets have proven to be very successful in a few cases, they are more risky; tigers and leopards can potentially break free, rendering bystanders and RRT/forest department personnel vulnerable to retaliatory attacks. The use of nets also leaves the captured animal vulnerable to spontaneous mob attacks, and therefore to injury or death. Nets are also sometimes used to physically restrain partially sedated tigers or leopards, which is not a good practice. Ideally, the anaesthetic should be topped off with an additional dose and the animal should be approached only after complete sedation. Other relevant methods for the tactical capture of big cats are discussed in *Chapter 6*.

Chemical capture operations are most useful when the conflict animal is confined and unable to move around much – for instance when it is trapped in a well or pit. Chemical capture is also essential while using tactical techniques such as netting or pitfall traps. This is because both tigers and leopards cannot be contained in nets or pits for long and need to be moved into transportation crates. More important, besides box trapping, chemical capture is often the method most used to capture big cats in free ranging situations, whether from a vehicle, elephant back, or from strategic locations like watchtowers.

Chemical immobilisation is therefore an absolute necessity in all capture cases. It involves the remote delivery of anaesthetic drugs intra-

muscularly, immobilising the animal for a specific period of time. It allows the capture team to thoroughly examine the animal for impairments, injuries etc, and is also used at times to calm down an agitated/stressed animal during translocation.

The most common combination of drugs used for the chemical immobilisation of big cats in India is Ketamine hydrochloride and Xylazine hydrochloride, as well as the antidote for Xylazine, Yohimbine hydrochloride. Drugs like Medetomidine hydrochloride, a better substitute for Xylazine, are not marketed in India and are therefore not available easily. The Ketamine and Xylazine dosage used in an operation depends primarily upon the perceived/identified body weight of the animal (inferred from the body size or its indicator). The ratio of Ketamine to Xylazine used also depends on the personal experience of the veterinarian (*Table 2*). These drugs are typically used in air/gas pressurised or charge-fed syringe darts that are remotely fired through air/gas propelled syringe projectors, more commonly called tranquilisation guns (*Plate 9*). If the animal is stationary or moving at a relatively slow pace and is at a close distance, such darts can be delivered through blow pipes, and if the animal is already restrained or unable to move, jab sticks can be used to deliver the drugs.

Chemical capture operations are mandatorily performed by the trained RRT veterinarian (with appropriate permission from the state forest department), as many of the immobilisation drugs can result in the death of the sedated animal if used in improper dosages or without veterinary supervision.

(iii) Sensitising and Motivating Local Communities

Resolving conflict situations through the capture and removal of the animals involved is a short-term measure to ensure that individual big cats (and sometimes other wild animals) are not killed, and instances of human injury and death are minimised. These efforts in no way aim at reducing the intensity or frequency of conflict in the long run.

Traditionally, human-wildlife conflict is understood to comprise human-wildlife interactions leading to adverse impacts or costs to the humans involved (Woodroffe *et al.*, 2005). However, it can also be viewed as a negative human perspective towards the mere presence of a wild animal in proximity to an area of human habitation. Such perceptions can only be altered through long-term education and sensitisation initiatives, tailored to specific needs and outcomes.

In its efforts to reduce the overall intensity of conflict in the Dudhwa-Pilibhit TR landscape, WTI's project therefore focuses on two important initiatives aimed at sensitising local communities towards the reasons for conflict and how it can be

Plate 9: Examples of gas powered (DanInject) tranquilisation rifles (left), and a forest officer holding a double barrel DanInject rifle (right)

Table 2: Proportion of Ketamine and Xylazine hydrochlorides used for restraining tigers and leopards

TOTAL DOSE	DOSAGE (per kg body weight)	REFERENCES
(a) Tigers		
	Ketamine: 7 mg/kg BW Xylazine: 1 mg/kg BW	Lumb, W and E Jones (1984). Anesthesia of lab and zoo animal. Veterinary anesthesia. 2nd Edition. Lew and Febiger, Philadelphia. Pages 413-92
Total dose: Ketamine: 500 mg Zylazine: 200 mg		Gogoi, BK (2005). Immobilization of a free ranging Royal Bengal Tiger (*Panthera tigris tigris*) at Tezpur, Assam. ZOOS' PRINT, Volume XX(4): 12-13
Ketamine: 350-570 mg Xylazine: 42-142 mg	Ketamine: 0.5 mg/kg BW Xylazine: 0.3 mg/kg BW	Seal US, Armstrong DL, Simmons LG. (1987). Yohimbine hydrochloride reversal of ketamine hydrochloride and xylazine hydrochloride immobilization of Bengal tigers and effects on hematology and serum chemistries. Journal of Wildlife Diseases. 23(2): 296-300
Total dose: Ketamine: 300 mg Xylazine: 150 mg		Gupta, A, Jadav, K, Nigam, P, Swarup, D and Shrivastava, AB (2003). Eyelid neoplasm in a white tiger (*Panthera tigris*) as report. Veterinary Archive 83(1): 115-124.
(b) Leopards		
	Ketamine (2.32 ± 1.1 mg/kg) Xylazine (1.16 ± 0.5 mg/kg)	Sontakke, SD, Umapathy, G & Shivaji, S (2009). Yohimbine antagonizes the anaesthetic effects of ketamine–xylazine in captive Indian wild felids. Veterinary Anaesthesia and Analgesia. 36: 34-41
	Ketamine: 5 mg Xylazine: 1.5 mg	Deka, K, Athreya, V, Odden, M and Linnell, J (2012). Chemical immobilization of leopard *Panthera pardus* in the wild for collaring in Maharashtra, India. Journal of Bombay Natural History Society. 109(3): 153-157
	Ketamine: 5 +/- 2 mg/kg Xylazine: 1.4 +/- 0.3 mg/kg	Belsare, AV, Athreya, VR 2010. Use of xylazine hydrochloride – ketamine hydrochloride for immobilization of wild leopards (*Panthera pardus fusca*) in emergency situations. Journal of Zoo and Wildlife Medicine. 41(2): 331-3.

minimised through simple behavioural changes. These initiatives attempt not only to impart vital information that can help reduce conflict with big cats, but also create a lasting rapport with the populace, thus garnering crucial support required during on-ground mitigation activities.

(a) Spreading awareness and sensitising local communities

The focus here is on the adult populations of villages that regularly experience conflict with large carnivores as well as other animals. The endeavour is to establish an open dialogue and develop a long-term rapport, and make people realise that conflict can be reduced through their own initiative, by constituting groups that are aware of the nuances of conflict with big cat species.

Consultative meetings are organised on a regular basis in villages that have experienced conflict (*Plate 10*). These meetings provide a platform for local community members to speak about their experiences and learnings from conflict situations, and articulate what according to them are possible reasons and solutions. These meetings also help in the constitution of PRTs (provided villagers voluntarily accept the formation of PRTs in their respective villages) and certain people volunteer to be part of these teams. Vital information is also shared during these consultative meetings, such as the basic precautionary measures to be taken during conflict situations involving potentially dangerous wild animals such as tigers and leopards.

In most cases, consultative meetings are organised with the help of already constituted PRTs and invariably start with open-ended discussions about human-big cat conflict. These discussions are initiated by the RRT sociologist, who also imparts knowledge about wild animals, especially big cats, their requirements, behaviour etc, as well as the importance of forested landscapes and how people living around these need to take an active part in conserving them.

The PRTs constituted in the landscape following these consultative meetings act as ambassadors of wildlife education and human-big cat conflict resolution (*Plate 11*). PRT members are taught, through periodic capacity building and awareness sessions, about the ways in which they can effectively sensitise people who are experiencing conflict in nearby villages. PRTs also form a bridge between the local community or village and the larger system, for instance by relaying first-hand information about a potential conflict situation to the RRT and forest department, or by mobilising communities to avoid the formation of crowds in areas where conflict animals may have taken refuge.

During conflict situations PRTs also act as *in situ* paramedics, delivering first-aid to persons injured by wild animals. They negotiate with local authorities such as the police or the forest department to mobilise manpower if required. They facilitate the disbursement of prescribed relief compensations in case of accidental deaths or injuries due to conflict. They also assess particular villages in their area of operation and suggest the implementation of specific conflict mitigation measures (e.g. the erection of signboards elucidating precautionary measures to avoid conflict, the provision of village electrification, the organisation of children's awareness programmes etc).

(b) Sensitising the youth

The project also aims to change the younger generation's attitudes towards wildlife in general. This initiative is targeted at school children in the project region, particularly in villages that continuously experience conflict with large carnivores such as tigers and leopards.

To help local children understand why wildlife and wild habitats are important, a variety of activities are conducted under this initiative. While simple classroom sessions are widely conducted, more interactive sessions are planned and implemented alongside, including the screening of short wildlife films as well as painting, essay writing and poster making events. For younger children (Class 3 - 5), interactive sessions are designed using innovative educational packs that allow them to engage with complex topics in a simple and enjoyable manner.

Plate 10: A consultative meeting with village elders

At every awareness event, children are first assessed on their knowledge levels with respect to local wildlife (such as key species found in the forests around them, basic intuitive precautionary measures etc.) through a comprehensive set of objective questions. The same questionnaire is presented in a slightly modified form after the event to assess the change, if any, in their knowledge. Depending upon the interest expressed by the children and their teachers, such events are often repeated over the years in order to keep certain topics, such as conflict mitigation, fresh in their minds.

(iv) Long-term veterinary interventions

Besides the educational and motivational initiatives that aim at long-term conflict mitigation, certain other initiatives are also implemented under the project. From a veterinary perspective there are two main activities, both of which involve safeguarding focal species and their prey bases from disease outbreaks that could potentially increase the intensity of conflict with humans and decimate populations of the focal species as well.

(a) Livestock immunisation

One common understanding with respect to large carnivores such as tigers and leopards is that they invariably rely on natural prey species for food. Most of these prey species are ungulates, which are biologically very similar to domestic ungulates and therefore susceptible to contagious diseases prevalent among domestic livestock.

In situations where livestock graze extensively within forested areas, outbreaks of diseases such as anthrax and Foot-and-Mouth among domestic ungulates can potentially wipe out entire wild ungulate populations. Such abrupt disease outbreaks can cause a number of large carnivores to come in direct conflict with humans, since with their natural prey base depleted they could begin frequenting human habitats in search of easy prey.

It is essential, therefore, that existing livestock populations around the forest fringes are immunised against common contagious diseases. This creates an 'immune belt' around the forests, safeguarding natural prey species and their predators against such stochastic events. The project therefore endeavours to organise regular livestock immunisation and health camps in fringe villages of Dudhwa and Pilibhit TRs, in an effort to systematically immunise as many heads of livestock as possible against common communicable diseases.

(b) Post-mortem investigations

There are certain diseases such as Canine Distemper Virus that affect big cat species as well. It is thus important to record and investigate all detected mortalities of wild animals within and outside Protected Areas. Post-mortem investigations are conducted at the request of the state forest department and in the presence of forest department staff. In all investigations it

Plate 11: A group photo of the members of four PRTs established in the Dudhwa-Pilibhit TR landscape

is mandatory to take biological samples such as blood and tissues to test for possible infections. Post-mortem investigations are regularly conducted by the RRT veterinarian, in some cases (especially those involving charismatic species such as tigers and rhinoceroses) in the presence of external veterinary doctors, to arrive at unbiased diagnoses.

(v) Capacity enhancement of frontline forest staff

To ensure effective and enduring conflict mitigation, it is critical that the skills of local forest department staff be appropriately enhanced. While a number of forest department offices are relatively well equipped with capture equipment such as trap cages, nets, tranquilisation guns etc., frontline personnel often lack knowledge and skills regarding the appropriate use and maintenance of such equipment.

Most forest department staff also do not receive adequate training with respect to the nuances of tracking and monitoring wild animals in the field, whether through signs of animal presence or the use of modern tools such as camera traps. They are also rarely aware about the need or indeed the well-established methods of building a rapport with local communities and working in concert with them. The project thus aims at organising comprehensive capacity building (training) workshops across its area of operation as well as in other parts of the state of Uttar Pradesh, to address all these lacunae (*Plate 12*).

These capacity building workshops aim at enhancing the existing skillsets of frontline forest staff to enable them to handle conflict situations independent of external support. The workshops incorporate classroom as well as field level training sessions, wherein a variety of information, ranging from the tracking of different wildlife species to the recording of conflict data and the operation and maintenance of trap cages, lures etc. is imparted. Trainees are also taught the mechanisms of building a rapport with local communities and the usefulness of community networks in handling conflict situations. They are apprised, in addition, of the methods and legal provisions for controlling crowds during conflict situations, as well as relevant aspects of wildlife conservation policies and laws.

It is expected that this initiative, systematically implemented over time, will further the development of a highly skilled force of forest department personnel to mitigate human-wildlife conflict in more effective ways.

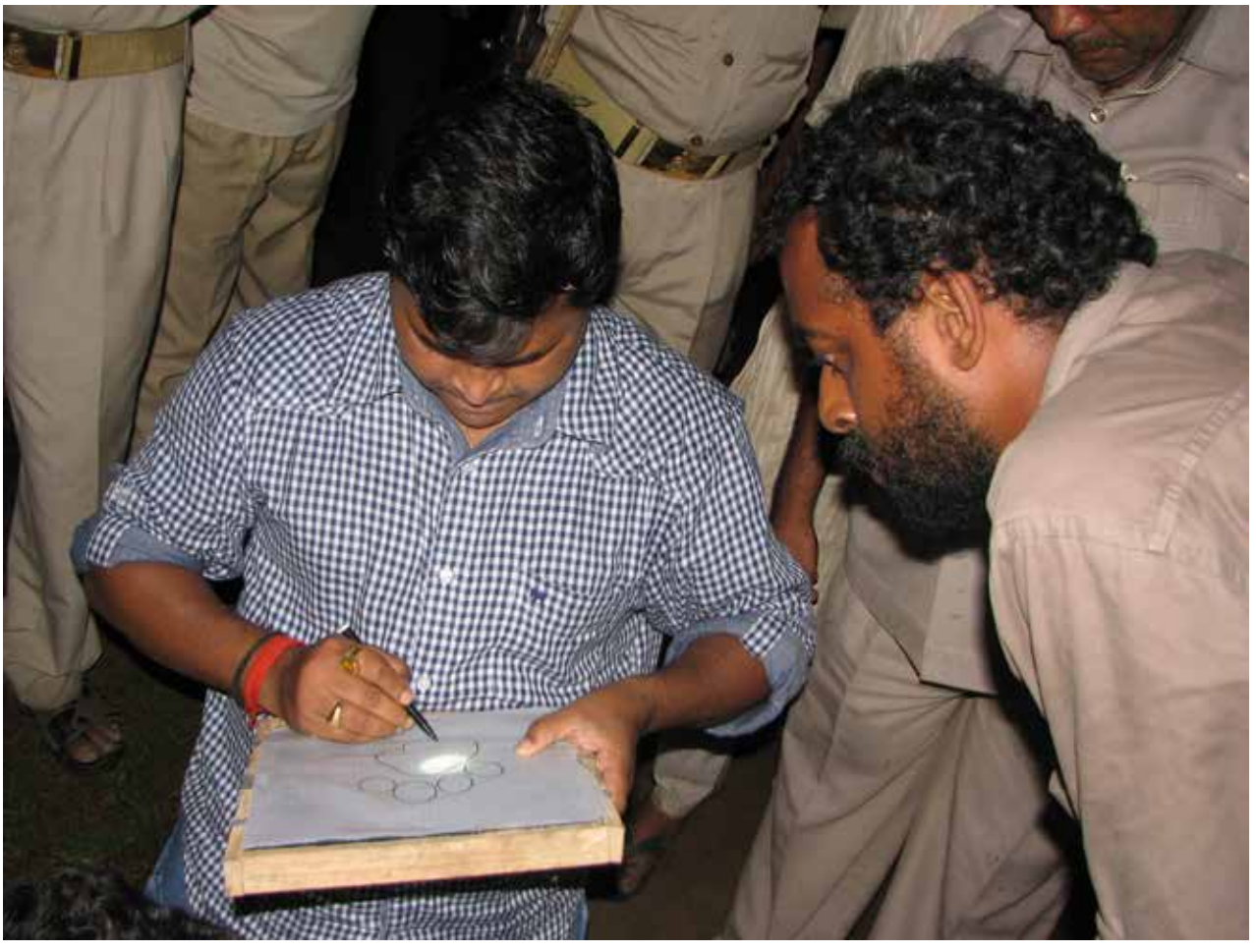


Plate 12: Forest department staff being trained in managing local communities during conflict (top), and a training session on recording and analysing pugmarks of tigers and leopards

4. PROJECT IMPLEMENTATION AND RESULTS

(i) Patterns of Human–Big Cat Conflict in Dudhwa and Pilibhit Tiger Reserves

(a) Human deaths and injuries caused by tigers and leopards

A total of 151 conflict cases were recorded in the Dudhwa-Pilibhit TR landscape between February 2000 and December 2013, where humans either died (n = 68) or were injured (n = 83). Five species of mammals, namely tigers (n = 73), leopards (n = 63), sloth bears (n = 11), elephants (n = 2), an unidentified canid (n = 1) and one reptile species, the Indian marsh crocodile (n = 1) were involved in these cases, with tigers and leopards accounting for 90.1% (n=136) of the total recorded incidents (*Figure 4*). It is worth pointing out that while these records reveal the overall patterns of conflict in the landscape, they by no means represent the actual number of cases that occur, considering the fact that cases in the more remote areas generally go unreported and unrecorded. Further, most forest department offices do not have a consistent practice of systematically recording data pertaining to conflict: for instance, there are no recorded cases of conflict from any of the regions between 2001 and 2002.

It was interesting to note that in almost all villages where conflict with large carnivores had been recorded (including the surveyed eight villages) there were virtually no sanitation facilities – most village folk utilised the boundaries of their agricultural fields or the forest fringes for defecating or urinating.

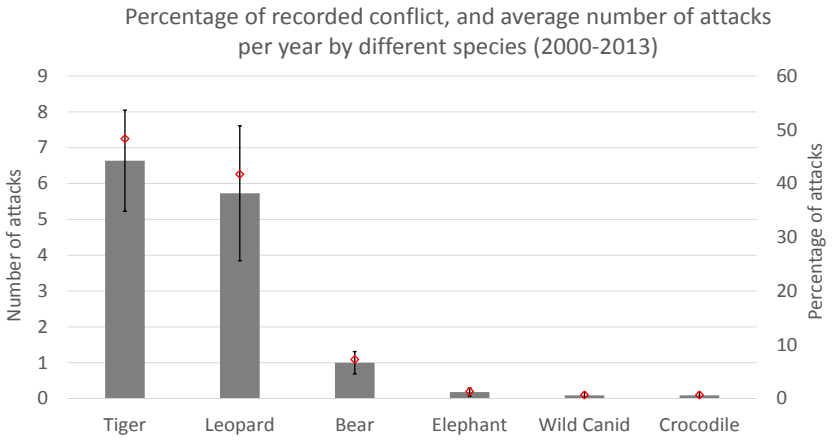


Figure 4: Bar graph showing average number of human-wildlife conflict cases per year (grey bars; left Y axis) leading to human death or injury, and percentage of cases (red markers; right Y axis) recorded involving different species in the Dudhwa-Pilibhit TR landscape

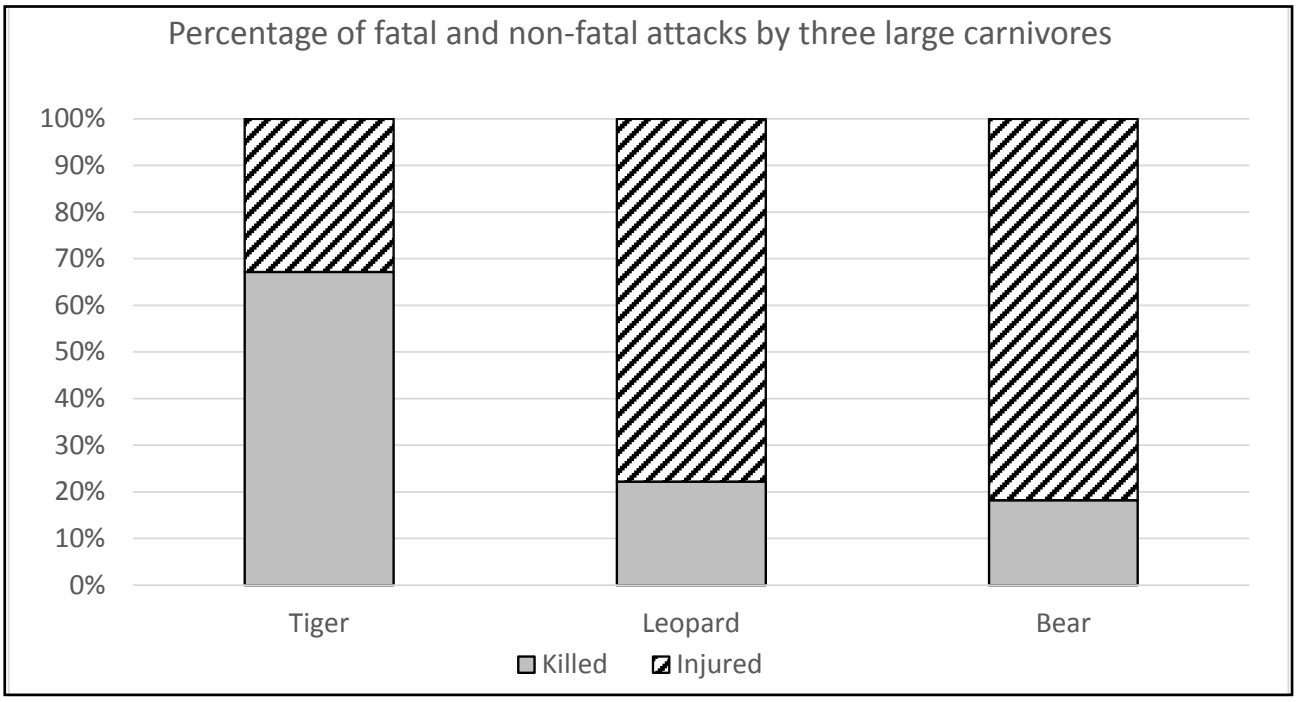


Figure 5: Stacked bar graph showing the percentage of humans killed and injured in attacks by tigers, leopards and bears in Dudhwa and Pilibhit TRs

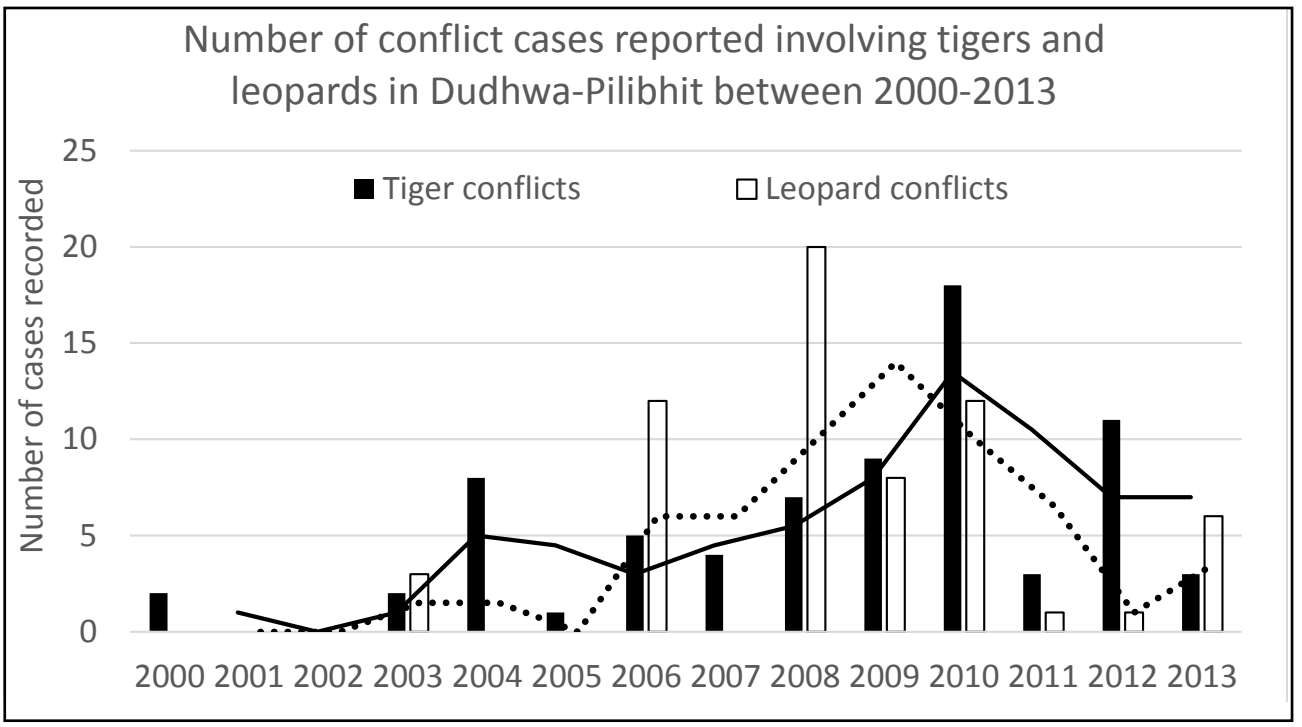


Figure 6: Bar graph showing the number of recorded cases in the Dudhwa-Pilibhit TR landscape between 2000 and 2013. Trend lines are two step moving averages for the number of cases involving leopards (dotted) and tigers (solid)

The 151 reported conflict cases were all recorded from 94 fringe villages of Dudhwa and Pilibhit TRs, with a total of 136 humans having been attacked by tigers or leopards in these villages between 2000 and 2013 (*Figure 4*). Among these cases, tiger attacks led to a significantly higher number of human fatalities (49 deaths and 24 injuries; Wilcoxon sign rank test with 10,000 Monte Carlo simulations: V=54; P=0.03). Leopard attacks on the other hand caused a significantly higher number of injuries (14 deaths and 49 injuries in the same period; Wilcoxon sign rank test with 10,000 Monte Carlo simulations: V=3; P=0.036; *Figure 5)*.

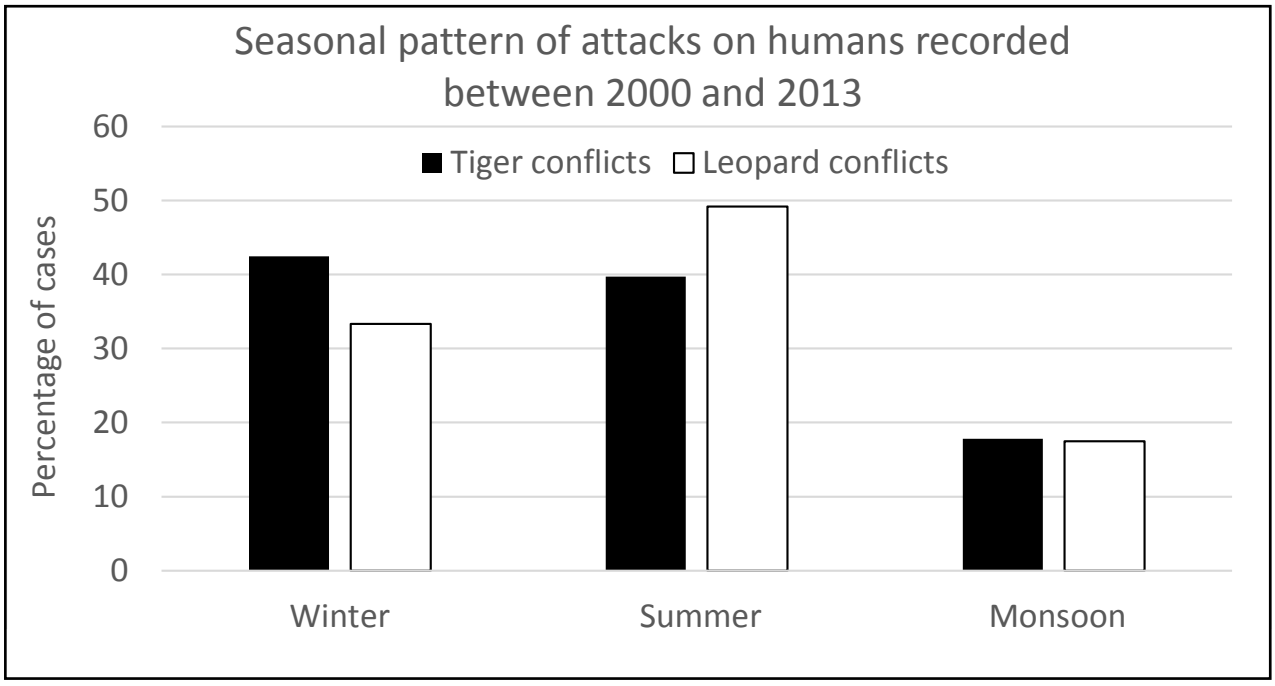


Figure 7: Bar graph showing the seasonal distribution of human–leopard/tiger conflict cases recorded in Dudhwa and Pilibhit TRs

A majority of the attacks caused by tigers (57 attacks, or 78.1%) were recorded during a seven year period (2006-2012), while conflict with leopards peaked between 2008 and 2010 (40 attacks, or 63.5%) with a subsequent sharp decline thereafter (*Figure 6*). Leopard and tiger attacks on human beings appeared to have a significant seasonal variation as shown in *Figure 7*. Tiger attacks were found to be higher in winter (October-February: n=31 or 42.5%) with the highest peak in February (n=14 or 19.2%), which probably corresponds to a high influx of people collecting fuelwood in forest areas, followed by summers (March–June: n=29 or 39.7%).

Among human casualties caused by tigers, most victims were male (n=40 or 81.6%) (Wilcoxon sign rank test with 10,000 Monte Carlo simulations: V=21; P=0.036). Similarly, among humans injured by tigers, almost 75% (n=18) of victims were male (Wilcoxon sign-rank test with 10,000 Monte Carlo simulations: V=21; P=0.03). *Table 3* shows the sex and age composition of people killed or injured by tigers between 2000 and 2013. No such significant difference between the gender of leopard attack victims was observed (Wilcoxon sign rank test with 10,000 Monte Carlo simulations: deaths: V=2; P=1; injuries: V=24.5; P=0.09). This significant preponderance of male fatalities due to tiger attacks is most likely because men venture into forests to a greater degree than women, and most tiger attacks are recorded to occur in such areas (*Figure 8*).

Although the range of ages of people attacked by tigers varied vastly from seven to 70 years, a deeper scrutiny revealed that people in the 11–50 age category were most commonly attacked (69.9%). Contrastingly, the percentage of humans attacked by leopards reveals that some 42.9% of attacks involved children below 10 years of age, with no significant difference between the sexes of victims. The sex and age class of leopard victims have been summarised in *Table 3*. Among the human casualties caused by leopards, almost all (n=11 or 78.6%) were children below 10 years. Among the 49 humans injured, 32.7% were children below 10 years. However, young and middle-aged people (age 21-50) were most commonly (42.9%) injured by leopards.

In terms of location, leopard attacks were mainly concentrated within/near village boundaries (92.1%), with 47.6% of attacks occurring inside houses or near homesteads, 15.87% occurring within village peripheries and 28.6% taking place in agricultural fields (*Figure 8)*. A far less

Table 3: Sex and age class of tiger victims (2000- 2013)

Age-group (Years)	Tiger				Leopard			
	Killed		Injured		Killed		Injured	
	M	F	M	F	M	F	M	F
<10	1	1	0	0	7	4	9	7
11-20	7	3	4	3	1	1	4	3
21-30	6	0	4	1	0	1	6	2
31-40	12	1	5	1	0	0	6	3
41-50	6	2	1	0	0	0	1	3
51-60	6	1	2	0	0	0	4	0
61-70	2	1	2	1	0	0	1	0
>70	0	0	0	0	0	0	0	0
Total	**49**		**24**		**14**		**49**	

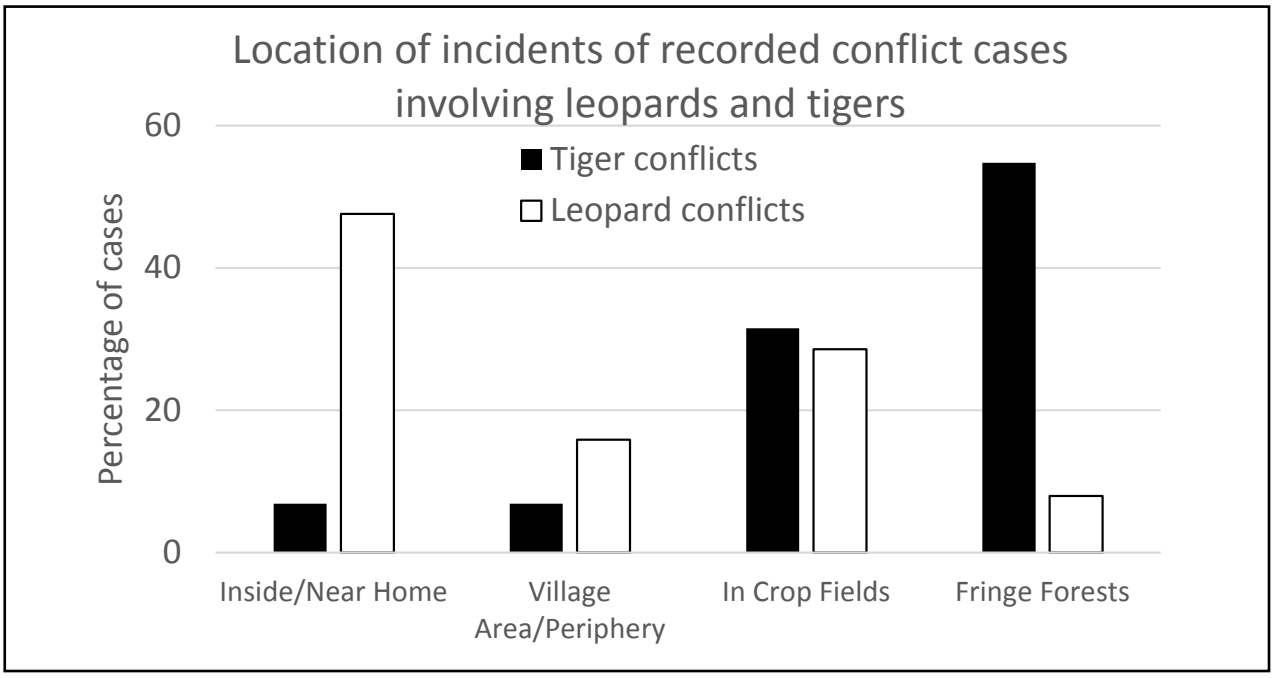


Figure 8: Recorded cases of attacks by leopards and tigers and their spatial distribution

significant percentage of attacks by leopards (7.94%) occurred inside forests or on their fringes.

Tiger attacks on the other hand occured largely inside forests or on their fringes (54.79%), while (31.5%) of attacks occured in crop fields, primarily sugarcane. As tigers are rarely found in villages or areas of dense human populations, only a small proportion of attacks (13.7%) were recorded to have occurred within houses or near homes (*Figure 8*).

The data on attacks by tigers and leopards also shows that 90.6% of tiger attacks occurred during the day (*Figure 9*). Most (75.5%) tiger attacks occurred between 9a.m. and 4p.m., exhibiting two peak periods, the first during forenoon (11a.m. – 12p.m.) and the second in the late afternoon (3p.m. – 4 p.m.). Conversely, a significant proportion of leopard attacks (44.6%) took place during the night hours (*Figure 9*), although the majority (55.4%) occurred in the evening hours. Leopard attacks were highest between 4p.m. and 8p.m. (53.6%), and

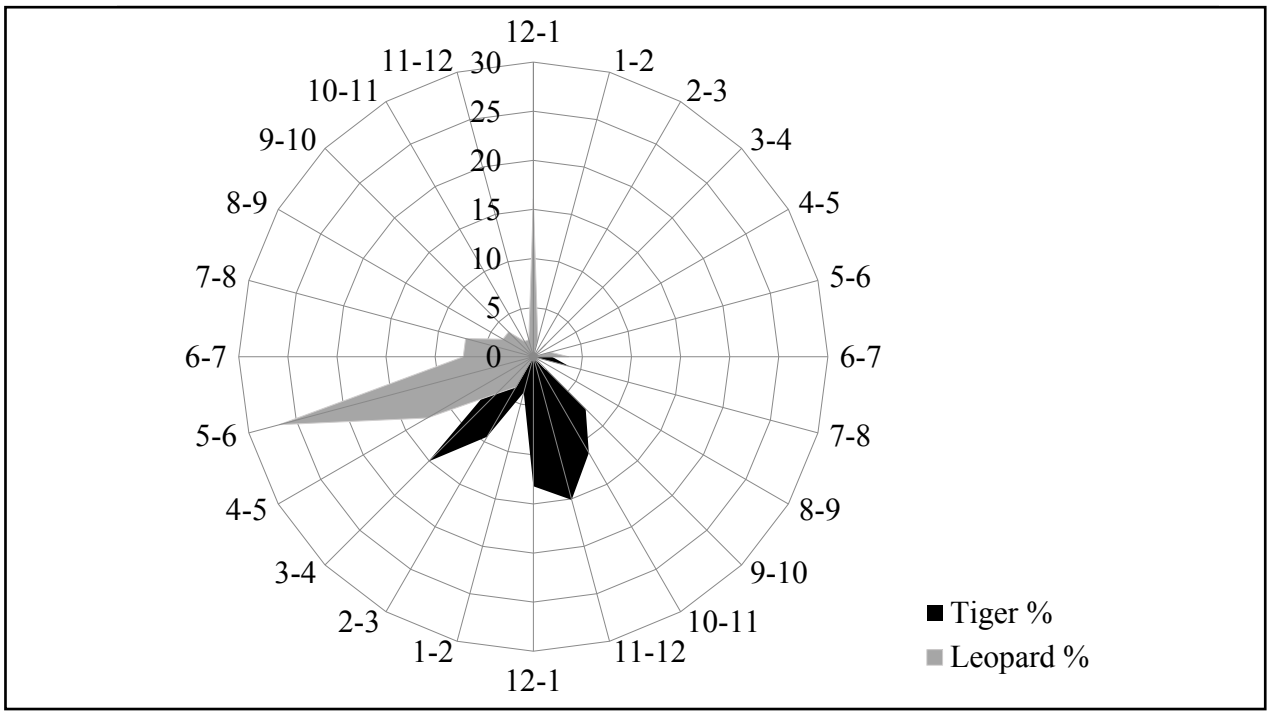


Figure 9: Distribution of attacks on human in relation to time. Time flows clockwise from midnight (12-1) indicated on the top of the circular axis

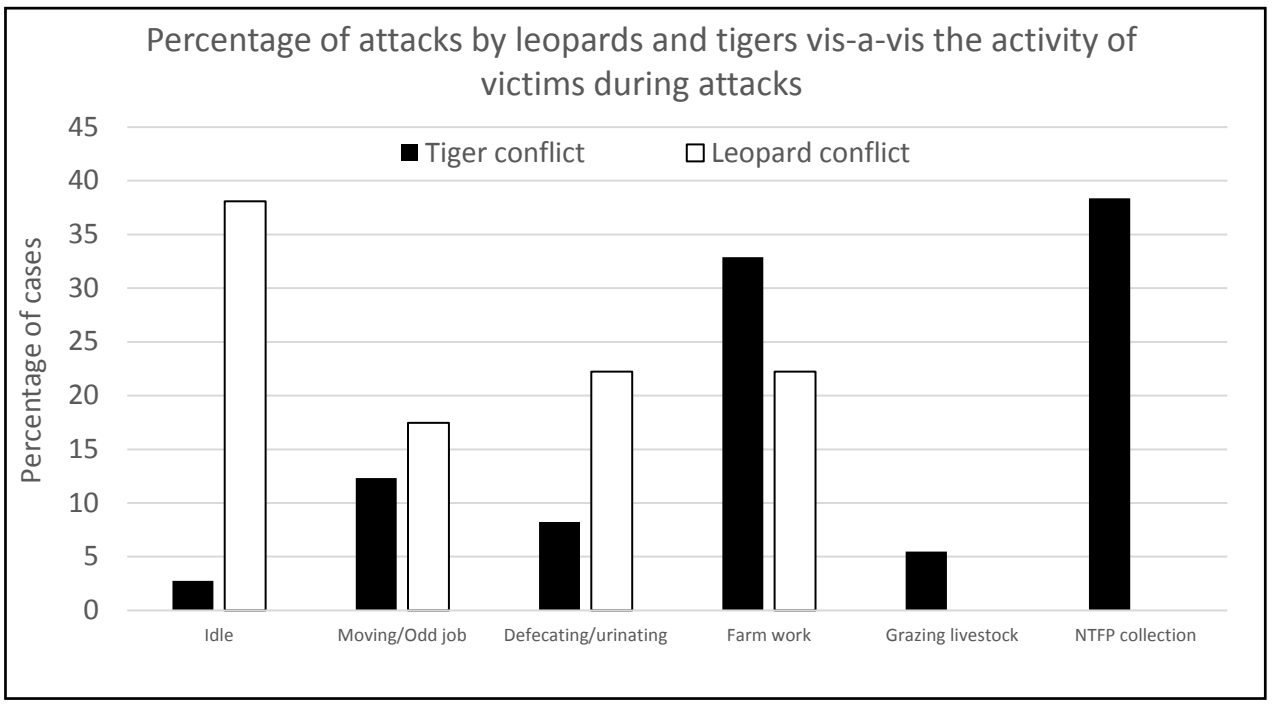


Figure 10: Bar graph showing activity of victims during attacks by tigers and leopards

between 12a.m. and 1a.m. (16.1%). This possibly indicates that while most tiger-human encounters are caused by humans accidentally disturbing tigers that are at rest in crop fields or fringe forests during the day, leopards may have sought humans out as potential prey during the twilight and night hours. It is notable that most leopard attacks were on children, and within villages and inside homes.

A closer look at the distribution of incidents *vis-à-vis* the nature of activity of the victims reveals interesting patterns *(Figure 10)*. Attacks by tigers were higher when people visited forests to collect firewood and other NTFP (38.6%). A high

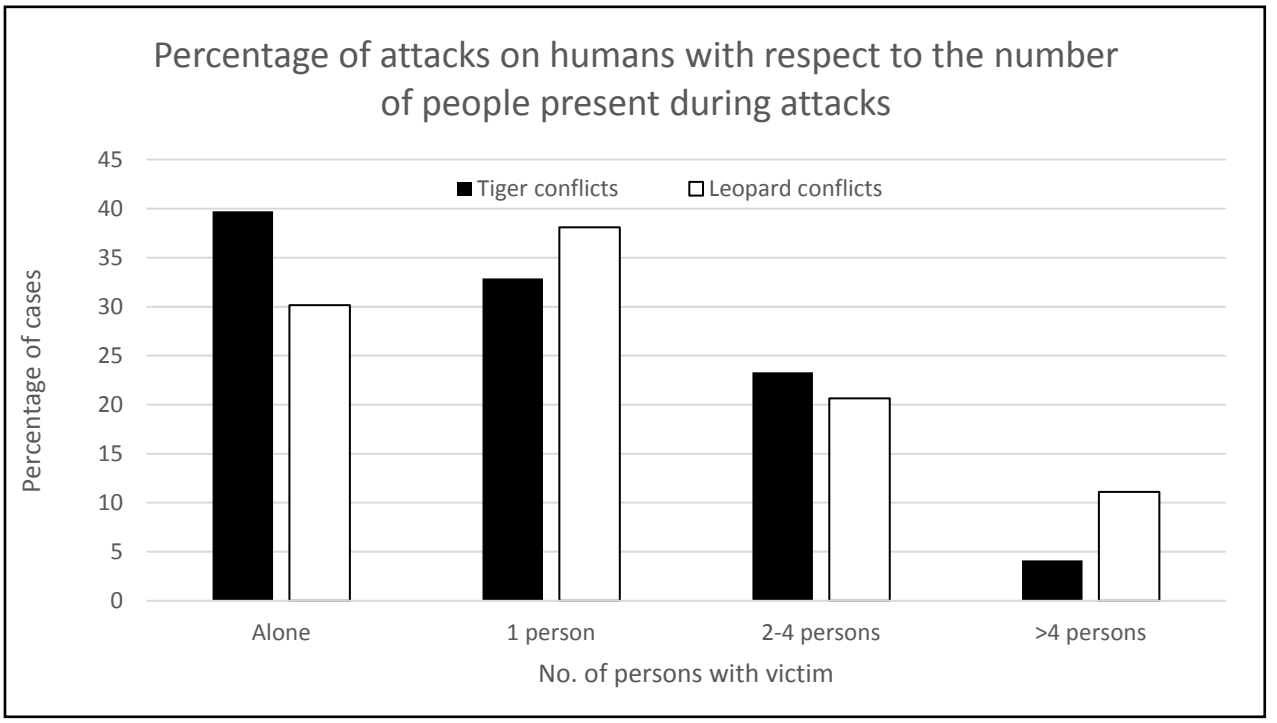


Figure 11: Human group sizes and distribution of recorded attacks by tigers and leopards

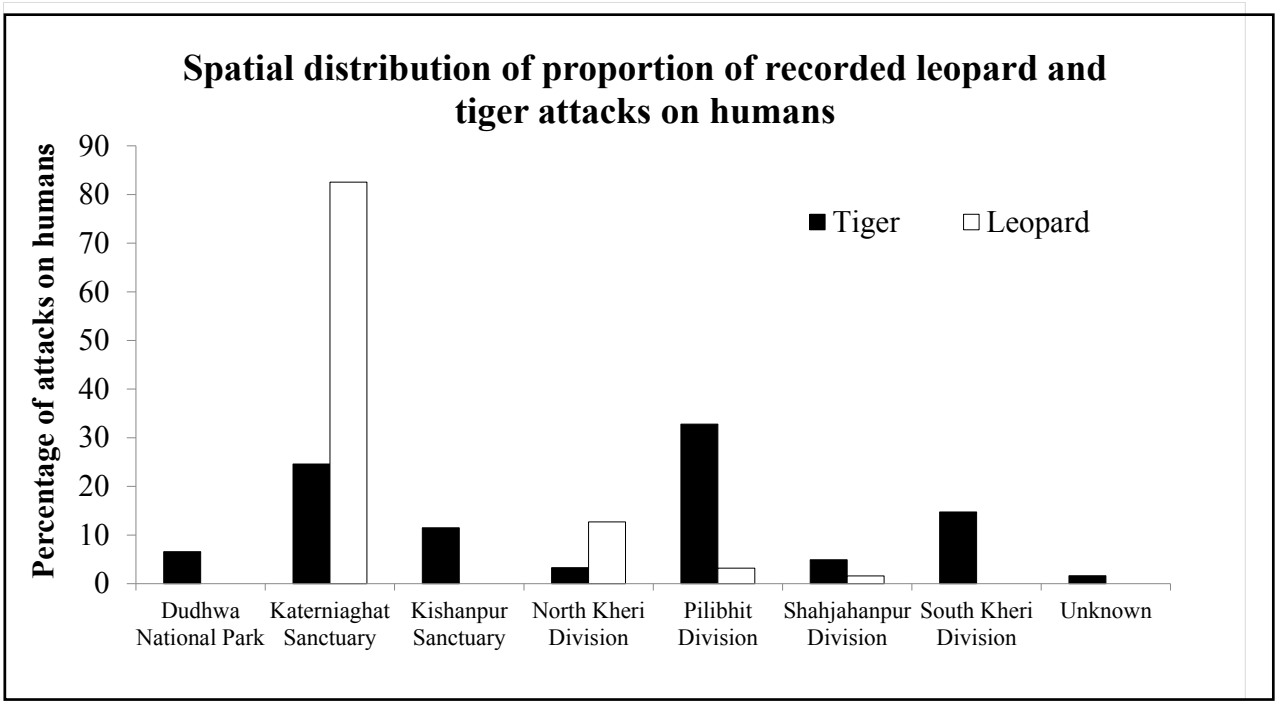


Figure 12: Distribution of recorded conflict cases with the two big cat species in various forest divisions of Dudhwa and Pilibhit TRs

percentage of tiger attacks (32.9%) also occured when people were working in their farms, and about 23.3% of the attacks occured when people were doing odd jobs, sitting, moving, defecating or urinating in the village periphery or fringe forests.Contrastingly, the highest proportion (77.8%) of leopard attacks occured when victims (mostly children) were sleeping, sitting/standing idle, doing odd jobs or defecating/urinating. Only about 22.2% of the attacks occured while victims were engaged in farm work *(Figure 10).*

Group sizes of people present with the victim when attacks by tigers and leopards occurred ranged from one to six individuals. It is evident that the majority of attacks by tigers and leopards occurred while the victims were alone or with just one additional person close by (*Figure 11*), and the proportion of attacks reduced with an increase in group size. One could also possibly expect that the severity of attacks would be reduced in the presence of other people and the chances of providing immediate medical care to victims would also be presumably higher with a larger number of people present.

Lastly, conflict with leopards and tigers was not evenly distributed across the Dudhwa-Pilibhit TR landscape (*Map 6*). Out of seven protected or conserved areas (Dudhwa National Park, Katerniaghat Wildlife Sanctuary, Kishanpur Wildlife Sanctuary, North Kheri Forest Division, Pilibhit Forest Division, Shahjahanpur Forest Division and South Kheri Forest Division) the highest percentage of recorded tiger attacks on humans was in Pilibhit Forest Division (33.9%), followed by Katerniaghat Wildlife Sanctuary (22.0%) and South Kheri Forest Division (15.3%). Kishanpur Wildlife Sanctuary also experienced significant human-tiger conflict with 11.9% of recorded attacks (*Figure 12*).

Most recorded cases of leopard attacks occurred near Katerniaghat Wildlife Sanctuary (82.1%), followed by North Kheri Forest Division (12.5%). A few isolated cases of leopard attacks on humans were also reported from Pilibhit and Shahjahanpur Forest Divisions (*Figure 12*). Overall, the data indicates Katerniaghat WLS and Pilibhit Forest Division to be the worst affected in terms of humans killed or injured by the two big cat species.

(b) Livestock depredation by tigers and leopards

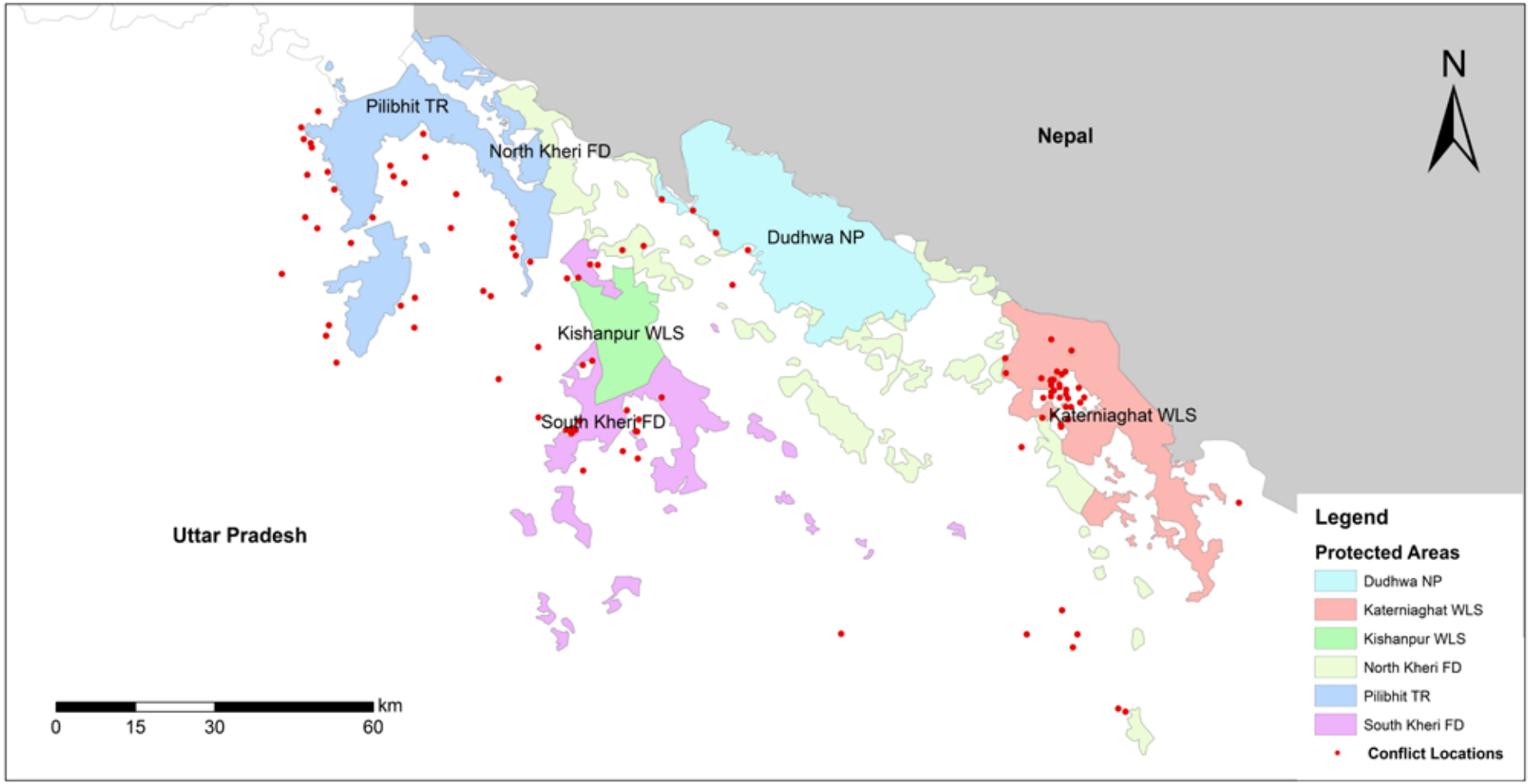
Official records from 2003 to 2012 reveal 474 livestock deaths across the Dudhwa-Pilibhit TR landscape, although data from a number of forest divisions was not complete or recorded systematically. For instance, from Pilibhit TR (the erstwhile Pilibhit Forest Division), no data prior to 2011 is available. The data was therefore clubbed to facilitate comparisons across various regions of the landscape.

Out of the 474 recorded livestock depredation cases, Katerniaghat Wildlife Sanctuary accounted for the highest (n = 342), almost 2.5 times more the total number of cases recorded from Dudhwa National Park, Kishanpur Wildlife Sanctuary and Pilibhit Forest Division taken together (*Figure 13*). Even after controlling for the disparity in the available data sets across years and examining the depredation cases recorded only for 2011, Katerniaghat WLS showed the highest number of recorded cases. On average, Katerniaghat WLS recorded about 49.6±33.6 cases of livestock depredation annually, while Dudwha National Park, Kishanpur WLS and Pilibhit FD recorded about 11.6±6.4, 4.3±2.6 and 3.5±2.1 cases annually, respectively.

It is interesting to note that among the total recorded cases, tigers accounted for 58.6% of cases (n = 276) while leopards were responsible for 41.4% of cattle killed (n = 195) across the landscape. Among the four key areas of this region, however, it is notable that in both Dudhwa NP and Pilibhit FD cattle depredation was largely by tigers, while in Kishanpur and Katerniaghat WLS both leopards and tigers were comparable in their depredation of livestock (*Figure 14*).

It is interesting to note that among all livestock killed in the four areas, leopards accounted for more small and medium-sized livestock loss, for instance goats, sheep and young calves of cows or buffaloes, while tigers were largely responsible for large livestock kills such as adult buffaloes, cows and horses (*Figure 15*).

This shows that tigers and leopards seem to



Map 6: Distribution of recorded human-leopard and human-tiger conflict cases (red dots) in the Dudhwa-Pilibhit TR landscape

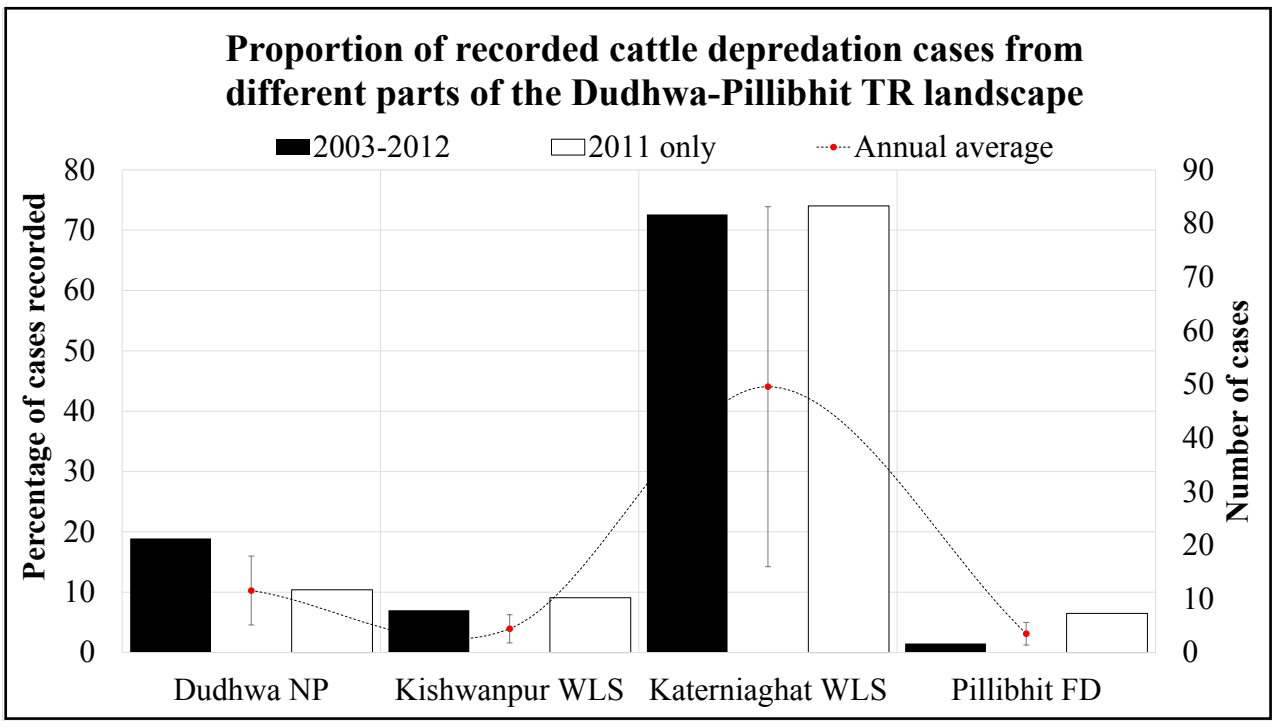


Figure 13: Bar graph showing percentages of livestock killed by tigers and leopards between 2003 and 2012 across Dudhwa-Pilibhit TRs (left Y axis), and the average number of cases per year (scatter plot along the right Y axis). The dotted line is only shown for visual corroboration of the uniform trend across the various sets of data represented.

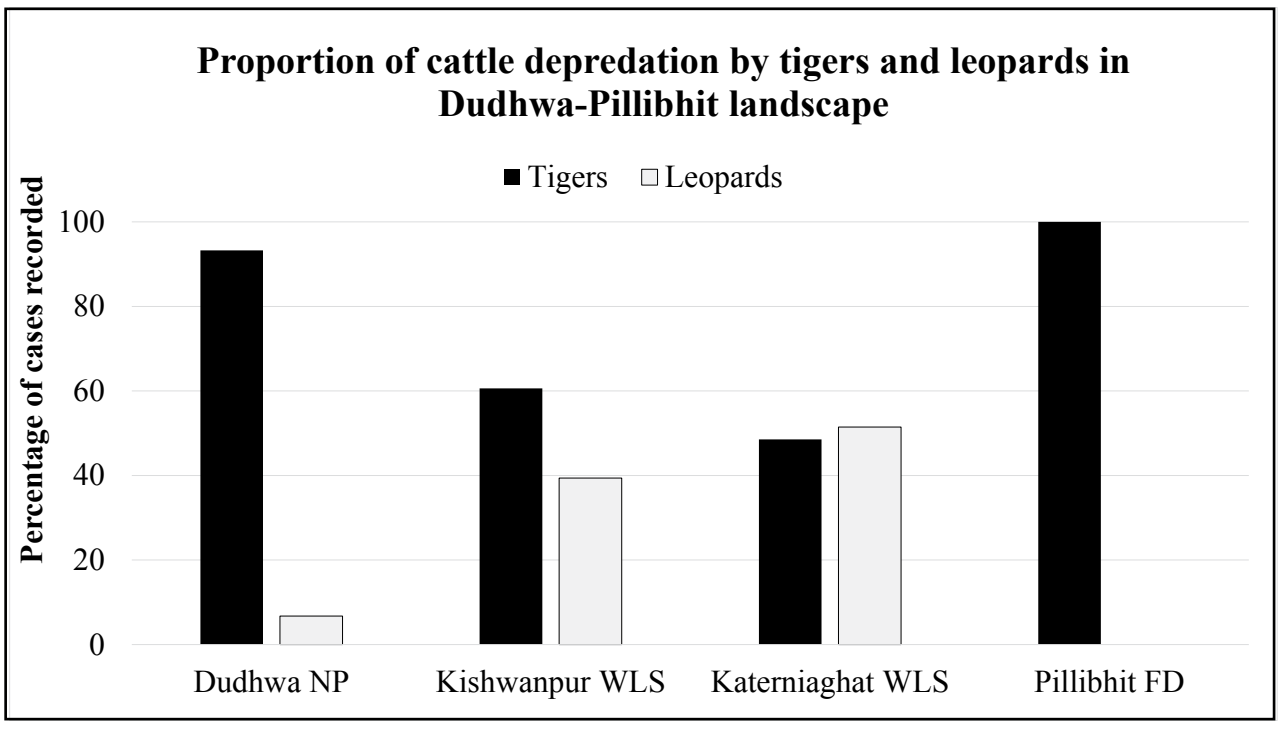


Figure 14: Proportion of livestock killed by leopards and tigers in the Dudhwa-Pilibhit TR landscape

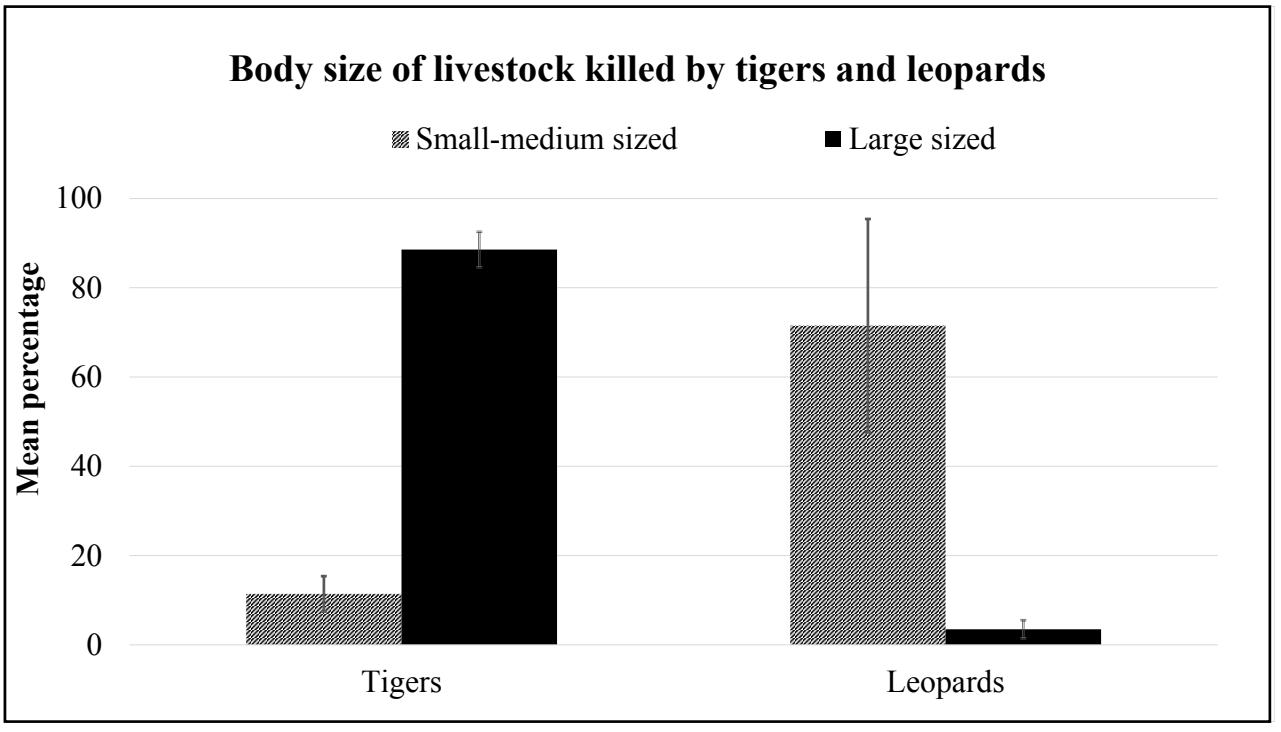


Figure 15: Livestock size selection by leopards and tigers in the Dudhwa-Pilibhit TR landscape

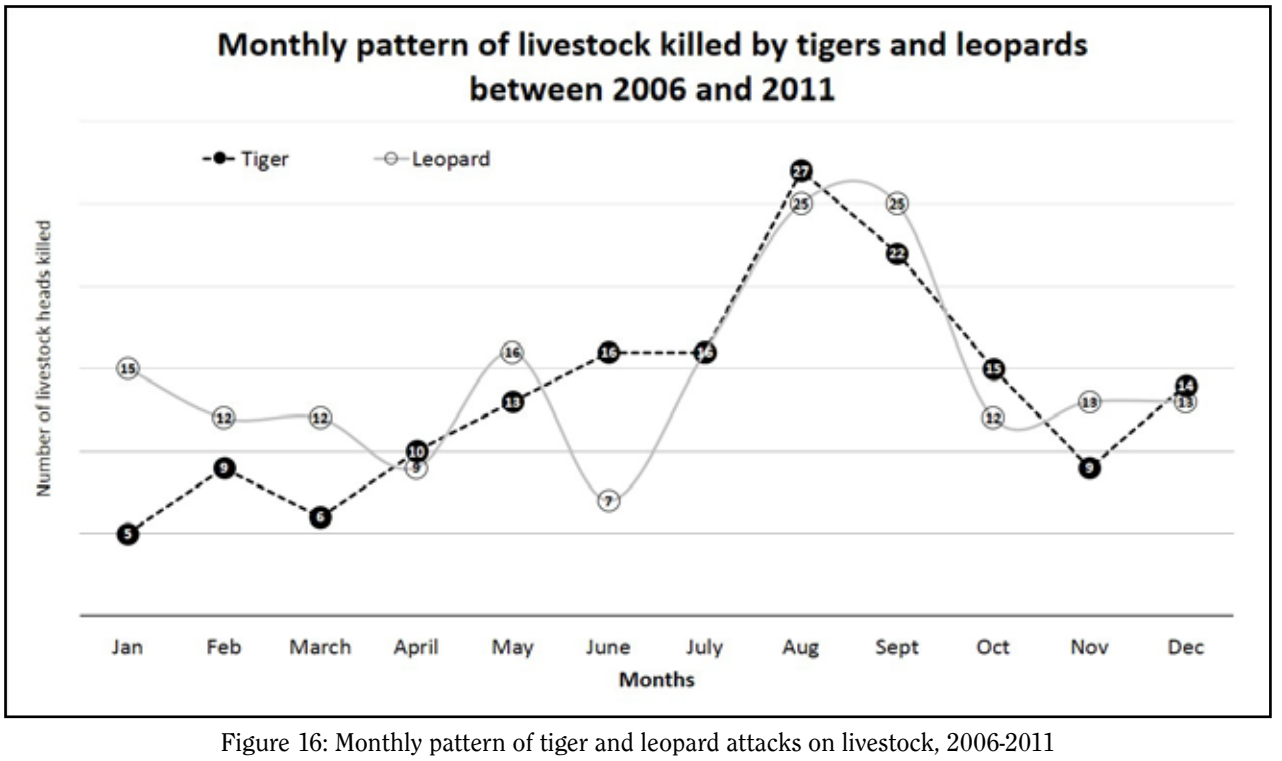


Figure 16: Monthly pattern of tiger and leopard attacks on livestock, 2006-2011

exercise choice of prey with respect to size, much as they would do in the natural environment with wild prey species. It is not surprising, therefore, that most of the children injured or killed in conflict with the two big cat species (as detailed earlier in this chapter) were due to leopard attacks. Between 2006 and 2011, some 337 incidents of livestock depredation by tigers and leopards were recorded (an annual average of 56.17) in Katerniaghat Wildlife Sanctuary, while at least 68 heads of livestock were killed (an annual average of 16) in Dudhwa National Park. It is interesting to note that most of these attacks occurred during the rainy season (July-October: 49.38% and 44.57% in Katerniaghat and Dudhwa respectively; *Figure 16*). This is in contrast to the seasonal patterns of attacks on humans by the two big cat species, and demands more detailed study to determine the underlying causality. One hypothesis is that livestock are more difficult to guard when grazing in the forests during the monsoons and are therefore more susceptible to being attacked by tigers and leopards. As a large part of this landscape is flood prone during the monsoons, heavy rains may also lead to some cattle getting lost or stranded in forest areas, thus falling prey to tigers and leopards. However, the exact causal explanation can only be fathomed through more detailed investigations.

(ii) Distribution and Abundance of Tigers, Leopards and their Prey Species

During the survey period (2011-12), 193 tiger and leopard scat samples were collected from the four key forest areas of the Dudhwa-Pilibhit TR landscape (*Table 4*).

In Dudhwa National Park, a total of 149.2 km of trails were covered with an average effort of 5.36 km/walk, resulting in the collection of 80 scat

Table 4: Key areas surveyed and number of scat samples encountered in each area

Study area	Ranges covered during survey	Total distance walked (km)	Number of scat samples
Kishanpur WLS (KWLS)	Mailani, Kishanpur	201.81	53
Katerniaghat WLS (KAT)	Nishangada, Katerniaghat	91.77	29
Dudhwa NP (DNP)	Sathiyana, Dudhwa, South Sonaripur, Belrayan	149.2	80
Pilibhit FD	Haripur, Barahi	99.91	31
TOTAL		**542.68**	**193**

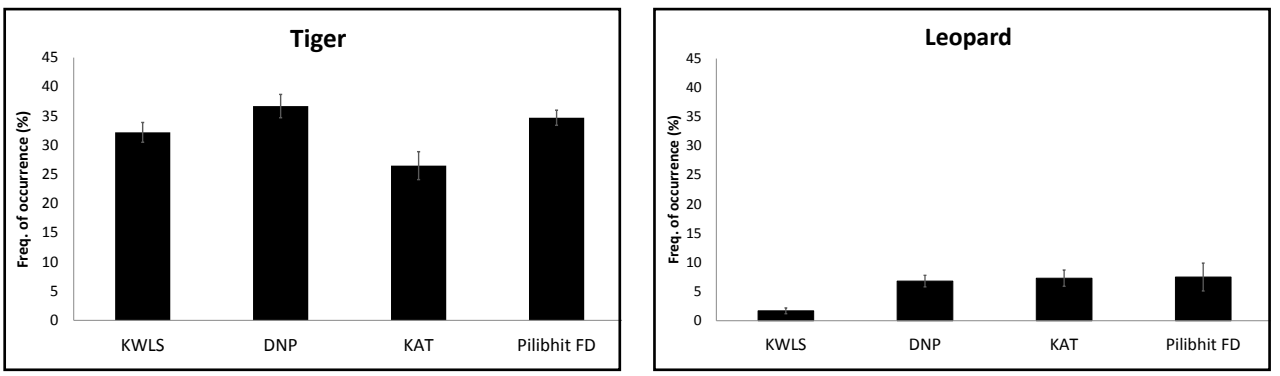


Figure 17: Frequency of occurrence with standard deviation values of tiger and leopard in the study areas across the landscape

samples. Within the Rhino Re-introduction Area (RRA), surveys were conducted with an average effort of 6.69 km/walk, resulting in a scat detection rate of 5.97/10 km. In Kishanpur WLS, about 201.81 km of trails were covered in the Mailani and Kishanpur Ranges with an average effort of 6.95 km/walk. Here a total of 53 scat samples were collected, with a scat detection rate of 2.62/10 km. In Katerniaghat Wildlife Sanctuary, 91.77 km of trails in the Nishangada and Katerniaghat Ranges were surveyed with an average effort of 6.55 km/walk, revealing a scat detection rate of 3.16/10 km (29 scat samples collected). In Pilibhit FD, the stretch adjoining Kishanpur WLS through the existing divisional forests was surveyed to investigate the continuity of tiger occupancy across the stretch. A total survey effort of 6.60 km/walk resulted in the surveying of about 99.1 km and collection of 31 scat samples. The scat detection rate in Pilibhit FD was 3.10/10 km.

The observed tiger space use was highest in Dudhwa National Park (36.7±2), with Kishanpur WLS revealing the second highest frequency of occurrence of tiger signs (32.2±1.7), followed by Pilibhit FD (34.7±1.3). However, on a relative scale, tiger space use was the highest in Kishanpur Wildlife Sanctuary (85.76%) followed by Katerniaghat WLS, Dudhwa NP and Pilibhit FD (*Table 5*).

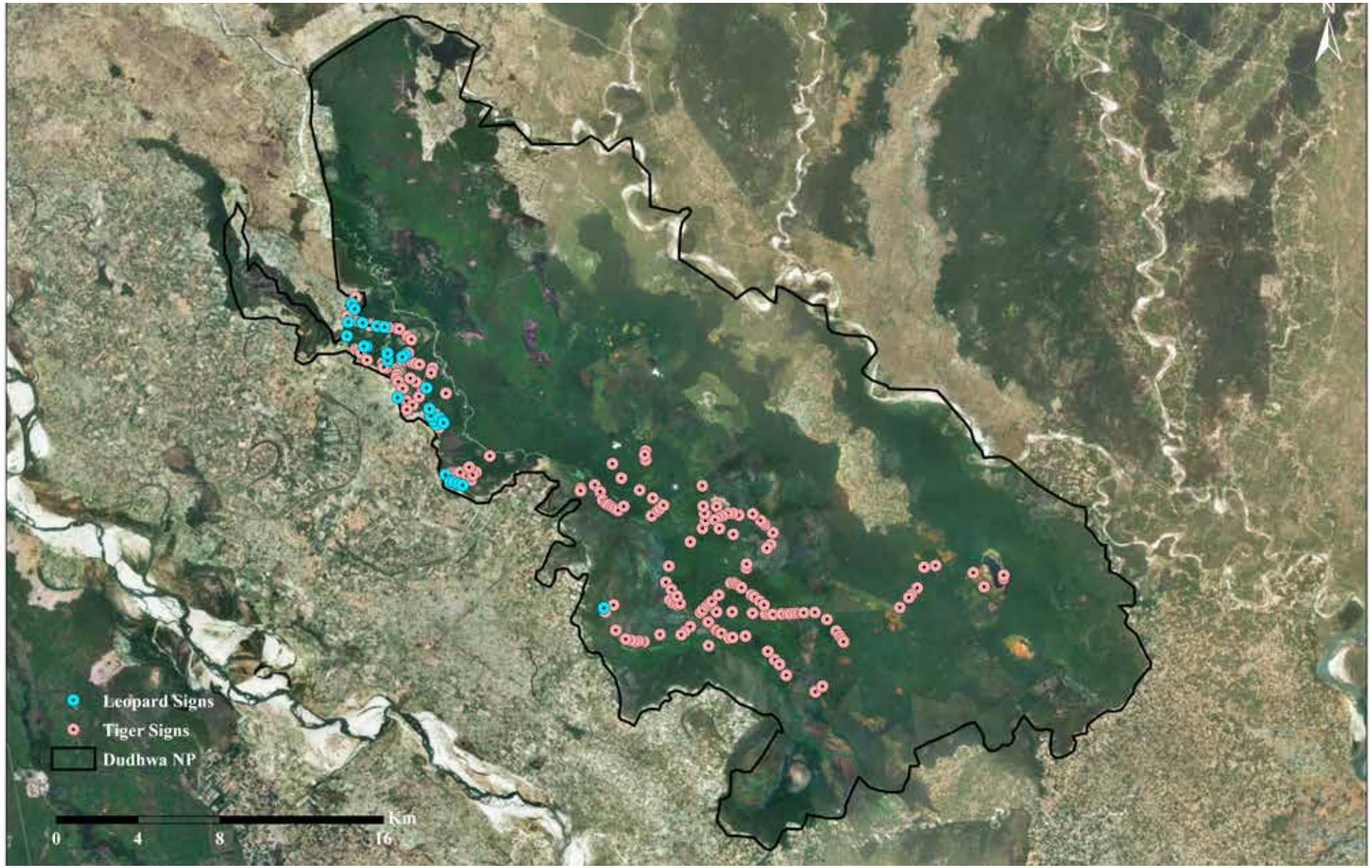
Observed space use by leopards was lowest in Kishanpur WLS (4.75%) and moderate in Dudhwa NP (13.87%) and Pilibhit FD (14.83%). Relative space use by leopards was highest in Katerniaghat WLS at 21.55% (*Table 5*). Leopard signs were mostly recorded in peripheral areas near forest fringes bordering agricultural fields (*Maps 7, 8, 9 & 10*) and had a lower detection probability relative to tiger scats. This may be accounted for by the tendency of tigers to habitually defecate

Table 5: Mean frequency of occurrence with standard deviation values and relative frequencies of three extant large carnivores (tiger, leopard and sloth bear) in the Dudhwa-Pilibhit TR landscape

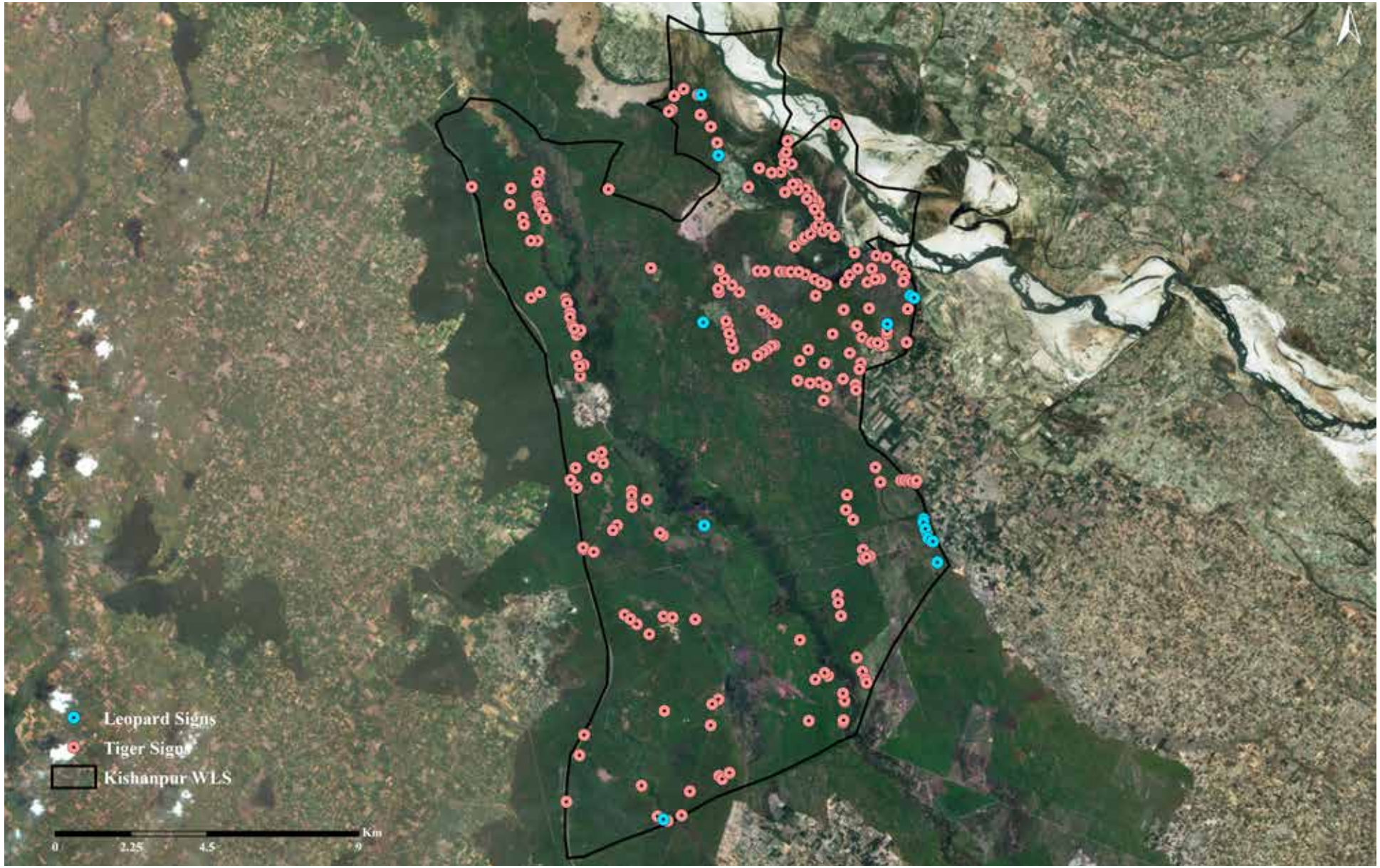
Carnivore Species	Kishanpur WLS (n=29, s=787)		Dudhwa NP (n=26, s=578)		Katerniaghat WLS (n=14, s=344)		Pilibhit FD (n=15, s=375)	
	Freq. of Occurrence (%)	Relative Freq. (%)	Freq. of Occurrence (%)	Relative Freq. (%)	Freq. of Occurrence (%)	Relative Freq. (%)	Freq. of Occurrence (%)	Relative Freq. (%)
Tiger	32.2±1.7	85.762	36.7± 2	75.089	26.5±2.4	78.448	34.7±1.3	70.879
Leopard	1.7±.5	4.746	6.8±1	13.879	7.3±1.4	21.55	7.5±2.4	14.84
Sloth Bear	3.55	9.492	5.36	11.03	-	-	6.933	14.286

Table 6: Tiger and leopard sign encounter rate in four sites in the Dudhwa-Pilibhit TR landscape

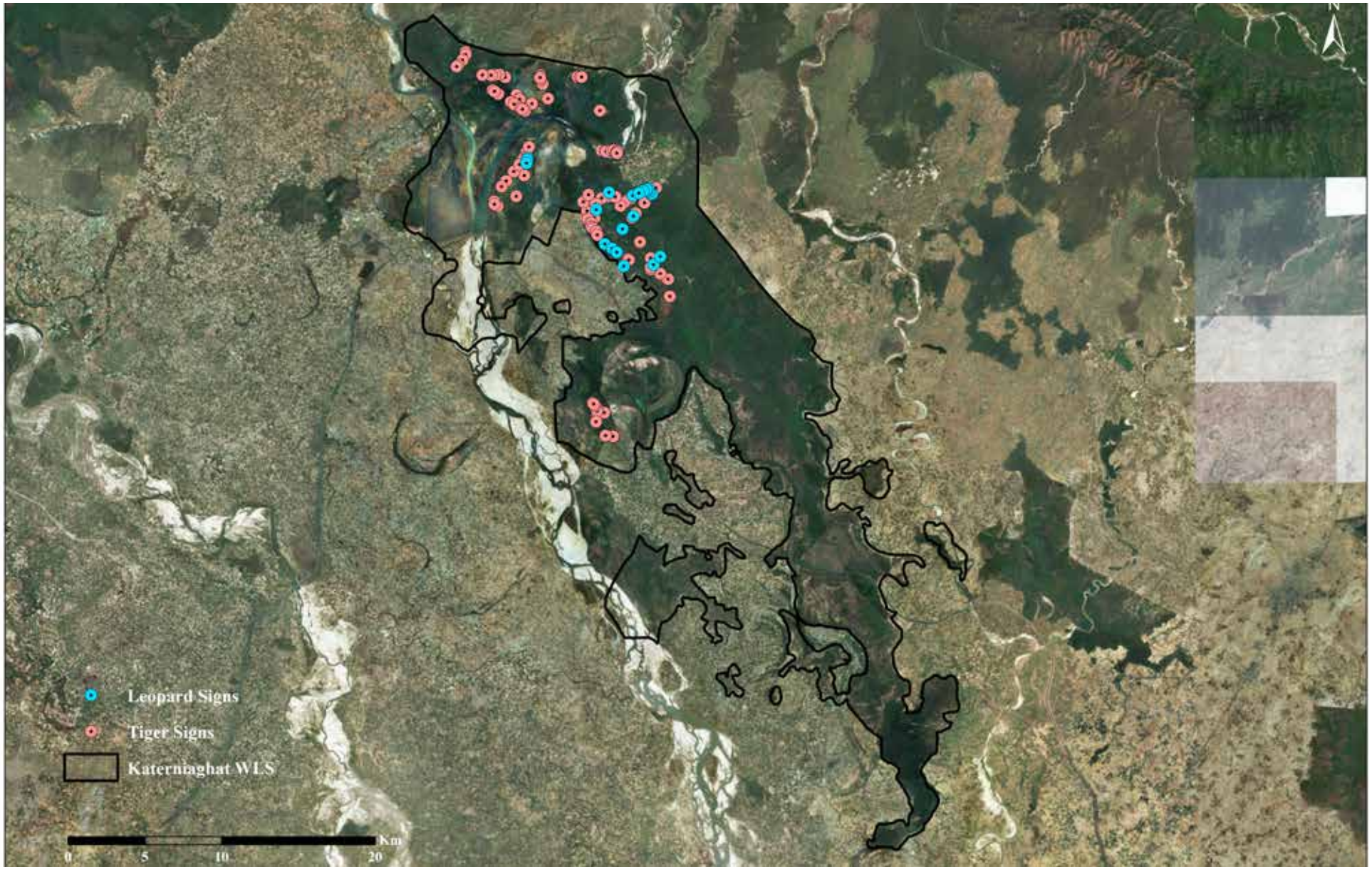
SPECIES	Kishanpur WLS		Dudhwa NP		Katerniaghat WLS		Pilibhit FD	
	Encounter/km		Encounter/km		Encounter/km		Encounter/km	
	Scat	Scrape	Scat	Scrape	Scat	Scrape	Scat	Scrape
Tiger	0.244	0.330	0.512	0.291	0.395	0.419	0.288	0.587
Leopard	0.025	0.005	0.042	0.007	-	0.023	0.0427	0.0427



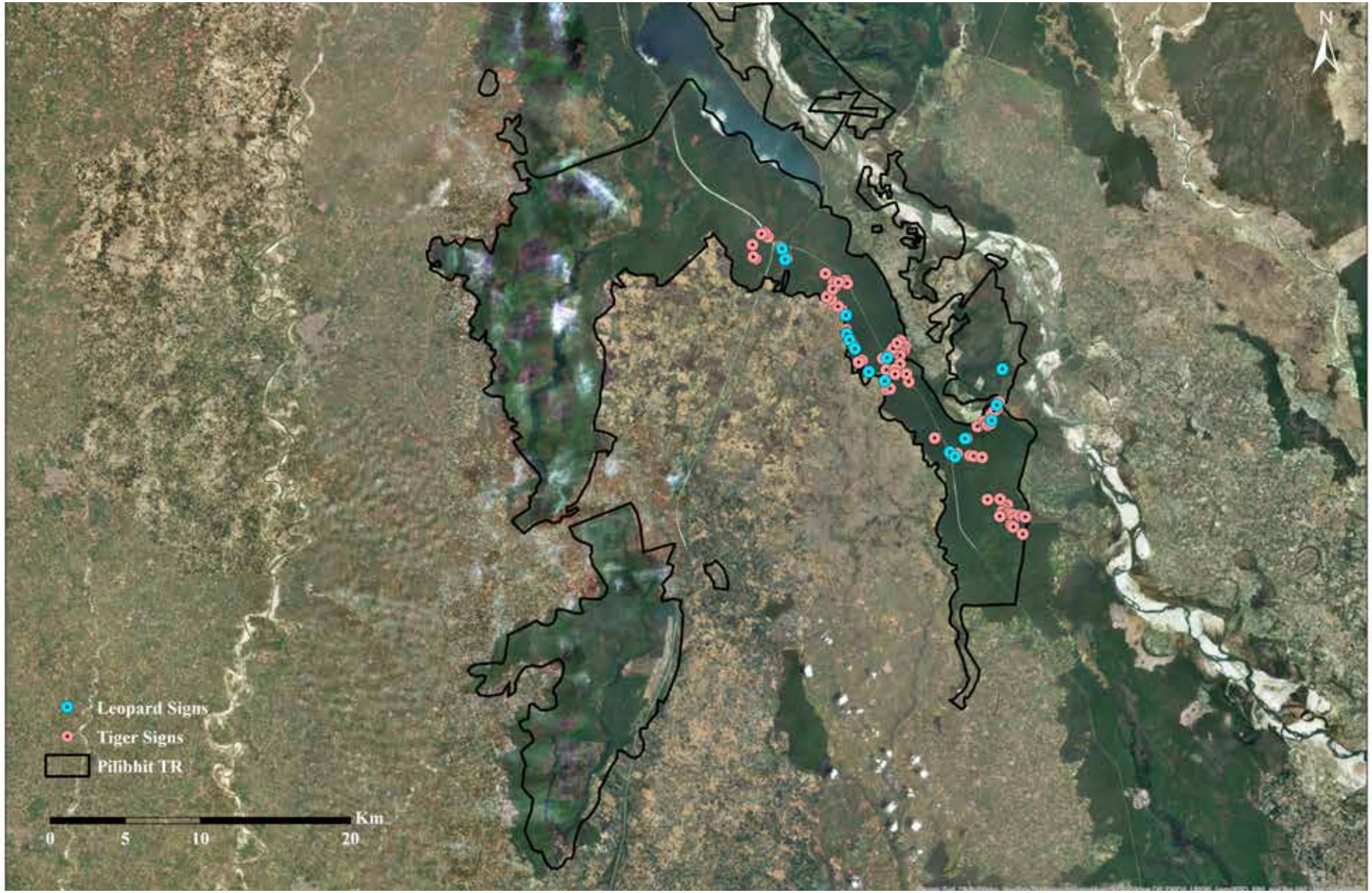
Map 7: Tiger and leopard distribution in sampled areas of Dudhwa National Park



Map 8: Tiger and leopard distribution in sampled areas of Kishanpur Wildlife Sanctuary



Map 9: Tiger and leopard distribution in sampled areas of Katerniaghat Wildlife Sanctuary (Nishangada and Katerniaghat Ranges)



Map 10: Tiger and leopard distribution in sampled areas of Pilibhit Forest Division

on relatively open forest roads, a trend not so commonly observed among leopards. Scat and scrape mark encounter rates (0.24/km and 0.33/km respectively) for tigers was relatively low in Kishanpur WLS. Tiger scrape encounters were highest in Pilibhit FD (0.58/km) and scat encounters in Dudhwa NP (0.51/km) (*Table 6*). Tigers, leopards and sloth bears were found to share space in Dudhwa NP and Pilibhit Forest Division, and while sloth bears were absent in Katerniaghat WLS, the relative occurrence of leopards was highest (21.55%) here.

Tiger and leopard prey species in the surveyed areas were spotted deer (*Axis axis*), wild boar (*Sus scrofa*), hog deer (*Cervus porcinus*), sambar deer (*Rusa unicolor*), barking deer (*Muntiacus vaginalis*), swamp deer (*Rucervus duvaucelii duvaucelii*), nilgai (*Boselaphus tragocamelus*) and Hanuman langur (*Semnopithecus entellus*). Spotted deer were found to be the most abundant prey species relative to other ungulate species in the sampled areas of the landscape (*Table 7 & Figure 21*). Only in the case of Pilibhit FD were wild boar found to be more abundant than spotted deer (*Figure 18*). Dudhwa NP retained higher abundance values for all the ungulates except nilgai (4±0.8), which was lowest in this region with both relative frequency of occurrence as well as pellet group encounter rates being relatively lower than for other species here (*Table 8 & Figure 19*). Nilgai were found in greater abundance in Pilibhit and Kishanpur WLS.

An independent study on prey selection by tigers in Kishanpur Wildlife Sanctuary indicated that medium-sized prey were important for tiger diet and sustainability. The calculated frequency of occurrence of medium-sized prey (spotted deer and wild boar) was highest in Pilibhit

Table 7: Mean frequency of occurrence with standard deviation values of different prey species in the Dudhwa-Pilibhit TR landscape

Prey Species	Kishanpur WLS (n=29, s=787)		Dudhwa NP (n=26, s=578)		Katerniaghat WLS (n=14, s=344)		Pililbhit FD (n=15, s=375)	
	Freq. of Occurrence (%)	Relative Freq. (%)	Freq. of Occurrence (%)	Relative Freq. (%)	Freq. of Occurrence (%)	Relative Freq. (%)	Freq. of Occurrence (%)	Relative Freq. (%)
Spotted deer	44.2±1.7	46.26	65.7±2	50.40	29.9±2.5	48.13084	63.5±2.55	33.95
Nilgai	30.2±1.6	31.46	4±.8	2.93	18.3±2.1	28.97196	41.3±2.75	22.08
Wild pig	15.8±1.3	16.4	19±1.6	14.50	8.5±1.5	13.08411	68.3±2.44	36.52
Barking deer	0.9±.3	0.93	2.9±.7	2.13	1.8±.7	2.336449	8±1.63	4.27
Swamp deer	1.4±.4	1.33	8.4±1.1	6.52	-	-	-	-
Hog deer	2.2±.5	2.13	27±1.9	20.75	4.7±1.1	7.476636	4±1.22	2.13
Sambar	1.5±.4	1.46	3.8±.8	2.79	-	-	1.9±0.91	1.01

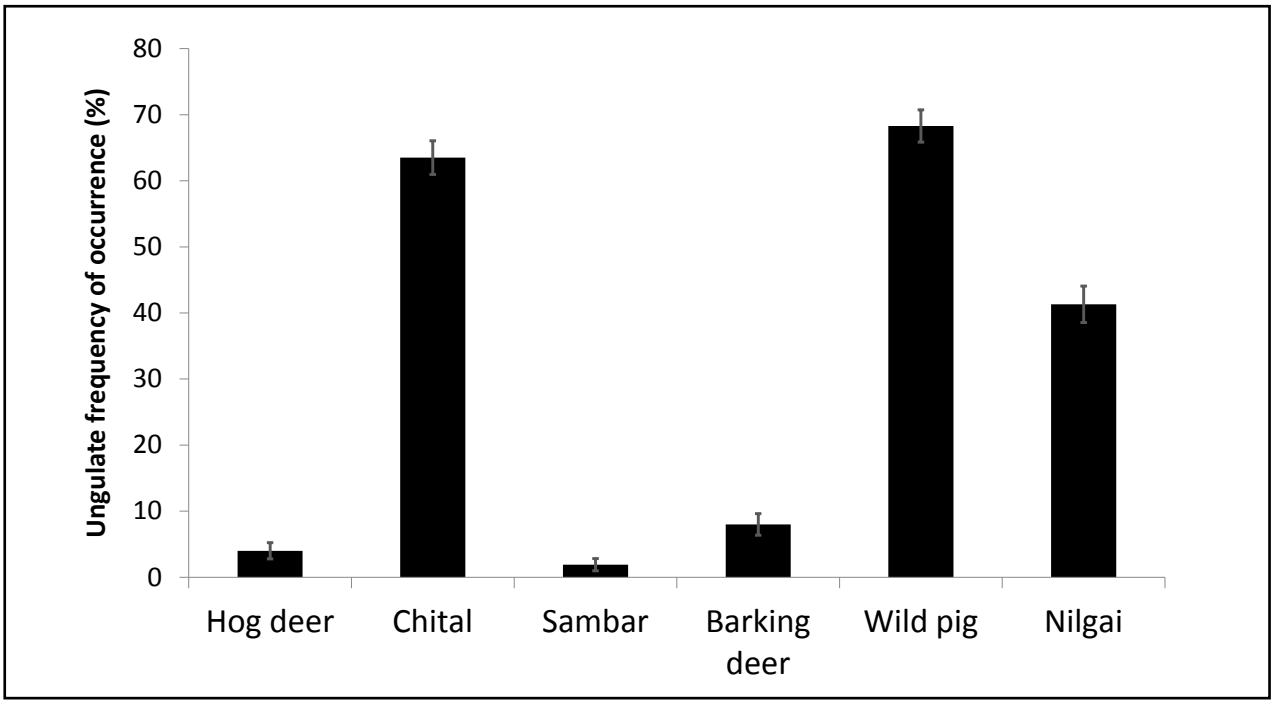


Figure 18: Frequency of occurrence of tiger prey species in Pilibhit Forest Division

FD and Dudhwa NP, followed by Kishanpur WLS. Katerniaghat WLS showed the lowest (38.4%) values for medium-sized prey species. Here, instead, the frequency of occurrence was relatively higher for hog deer and barking deer which are small-sized prey species and are the preferred prey of leopards.

It is not surprising, therefore, that Katerniaghat WLS also revealed a higher relative frequency of leopard occurrence compared to the other areas in the Dudhwa-Pilibhit TR landscape (as detailed earlier in this chapter). This imbalance in prey species abundance may also be one of the causal reasons for the low abundance of tigers in Katerniaghat and a subsequent higher abundance of leopards, which may be driving higher conflict in this region.

Table 8: Encounter rate based on pellets of different prey species in the Dudhwa-Pilibhit TR landscape

Prey Species	**Kishanpur WLS (n=28, s=787)**	**Dudhwa NP (n=27, s=578)**	**Katerniaghat WLS (n=14, s=344)**	**Pilibhit FD (n=15, s=375)**
	Encounter/km	Encounter/km	Encounter/km	Encounter/km
Spotted deer	0.34±0.18	0.83±0.44	0.16±0.06	0.48±0.16
Nilgai	0.79±0.13	0.037±0.026	0.21±0.10	1.39±0.32
Wild pig	-	-	-	-
Barking deer	-	0.05±0.04	-	0.07±0.04
Swamp deer	-	0.04±0.04	-	-
Hog deer	0.03±0.02	0.29±0.16	0.12±0.07	-
Sambar	0	0.11±0.09	-	0.048±0.48

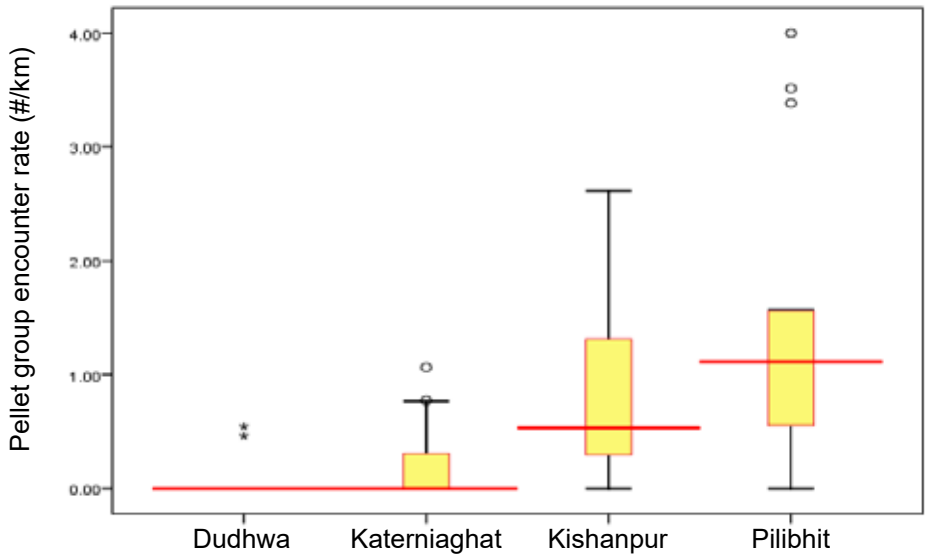


Figure 19: Encounter rate of nilgai (*Boselaphus tragocamelus*) in the Dudhwa-Pilibhit TR landscape (Kruskal-Wallis test (χ^2=46.054, df=3, p<0.05))

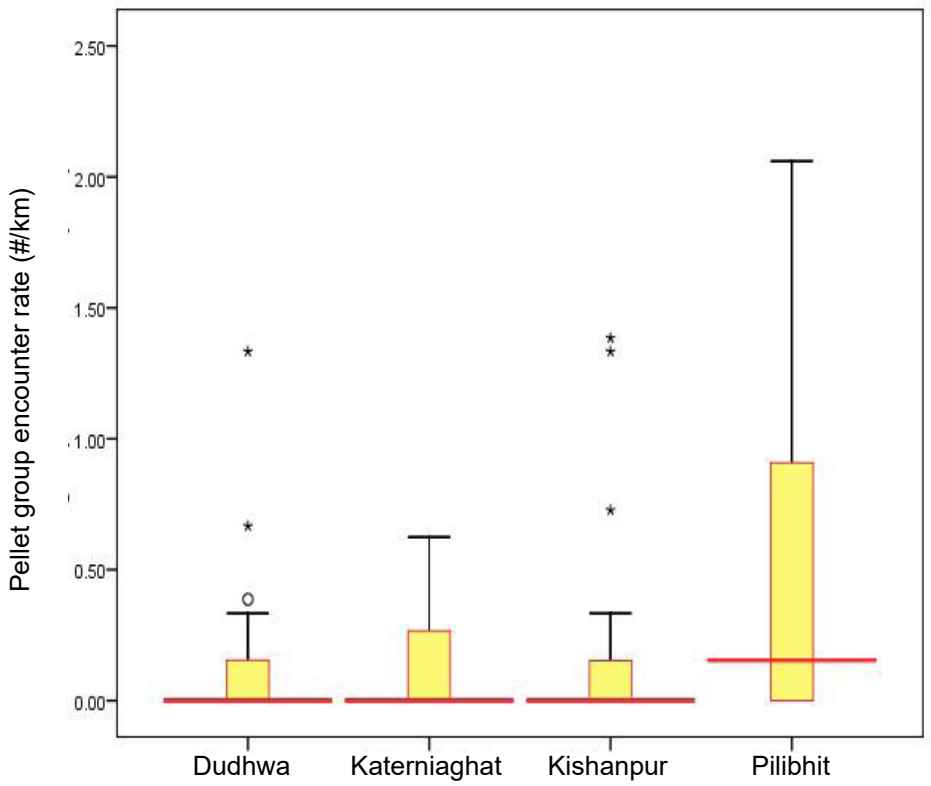


Figure 20: Pellet group encounter rate of spotted deer (*Axis axis*) in the Dudhwa-Pilibhit TR landscape (Kruskal-Wallis test (χ^2=2.351, df=3, p>0.05))

Swamp deer and sambar were the least recorded cervids in the sampled areas of the landscape. This is largely due to the fact that much of the habitat surveyed did not cover ample specific habitat niches that these cervid species occupy. As most of the surveys were conducted along existing forest trails, large parts of the grasslands and thick undergrowth areas, which are preferred habitat types of the swamp deer and sambar deer respectively, were not surveyed.

The distribution of nilgai, which is largely a habitat generalist, was observed mostly in the peripheral forest areas near agricultural fields and clustered in high abundance in Kishanpur WLS and Pilibhit FD. Spotted deer on the other hand seemed to be ubiquitous across the landscape, with higher abundances in Dudhwa NP and Pilibhit FD followed by Kishanpur WLS, but with a comparable relative frequency of occurrence across all four Protected Areas. It may be noted here that although spotted deer seemed ubiquitous by their relative frequency of occurrence, their relative abundance (pellet group encounter rate) was found to be extremely low in Katerniaghat WLS, and was compensated for by a relatively higher abundance of hog deer and nilgai. Dudhwa NP and Pilibhit FD by far seemed the most conducive regions for tigers to thrive, followed by Kishanpur WLS which is interconnected with Dudhwa NP. Katerniaghat WLS, on the other hand, with its low availability of the medium to large-sized prey species preferred by tigers (nilgai, sambar and spotted deer), potentially serves as a prime leopard source population. It may be noted here that the results of the current study followed a similar sampling framework as an earlier study in the same landscape, by Johnsingh *et al.,* 2004, assessing the relative abundance of both big cat species (*Table 9*) as well their principal prey species (*Figure 22*).

While for the predators the present sampling effort revealed a higher relative abundance estimate for all four areas surveyed, the abundance of principal prey species of these big cats was not as consistent in the findings (*Figure 22*). For all the six prey species considered, the current results showed a decline across the four areas, with the most apparent decline from past estimates seen in Dudhwa NP, Katerniaghat WLS and Kishanpur WLS. In Pilibhit FD, however, the difference between past and present was not found to be significant. In Katerniaghat WLS and Pilibhit FD there seemed to be an increase in hog deer population when compared to the past

Table 9: Comparative results between the previous study by Johnsingh *et al.*, 2004 and the present study, 2012, on proportional occurence of large felids in the Dudhwa-Pilibhit TR landscape

Species	**Kishanpur WLS**		**Dudhwa NP**		**Katerniaghat WLS**		**Pilibhit FD**	
	Past	Present	Past	Present	Past	Present	Past	Present
Tiger	31.9±12.69	32.2±1.7	35.2±12.94	36.7± 2	12.1±6.36	26.5±2.4	12.0±2.75	34.7±1.3
Leopard	0	1.7±.5	1.3±0.45	6.8±1	0.6±0.2	7.3±1.4	3.1±0.66	7.5±2.4

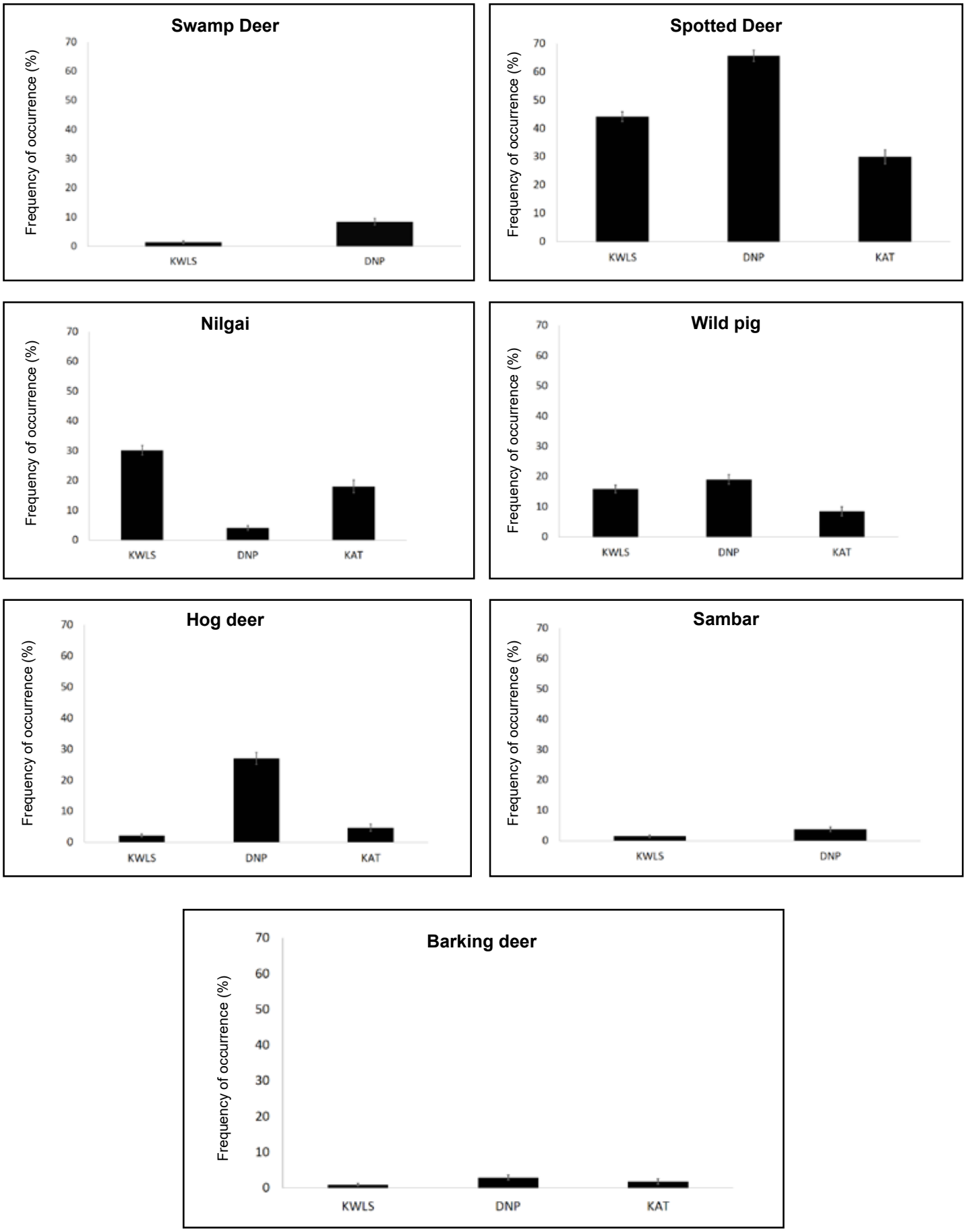


Figure 21: Frequency of occurrence with standard deviation values of each tiger prey species in the study area

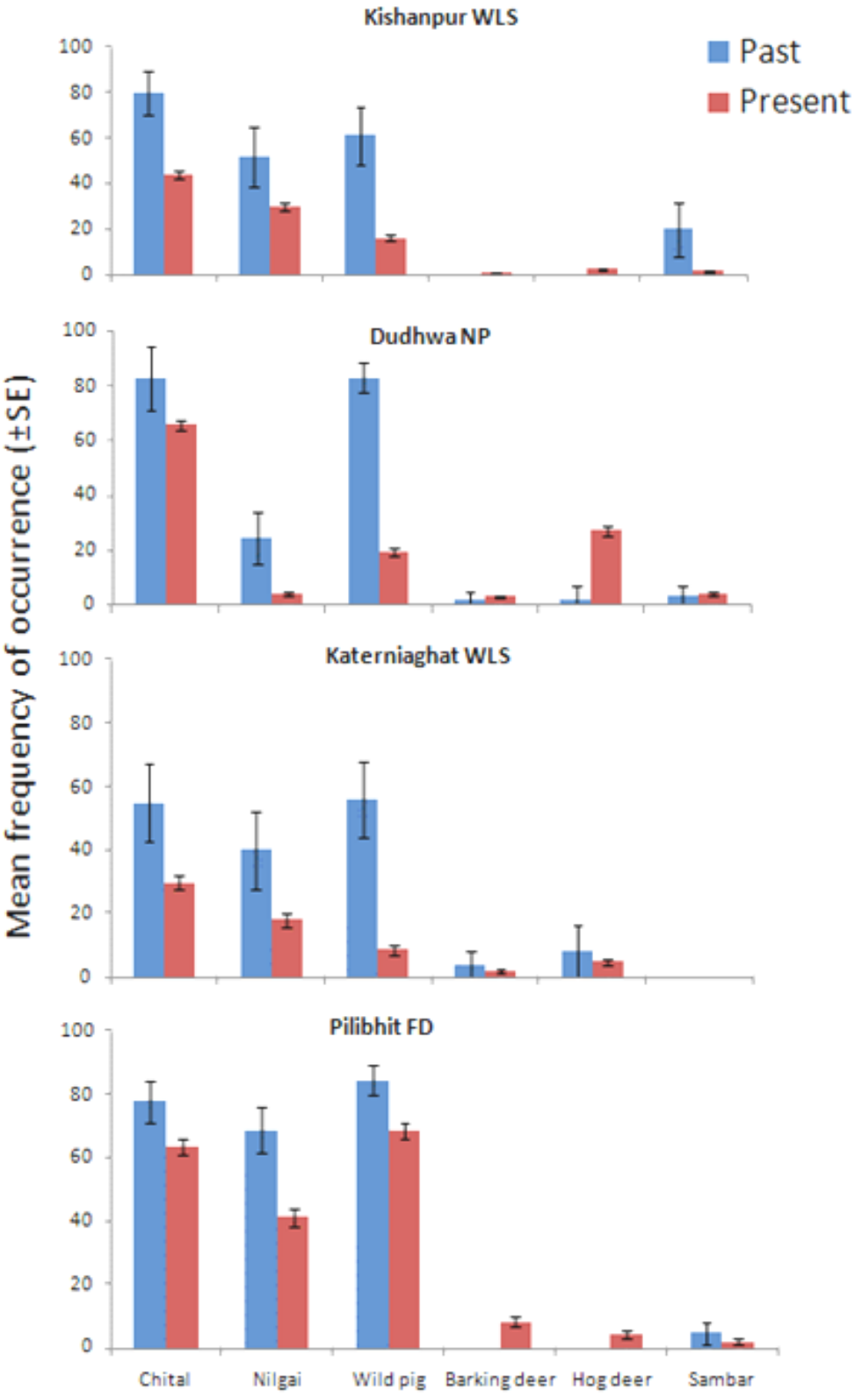


Figure 22: Comparative results between the previous study by Johnsingh *et al.*, 2004 (■) and the present study, 2012 (■), on proportional existence of wild ungulate species in the Dudhwa-Pilibhit TR landscape

abundance estimates. Pilibhit FD also showed a higher abundance estimate for barking deer when compared to earlier estimates (*Figure 23*).

(iii) Communities in Conflict with Big Cats – Socio-economics and Community Perceptions of Conflict

A total of 355 persons were interviewed across eight prioritised villages (on average 12.5±2.5 persons/village) from among those recorded to have experienced conflict with big cat species.

Household size as reported by respondents in various villages ranged from 7 to 11 members, with an average of 8.44±4.33 members per household. The primary occupation of villagers was wage labour (65.5±9.41% of respondents). A majority of respondents also pursued agriculture (62.3±10.7% of respondents) alongside other livelihood pursuits such as wage labour and small businesses (*Figure 23*). The main agricultural crops in these villages were wheat, paddy and sugarcane. (It is interesting to note here that none of the respondents in two of the surveyed villages, Anandnagar and Rampurwa Matehi, owned agricultural land, but many of them did work as agricultural labourers under landlords.) About 8.8±4.9% of respondents owned small businesses such as grocery or tailoring shops, or were traditional medical practitioners etc. Only about 2.7±1.3% of respondents were in government service, or had retired from government service and were dependent on a pension from the government (*Figure 23*).

All eight surveyed villages are located on the fringes of Dudhwa and Pilibhit Tiger Reserves and had regularly experienced conflict with tigers and leopards. The respondents were also asked what conflict with big cats meant to them, and what they thought was the main driver of conflict with big cats. While responses varied from village to village, the overall patterns that were observed provide useful insight into how people perceive conflict with big cats such as tigers and leopards. Interestingly, only about 11.72% of respondents (all from Karikot village) regarded livestock depredation as a commonly perceived outcome of conflict.

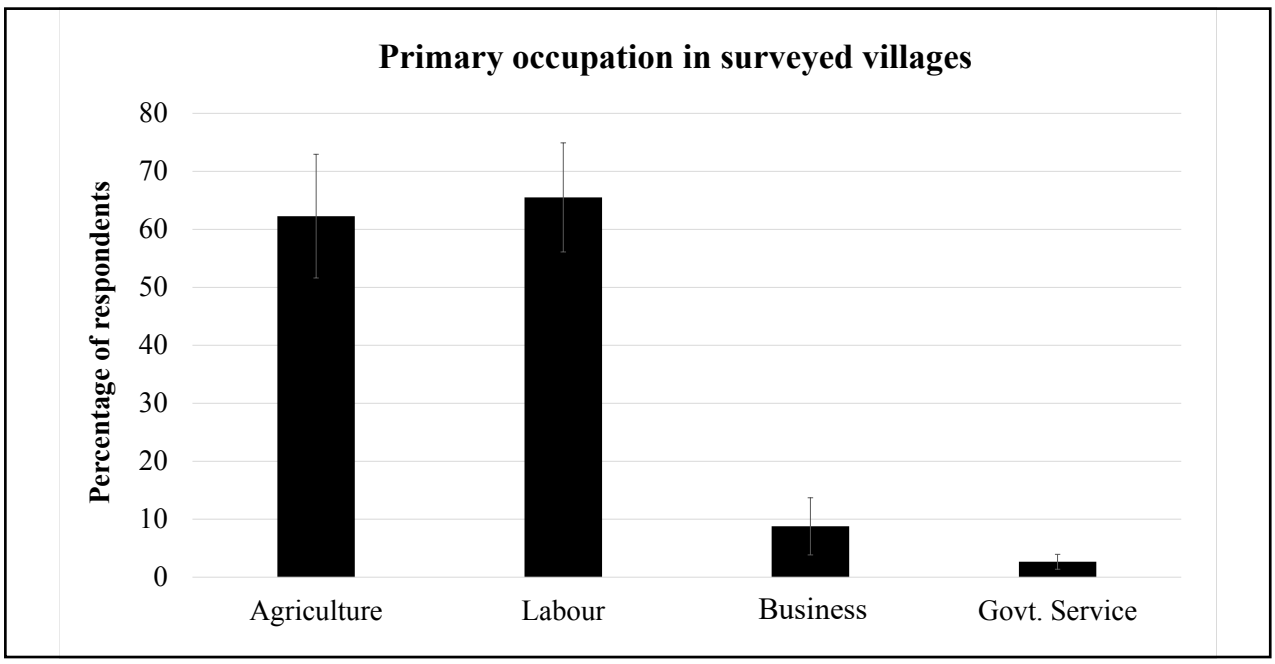


Figure 23: Bar graph showing the mean percentage of respondents pursuing different occupation types in surveyed villages

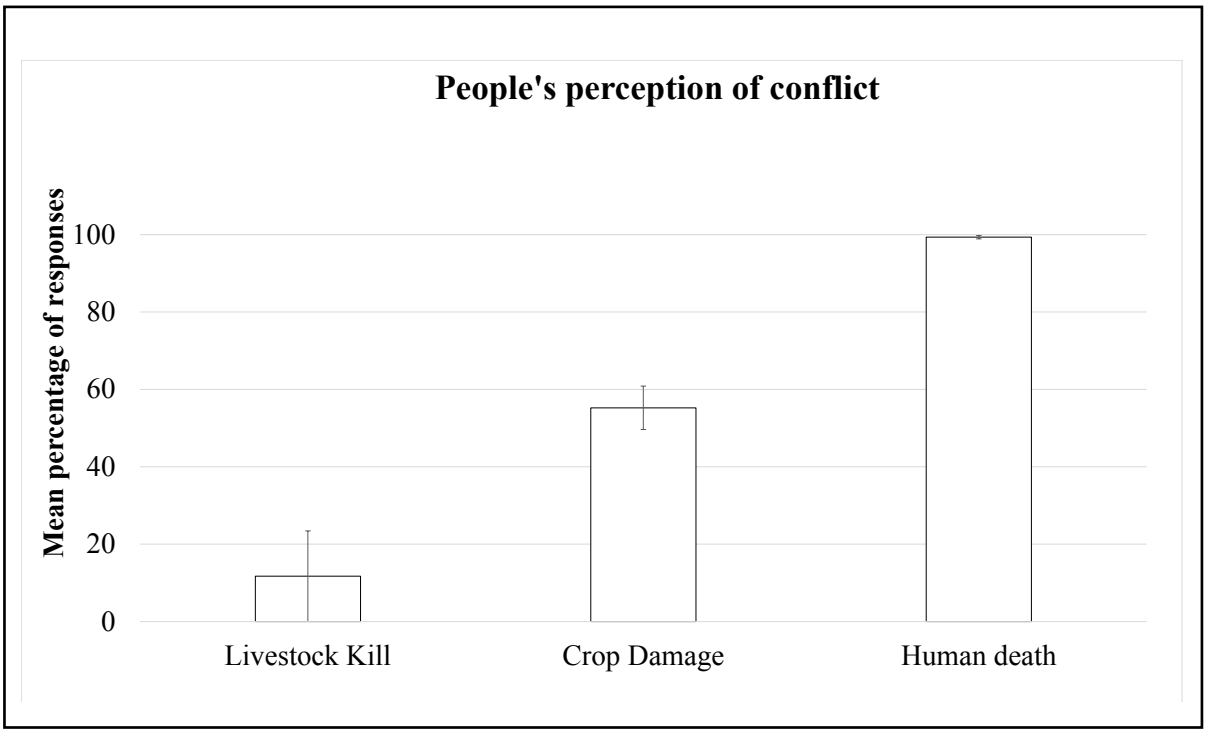


Figure 24: Bar graph showing mean proportion of responses received pertaining to the three main outcomes of conflict with wildlife species, as perceived by respondents

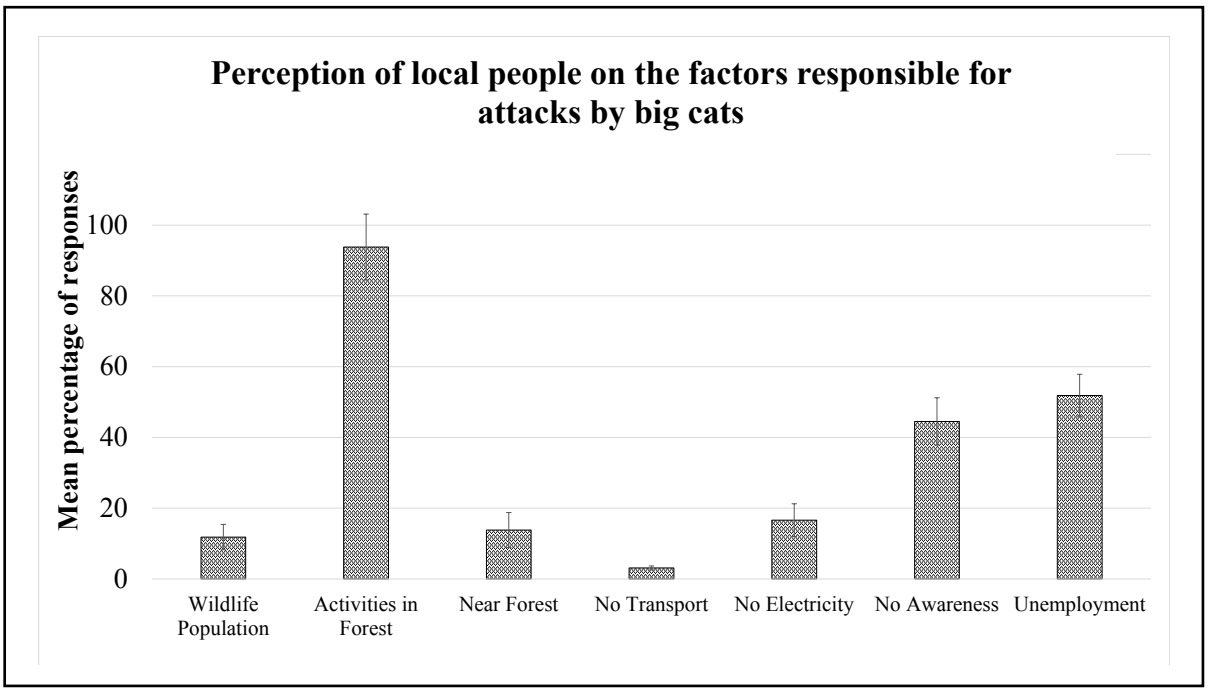


Figure 25: Bar graph showing mean proportion of responses towards seven crucial factors perceived by respondents as drivers of conflict with leopards and tigers, in surveyed villages

Almost all other respondents from the other seven villages invariably regarded human death as the most common form of conflict with wildlife. 55.23±5.6% of respondents considered damage to crops by wild herbivores as conflict. These findings are interesting for two reasons. Firstly, it is known that livestock depredation in the landscape may exceed human deaths and injuries by almost five-fold, yet people do not seem to commonly relate to such instances as human-wildlife conflict. Second, despite a substantial number of people considering crop damage as a common form of conflict, it is rarely recorded or reported.

When asked specifically about human deaths/ injuries caused by wild carnivores and the prime drivers for these, people provided seven broad categories of responses. Attacks by big cats, they felt, were precipitated by: 1) Villages being situated on the fringes of forests with no physical barriers in between; 2) People's dependence on forest resources, which makes them venture into forests; 3) Increase in wild animal populations; 4) No public transport facilities, forcing people to walk or bicycle; 5) No electricity in villages; 6) Unemployment, resulting in more people venturing unnecessarily into forest areas or loitering around village lands, or even mobbing wild animals during conflict situations; and 7) A lack of awareness about what to do when a dangerous wild animal is encountered.

It is interesting to note here that in almost all villages where conflict with large carnivores had been recorded (including the surveyed eight villages) there were virtually no sanitation facilities – most village folk utilised the boundaries of their agricultural fields or the forest fringes for defecating or urinating. A number of attacks on humans by big cats occured when people were squatting on the ground during such activities. Despite this understanding, not a single respondent considered this as a valid reason for attacks on humans by big cats.

Among the seven elicited response categories, almost all respondents (93.80±9.31% of responses) believed that one of the main factors behind attacks by big cats was increased human activity in forests or forest fringes (*Figure 25*). This was driven by various factors such as people travelling on forest roads, or the use of forested areas (including fringes) for defecation, or the collection of fodder, firewood and other NTFP. Respondents considered much of this activity inevitable since most villagers in the region, even though they were pursuing non-forest-based professions, were heavily dependent on forested lands especially for fodder, thatching grasses and fuel wood.

The second most common response received was that of unemployment (58.83±6.01% of responses) followed by a lack of awareness (44.51±6.7% of responses). These were followed by a lack of electrification (16.62±4.64% of responses) and the location of villages near forests without any intervening physical barriers (13.80±4.97% of responses) (*Figure 25*). This is noteworthy because a number of attacks on humans, especially by leopards, have occurred on village roads, homesteads, or sometimes even within houses at night time, and in most of these cases the area was not well lit. Further, almost all the villages where big cat attacks have been recorded over the past decade or more, lack proper lighting in the streets as well as homes. Not only do dark environments suit leopards and tigers, which are both nocturnal animals, they disadvantage humans whose reduced visual capabilities make them vulnerable to big cats as well as other wild animals.

People who declared that conflict occurred simply as a consequence of villages being in proximity to forests also invariably opined that there needed to be a physical barrier separating village lands from forest lands, thus inhibiting wild animals from venturing into human habitations. Whilst this response may show that a number of people understand conflict to be an inevitable consequence of living near forests, it also possibly indicates a sense of detachment from natural ecosystems. Such responses perhaps indicate that people consider forests and their denizens as government property, and thus prefer strict demarcation and barricading of territories.

Table 10: List of PRT villages and the adjoining villages covered by these PRTs

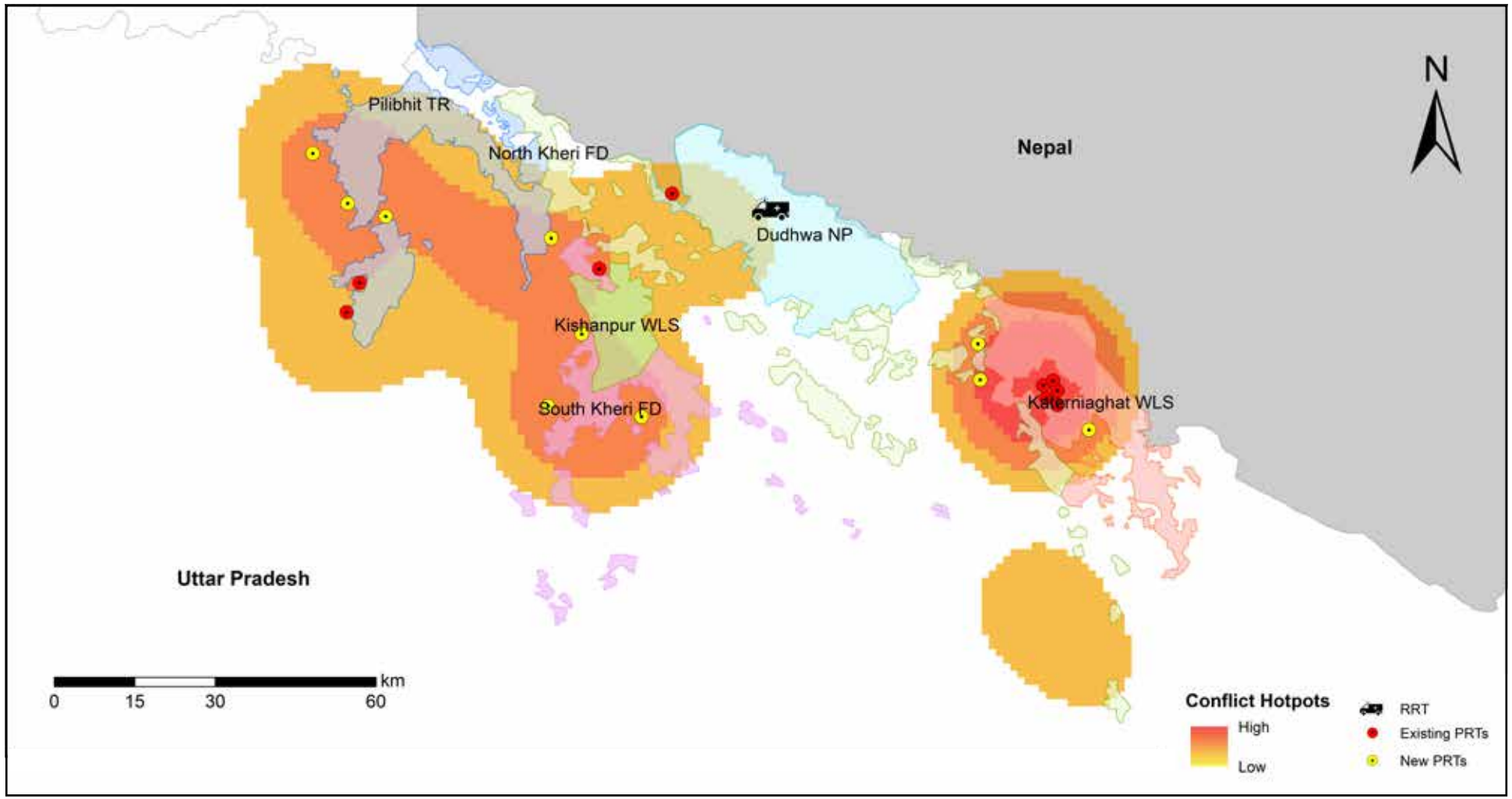
PRT village	Adjoining villages covered by PRT	Nearest Forest Division / Protected Area
Karikot	Jamuniha, Amirsingh Purwa, Rajaram Tanda, Lohra, Tepra, Tharu Purwa, Azamgarh Purwa, Bhathha, Bargad Purwa, Azadnagar, Hajari Purwa, Hardevsingh Purwa	Katerniaghat WLS
Sujauli	Ayodhyapurwa, Sukhripurwa, Ghoore Purwa, Trilokigaurhi, Srirampurwa, Paras Purwa, Mojwa, Bhainsahi	Katerniaghat WLS
Rampurwa-Matehi	Kohli, Rana Farm, Naotod, Bankati, Mukhiya Farm, Lambe Purwa, Pakariya	Katerniaghat WLS
Anandnagar	Maurahwa, Barkhariya, Jungle Gulahriya, Teliyan Purwa, Dhonrhe Purwa, Sitaram Purwa, Mohkam Purwa, Dharmpur	Katerniaghat WLS
Mangalpurwa	Biharipurwa, Dodhnath Purwa, Jammutanra, Kurkuri Kuan, Ghosiana, Kailashpuri, Katerniaghat, Bhawanipur	Katerniaghat WLS
Sumernagar	Sumer Pur, Bishenpuri, Nishad Nagar, Azadnagar, Patihan, Gajraula	Dudhwa National Park
Koptanda	Elanganj, Uttar Tanda, Dakkhin Tanda, Bangali Kaloni, Kishanpur	South Kheri FD
Deoria	Kataiyya, Gajna, Mohammad Pur, Lamhauwwa, Meer Pur, Kishanpur Pakaria	Pilibhit FD
Devhana	Aamdanda, Patti, Jainagar, Piprari, Himmatpur, Baldevpur	Pilibhit FD

(iv) Integrating and Sensitising Local Communities for Conflict Mitigation

(a) The Primary Response Teams

With the aim of addressing human-big cat conflict in the Dudhwa-Pilibhit TR landscape in a holistic manner, and with community integration being the primary strategy, rapid consultative meetings were organised by the project team across several villages that had a history of conflict with big cat species. After meetings with villagers in various parts of the landscape, three villages were found to be conducive for the establishment of Primary Response Teams (PRTs) by 2011: Sumernagar, Barkharia, and Deoria.

Primary Response Teams comprising three to four village volunteers, one or two village elders or influential persons, and one or two forest guards were established in these villages. These groups were subsequently trained through repeated interactive meetings, where they were informed about the possible factors that drive conflict, the role of wildlife and natural forests, national conservation



Map 11: 95% kernel density map portraying conflict hotspots in the Dudhwa-Pilibhit TR landscape, showing the location of the existing RRT and the existing and new PRTs (planned to be established)

laws, and basic precautionary measures to be taken during conflict situations. These teams were also provided basic equipment such as flashlights and first-aid kits.

In the following year seven more PRTs were constituted in the villages of Karikot, Sujauli, Rampurwa-Matehi, Anandnagar, Mangalpurwa, Koptanda and Devhana. These villages were prioritised based on the frequency of human-big cat conflict cases recorded in the last decade, their closeness to clusters of villages where similar cases had been recorded in the past, and the willingness of local people to play an active role in conflict mitigation. Although a total of 10 PRTs were constituted, the Barkharia village PRT was subsequently dissolved and a few of the PRT members assimilated into the Anandnagar PRT, as no cases of big cat related conflict had arisen in Barkharia in 2011-12.

The nine PRTs currently set up across the landscape cater to over 60 adjoining villages whenever conflict scenarios are reported. During any reported case in a village, the nearest PRT relays information to locally appointed forest guards and the nearest RRT unit. Concurrently, they notify all villagers of the presence of a big cat and inform them about the precautions to be taken. In case of attacks on humans, PRTs also deliver first-aid care and/or rush the injured to nearby hospitals or medical care centres, and later liaise with the local forest department for the disbursement of compensation. They also actively prohibit the formation of crowds, especially around the area where the animal may be hiding. Additionally, PRTs organise village level meetings at various locations in the larger landscape and assist the project team in conducting consultative awareness programmes for local villagers. In these programmes or meets, PRT members interact with villagers about their own experiences of conflict and help sensitise local people about the need to conserve wildlife.

Plate 13: An ongoing PRT meeting

Plate 14: A signboard displaying precautionary measures to be taken during conflict situations, erected at a PRT village (left); and PRT members being provided with first-aid kits and flashlights

Table 11: Important cases of human-big cat conflict addressed independently by PRTs, that directly resulted in the saving of human and animal lives

Date	Nature of incident	Intervention by PRT
22 March 2015 (7.30p.m.)	A 14-year-old boy was attacked and mauled by a leopard just outside his house in Ajamgarh village of Karikot Forest Circle in Katerniaghat WLS.	The Karikot village PRT helped in rescuing the victim, rushing him for medical treatment and facilitating the reimbursement of relief (medical expenses) from the forest department, thus saving the boy's life. The PRT also held a meeting with the victim's family and neighbours, pacifying them and preventing any aggravated reaction against the leopard.
04 June 2015	A six-year-old boy named Alam was attacked by a leopard inside his house in Karikot village in Katerniaghat WLS. The boy's mother raised alarm and villagers rushed in and mobbed the leopard, upon which it left the boy and retreated into the forest.	The Karikot PRT members were immediately summoned and the boy was rushed to the hospital in Bahraich without delay. At the hospital, the boy was treated for two puncture wounds on the neck and head. The PRT members addressed the situation expediently, preventing the formation of a mob and any retaliatory action against the leopard. As a consequence, the project RRT did not have to intervene directly.
04 September 2015 (6.30p.m.)	An 11-year-old boy named Rohit was attacked by a leopard while he was sitting in the courtyard of his house in Azamgarpurwa village near Katerniaghat WLS. The leopard dragged the boy into the nearby paddy fields and his family raised the alarm on hearing his screams. As other villagers gathered and the news spread, they contacted the nearest (Rampurwa-Matehi) PRT.	The villagers along with the PRT members promptly launched a search among the paddy fields. They found the boy in a state of shock; fortunately the leopard had not seriously injured him. He was rushed to the nearest dispensary/medical centre for the treatment of his injuries. The PRT's swift intervention saved the boy's life and ensured that there was no retaliatory action against the leopard.

In three years of implementation, PRTs have proven invaluable in mitigating conflict with big cat species on the ground. They have been instrumental in relaying information about conflict in several cases and have played a direct role in resolving a number of them, a few of which helped save the lives of three children and the animal involved, through proactive action, without external support from the RRT.

To maintain a rapport with and develop the capacity of constituted PRTs, regular awareness meetings and annual training workshops have been organised. Basic equipment such as flashlights and first-aid kits, and resources sich as pamphlets and posters are distributed to help PRTs more effectively resolve conflict cases and spread awareness among neighbouring villagers. Additionally, based on the number of cases handled successfully by the PRTs – their overall efficiency in relaying information, providing first-aid or other voluntary support when required, and in organising awareness meetings with local villagers – they are also given awards on an annual basis.

(b) Sensitising adults

Besides constituting Primary Response Teams in conflict hotspots, it is imperative that continuous awareness and sensitisation programmes and meetings are held with villagers in areas that experience conflict but have no PRTs constituted. Such efforts are expected to create a population that is more conducive to adopting passive measures to ameliorate conflict with big cat species in the long run.

These meetings and programmes are geared towards imparting basic knowledge on wildlife and wildlife conservation to villagers, as well as informing them about simple precautionary measures to be taken in situations of conflict with potentially dangerous wildlife species, thereby reducing the chances of injuries and casualties. The data pertaining to conflict with big cats reveals that many human casualties occur as a result of practices such as sleeping outdoors, using fringe forest areas for defecation etc., and awareness initiatives are also therefore geared towards inducing behavioural changes.

Similarly, livestock depredation is primarily found to be caused when unguarded livestock are grazing in the fringe forests or because most of them are tied in the open at night. Simple measures such as creating leopard-proof pens can greatly minimise the number of livestock lost to wild carnivores, and awareness programmes can help in imparting knowledge of such measures to local people.

Most important, awareness meetings held during conflict situations greatly reduce the animosity levels of local people and promote greater cooperation, which is essential to ensure that no humans or conflict animals are injured or killed.

Over the years numerous such meetings have been held with local villagers across the Dudhwa-Pilibhit TR landscape during and outside of conflict situations, as summarised in *Table 12* below. Many of the meetings held in 2010-11 helped in the constitution of PRTs. In subsequent years a number of meetings were co-organised or also attended by constituted PRTs. The impact of

Table 12: Number of awareness and consultative meetings held with villagers across the project period, and the number of people sensitised

Year	No. of meetings	No. of villages	No. of people
2010	6	21	2150
2011	3	3	450
2012	10	9	1160
2013	17	12	1113
2014	17	17	1363
2015	9	10	300

such meetings cannot be quantified, but is evident in the reduced number of conflict cases that have resulted in human injuries and/or deaths, or even livestock loss.

Another major initiative during the project period has been to install, in high conflict villages, signboards outlining precautionary measures to avoid conflict. Thus far, 19 signboards have been installed in 12 villages in the landscape. In addition, numerous leaflets elucidating various precautionary measures to be taken to reduce the chances of being attacked by big cat species have been distributed to local people during awareness meetings.

(c) Developing awareness among and sensitisation of children

Apart from conducting awareness meetings and programmes for adults in villages across the Dudhwa-Pilibhit TR landscape, the project has also conducted awareness programmes for the school children of the region since 2011. These programmes have varied in their approaches from general classroom sessions to more interactive events including wall painting, essay writing and quiz competitions, forest safaris and the like.

All education programmes and events for children commence with a brief assessment of their overall knowledge of local wildlife and certain other related matters through a Multiple Choice Question paper (MCQ). After the event, the children are provided another question paper covering aspects taught during the event. These assessments are utilised to ascertain the difference in the performance of children and therefore in their levels of knowledge, as a proxy measure of the effectiveness of the events and programmes organised.

Table 13: Details of educational and awareness programmes organised in the Dudhwa-Pilibhit TR landscape for school children.

	Date	Village and school		No. of students	Nearest FD/PA
1	1-Mar-2010	Primary and junior schools, Nishadnagar and Ghola	🟡 🟢	33	Dudhwa National Park
2	1-May-2010	Higher secondary and primary schools, Sumernagar Shantinagar, Ghola and Bishenpur	🟡 🔵	102	Dudhwa National Park
3	1-Oct-2010	15 different primary schools from Palia	🟡 🔵 🔴	220	Dudhwa National Park
4	1-Mar-2011	Primary school, Bishenpuri village	🟡	55	Katerniaghat Wildlife Sanctuary
5	1-Mar-2011	Primary school, Gulra village	🟡	128	Katerniaghat Wildlife Sanctuary
6	25-Apr-2012	Primary and junior school of Sujauli village	🟡	215	Katerniaghat Wildlife Sanctuary
7	31-Aug-2012	Junior school, Gajraula village	🟡	120	Pilibhit Forest Division
8	22-Nov-2012	Junior school, Karikot village	🟡	80	Katerniaghat Wildlife Sanctuary

9	23-Nov-2012	Junior school, Kohli village	🟡	80	Katerniaghat Wildlife Sanctuary
10	23-Nov-2012	Junior school, Pipraiyya village	🟡	100	Pilibhit Forest Division
11	21-Dec-2012	Junior school, Rampurwa Matehi	🟡	100	Katerniaghat Wildlife Sanctuary
12	21-Jan-2013	Junior school, Dioria village	🟡	250	Pilibhit Forest Division
13	14-Feb-2013	Junior school, Devhana village	🟡	120	Pilibhit Forest Division
14	8-Mar-2013	Junior school, Koptanda village	🟡	150	Kishanpur Wildlife Sanctuary
15	21-Jan-2013	Junior school, Dioria village	🟡	250	Pilibhit Forest Division
16	14-Feb-2013	Junior school, Devhana village	🟡	120	Pilibhit Forest Division
17	18-Feb-2013	Junior school, Pipraiyya village	🟡	100	Pilibhit Forest Division
18	8-Mar-2013	Junior school, Koptanda village	🟡	150	Kishanpur Wildlife Sanctuary
19	29-Jul-2013	Gurukul Academy, Palia	🟡🟢	250	Dudhwa National Park
20	1-Oct-2013	Palia (eight different junior and primary schools)	🟡🔵🔴	400	Dudhwa National Park
21	17-Oct-2013	Junior school, Anand Nagar	🟡	160	Katerniaghat Wildlife Sanctuary
22	28-Oct-2013	High school, Kataiyya	🟡	110	Pilibhit Tiger Reserve
23	19-Nov-2013	Priamry school, Jamuniha	🟡	150	Katerniaghat Wildlife Sanctuary
24	21-Nov-2013	Junior school, Matehi	🟡	150	Katerniaghat Wildlife Sanctuary
25	23-Nov-2013	Bhagwant Nagar Gulara	🟡	60	Dudhwa National Park
26	20-May-2014	Kataiyya	🟡	60	Kishanpur Wildlife Sanctuary
27	14-Jul-2014	Medai Purwa	🟡	42	South Kheri Forest Division
28	17-Jul-2014	Majhaura	🔵🔴	20	South Kheri Forest Division
29	29-Jul-2014	Bhira	🟡🟢	48	Kishanpur Wildlife Sanctuary

30	29-Jul-2014	Dudhwa	🔵	70	Dudhwa National Park
31	12-Aug-2014	Bhira	🔵	43	Kishanpur Wildlife Sanctuary
32	13-Aug-2014	Majhaura	🟡	52	Kishanpur Wildlife Sanctuary
33	18-Sep-2014	Rampurwa	🟡 🔴	30	Katerniaghat Wildlife Sanctuary
34	1-Oct-2014	Paliya	🔵	300	Dudhwa National Park
35	2-Oct-2014	Bishenpuri	🟡	100	Dudhwa National Park
36	7-Oct-2014	Matolee	🟡	200	South Kheri Forest Division
37	13-Oct-2014	Dioria	🟡	28	Pilibhit Tiger Reserve
38	25-Nov-2014	Rampurwa	🟡	36	Kanterniaghat Wildlife sanctuary
39	18-Dec-2014	Junior school, Mathei	🔵	42	Kanterniaghat Wildlife Sanctuary
40	26-Mar-2014	Primary school, Ghola	🔵	90	Dudhwa National Park
41	26-Mar-2014	Primary girls school, Palia	🔵	100	Dudhwa National Park
42	20-May-2014	Kataiyya	🟡	70	Kishanpur Wildlife Sanctuary
43	14-Jul-14	Medai Purwa	🟡	70	South Kheri Forest Division
44	17-Jul-14	Majhaura	🟡	110	South Kheri Forest Division
45	29-Jul-14	Vivekananda Academy School, Bhira	🔵	48	Kishanpur Wildlife Sanctuary
46	29-Jul-14	Dudhwa Forest campus	🟡	70	Dudhwa National Park
47	12-Aug-14	Chaju Ram Crane Grower school, Bhira	🔵	40	Kishanpur Wildlife Sanctuary
48	13-Aug-14	Majhaura	🔵	30	Kishanpur Wildlife Sanctuary
49	18-Sep-14	Rampurwa	🟡	120	Katerniaghat Wildlife Sanctuary
50	01-Oct-14	10 different primary schools, Paliya	🟡 🔴	300	Dudhwa National Park

51	02-Oct-14	Kissan Uchhtar Madhyamik Inter College, Bishenpuri	🔵 🟡	100	Dudhwa National Park
52	07-Oct-14	Navodaya Vidyalaya, Matolee	🟡	200	South Kheri Forest Division
53	13-Oct-14	Intermediate College, Dioria	🟡	200	Pilibhit Tiger Reserve
54	25-Nov-14	Junior School, Rampurwa	🟡	180	Kanterniaghat Wildlife sanctuary
55	18-Dec-14	Junior School, Mathei	🔵	40	Kanterniaghat Wildlife Sanctuary
56	26-Mar-15	Dudhwa National Park, Palia Kalan	🟡 🟢	90	Dudhwa National Park
57	26-Mar-15	Poorva Madhyamik Vidyalaya, Ghola	🟡	100	Dudhwa National Park
58	14-Jul-15	Kastoorba Gandhi Aavasiya Balika Vidyalaya, Palia Kalan	🟡	90	Dudhwa National Park
59	15-Sep-15	Junior School, Hanumangarhi village	🟡	70	Katerniaghat Wildlife Sanctuary
60	02-Oct-15	12 different primary schools, Palia Kalan	🔵 🔴	350	Dudhwa National Park
61	05-Oct-15	Forest campus, Dudhwa National Park, Palia Kalan	🔵	60	Dudhwa National Park
62	19-Oct-15	Gurukul Academy, Palia Kalan	🔵 🟡	60	Dudhwa National Park
63	19-Nov-15	Goyal	🟡	60	Pilibhit Tiger Reserve
64	27-Nov-15	Bishenpuri	🔵 🟡	60	Dudhwa National Park
65	07-Dec-15	Sumernagar	🟡 🟢	120	Dudhwa National Park

🟡 Classroom session
🔵 Painting, quiz, essay and slogan-writing competitions
🟢 Interactive field visit
🔴 Wildlife parade/march

Plate 15: School children with activity packs during an interactive field visit (overleaf top); students participating in a wall painting competition (overleaf bottom); children being taken on a nature trail walk (top); a school student painting on his school wall (centre left); a student enjoying an interactive activity education pack (centre right); and girl students being briefed about wildlife in Dudhwa TR (above)

A total of 65 educational events and programmes were organised in approximately 109 schools of 40 to 50 villages in the region from 2010 to 2015. The events and programmes comprised classroom lecture sessions with appropriate audio-visual media such as presentations or short wildlife films. In some cases the school children were additionally engaged in interactive activities such as painting, quizzes, essay writing and slogan writing. In a few cases the children were taken on town/village-wide parades with banners. Some events involved taking the children to Dudhwa National Park to get them acquainted with various wild fauna and flora, signs of animal presence etc. In all, above 4000 school students ranging from Class 4 to Class 12 have been sensitised through the awareness programmes organised under the project. *Table 13* (pages 61-64) provides details of the children's awareness programmes and events conducted in the region.

The pre- and post-event evaluations of the knowledge levels of school children revealed that during the pre-test a majority of students scored around 40.4±13.22% (approximately six correct answers out of 15 questions), but scored on average 29.1±10.9% higher in post-test scores, answering about 69.5±12.1% questions correctly (approx. 11 out of 15 questions) (*Figure 26*).

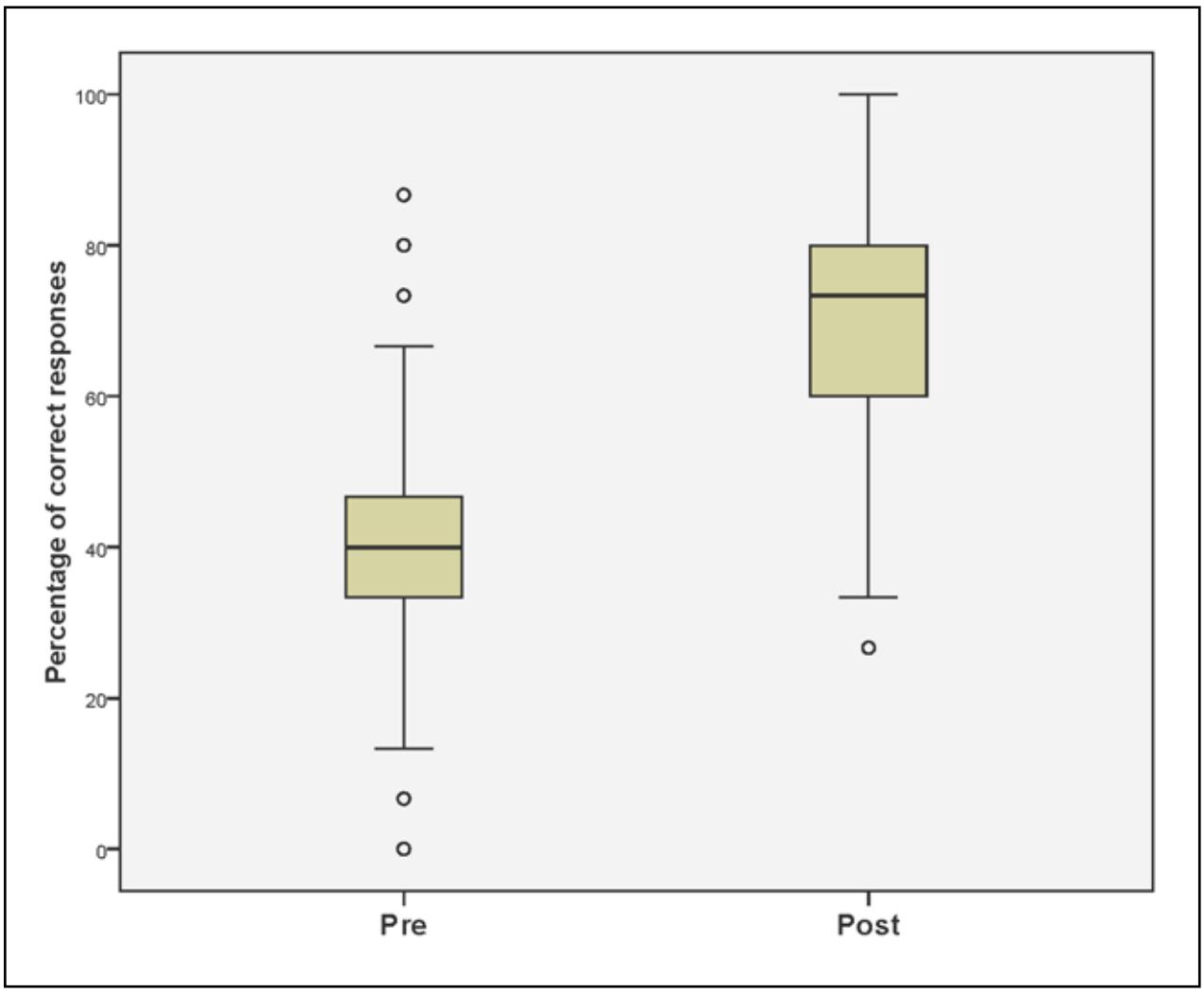


Figure 26: Box plot showing number of questions answered correctly by each child before and after awareness events were conducted

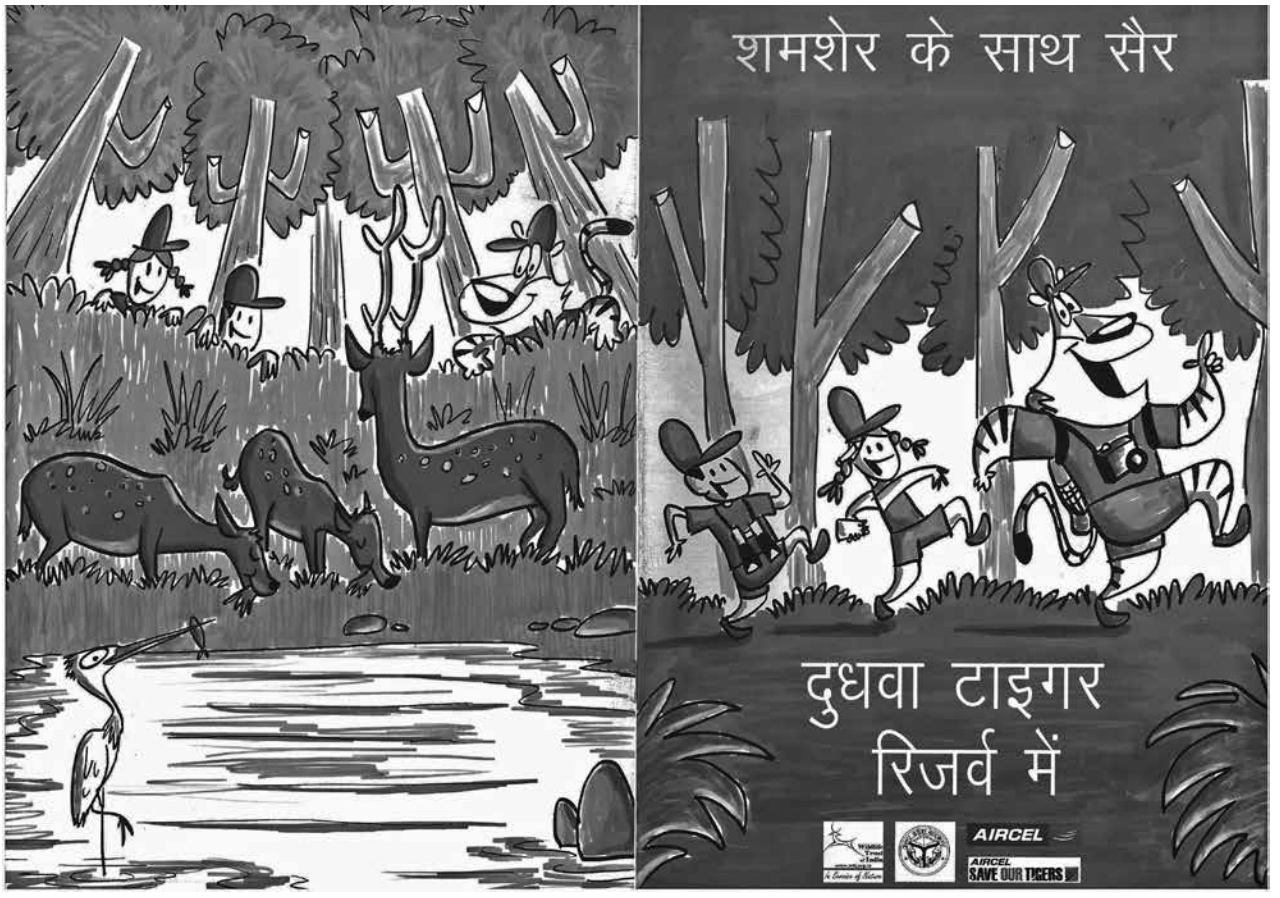


Plate 16: Cover of the activity pack prepared for school children of Class 4 to 6 around Dudhwa TR

With a non-normal distribution of the data (Shapiro-Wilk's test, pre-test, W = 0.97, p = <0.0001; post-test, W = 0.96, p = <0.0001), a non-parametric pair-wise comparison of the pre- and post-event evaluations also revealed that post-event evaluation scores were significantly higher than pre-event scores of the same students (left tailed Wilcoxon's sign rank test, V = 0, P = <0.0001).

In 2014, as an additional initiative, a novel education pack aimed at sensitising young children (Class 4 to 6) was developed. This pack was designed as a comic book with the lead characters being played by various large mammals found in the Dudhwa-Pilibhit landscape, and sought to familiarise young children with these species and their interrelationships as well as the problems they face, through a short, enjoyable storyline that also elaborated the need for conserving wildlife and wild habitats. These activity packs were distributed among a number of teachers in schools where educational activities had been conducted in the past.

(v) The Rapid Response Team

Besides long-term measures such as education and awareness based activities, it was also considered essential that a support system be developed that could respond to community needs during conflict situations. For this, a team consisting of a trained wildlife biologist, a veterinarian and a sociologist / social worker was constituted and equipped with a four-wheel-drive vehicle and additional gear required for managing conflict situations. This unit is termed the Rapid Response Team (RRT). While a Mobile Veterinary Service unit had already been established under the project by 2010, it was enhanced into an RRT by early 2012 through additional financial support from Aircel Pvt Ltd.

Plate 17: The RRT vehicle

Plate 18: A tiger involved in conflict that was captured by the RRT in Puranpur and subsequently translocated and released into Chukka Forest in Pilibhit TR

Table 14: Important cases addressed by the RRT from 2012 to 2015;
highlighted rows ( ) indicate cases where the situation required the RRT to capture the animal

Case Details	Area/Location	People Injured	People Killed	Interventions	Intervention Period
An adult male tiger was reported from the outskirts of Lucknow city and was suspected to have moved out from the forests of Pilibhit	Lucknow city	0	0	The tiger was captured, radio-collared and translocated 200km from the capture site	11 Jan – 25 April, 2012
A sub-adult male tiger suspected to have moved out from the forests of Pilibhit reportedly entered the fringe village of Puranpur	Puranpur, Pilibhit FD	0	0	The tiger was captured and translocated 40km away from the capture site	1–21 June, 2012
An adult male tiger moved out from the forests of Pilibhit and entered the fringe village of Mailani	Mailani	0	0	People were kept at bay and the tiger was monitored until it returned to the forest by itself	9 July – 1 Oct, 2012
A tiger moved out of the forests of Dudhwa Tiger Reserve and entered an adjoining village, Lagdahan	Lagdahan, Kishanpur	0	0	The team visited the site and confirmed the presence of a tigress. The tigress was closely monitored and eventually returned to the forest.	1 – 14 January, 2013
A sub-adult leopard moved out of the forest and entered a house situated on the outskirts of Meerut city	Hastinapur, Meerut	0	0	The tiger was captured and translocated 200km from the capture site	22 – 23 January, 2013

A female tiger cub was trapped in a leg-hold trap on the fringes of North Kheri Forest Division. The trap had been set by a poacher for small game	Mailani, Kishanpur	0	0	The tiger was captured, treated, and sent to Lucknow zoo	25 – 26 February, 2013
A tiger moved out of the forests of Valmiki Tiger Reserve, Bihar and entered a village in the Kushinagar district of Uttar Pradesh	Kushinagar, Katerniaghat	0	0	The team visited the site and installed a trap cage. The tiger was monitored with minimal disturbance. As expected, it returned to the forest area.	23 – 25 March, 2013
An adult leopard was found in an agriculture field in Khekra village in the Bhagpath district of Uttar Pradesh, on the banks of the river Yamuna	Khekra, Bhagpath	1	0	The team visited the site and installed a trap cage. The leopard was monitored and eventually returned to the forest.	10 May, 2013
A sub-adult leopard moved out of the forest and entered a house in Chartapati village, situated on the outskirts of Puranpur town in Pilibhit district. The leopard was trapped in a room.	Puranpur, Pilibhit FD	1	0	The leopard was captured and translocated 26km from the capture site	11 – 12 May, 2013
A tigress with three cubs moved out of the Pilibhit Forest Division area and entered the Gajrolla farmlands situated 12km away from the forest boundary.	Gajrolla, Pilibhit FD	0	0	The tigers were monitored with minimal disturbance and information was collected on their movement, prey availability and its utilisation. The tigers eventually returned to the forest	27 May – 18 June, 2013

An adult leopard was located in the cantonment area of Bareilly	Bareilly town	0	0	Trap cages were set up and the leopard was monitored closely with minimal disturbance. The leopard eventually found safe passage back to the forest.	30 June – 14 August, 2013
A tigress moved out of the South Kheri Reserve Forest area and entered adjoining farmlands. It had killed one person besides seriously injuring another	Bhira, Lakhimpur Kheri	1	1	The tiger was captured, translocated and released in Dudhwa National Park approximately 30km away from the capture site	22 February – 10 March, 2014
A tiger had killed 10 people in the farmlands of the Moradabad, Sambhal and Bijnor districts of Uttar Pradesh. The tiger was believed to have moved out of the forests of Corbett Tiger Reserve, travelling over 200km away and then traversing back.	Moradabad, Bijnor and Sambhal	0	10	A Task Force was formed and continuously tracked the tiger through secondary sighting records and secondary signs of presence. The tiger's return to the forest was finally confirmed through pugmarks.	29 December, 2013 – 20 February, 2014
A leopard was trapped in a leg-hold trap in Jharoda village near Kithore, Meerut district. It had managed to break the chain of the trap and hide in a nearby sugarcane field with the trap still attached to its leg.	Jharoda, Meerut	0	0	The leopard was captured, treated and translocated to the Shivalik forest area approximately 100km away from the capture site	13 February – 5 March, 2014

A leopard entered the Meerut cantonment area. While trying to escape from the area, it got trapped in a hospital run by the Indian Army.	Meerut city	6	0	The RRT veterinarian attempted to dart the leopard, but the animal managed to hide in a hospital and moved into a forested patch outside Meerut city. The RRT camped in the area until 8 March, 2014 to address rescue situations, if any.	23 February – 8 March, 2014
A leopard entered a populated area of Hastinapur, Meerut, and got its leg caught in a leg-hold trap. However, it managed to break the shackle of the trap and took refuge in a nearby sugarcane field with the trap still attached to its leg	Hastinapur, Meerut	2	0	The leopard was captured using nylon nets and moved into a cage, after which it was chemically immobilised to remove the trap. It later died due to extreme dehydration and starvation, as was ascertained through a post-mortem examination	30 March – 1 May, 2014
A tigress was located on the outskirts of Kanpur city. It was ascertained to have moved out from the forests of Pilibhit Tiger Reserve	Kanpur city	0	0	The RRT team visited the site and confirmed the tigress' presence. The animal was closely monitored and capture efforts made. However, the animal eventually moved back to Pilibhit TR.	26 October 2014- 28 February 2015

Plate 19: The CISH farm near Lucknow where the Rehmankhera tiger had taken up residence

The RRT is typically summoned by conflict affected communities through the constituted PRTs or the local forest department, and seeks to resolve conflict situations through active interventions such as crowd control and capture of the animals involved.

From 2012 to 2015, the RRT was called in to resolve 17 big cat related conflict situations that required direct on-ground interventions. Nine of these cases were from outside the Dudhwa-Pilibhit landscape and were not confirmed to have been caused by animals moving out of forests in the project region. However, as these cases occurred in areas of high human population density, the RRT was asked to intervene by the state forest department. In the remaining eight cases, intervention was required either because PRT members and forest department personnel were unable to actively handle crowds, or the animal involved was in dire need of rescue or capture. Of the 17 cases attended by the RRT, 10 pertained to tigers while the remaining involved leopards.

(vi) Case Studies

(a) The Rehmankhera tiger

In the first week of January 2012 a tiger was spotted in Lucknow, the capital of Uttar Pradesh. Believed to have travelled nearly 200km from Pilibhit Forest Division, the tiger was inhabiting the horticulture farm of the Central Institute for Subtropical Horticulture (CISH), located 25 km from the city proper. The CISH farm is spread across 133 ha and has vast mango and guava plantations and a large area of scrub forest. The dense woodland areas within the horticulture patches of the farm enabled the tiger to stay out of sight.

Camera traps were first deployed to identify the animal and determine its approximate age and physical condition. The tiger, photographed on three occasions and at three different sites, was confirmed to be a sub-adult male. Its approximate location was soon established and efforts were then focussed on confining it to this area. For this, first, the movement of local people was heavily restricted. Second, live bait were placed to keep the tiger localised. This strategem proved successful as the tiger remained in the area for the next three months, regularly feeding on the live bait. Finally, three techniques were employed to capture the tiger: caging, pitfall trap, and darting (chemical capture) from *machans* built atop trees.

Plate 20: A camera trap image of the Rehmankhera tiger (top left); and various camouflaged trap cages set up by the RRT and forest department during the capture operation

Plate 21: Pitfall trap method for capturing the Rehmankhera tiger: A pit (12x12x12 feet) was dug and covered with a light bamboo mesh, with vegetation spread over the pit as camouflage (left); a buffalo calf was then placed on the pit as live bait (right)

Plate 22: Claw marks suggesting that the tiger climbed out of the pit using its claws

Four trap cages were deployed in the CISH campus, each well camouflaged with natural foliage (*Plate 20*) and with live bait (goats) to lure the tiger. Trapping efforts totalled around 157 trap nights (one trap night=one cage set out for one entire night), and although the tiger approached the cages a total of 22 times, it did not enter them.

Subsequently, the urine of a captive tigress from Lucknow zoo was also used to lure the tiger into one of the cages. While this seemed to attract the tiger as it visited the cage almost every day for the next 19 days, it never entered the cage. In another attempt, a stuffed tiger was placed inside one of the trap cages and the vocalisations of a tigress continuously played using a concealed

Plate 23: Treetop *machans* were built in an attempt to dart the tiger

audio player. This also attracted the tiger to the cage as evident from frequent pugmarks, but the tiger again did not enter the cage.

A pitfall trap was also built, consisting of a platform supported by a wooden pole driven into the middle of an excavated pit (12x12x12 feet). A buffalo calf was tied on the platform to lure the tiger onto it, the intention being that the platform would collapse under the tiger's heavier weight (*Plate 21*). The pit was covered with a light bamboo mesh over which a layer of grass was spread as camouflage. The pitfall trap efforts totalled seven trap nights (one trap night=one pit set out for one night). The tiger was successfully lured onto the platform and duly fell into the pit on one occasion, but managed to escape by clambering out using its claws (*Plate 22*).

Darting over live bait from camouflaged *machans* was the most frequently used method. The total tranquilisation effort amounted to 192.3 hours. A team comprising one to two shooters waited on treetop *machans* with live bait placed 15-20 m away. *Machans* were placed at seven strategic locations (*Plate 23*).The tiger approached the live bait on two occasions. The first incident occurred between 4p.m. and 4.30p.m. on January 21. A tranquiliser dart was fired but missed its target; the tiger killed and sat near the bait for about 10 minutes before disappearing into the bushes.

Plate 24: Search and tranquilisation teams on elephant back searching for the Rehmankhera tiger

Plate 25: The Rehmankhera tiger after being tranquilised (left), and the tiger being transferred to a transportation cage prior to being taken to the release site on April 25, 2012

Plate 26: The Rehmankhera tiger being transported to a release site in Dudhwa NP amidst crowds of local villagers

The second opportunity came on February 22 at approximately 5a.m., when the tiger killed and sat near another live bait. No darting attempt could be made, however, due to poor light and visibility. Using another approach, three different teams actively searched for the tiger on elephant back (*Plate 24*), including areas where live bait had been tethered. The total search effort amounted to 48.9 hours. More than 10 encounters with the tiger occurred using this approach, but obstructing vegetation prevented a successful darting each time.

The Rehmankhera tiger was eventually captured on April 25. It had killed a tethered bait on the night of April 23 and was left undisturbed for two successive nights as it stayed localised and consumed its kill. On the morning of April 25, three tranquilising teams sitting atop different

Plate 27: The Rehmankhera tiger being fitted with a satellite collar, ensuring an adequate gap to allow for the growth of its neck till adulthood (left), and the tiger after release into Dudhwa NP

Plate 28: Tracking the radio-collared tiger in Dudhwa from a watch tower (left), and from a vehicle

elephants encircled the small forest patch in which the tiger was feeding. A veterinarian from Lucknow zoo fired two darts using a gas-propelled syringe projector, of which one hit the target. Once it was confirmed that the tiger had been sedated, a core team of five or six people moved the tiger into a transportation crate. Throughout this process the tiger's eyes were covered with a damp cloth and water was continuously sprayed on its body to prevent it from overheating. The operation lasted approximately three hours.

Immediately after the capture, the tiger was taken to Dudhwa National Park by truck, a distance of over 200 km. The tiger was transported the next morning to the release site near Salukapur, about three kilometres from the Dudhwa Forest Campus, where it was sedated once again. The tiger's morphological measurements were then recorded and it was examined for external injuries. It was then fitted with a Satellite-VHF collar (Telonics TGW-3580-GPS/SOB/ARGOS, provided by the Wildlife Institute of India) with a battery life of more than two years and programmed to collect data at the rate of one to two locations per day. At around 9:30a.m. the tiger was revived and released into the core area of Dudhwa National Park. Once it moved away from the release site, the satellite-

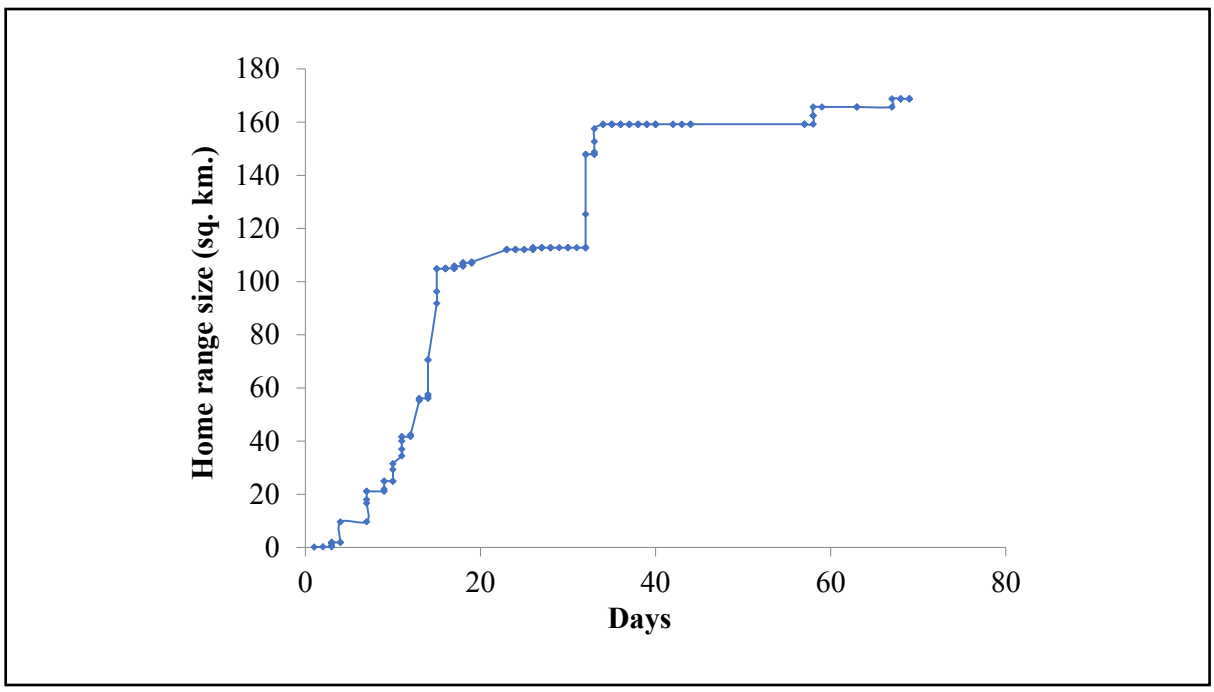
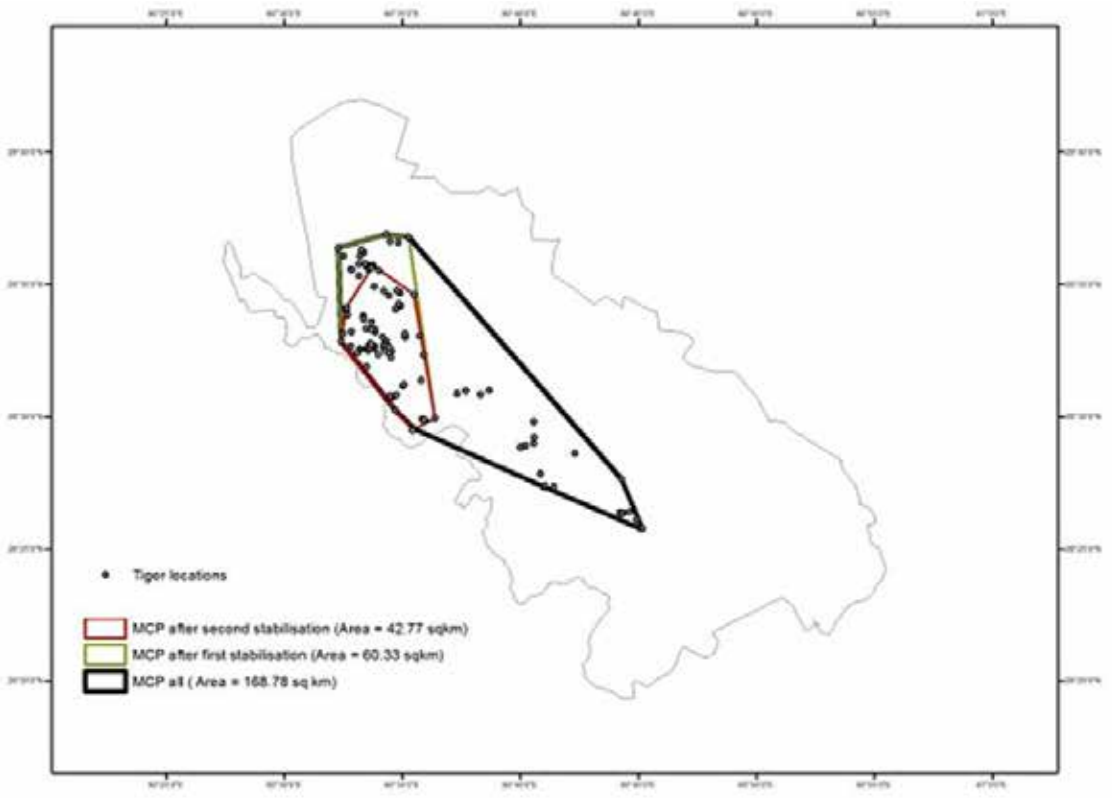


Figure 27: A graph showing the stabilisation curve of the released tiger in Dudhwa National Park



Map 12: Estimated home range size of the released Rehmankhera tiger in Dudhwa National Park by using the Minimum Convex Polygon (MCP) method. The black line delineates the whole sample size used for home range estimation. The green line delineates the home range after the first stabilisation.

VHF collar was used to monitor its movements and survival.

A total of 189 locational data points were received between April 26 and August 15, 2012 from the collar. After release, the tiger showed rapid movement from one area to another across the forested landscape. The first stabilisation was observed after around 15 days followed by a second stabilisation phase after 31 days (*Figure 27*). The time taken for stabilisation of territory appeared to be much shorter than that determined in earlier studies (Priatna *et al.,* 2012).

Subsequently, Minimum Convex Polygon (MCP) and Kernel methods were employed on the entire locational data set to estimate the effective home of the tiger. The estimated overall home range size was 168.78 sq km (*Map 12*) and the estimated home range during first and second stabilisation periods was 60.33 sq km (n=47 locations) and 42.77 sq km (n=101 locations) respectively. The estimated overall home range size of the tiger using Kernel methods was 179.97 (90%) sq km and during first and second stabilisation periods was 80.207 sq km and 51.91 sq km respectively.

On August 16, 2012 all contact with the radio collared tiger was unfortunately lost, perhaps due to unprecedented battery failure as neither satellite nor VHF signals were being received despite extensive tracking attempts. Subsequently, camera traps were installed for opportunistic monitoring of the tiger. The tiger was camera-trapped at Belrayan Range on March 10, 2013.

The tiger survived its first 11 months after being released into Dudhwa National Park, which is the mark of a successful translocation for a tiger involved in conflict with humans. Translocation has often been recommended in cases of human-wildlife conflict (Karanth and Madhusudan, 2002; Treves and Karanth, 2003) and has become a standard method of intervention (Linnel *et al.,* 1999). However, the effectiveness of translocation is heavily criticised by others, mainly due to insufficient data on survival of

Plate 29: Latest photograph of the radio-collared Rehmankhera tiger, taken on December 19, 2014

the individual translocated animal after release (Linnel *et al.*, 1997; Goodrich, J.M. and Miquelle, D.G., 2005).

Through continuous efforts, the translocated tiger was again camera-trapped on December 19, 2014 (*Plate 29*), indicating that when translocated into appropriate habitats with ample prey and a low density of co-predators, animals that have come into conflict with humans can successfully be rehabilitated into the wild.

(b) The Puranpur tiger

In early February 2012, a tiger sighting was reported from the Puranpur region adjoining Kishanpur WLS. Although the initial reports appeared apocryphal, over the next several months the sightings increased and panic erupted among local villagers. The presence of a tiger was confirmed and the animal was reported entering villages and killing livestock. By June 1, 2012, about 15 heads of livestock were confirmed to have been killed by the tiger and WTI's RRT arrived at the site to address the ongoing conflict. Based on the situation on the ground, it was decided that the tiger should be captured and released back into the wild as it was continuously targetting livestock.

As per standard protocol, the area was extensively searched based on anecdotal accounts of where the tiger was last spotted. Several pugmarks were observed and the animal was believed to be an adult-sized animal, although its sex could not be ascertained through its pugmarks. The tiger was finally located in an area of about four sq km, comprising scrub forest of primarily *Ipomea sp.* bushes (*Plate 30*).

Once its location was determined, efforts were made to prevent the tiger from leaving the area by providing live bait at four locations. Two camouflaged trap cages were installed with live bait (*Plate 31*). Caging efforts totalled 30 trap nights (one trap night=one cage set out for one night), but did not succeed in trapping the tiger, which on four occasions came very close to the cages but did not enter them or kill the bait. *Machans* were also set up at two strategic

Plate 30: Habitat of the site where the Puranpur tiger was located

Plate 31: Live bait tied outside a trap cage to attract the Puranpur tiger

locations to attempt darting the tiger. The total effort made through this method accounted for about 12.3 hours, after which it was abandoned.

Finally, two *kumki* (captive trained) elephants were called in by the local forest department to allow tranquilisation teams to actively search for the tiger. On June 21, the tiger was spotted in a small patch of bushes. It was encircled and confined to the spot for three to four hours by three tracking teams on elephant back. A tranquilising team was then moved into position on another elephant to dart the tiger. After several hours of failed darting attempts, with the tiger repeatedly charging at the elephants, one of the WTI veterinarians fired a dart hitting the tiger and delivering the sedative successfully. Once the tiger was sedated (*Plate 32*), it was promptly

Plate 32: The sedated Puranpur tiger (left); and the tiger being taken to the release site

moved into a transfer cage. The entire operation lasted approximately six hours. Immediately after capture, the tiger was transported to the Chukka forests of Pilibhit Tiger Reserve more than 40 km away. It was released in a grassland area at approximately 7p.m. A total of 21 days had been spent trying to capture it.

An overview of the different methods used to capture the tigers in Rehmankhera and Puranpur is provided in *Table 15*. The results clearly indicate that to achieve maximum success in the shortest amount of time, darting from elephant back is the best method – probably because it allows larger areas to be searched and provides ample vantage clearance for darting attempts. It is also possibly the best method because tigers are generally not deterred by elephants and often do not run away, while they are relatively more wary of vehicles and humans on foot.

Table 15: An overview of the different methods used to capture the tigers at Rehmankhera and Puranpur

Trap cage deployment						
	No. of cages installed	**Trap nights**	**No. of times cages shifted**	**No. of times tiger visited trap sites**	**No. of times tiger entered cage**	**Outcome**
Rehmankhera	4	157	05	22	1	Returned from halfway into cage
Puranpur	2	30	01	04	0	
Pitfall trap deployment						
	No of pit traps dug	**Trap nights**	**Days spent in building pit traps**	**No. of times tiger visited trap sites**	**No. of times tiger fell into trap**	**Outcome**
Rehmankhera	01	07	2-3	4	01	Tiger escaped from the pit
Puranpur	-	-	-	-	-	-

Darting attempts from *machan*						
	No. of machans	**No. of darting teams deployed**	**Time spent in darting efforts (hrs)**	**Darting opportunities availed**	**No. of times darting carried out**	**Outcome**
Rehmankhera	07	01	192.3	01	01	Target missed
Puranpur	02	02	48.0	01	01	Target missed
Darting attempts from elephant back						
	No. of elephants deployed	**No. of darting teams deployed**	**Time spent in darting efforts (hrs)**	**Darting opportunities availed**	**No. of times darting carried out**	**Outcome**
Rehmankhera	03	2-3	48.9	10	01	Tiger darted
Puranpur	02	01	26.5	02	01	Tiger darted

(c) The Bhira tigress

A tigress was reported roaming in the populated areas bordering South Kheri Forest Division. It had killed one person and seriously injured another (*Plate 33*) in a fringe village, causing widespread panic and leading villagers to demand that it be captured immediately. The tigress was reportedly frequenting sugarcane fields in the area, disrupting harvesting and other agricultural activities. The forest department decided that it should be captured to prevent any further attacks on humans, and summoned the RRT team based at Dudhwa National Park.

The RRT team arrived at the site on February 22, 2014, two days after the first attack. The team explored the region on foot for signs of the tigress's presence (*Plate 33*), such as pugmarks, scat piles and scrape marks. The tigress had been moving from one place to another through tall sugarcane fields, which not only provided the perfect cover but also restricted the rescue team's access by vehicle

Plate 33: Person attacked by the tigress (left); and pugmarks at the site of attack

or on foot. Subsequently, the team established the tigress' location in the vast agricultural expanse. It was spotted on March 7 near the carcass of a nilgai that it had killed inside a small patch of sugarcane. Two teams approached it on elephant back in an attempt to dart it but the darts missed, allowing it to escape into the adjoining sugarcane fields. Efforts were then made to confine it to a smaller part of this area, by leaving dead bait in the same area where the nilgai carcass had been found.

The tigress was spotted near the bait on March 10 and the patch of sugarcane was immediately encircled with large nylon nets. Tranquilising teams on elephant back then scouted the area for three to four hours, after which the tigress was successfully darted (*Plate 34*). As it attempted to avoid being spotted by the two teams on elephants, it got entangled in the net lining on the periphery of the sugarcane patch and one of the veterinarians fired a dart from a DanInject Syringe Projector, hitting the target. The induction time was less than 10 minutes and the tranquilised tigress was soon moved into a holding crate (*Plate 31*), which was loaded onto a truck for further transport. The tigress' health was examined by the project veterinarian at the capture site (*Plate 31*). The capture operation lasted over five hours, while the entire case took 17 days to resolve. The forest department decided to release the tigress into Dudhwa National Park in an area approximately 30 km from the capture site, on the same day. The 'Bhira Tigress' became the third displaced tiger in Uttar Pradesh to be successfully captured and relocated back to the wild. No human-tiger conflict was reported around Dudhwa National Park for over ten months after the release.

(d) The Jharoda leopard

On February 13, 2014, the project team received a call from the Divisional Forest Officer, Meerut, about

Plate 34: (clockwise from upper left) Tranquilisation teams on elephant back searching for the tiger; the tranquilised tigress being checked by the project veterinarian; the tranquilised tigress being carried to the transportation cage; a wildlife veterinarian checking the size of canines to determine the tigress' age

a leopard sighting in Jharoda village near Kithore in Meerut district. The leopard had apparently got its leg caught in a leg-hold trap, which the locals claimed had been deployed to catch jackals. It had managed to break the chain of the trap and escape into a nearby sugarcane field with the trap still clamped to its paw.

The team reached Jharoda village at 2:30p.m. and found that locals from nearby villages had assembled in the thousands and surrounded the sugarcane field where the leopard was hiding (*Plate 35*). This patch was immediately cordoned off using nets and with the assistance of local civil administration personnel, including the police. The forest department provided a trap cage, though it was kept aside to be used only to hold and transport the leopard as the pulley system of the door was broken. Due to low visibility in the sugarcane field, the team decided to search for the injured leopard using two JCB earthmovers. Once located, the chemical capture team climbed on to the excavator of one of the JCBs to get a clear shot. A dart was administered by the WTI veterinarian at 4:15p.m. using a pneumatic pistol, after which the animal crawled further into the sugarcane thickets. The team found the animal sedated and hidden at 4:50p.m. After ensuring that the leopard was completely sedated, the team removed the leg-hold trap (*Plate 35*) from its right forelimb. The team inspected the leopard for injuries and administered treatment accordingly. The leopard was a sub-adult female aged between three and five years. Since the injuries to its right forelimb were severe, the project veterinarian advised that it be kept under care and observation for seven to ten days. This was to ensure that the wound healed and the animal was fit for wild release. The authorities looking after the leopard were provided a feeding regimen and instructed to keep the cage covered at all times. The forest department was also advised to move the leopard to a more secure location and Hastinapur WLS was selected as the site where the leopard could be kept inside the cage, away from local human habitations. The team returned to examine the leopard on three occasions and the animal was finally released into the Shivalik Forest Division in Saharanpur district, approximately 100 km away from the capture site, on March 5, 2014.

Plate 35: (clockwise from top left) Villagers crowd around the site where the leopard was reportedly hiding; the RRT team atop a JCB attempting to dart the leopard; the leopard after tranquilisation with the jaw trap still attached to its leg; and the right forepaw of the leopard being examined by the project veterinarian after the jaw trap had been removed

(vii) Additional Veterinary Interventions

(a) Disease screening and treatment of wildlife in distress

Apart from providing assistance in capturing and assessing the condition of big cat species during conflict situations, the RRT's wildlife veterinarian/s also aid in delivering veterinary care to other species in need, and in conducting immunisation programmes for livestock in the region to guard against disease outbreaks. The veterinarian also performs disease and post-mortem investigations from time to time to ascertain if any disease outbreaks are imminent.

Between 2009 and 2015, 46 cases involving 15 animal species were addressed by the project veterinarian with varied levels of veterinary care provided. Of the 15 species, nine were mammals, four were reptiles and amphibians, and two were birds. Several species dealt with during this period, such as hog deer, rhesus macaques etc. are also important prey species of leopards and tigers, and providing them treatment and checking for disease incidence is a crucial part of preventing disease outbreaks in their wild populations. *Table 16* provides details of the cases handled by the project veterinarian.

(b) Post-mortem investigations

Post-mortem investigations are vital to ascertain cause of mortality and are therefore required not only to safeguard against disease outbreaks through early detection, but also to ascertain whether causes

Table 16: Details of wild species treated by the project veterinarian between 2009 and 2015

S. No.	Date of admission	Common name	Rescued from	Age	Sex	Cause of displacement	Outcome
1	01-03-2009	Tiger	Kishanpur, Lakhimpur	Sub-adult	M	Caught/ trapped (conflict)	Transferred to zoo
2	22-11-2009	Spotted pond turtle	Tiger taal, Dudhwa NP	Adult	UN	Stuck in mud (turned turtle)	Released
3	24-11-2009	Small Indian mongoose	Bhira forest range, Lakhimpur	Adult	UN	Injury (road/ train hit)	Released
4	03-02-2010	Bronzeback tree snake	Dudhwa NP	Adult	UN	Injury (unknown)	Died in captivity
5	14-02-2010	Leopard	Dhampur, Bijnaur	Infant	F	Disease/ Debility	Transferred to zoo
6	19-02-2010	Spotted deer	Dudhwa NP	Sub-adult	M	Injury (road/ train hit)	Died in captivity
7	19-02-2010	Nilgai	Dudhwa NP	Sub-adult	M	Injury (unknown)	Dead on arrival
8	22-02-2010	Leopard	Nishangandha Range	Sub-adult	M	Caught/ trapped (conflict)	Transferred to zoo
9	14-03-2010	Hog deer	Buchnanpurwa, Palia	Sub-adult	M	Caught/ picked up by people	Released
10	17-03-2010	Hog deer	Dudhwa NP	Sub-adult	M	Caught/ picked up by people	Released
11	24-03-2010	Leopard	Moradabad	Adult	UN	Injury (unknown)	Released

12	16-04-2010	Hog deer	Kishanpur WLS	Sub-adult	F	Injury (unknown)	Died in captivity
13	22-04-2010	Spotted deer	Dudhwa NP	Adult	F	Injury (unknown)	Died in captivity
14	31-07-2010	Leopard	Krishanpur Village	Adult	M	Caught (poaching/ hunting/ trade)	Released
15	13-08-2010	Crocodile	Kiriyara Village, Pashgara, South Kheri	Sub-adult	M	Caught/ picked up by people	Released
16	17-09-2010	Spotted deer	Dudhwa Railway Track	Sub-adult	M	Injury (road/ train hit)	Died in captivity
17	14-10-2010	Tiger	Farukabad	Sub-adult	M	Caught/ trapped (conflict)	Transferred to zoo
18	07-12-2010	Hog deer	Patian Village	Sub-adult	F	Caught/ trapped (conflict)	Released
19	14-02-2011	Leopard	Bahadurgarh	Adult	M	Caught/ trapped (conflict)	Died in captivity
20	01-12-2011	Rhinoceros	Dudhwa NP	Adult	F	Injury (predation)	Released
21	04-01-2012	Indian rock python	Dudhwa NP	Adult	UN	Injury (unknown)	Released
22	17-01-2012	Hog deer	Sumerpur	Adult	F	Injury (unknown)	Died in captivity
23	26-02-2012	Tiger	South Kheri FD	Juvenile	F	Caught (poaching/ hunting/ trade)	Transferred to zoo
24	25-04-2012	Tiger	Rehmankheda, Lucknow	Adult	M	Caught/ trapped (conflict)	Released
25	29-04-2012	Hog deer	Patihan, Village	Adult	F	Injury (unknown)	Died in captivity
26	21-06-2012	Tiger	Kadher chouraha village, Puranpur	Sub-adult	M	Caught/ trapped (conflict)	Released
27	09-09-2012	Crocodile	Katarniaghat WLS	Sub-adult	M	Injury (road/ train hit)	Died in captivity
28	30-09-2012	Rhesus macaque	Dudhwa NP	Sub-adult	M	Disease/ Debility	Died in captivity
29	30-11-2012	Black kite	Palia Kalan	Adult	M	Disease/ Debility	Released
30	22-01-2013	Leopard	Batawali, Sahapur, Meerut	Sub-adult	M	Caught/ trapped (conflict)	Released

31	24-04-2013	Hog deer	Maocha, Palia range	Neonate	F	Orphaned	Released
32	11-05-2013	Leopard	Village Chatrapati Gotia, Puranpur, Pilibhit	Sub-adult	M	Moved into human habitation	Released
33	14-05-2013	Hog deer	Palia range, Dudhwa National park	Adult	M	Moved into human habitation	Released
34	13-02-2014	Leopard	Jharoda, Meerut	Sub-adult	F	Caught (poaching/ hunting/ trade)	Released
35	10-03-2014	Tiger	Sikh-tanda village of Bhira range	Sub-adult	F	Moved into human habitation	Released
36	30-03-2014	Leopard	Amarsinghpur village, Hastinapur	Sub-adult	F	Caught (poaching/ hunting/ trade)	Died in captivity
37	07-06-2014	Hog deer	Patihan village	Sub-adult	F	Injury (unknown)	Released
38	23-07-2014	Fishing cat	Dudhwa-Gaurifanta road	Adult	F	Disease/ Debility	Released
39	10-11-2014	Rhesus macaque	Near Dubagga rest house, Lucknow	Sub-adult	M	Disease/ Debility	Died in captivity
40	18-11-2014	Indian rock python	Unnao	Adult	M	Moved into human habitation	Released
41	07-04-2015	Hog deer	Makanpur village	Adult	M	Injury (attacked by stray dogs)	Released
42	11-04-2015	Hog deer	Aethpur village, Palia	Adult	M	Injury (attacked by human)	Released
43	18-05-2015	Hog deer	Aethpur village, Palia	Adult	F	Injury (attacked by stray dogs)	Released
44	24-06-2015	Rufous treepie	DNP forest campus	Adult	NA	Eye infection	Released
45	17-08-2015	Hog deer	Farsaiya tanda village, Palia	Adult	F	Injury (attacked by stray dogs)	Released
46	19-09-2015	Indian rock python	Chandan chouki, Dudhwa	Adult	M	Injury (attacked by small carnivore)	Released

Table 17: Wildlife species for which post-mortem examinations were conducted by the RRT veterinarian during the project period

No	Date	Species	Place	Diagnosis
1	03-02-2010	Bronzeback Tree Snake	Dudhwa NP	Hypovolemic shock
2	19-02-2010	Spotted deer	Dudhwa NP	Hypovolemic shock
3	19-02-2010	Nilgai	Dudhwa NP	Hypovolemic shock
4	16-04-2010	Hog deer	Kishanpur WLS	Hypovolemic shock
5	22-04-2010	Spotted deer	Dudhwa NP	Hypovolemic shock
6	17-09-2010	Spotted deer	Dudhwa Railway Track	Hypovolemic shock
8	14-02-2011	Leopard	Bahadurgarh	Hypovolemic shock
9	27-12-2011	Rhinoceros	Salukapur, DNP	Cadio-respiratory failure because of tiger attack
10	18-01-2012	Hog deer	Sumerpur	Hypovolemic shock
11	27-01-2012	Crocodile	Near Suheli river, midway of palia and DNP	Natural death due to old age
12	29-04-2012	Hog deer	Patihan, Village	Cardio-respiratory failure
13	27-05-2012	Tiger	Kataiya Beat, Kishanpur, DTR	Blood loss and shock from conspecific fighting injuries
14	30-05-2012	Spotted deer	Basantapur	Hypovolemic shock
15	30-09-2012	Rhesus macaque	Dudhwa NP	Disease/Debility
16	09-09-2012	Crocodile	Katarniaghat WLS	Hypovolemic shock
17	18-10-2012	Crocodile	Near Suheli river	Hypoxia of brain tissue because of extensive brain haemorrhages
18	04-11-2012	Spotted deer	DNP railway track	Hypovelmic shock because of fatal train accident injury.
19	09-01-2013	Rhinoceros	Salukapur	Pneumonia
20	29-01-2013	Rhinoceros	Salukapur	Shock because of tiger attack
21	12-02-2013	Hog deer	Dudhwa	Electrocution
22	19-02-2013	Rhino	Salukapur	Hypovolemic shock
23	06-03-2013	Spotted deer	Dudhwa	Cardio-respiratory failure due to collision with vehicle
24	13-07-2013	Crocodile	Dudhwa	Hemorrhaging
25	07-09-2013	Swamp deer	Dudhwa	Natural death due to old age
26	25-11-2013	Hog deer	Dudhwa	Cardio-respiratory failure
27	28-11-2013	Rhinoceros	Salukapur	Hemorrhaging
28	20-02-2013	Rhinoceros	Salukapur	Predation by tiger
29	22-01-2014	Rhinoceros	Salukapur	Pneumonia
30	25-01-2014	Rhinoceros	Salukapur	Hypovolemic shock because of extensive bleeding and haemorrhages due to infighting
31	30-03-2014	Leopard	Amarsinghpur village, Hastinapur	Killed (Poached)
32	06-05-2014	Leopard	Murtiha	Extensive skull fractures and hemorrhages

33	16-06-2014	Elephant	DNP	Cardio-respiratory failure
34	19-10-2014	Rhinoceros	Salukapur	Severe injuries and liver disease
35	10-11-2014	Rhesus macaque	Near Dubagga rest house, Lucknow	Disease/Debility
36	23-02-2015	Rhinoceros	DNP	Extensive hemorrhage due to injuries in-fighting
37	14-08-2015	Crocodile	DNP	Extensive brain hemorrhage due to road accident
38	14-10-2015	Crocodile	DNP	Extensive brain hemorrhage due to road accident
39	23-12-2015	Elephant	DNP	Cardio-respiratory failure

such as poaching or retaliatory killings are at play. Between 2010 and 2015, 39 cases of wild animal mortality were attended to under the project, involving eight mammalian species. The details of these cases are listed in *Table 17*.

As mentioned, post-mortem investigations can help in ascertaining unnatural causes of mortality such as retaliatory killings, poaching etc. In May 2014 for instance, a leopard carcass was reported from Murtiha village near Katerniaghat WLS. On conducting a post-mortem examination it was ascertained that the leopard, a young female, had undoubtedly been killed because of severe blows to the head and body, fracturing the skull and other skeletal regions. This resulted in further investigations that led to the arrest of two people from Murtiha, who were found to be responsible for lynching the leopard. Evidence in the form of blood-stained wooden staffs was also recovered from their homes. This case exemplifies the importance of conducting post-mortem examinations, besides the function of such examinations to detect disease prevalence.

(c) Livestock immunisation

In 2013 it was decided that efforts needed to be made to create a 'disease-free' or immune belt around Dudhwa TR, to safeguard wildlife prey populations from disease outbreaks emanating from livestock. It was believed that this would be beneficial if done consistently over a number of years, as depletion of wild prey populations is one of the foremost drivers of conflict. In 2013 and 2014, therefore, vaccination and health camps were organised in various villages around Dudhwa TR.

Three camps were organised in the fringe villages of Bankati, Bhura and Sariyapara, where 513 heads of livestock, mostly cattle, were immunised against Foot-and-Mouth Disease (FMD),

Plate 36: Livestock immunisation and health check-up camps organised in Surma village

Haemorrhagic Septicimia and Black Quarter. Similar camps were organised in five more villages in 2014, namely Barbata, Ramuapur Bodhiakala, Pakariya and Surma. A total of 396 cattle were immunised against FMD, while over 500 heads of livestock including goats and sheep were checked for ailments, ectoparasites etc.

(viii) Capacity Building of Frontline Forest Staff

One of the long-term goals of the project is to improve the capacity of the existing state forest department workforce, especially that of Dudhwa and Pilibhit TRs, to handle conflict situations involving large carnivores. The project team has therefore conducted numerous training programmes for frontline forest staff of the various Protected Areas of Uttar Pradesh.

While the trainings focussed primarily on activities pertaining to conflict mitigation with respect to big cat species, a variety of other topics such as the biodiversity status of India, the need for wildlife conservation, basics of ecology, food webs, wildlife laws etc. were also covered, depending on the duration of the training. Within conflict mitigation, all three approaches of the 'pro-active' model of human-wildlife conflict mitigation were detailed, with adequate case studies to substantiate the need for each approach.

Additionally, practical sessions were conducted to help the trainees familiarise themselves with some of the techniques and equipment used in conflict mitigation. Trainees were taught how to deploy camera traps and use handheld GPS units, identify signs and tracks of wild animals, and record data pertaining to signs of animal presence. They were also trained in using, preparing and maintaining tranquilisation equipment, and taught how to deploy trap cages to maximise trapping success.

Over the four years of the project 16 training programmes were conducted, covering over 350 frontline forest staff of various forest divisions. It is anticipated that with sustained training programmes over the next four to five years, the project will succeed in developing a more skilled workforce, capable of handling human-big cat conflict situations independently or in coordination with existing RRTs.

Table 18: Summary of trainings conducted for frontline forest staff of various PAs in Uttar Pradesh

Sl.	Year	No. of trainings	No. of staff trained	Protected Areas covered
1	2011	3	46	Dudhwa NP
2	2012	3	69	Dudhwa NP and various other PAs of UP
3	2013	2	38	Dudhwa and Pilibhit TR
4	2014	8	390	Various PAs of UP including major WLSs and TRs
5	2015	2	47	Various forest divisions of UP
TOTAL		**16**	**584**	

5. THE ROAD AHEAD

The implementation outcomes of various activities conducted under the project are becoming evident and appear to be showing a positive trend. In the last four years of the project, no leopard or tiger has been killed in direct retaliation for conflict by local people. While there are numerous other initiatives that need to be implemented before the project can either enter its exit phase or be enhanced, the results clearly indicate the success of this current model of conflict mitigation, which involves the integration of local communities as primary stakeholders.

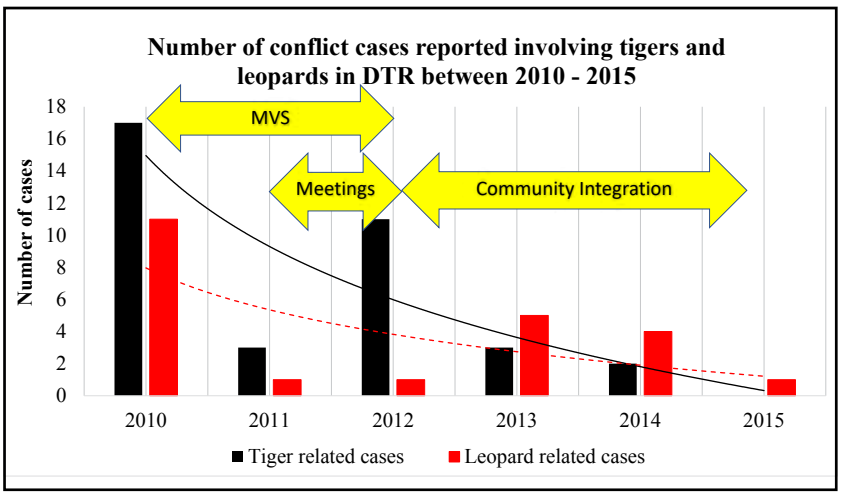


Figure 28: Histogram depicting a declining trend of attacks on humans by leopards and tigers between 2010 and 2015 (trend lines are for visual representation only and do not represent regression curves) in identified hotspots. Yellow arrow bars indicate the period of various interventions in the region. (Data for 2014 and 2015: unpublished data, WTI; shown here to emphasise effectiveness of holistic mitigation interventions.)

While the RRT - PRT approach needs to be expanded to address conflict directly, several habitat-based alterations also need to be made to reduce the number of individual tigers and leopards moving out of forests and into human-use areas.

Figure 28 above reveals that while attacks on humans by big cats tended to reduce even in the three years that the MVS unit was operational, the successful involvement of local communities in conflict mitigation has clearly been the more effective strategem. A proactive PRT setup continuously inhibits prolonged interactions between human populations and big cats, thereby reducing the chances of attacks on humans. Further, an increased level of sensitivity among local people, imparted through regular awareness meetings, often results in the presence of a leopard or tiger being reported without delay while also inhibiting crowd

formation in areas where a conflict animal has been spotted. Both these aspects greatly reduce the chances of attacks on humans, thereby reducing conflict.

It is imperative to understand, however, that while integrating and sensitising local communities can help in reducing the intensity of conflict and attacks on humans, leopards and tigers will continue to move out of their natural habitat from time to time for various reasons and come into contact with human populations. While the RRT approach needs to be expanded to address this directly, several habitat-based alterations also need to be made to reduce the number of individual tigers and leopards moving out of forests and into human-use areas. These alterations are specific to the different forested regions of the Dudhwa-Pilibhit TR landscape and are accordingly discussed below.

In Pilibhit Tiger Reserve, the Haripur and Barahi ranges are found to constitute some of the prime regions of the reserve. This narrow stretch, situated in the south-eastern part of Pilibhit, spans a 25 km long and 4 to 7 km wide tract of forest. It is arguably the only visible continuous forest patch connecting the north-western part of Kishanpur Wildlife Sanctuary to the North Kheri Forest Division.

It is interesting to note that there has been a proportional increase in the use of this habitat by large carnivores when compared to the past trend as per Johnsingh *et al.,* 2004. Among prey species, spotted deer and nilgai were found in high frequencies (pellet encounter rate) despite the high anthropogenic pressures in this area. Barking deer and hog deer, which were absent in past studies, were also found to be thriving here.

Pilibhit has high potential for sustaining a good population of wild ungulates and large predators, but needs major restoration of habitats, especially around the Haripur and Barahi ranges. Now that it has been designated as an independent tiger reserve, it is perhaps time that the severe anthropogenic pressures caused by lopping and felling of timber as well as extensive cattle grazing are brought under control. To facilitate the dispersal of large carnivores, it is also important that existing wildlife corridors such as the Lagga-Bagga complex are restored and protected. This will directly impact the number of tigers and leopards that move into human habitations.

In Kishanpur Wildlife Sanctuary, the distribution of tigers was not found to be significantly different from other study areas except Katerniaghat Wildlife Sanctuary, and ranked third in the Dudhwa-Pilibhit landscape. Both leopard and tiger populations were observed to be concentrated on the fringes of the sanctuary and were cumulatively the lowest compared to other study areas, although the sanctuary hosts all the wild ungulate species relatively uniformly throughout its forested regions.

Besides general habitat fragmentation, grazing pressures were found to be high along the northern edge of the Sharda river, especially during the dry season. During this season indirect signs of tiger presence were observed along this stretch, indicating that tigers were crossing the river bed and moving into the agricultural areas of Paraspur village in the Palia Range, nearly four to five kilometres from the sanctuary. Although human-carnivore conflict is not very serious in this part of the landscape, recent anecdotal records reveal that leopards and tigers are probably using the agricultural patches (mostly sugarcane) abutting the reserve forests of the Palia Range in North Kheri FD as well as the North and South Mailani Ranges of South Kheri FD. It is thus important to develop the habitat, especially south of the Sharda river, to support more wild prey species. A capable team must also be developed within the local forest department to track and monitor tiger and leopard movement across this area.

Katerniaghat Wildlife Sanctuary is another spatially isolated tiger habitat in the landscape. Here, although the mean frequency of occurrence of tigers was observed to be the lowest (26.5±2.4) among sampled areas in the landscape, the relative abundance of leopards was comparable to other

areas (7.3±1.4). This is surprising as medium-sized prey species (the prey size of choice for leopards) such as spotted deer (29.5±2.5) and wild pig (8.5±1.5) were observed to be in relatively lower abundance than in other sampled areas. Given this lower abundance though, it is not surprising that Katerniaghat experiences a high frequency of human-leopard conflict, especially pertaining to cattle depredation – about 56.17% of cattle depredation cases recorded across the landscape.

The Nishangada and Katerniaghat Ranges are among the best habitats available for wildlife in Katerniaghat WLS. While these areas need to be preserved for posterity, much of the region around them also requires extensive restoration through aided regeneration or other similar procedures, in order that it may sustain larger wild prey populations. It is worth recording that the sloth bear (*Melursus ursinus*) is almost locally extinct in these parts and serious conservation efforts need to be focussed on bringing back this species. Sloth bears not only indicate the overall health of the ecosystem, as they depend upon a large number of fruiting trees and insect species, they are an aesthetically important large mammal species in the region.

In Dudhwa National Park, tigers were found to be distributed across the south and south-eastern part of the national park in the Dudhwa, South Sonaripur, Belrayan and Sathiyana Ranges. The relative abundance of tigers was observed to be the second-highest (0.51/km) in the landscape, while among prey species, the spotted deer was found in high abundance across the various sampled areas.

As in most PAs, the relative abundance of wildlife was higher in the less disturbed zones. The Dudhwa, Sathiyana, South Sonaripur and Belrayan Ranges harboured a higher abundance of leopards, tigers and associated prey species compared to more disturbed areas such as the Bankatti, North Sonaripur and Gauriphanta Ranges. The leopard population was interestingly higher in the grassland patches of the Sathiyana Range.

Dudhwa NP has by far the best protected forest patches across the landscape, although stronger protection is required along the length that constitutes the international border with Nepal.

Besides habitat improvement and protection, other short-term and long-term solutions are required to effectively address and resolve human-large carnivore conflict situations in this landscape.

(i) Short-term Measures

Within short-term solutions, it is crucial that full-fledged Rapid Response Teams be constituted and made operational. The operational framework of a typical RRT is as below. Additionally, in this particular landscape it is important that a transit facility for holding and treating injured animals that are rescued be developed, ideally in Dudhwa National Park, minimising human exposure and increasing the chances of rehabilitation.

(a) Rapid Response Team: Constitution and Operational Framework

The RRT seeks to respond to and work towards resolving wildlife emergencies and human-wildlife conflict scenarios within the shortest possible time in the defined landscape, in the most amicable manner possible. Each RRT uses three dedicated skill sets:

The *Wildlife Biologist* works towards the following:

- Identification and scientific monitoring of wildlife species involved in the conflict
- Devising capture strategies through trapping based on in-depth knowledge of animal behaviour and ecology
- Identifying release/rehabilitation sites based on scientific understanding of ecology of release sites
- Scientifically monitoring the survival of released/rehabilitated animals in the post-release/rehabilitation stage

The *Sociologist* works towards the following:

- Working with local communities that face conflict and amicably resolving the issues

(including crowd control)

- Spreading awareness and sensitising local communities on the predicament, behaviour and ecology of various wildlife species that they come into conflict with, as well as various techniques through which direct confrontations can be minimised
- Developing ways of integrating local community members into active conflict mitigation measures
- Coordinating and managing a vast information relay network to ensure smooth and swift flow of information across the landscape to minimise wildlife mortalities

The *Wildlife Veterinarian* works towards the following:

- Tranquilising/sedating wild animals in conflict situations when necessary
- Treating wild animals for injuries and monitoring their health
- Providing healthcare to livestock of focal villages to build trust
- Assisting the forest department in vaccination of rural livestock to create immune belts around forest patches
- Assisting the forest department in captive animal treatment and care as and when required
- Assisting the forest department in conducting post-mortem examinations on wildlife to ascertain cause of death and help in the formulation of prevention strategies as needed

(b) RRT equipment

- 4x4 modified vehicle
- Leopard trap cages
- Tiger trap cage
- Transportation crates
- Baffle boards, batons, protective vests and helmets
- Tranquilisation equipment and accessories
- Nets, public announcement systems etc

(c) RRT success indicators

- Number of cases resolved amicably without requiring capture/elimination of wild animals responsible
- Percentage of animals released successfully after being caught, when capture is necessary to resolve the immediate situation
- Number of conflict and wildlife emergency prone villages where local community participation is successfully garnered (number of cases in which community participation was vital to success)

(ii) Long-term Solutions

As a primary long-term measure, the integration of villagers into active conflict mitigation is a must. It is important that local communities who face human-large carnivore conflict be actively sensitised in order to make them realise that instances of conflict are an 'occupational hazard' that results from their proximity to forest edges. This, if successfully instilled into public minds, eradicates the sense of alienation from the problem due to which local forest departments are often blamed when large carnivores foray into human habitations.

In addition, where possible, local community representatives may be selected and incorporated into Primary Response Teams solely on a voluntary basis. It is important to ensure that PRT members are not incentivised with salaries to avoid a sense of employment and thus the anticipation of further financial benefits. Once constituted, PRTs are required to be trained and aligned with RRTs during conflict situations, while also being encouraged to handle simpler conflict situations (for instance, those involving only the sighting of a wild animal) independently. A detailed operational framework for the formation and operation of PRTs is provided below.

(a) Primary Response Team: Constitution and Operational Framework

Team Members: 4-7 volunteer members from the local community who are keen on assisting in

conflict mitigation. Teams are to be constituted in villages where instances of conflict have been occurring frequently (ideally attacks on humans) – identified conflict hotspots.

Desired Qualification: PRT members may or may not have undergone formal education, but need to be literate as they must interpret awareness materials and disseminate the knowledge to local villagers. It is most crucial that the members be local volunteers who have substantial influence either at the village level or across an even larger area. It is also important that such people are cognisant of the need and utility of these PRTs, and that no incentive is promised other than capacity building training and basic equipment.

Skills Imparted: First-aid care, identification and documentation of secondary signs of the presence of wildlife species, and crowd control tactics

Equipment: PRT members are provided with the following:

- Flashlights (to each member)
- First-aid Kits (one large kit to each team)
- Mobile phones (to each member)
- Reflector jackets (to each member)
- Baffle shields and batons (to each member)
- Public announcement system (one to each team)
- Pamphlets and posters on 'Do's and Don'ts During Conflict Situations' (one set to each team)

(b) Conflict mitigation by PRTs

Each PRT is tasked with addressing conflict situations on the ground, within and in the vicinity of their respective villages. Their specific tasks involve:

- Swiftly relaying information to RRTs and FD staff of the presence of the animal involved in a conflict situation
- Controlling crowds, preventing the mobbing of the animal
- Monitoring location and movement of the animal
- Delivering first-aid immediately to any person injured
- Assisting RRTs and the forest department in creating organised 'drives' and/or in capturing the animal, when necessary
- Spreading awareness in nearby villages regarding precautions that may be taken to avoid conflict with wild animals

(c) PRT work/success indicators

- Phone call records: Information relayed successfully
- Number of cases where PRTs assist RRTs and forest department in resolving conflict cases successfully: where the animal is rescued/driven back/people are kept at bay and untoward incidents avoided
- Number of cases resolved successfully by the PRTs themselves: animal driven back/animal left alone by keeping people at bay
- Number of human lives saved through direct interventions by PRTs such as through the delivery of first-aid care.
- Patrolling logs and details of signs encountered, as indicators of animal presence and movement monitoring

(d) PRT training syllabus

Why conflict occurs (regarding only focal species)

- Broad overview of behaviour and ecology of focal species (territoriality, sociability, differences in predatory tactics, breeding patterns, when does an animal become man-eater or man-killer, and a focus on dispelling myths such as drinking of blood by big cat species etc).
- A brief on techniques used in other parts of the country to reduce Human Wildlife Conflict

Identifying a species in conflict and monitoring its presence and movement

- Broad overview of behavioural patterns of leopards, tigers, sloth bears, hyenas, wild dogs, nilgai, wild pigs and langurs (e.g. type of diet, seasonality of breeding,

commensal nature of some species).

- Identifying signs of presence and learning to document them (tracing, taking casts, taking measurements, marking locations without a GPS etc)
- Special attention: Identifying snakes

Dealing with wildlife related emergencies

- Medical care for humans (basic first-aid techniques: bandaging, arresting of bleeding, tourniquets etc)
- Confining wildlife species in conflict
- Controlling crowds: legal provisions and general *in situ* tactics

Problems in capturing and translocating animals in conflict situations

- Territoriality and homing instincts
- Capture myopathy
- Tranquilising using syringe projectors
- Trap shyness (particular species and individuals)

Function of civil society groups in resolving conflict

- How people (or PRTs) can help: relay of information, crowd control and spreading of awareness

One of the key long-term initiatives that may be implemented to reduce adverse interactions between people and large carnivores is the introduction of mechanical harvesters (*Plate 37*) for sugarcane crops. As the data from this project reveals, several of the attacks on humans by tigers and leopards occur during the harvest seasons. Sugarcane being tall, crop fields appear as extended habitat for large carnivores, in which they invariably thrive and even raise young. In sugarcane fields as far as 50 km away from protected forests, various ungulate species such as hog deer, nilgai, black buck and wild pigs may be found, which allow for vagrant and resident carnivores to thrive in these vast crop expanses. The introduction of mechanical harvesters is therefore a solution that can greatly reduce attacks on humans during harvesting of sugarcane. These machines can be introduced through the development of cooperatives linked to large sugarcane mills/factories, and can be financed through corporate funding.

Lastly, it is imperative that education and sensitisation processes be initiated on a large scale through the concerted efforts of civil society organisations and forest departments, to allow for a gradual change of mindsets.

Plate 37: The introduction of mechanical harvesters can greatly reduce attacks on humans during harvesting of sugarcane

6. PROTOCOLS FOR THE MANAGEMENT OF HUMAN-TIGER CONFLICT SITUATIONS

(i) Introduction

Human-wildlife conflict is widely understood as the inevitable competition between humans and certain wild species for resources, leading to incidents such as crop raiding and livestock depredation, as well as occasional attacks on people (Treves, 2009). Among the various fauna that humans regularly come into conflict with, predators, especially apex predators such as tigers, incite a unique blend of awe and fear in the human mind (Kellert *et al.,* 1996).

If the interests of humans settled near forest areas lie primarily in raising and herding cattle, collecting firewood, and cultivating crops, tigers are inherently designed to explore their surroundings for space and food, and to find mates and perpetuate their genes. Observations of conflict occurring even around well-protected tiger reserves with good prey populations suggest that simple correlates such as depleted prey are not sufficient to explain why tigers come into conflict with humans. Besides the general ecological and biological imperatives of predators like tigers, various aspects such as availability of livestock, livestock guarding methods and other human cultural practices have been found to greatly influence a higher frequency of human-predator conflict, the creation of 'problem individuals', and the type and scale of human reaction to such situations (Breck, 2004).

The purpose of these protocols is not to identify the precise causative factors for conflict, but rather to provide a systematic operational framework for wildlife managers to be able to tackle human-tiger conflict situations. Nonetheless, it must also be the responsibility of managers, especially in areas where conflict is chronic, to determine the causative factors in order to find effective, long-term solutions.

At present, human-tiger conflict in India occurs in three distinct situations:

High availability of livestock and humans: Today, humans, with their attendant spread of crop fields, livestock herds and other infrastructure, occupy landscapes around (and even within) protected source tiger habitats at a far higher density than ever before. It is understood that in areas where humans and their livestock habitually use forests and forest fringes for resources, predators are exposed to them as opportunistic prey − though it does not follow that such predators will necessarily become specialised in hunting either livestock or humans (Linnell *et al.,* 1999).

Dispersing individuals: Tigers being long-ranging and territorial in nature are hard-wired to disperse and establish their own territories (Sunquist, 1981; Karanth, 2003). Some of these individuals succeed in establishing their territories within natural, prey-rich habitats (often by ousting already established individuals), while others may settle in sub-optimal habitats on the fringes. Yet others may opt to search for altogether new habitats (mostly when they fail to find a place in their natal habitats). Tigers that are compelled to traverse great distances to find new homes almost invariably

encounter human habitations, owing to the sheer density of such habitations (Guha, 2001) between any two source tiger habitats.

Problem individuals: As in many other apex predator populations, certain individual tigers may become skilled at and resort to the chronic hunting of livestock, as well as, more rarely, humans. Such tigers, commonly labelled as 'problem animals/individuals', have also been observed in the Indian scenario. Although it is not quite clear why problem individuals arise, two main and not necessarily mutually exclusive factors are their relative inability to survive on natural prey alone, and their unrestricted access to a high population of livestock that are unmanaged (e.g. grazing unsupervised in fringe forests). Physical inability may stem from multiple factors ranging from debilitating injuries, age, congenital deformities or simply a weaker constitution, while the latter aspect deals with 'learning' and adaptation in the face of human strategies to prevent predation of livestock.

Despite the varied nature of causative factors, a common aspect is the increased spatial and temporal interface between tigers and humans. Thus, all human-tiger conflict mitigation strategies need to bear this aspect in mind and frame mitigation measures in terms of increasing the temporal and spatial segregation between humans and tigers.

Even where tigers are well protected, there are bound to be incidents involving their spillover into surrounding areas, especially as populations within protected forests multiply. There cannot, consequently, be a solution that results in a permanently conflict-free scenario. The protocol drafted here is therefore about the efficient management of tiger related emergencies that threaten the life of the tiger, or of humans, or both.

(ii) Existing Guidelines

The National Tiger Conservation Authority (NTCA) has issued some advisories in the form of Standard Operating Procedures (SOPs) to address tiger emergencies in the country. One of these deals with "emergencies arising due to straying of tigers into human dominated landscapes", but it dwells on the steps to be taken for chemical immobilisation and general protocols of operation. It omits capture techniques other than chemical restraint, and lacks details about potential infrastructure that can be developed to manage conflict situations in the long run. It also omits processes of community integration, a crucial part of long-term efforts to mitigate human-tiger conflict. The other two SOPs are specific to dealing with tiger mortality and disposal of tiger/leopard carcasses/body parts.

This protocol on the management of human-tiger conflict situations is an augmentation of the SOP for "emergencies arising due to straying of tigers into human dominated landscapes", in line with the comprehensive "Guidelines for Human-Leopard Conflict Management" of the Ministry of Environment, Forests & Climate Change.

(iii) Modus Operandi

The modus operandi for handling a human-tiger conflict situation depends primarily on where the conflict has erupted and the nature of the situation, besides other factors like the animal's age (gauged by body size and sex) and health (injured or not), as well as the level of preparedness and expertise in place.

(a) Place of conflict: Conflict resolution on the fringes of a Protected Area would involve simply maintaining the status quo by sensitising villagers and/or facilitating safe passage for the conflict animal back into the forest. A tiger that has moved out of its source area and entered human-dominated landscapes may however have to be captured and translocated, especially if it is found to chronically prey on livestock. Such movements are often termed 'straying' but wild animals do not actually 'stray', they only move out of their source areas with a purpose[1]. A better term to be used for such a situation is 'foray'.

[1] Tigers in Kaziranga National Park often swim across the Brahmaputra River and venture into the north bank. Tigers from Valmiki TR have in recent years moved southwards (towards Sonpur, Patna in one case). In UP, tiger movement out of Pilibhit or Kishanpur is a regular phenomenon. In most cases, the tigers return to their source habitat without the need for any active intervention, at times even without being noticed.

If tigers that move out of source areas get disoriented to the point of no return, or take shelter in forest patches or plantation areas that cannot hold them for long, the appropriate solution is capture and translocation.

Tigers that come into conflict with humans in fringe area villages and croplands could be (i) tigresses with cubs, (ii) young adults honing their skills on livestock, or (iii) incapacitated adult tigers. Since the type of intervention would depend on the kind of tiger involved, ascertaining the age, sex and condition of the animal through camera traps becomes extremely important.

» Tigresses that move out of the park temporarily to safeguard their cubs from resident males do not need capturing. Such tigresses are known to return to the forests once the cubs are reasonably grown. The strategy here would be to sensitise villagers of the tigress's presence and, through Primary Response Team (PRT) members (if PRTs have been constituted in the area), issue a set of precautionary measures to be observed to avoid unwanted confrontation till the tigress returns to the forest. Trapping tigresses with dependent cubs is ill advised and fraught with difficulties.
» Tigers that indulge in indiscriminate killing of livestock are most often older cubs accompanied by their mother. Since such incidents are invariably one-off (or rare) events, lighting camp fires and keeping vigil at night would likely ward off such tigers (or tigresses with cubs). Prompt ex-gratia payments to livestock owners are useful in preventing retaliatory killings. Cubs that persist with livestock killings should be captured and released into adjacent forest areas.
» Incapacitated adults looking for soft prey in fringe villages should be identified through camera traps, captured and placed under lifetime care.

(b) Nature of plight: Whether it is a forest habitat or a human-dominated landscape on the forest fringes, the nature of the animal's plight is a major factor that will determine the type of intervention required. A tiger may have fallen into a well, or taken refuge in an abandoned building, or may be occupying a patch of thorn scrub in or close to a human-dominated landscape, or may be caught in a snare, or have taken refuge in a cropland (especially where crops mimic natural habitat extensions, like sugarcane), or may even be stranded in a small forest patch surrounded by human settlements.

'To rescue', by definition means 'to (set) free from danger or evil plight'. In any human-wildlife conflict situation this will refer to both parties. In the case of people, it is often the threat perception that determines the nature of their plight in a conflict situation. Yet the tiger-human ratio is heavily skewed in favour of humans at conflict sites and since conflict most often pits a single tiger against hundreds (or sometimes even thousands) of people, it is the tiger that stands to lose more often than not. Through the mere act of congregation, people can set off a series of alarm reactions that can potentially build up into a direct physical confrontation with a tiger involved in a conflict situation.

(iv) Preparedness

(a) Infrastructure and equipment: To make conflict animal management comprehensive and effective, it is essential to ensure the integration and participation of local communities in conflict mitigation initiatives. Community support to tiger conservation is not possible without taking into consideration the socioeconomic dynamics of people living around PAs.

Involving all stakeholders in reducing the chances of harm to both the tiger and humans involved in a conflict situation should form the crux of any long-term human-wildlife conflict mitigation programme. Constituting PRTs comprising local people at conflict hotspots and enhancing their capacity to understand issues concerning tiger conservation and conflict dynamics, and their ability to deal directly with conflict situations, is a proven method of making local people active stakeholders in conflict mitigation and conservation. Such initiatives also improve tolerance among local people to the movement of tigers, or even the temporary occupation of their croplands by tigers. Active community participation in conflict resolution also helps in

preventing or minimising the retaliatory killing of tigers.

The successful handling of a conflict situation depends on the level of preparedness. This includes not only the necessary equipment and trained manpower, but also a systematic framework of operation. For conflict-prone areas, constituting and commissioning Rapid Response Teams (RRTs) with a central command under the Divisional Forest Officer (DFO) or Field Director (if it is a tiger reserve) of the region is key. The RRT should be manned by trained veterinarians and caretakers, and have a qualified wildlife biologist (to track and decipher the behaviour of the animal involved) as well as a qualified sociologist or social worker (to actively engage with the local communities experiencing conflict). Since capture is inevitable on certain occasions, the RRT should be provided the basic equipment for capture, treatment, translocation and release.

(b) Capacity building:

» Both PRT members and the core rescue team, the RRT, should be well drilled in dealing with big cat emergencies. They should be conversant with the various management options outlined in the protocol.
» RRT and PRT members should also be sent to other high human-tiger conflict areas to gain experience. Team members should be mentally and technically prepared when called upon to handle tiger related emergencies.
» PRT members need to be individuals of good standing in their own and neighbouring villages, to whom people will generally listen with respect. This is crucial as PRT members are often required to address agitated crowds during conflict situations.
» The RRT should include skilled trackers who can follow tiger movement in the field. Their skills in locating, identifying and following tracks and signs should also be honed through regular field exercises.
» RRT members should be trained in setting up box traps, pit traps, camera traps, humane snares and jaw traps, and in crowd control tactics. All these should form part of their capacity building module.
» The veterinary team of the RRT should be conversant with the use of remote drug delivery equipment and the dosages of drugs used for chemical capture.

(v) Managing Human-Tiger Conflict Situations

(a) Facilitating safe return: The word 'rescue' does not mean capturing a tiger involved in conflict, but rather employing appropriate means to mitigate threats to both humans and the tiger. The 'appropriate means' in many circumstances would simply involve providing safe passage to the tiger through crowd control and/or by regulating/preventing human activities in the area. The opportunity to resolve conflict situations through this approach comes from scenarios where tigers pass through or temporarily occupy human-dominated landscapes.

Both leopards and tigers are commonly found on croplands, but ecologically there is a significant difference in the nature of such habitations by the two big cats. In the case of tigers, the scenario is often restricted to the fringe area of the forest, unlike suburban leopards that take croplands and human-dominated landscapes as part of their usual range. Of course, in parts of the Terai landscape in Uttar Pradesh, vast stretches of sugarcane fields mimic tall, natural grasslands. Tigers often utilise such areas as part of their seasonal home ranges, especially since these fields harbour ample natural prey such as nilgai, hog deer, wild pigs and (in some places in Uttar Pradesh) blackbuck antelope. Tigers in this scenario are not cornered or entrapped by humans, rather seen occupying a piece of cropland, or a bamboo grove or thicket, not very far from the forest edge. When left to their devices such tigers invariably avoid confrontation with humans. It is only when people attempt to mob or catch a glimpse of the animal that accidental attacks occur, unless, as happens extremely rarely, the tiger is a man-eater. The most feasible way to deal with such situations is to keep people away, prevent/restrict human activities in the croplands particularly at night and the twilight hours, and maintain a status quo until the tiger goes back to the forests. This is also where the role of the PRT comes into focus. If, however, the tiger proves to be a persistent cattle lifter and a threat to human life, capture and translocation/lifetime captivity is the only option.

Table 19: Equipment typically required by Rapid Response Teams for handling human-tiger conflict situations

Equipment	Purpose
Trapping / Capture Equipment	
Trap cages	For trapping the tiger
Crates	For transportation of the captured tiger
Treatment cage	A long cage to accommodate an injured tiger for about a week
Netting	To trap a tiger flushed out of thick crop fields
Syringe projector (gas propelled)	For capture in free-ranging situations
Humane leg-hold traps and snares	Capturing animals that are highly shy of cages or human presence and evade darting attempts
Ropes (climbing ropes or thick nylon ropes)	Restraining the animal, ascending from or descending into certain locations (e.g. wells) etc
Blow pipes	For capture/restraint in confined situations
Field Support Equipment	
Vehicle (4-wheel drive)	As a mobile veterinary unit for transporting personnel and equipment
Vehicle (mini truck)	For transporting the tiger with the crate or trap cage
Public Announcement system	For crowd control
Search lights	To assist during conflict mitigation or tracking operations at night
Quadcopters and unmanned ground vehicles	For aerial surveys to detect tiger presence, and to flush out the tiger from a crop field
Wireless sets	For use in areas where the mobile network is poor
Cameras (SLR, action cameras)	For video documentation of rescue operations
Kumki elephants / JCB Earthmovers	For tracking/darting tigers hiding in thickets/fields
Digital spring balance and makeshift/professional hoisting tripods	For weighing the tiger post-capture
Reflective jackets	As uniforms for members of the PRT
Caution tapes	To cordon off areas and keep bystanders away from core operational area
Veterinary Equipment	
Anesthetics and tranquilisers	For chemical capture / restraint
Pulse oximeter (portable)	For monitoring the tiger while anaesthetised
Supportive drugs	For emergency care, respiratory stimulation
Stretcher	For transferring the chemically immobilised animal to the crate, and for weighing the animal
Medicals & surgicals	Syringes, topical applicants, cotton, swabs etc
Monitoring Equipment (pre & post capture)	
Camera traps	To establish the identity and movement of the tiger
GPS	For recording rescue and release site coordinates
Binoculars / Night vision scope	For direct observation of the conflict animal (pre-capture and post-release)
Telemetry equipment	For post-release monitoring

(b) Monitoring without intervention: There are times when a tiger will move far from its source habitat and occupy a large tract of degraded forest, a ravine or a tall riverine grassland, or a fringe patch of tall sugarcane crop, for a long period[2]. The habitat may have adequate natural prey in the form of wild pigs and nilgai. If the animal does not show any sign of attacking humans or livestock, and if there is potential for it to return to its source area, it should be left undisturbed but monitored regularly. Monitoring could be done based on tracks and signs, the use of camera traps, and where possible, using quadcopters or unmanned ground vehicles without disturbing the animal. Any attempt to pursue and capture the animal might force it to stray further into human-dominated landscapes and attack humans and/or livestock.

(c) Rescue by capture: Since the rehabilitation potential of any captured animal diminishes when it gets displaced from its habitat, capture should be the last resort. Capturing and placing an animal in captivity is not a true 'rescue', which is why all captures should be followed by release – provided the animal is not physically or behaviorally compromised.

Here are the situations where a tiger will require capture:

a) Moved far (>20-30 km, approximately) from its source area and entered human-dominated landscapes with little or no habitat that can sustain it.
b) Trapped in a hut/abandoned house, fallen into well or trench, caught in a snare or jaw trap, or in a net or barbed wire.
c) Repeatedly involved in attacking/killing livestock and/or humans.

(vi) Capturing Tigers

If the decision is to capture, the choice of method would depend on the nature of plight and the specifics of the conflict scenario.

» Tigers that are localised in a fringe area are easier to capture than tigers that have moved out of their natal area and are constantly on the move.
» A confined or cornered tiger, for instance one that is trapped in a tunnel or well, is best caught by chemical capture. Unlike leopards, tigers cannot be made to use tree branches to escape from deep wells. However, cubs may succeed in clinging to branches placed in shallow wells.
» Tigers caught in leg-hold traps and snares should be chemically restrained so that the trap can be removed. Their suitability for release will depend on the nature and extent of the injury to the paw or other body part caught in the trap. If the phalanges (digits) and claws are intact, complete healing is possible in about two weeks. The injured tiger can be treated and kept in a holding facility in the forest itself, or in a rehabilitation centre. Once it is deemed fit to return to the wild, it should be released at or near the site of capture. If the intention is to release it back to the wild, care should be taken to expose the animal to minimal human contact while under treatment, lest it become habituated to humans.

BAITS AND LURES

Whether box trapping, pit trapping or chemical capture from vantage points, the procedure requires an attractant to lure the tiger to the capture site. The bait may include meat, a live animal or a partly eaten kill. The use of meat as a lure inside a trap cage does not usually attract big cats as much as live bait does. Kills partly eaten by the targetted tiger are highly coveted and can be dragged to attract it to a particular a location where it can be darted or trapped.

Besides commercially available scent lures such as catnip, the urine of a zoo tiger/tigress may also be used. These can be sprayed at brief intervals along a path ascertained to be used by the animal, leading it to the trap cage. Tiger/tigress urine sprinkled over a stuffed tiger that has been placed inside the cage can potentially lure the animal to enter the cage. This technique was used in Uttar Pradesh with mixed results (the tiger entered the cage but the cage trigger did not fire) in a case involving a sub-adult tiger.

[2] Such instances are not uncommon. In one case, a tiger from Ranthambore had occupied territory in the Chambal ravines for months together. In another instance a tiger, probably from Lakhimpur in UP, travelled 300-odd kilometres and occupied a large tract of riverine habitat along on the Ganga River near Katri, about 20 km from Kanpur. Both these tigers survived almost entirely on wild prey.

Any capture attempt of free-ranging individuals (e.g. a tiger localised in a large patch of sugarcane) involves two aspects: Mechanism and enticement. 'Mechanism' refers to the kind of equipment or device employed to capture the animal, and 'enticement' to the attractant used to lure the animal to a strategic place where the capture team or the trap is in place.

(a) Box (cage) trapping: Traditional trapping methods involve the use of trap cages and pitfall traps. Trap cages are traditionally made of heavy gauge steel or iron, with a trapping mechanism that is triggered either by pressure (the animal's weight) or by motion (the moving of a trigger lever by the animal). Modern trap cages are lightweight, made of fibreglass, but are yet to be comprehensively field-tested (*Plate 38*). Most trap cages consist of an additional compartment to allow for the placement of live bait.

Since tigers are known to be very trap shy, trap cages should be strategically placed and well camouflaged. Tigers often come very close to traps without entering them, as ascertained from pugmark evidence. One of the main reasons is the heavy presence of human scents in and around the cage, which happens because the transportation and deployment of the cage requires a certain amount of manpower. It is important that once a trap cage has been placed at a particular location, the site is vacated except for two to three people who are experienced in camouflaging it. Care must be taken to keep the site free of strong human scents (campfires, eatables, urination etc should all be avoided at site of deployment), and to dampen such scents possibly by using cattle dung or wet mud/clay. As a rule, tigers should be adequately habituated to the trap cage before the bait is placed inside and the cage trigger armed. Habituation is done by tying the bait outside the crate on at least two to three occasions, then keeping it at the mouth of the cage, then inside.

(b) Chemical capture: This involves intramuscular remote administration of anaesthetic drugs to immobilise an animal for a designated period. The duration of anaesthesia depends on the type of drugs and dose injected. Over the years, chemical capture has proven to be a useful method as it has its advantages over other methods. For all opportunistic capture operations there is no better substitute for chemical capture. Opportunities can be created by moving through the area either on elephant back or using a vehicle, or by using a bait or lure alongside a makeshift *machan*.

Plate 38: A traditional trap cage (*inset*), and a modern lightweight fibreglass trap cage

A tiger hiding in a thicket or in the forest should not be searched for on foot, even with an armed escort for support.

The biggest challenge in chemical capture is to get a proper view of the tiger within the ideal darting distance of 10-20 metres. Anything beyond 20 metres introduces an element of risk in terms of the propelled syringe striking an undesirable part of the tiger's body. The other challenge lies in tracking and locating an immobilised tiger in the forest once visual contact is lost. Unlike the controlled conditions in captivity, it is difficult to record the reaction time, down time (induction time) and anaesthesia time in free-ranging situations. Search time should not be confused with induction time since the tiger would have been knocked down (sedated) well before a search team manages to locate it.

Even tigers that have already been captured by physical means (trapping, netting etc) should be chemically restrained for a thorough veterinary examination. Chemical restraint is also useful to calm down aggressive animals being transported in crates that are not ideal for transport. Thus, in most physical captures, chemical restraint is mandatory.

Chemical capture operations are most useful when the conflict animal is confined or has been lured to a location. Typical scenarios include a tiger near its kill or live bait, or when it is trapped in a well or pit, or confined to a house or shed or the like.

Syringe projectors: Syringe projectors (commonly called dart guns) are of various types. Broadly, they can be categorised based on the mechanism of propulsion, as gas/air or powder-charge propelled, and based on the distance of propulsion, as blowpipes, pistols or rifles. If the animal is relatively stationary and at close quarters, darts can be delivered through blowpipes, and if it is already restrained, caught or unable to move, even jab sticks can be used to deliver the drugs. However, long distance syringe projectors, either pistols or rifles, are required to target animals in free-ranging situations.

Commercial blowpipes are made of synthetic materials that do not rust. Since commercially-made blowpipes are costly, locally available plastic, metal, acrylic and fiberglass pipes with a 12mm diameter bore can be effectively used for darting. A blowpipe should be 1.1 metres long and without any bend when held horizontal. Two or three pipes, each a metre long, can be joined at the ends to provide a three-meter pipe that can propel the syringe beyond the usual 5-metre distance.

Since tigers are soft-skinned animals, powder charge rifles should be avoided unless it is an emergency and no gas rifles are available. The syringe projector of choice is the gas rifle, which can also operate with compressed air. Gas rifles come under various trade names like DanInject, TeleInject, PneuDart, TeleDart, CapChur and DistInject.

Drugs for chemical capture/restraint: All chemical capture operations should be done in the presence of a trained veterinarian.

DO'S AND DON'TS

» The barrel of syringe projectors is at times not rust-proof. It is essential to clean the barrel of the syringe projector every day when it is in use, and fortnightly when it is not in use.
» Never keep the projector loaded with the prepared dart as this can lead to the leakage of drugs during transit, which can then lead to rusting. The syringe projector should be loaded only when darting is imminent.
» Keep the loaded syringe projectors 'locked', unlocking them only before darting.
» While moving through the forest on an elephant or vehicle, hold the projector pointing upwards to prevent darts being fired towards team members accidentally.

A wildlife veterinarian's role is not limited to selecting drugs and deciding on the dosage, it encompasses post-capture management of the anaesthetised animal. Post-capture complications like dyspnoea, hyper or hypothermia, bradycardia and seizures require the presence of a qualified and experienced veterinarian.

The most commonly used combination of drugs, often the only combination used for big cats in India, is Ketamine and Xylazine hydrochlorides, and the antidotes for Xylazine, Yohimbine hydrochloride or Tolazoline hydrochloride. Drugs like Medetomidine hydrochloride, a better substitute for Xylazine, are not marketed in India and therefore not readily available to Indian vets. Medetomidine is not only much safer than Xylazine liquid (available as 100 mg/ml solution), but also demands less volume when combined with Ketamine.

The Ketamine and Xylazine dosage selected for the operation depends on the inferred body weight of the animal (from visual sightings or from pugmark, stride, or straddle measurements). To minimise the undesirable effects of Xylazine, the ratio is often completely skewed towards Ketamine whenever used on carnivores. For every 5-7 mg per kg body weight of Ketamine used, the corresponding proportion of Xylazine is not more than 1 mg per kg body weight. An adult tiger weighing 140 kg would therefore require about 850 mg of Ketamine and 140 mg of Xylazine. This demands a 10 ml dart to accommodate 8.5 ml of Ketamine and 1.4 ml of Xylazine (both of which are sold as 100 mg/ml solutions). However, 10 ml darts are rarely available and 7 ml darts are most often used in chemical capture operations.

Many of the modern gas propelled rifles like DanInject, PneuDart and TeleDart also come with a 13 mm barrel that can accommodate larger darts. Despite being heavier than the 11 mm darts, these can be effectively propelled for medium-range distances, especially from elephant back. The total volume of the drugs can be reduced by increasing the proportion of Xylazine, with a substantial reduction in the quantity of Ketamine in the dart. The Ketamine-Xylazine proportion however should preferably not fall below a 3:1 ratio. The antidote Yohimbine (or Tolazoline) hydrochloride should be kept

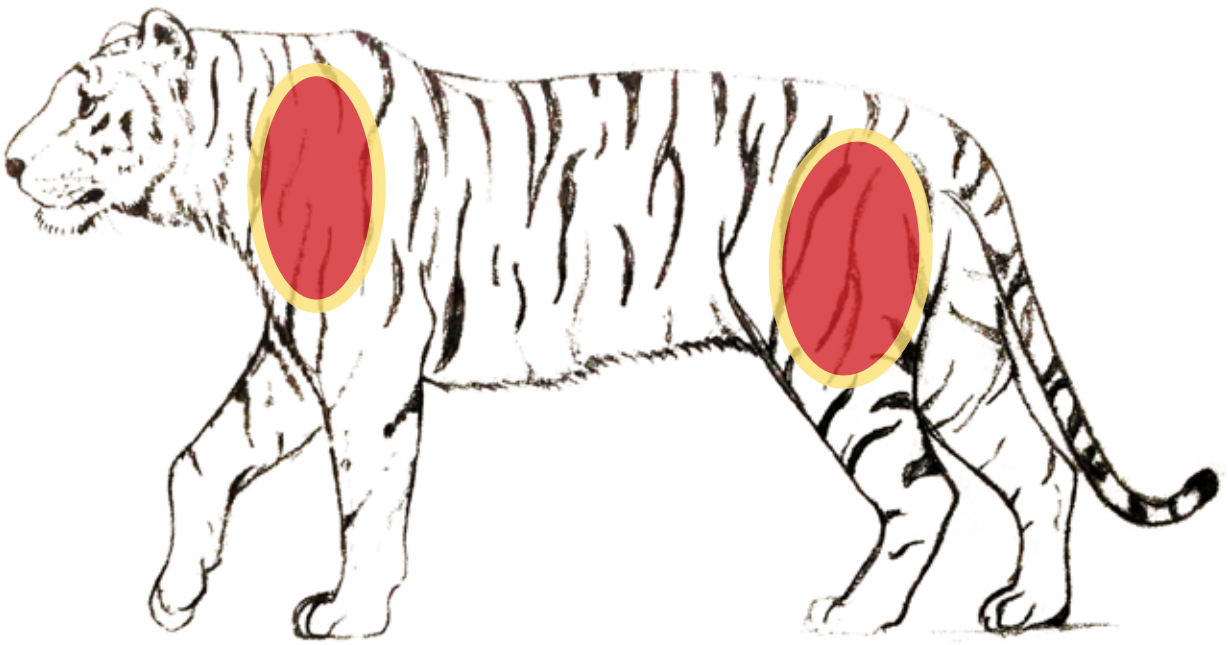


Figure 29: Appropriate darting sites

ready on all occasions, and is a must when the proportion of Xylazine is on the higher side.

Preparation of darts: Most of the darts that fit into a modern gas rifle are plastic darts. DistInject gas rifles are capable of accommodating metal darts that propel the drugs using power-charges, but such equipment has now become rare in the field in India. Plastic darts, depending on the make, use either compressed air or liquid butane to propel the drug upon impact. Needles (cannulas) should not be less than 40mm length to ensure intramuscular delivery. Needles and insides of barrels should be sterilised every time.

As there is every chance of the first dart either missing the target or not delivering the required volume of the drug, at least two more darts should be prepared in advance and carried separately to avoid the trouble of preparing the dart on site. Additionally, collared needles may be used to prevent the dart from dislodging prematurely as the animal moves through vegetation. Collared and barbed needles do however leave a wide entry wound that needs to be treated to prevent infection.

Darting sites: Though the shoulder muscles are a suitable target on adult tigers, the site most often targetted is the thigh region as it is more muscular and thus, safer (*Figure 29*). Besides being a sharpshooter, the person chosen for darting should have a good idea of the tiger's anatomy to avoid hitting the bony protuberances of the body. Injected sites on the body should be inspected for any injury and treated as required.

(c) Other capture methods

Pitfall method: Improvised pitfall traps can also sometimes be used to capture big cats in conflict situations. Trapping success here should in principle be higher than with box trapping as there are no physical structures visible to the tiger. The challenge lies in retaining the tiger in the pit, which must be deep enough and its soil not loose or sandy, lest the tiger grip the walls or loosen the soil while attempting to jump out.

Pitfall traps consist of large pits that are covered with a loosely woven bamboo mat on top, topped with vegetation as camouflage. The tiger's sheer weight makes the flimsy bamboo mesh break, dropping the tiger into the pit below. The pit's depth should be not less than 17 feet, its side walls vertical and its dimensions about 12x12 feet (*Figure 30*). Care should be taken to ensure that water does not accumulate at the bottom of such pits due to overnight rains. The camouflaged covering of the pit can be further improvised to allow for a live bait to be tethered on it[3]. This should be planned carefully to prevent the live bait from disturbing the covered top and falling in. Partly eaten kills can also be placed on the bamboo mesh as bait.

The pit trap method cannot be attempted in scenarios where the tiger is on the move, i.e. shifting locations continuously. It will potentially work with tigers that are localised to specific areas and adequately habituated to baiting. Once trapped, the tiger should be chemically restrained. The specifics of the darting exercise, in terms of the construction of a platform or hide from which the dart can be fired into the pit without disturbing the animal, needs to be thought through beforehand.

Humane snares and leg-hold traps: Across the world, a wide range of animals are ritually trapped by indigenous communities that share space with them, whether for subsistence hunting or trade-related poaching, using snares and leg-hold traps. Traditional snares and leg-hold traps are designed not only to trap but also maim the animal. Over the past few decades, however, humane versions of these traps have been developed by a number of agencies. These are now widely used for safely capturing a variety of large carnivores, from grizzly bears to cougars, jaguars, snow leopards, and Amur tigers.

In India, such traps have also been used by scientists to capture free-ranging jackals and wolves in recent years. These devices are designed to trap the animal at a specific location while not causing any injuries to the body part that is held by the trap or snare. These humane traps are extremely useful in facilitating safe chemical capture, especially of individuals that prove

[3] This method was attempted in Uttar Pradesh and nearly proved to be successful. The tiger fell into the camouflaged pit, but managed to climb out and escape as the depth was just about 12 feet.

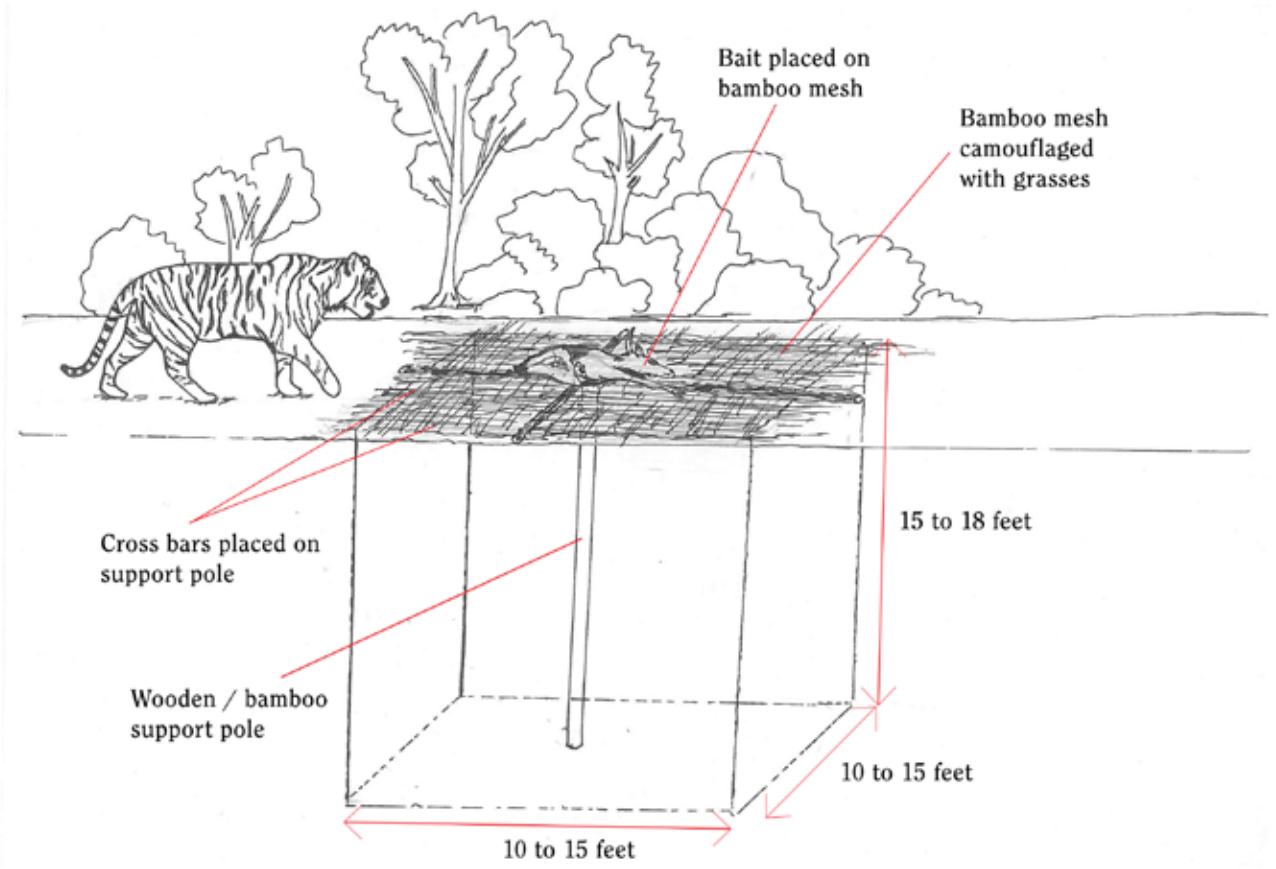


Figure 30: An illustrated three-dimensional section of a typical pitfall trap for tigers

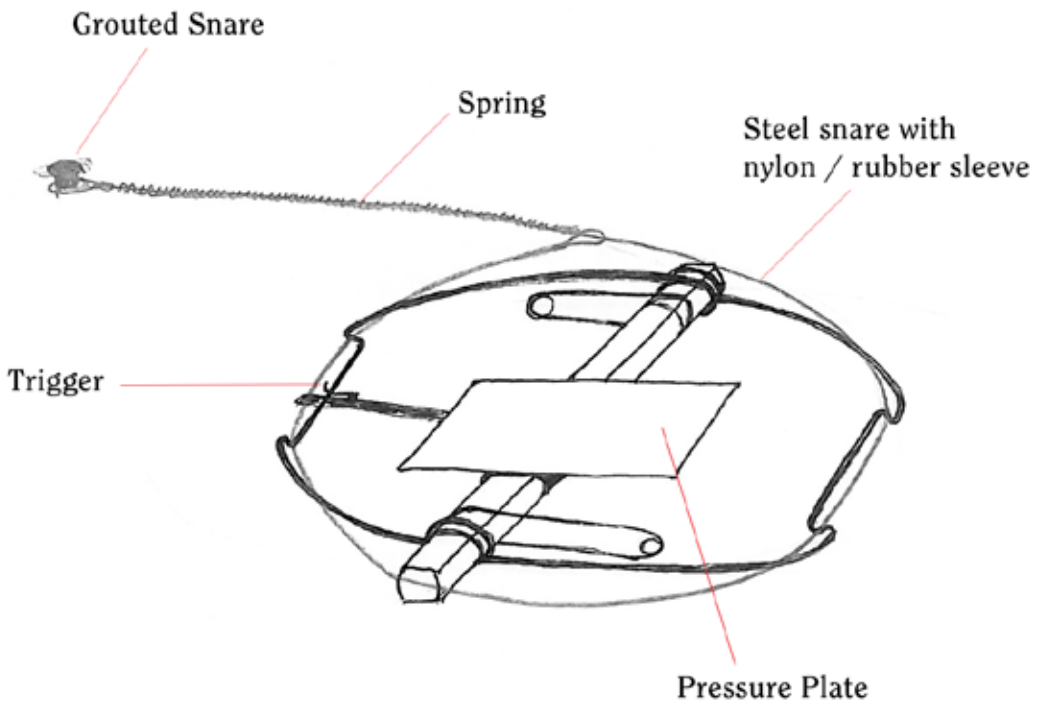


Figure 31: An illustration of a humane snare trap with a snare throw mechanism

extremely shy of box traps. Placed on regular paths/trails used by the animal that is to be captured, these traps are cheap, easy to transport and require very little maintenance. Multiple traps can therefore be set up to increase the chances of capturing an animal; they can be coupled with an alarm system to notify the capture team of a successful triggering.

Such traps have almost never been used to capture tigers or leopards during conflict situations in India, but they have a promising future in this field. Humane snares and leg-hold traps are sold in USA and Europe under brand names such as Aldrich, Fermont, Belisle etc and can be imported for the capture of animals involved in conflict, like tigers.

When installing humane leg-hold traps or snares, care must be taken to ensure that the trap/snare is grouted well into the ground to prevent the animal from escaping with the device itself. Grouting to trees is a possibility, but sufficient cable slack needs to be provided so that the trap can swivel around the tree trunk. Cable slack should be allowed irrespective of where the trap is grouted, so that the trapped animal can roam around within a radius of at least 10 metres from the trap, which is crucial to reduce the stress it faces after it is trapped. Short cables may cause the animal to struggle more, which may lead to disabling injuries to the limb that is caught in the snare or leg-hold trap. Care must be taken to not place traps in areas with overhangs or pits nearby, which may cause a trapped animal to injure itself.

If capture teams cannot be stationed close to the trapping location, remote alarm devices are a must to alert them of a successful triggering. Once alerted the team must reach the site without delay and chemically restrain the trapped animal.

Netting: Another, albeit less used capture method is trapping the animal with netting, followed by immediate chemical restraint. Netting is commonly used to isolate an animal to a patch of crop land or man-made structures such as abandoned buildings or sheds. Netting is more apt in situations when a tiger is hiding in a small agricultural patch, a thicket, a small forest patch, or an abandoned shed or man-made structure. Rolls of long, thick gauge nylon or cotton net with a mesh size of not more than four to five

Plate 39: Netting placed around an open shed in Meerut in 2016, to confine a leopard before its capture (left); and netting placed on the sides of a sugarcane field (right)

inches, light coloured sheets of cloth or tarpaulin about seven feet in width, and wooden (bamboo) poles about eight to nine feet long are the basic items required for this exercise.

The net should be not less than seven feet in height and erected strategically on one side of the crop field, while plain opaque cloth or tarpaulin sheets of a similar height, also hoisted on wooden or bamboo poles, cover the remaining sides as a visual barrier. Driving teams on elephant back or vehicles can then flush the animal towards the net. As big cats (or any wild animal for that matter) do not perceive nets as barriers, they get entangled while attempting to rush through. The net should be freely hung and secured to the poles and ground just enough to hold it in position.

Netting is only an act of temporary capture and should promptly be followed by chemical restraint. It is primarily useful to keep an animal from rapidly moving out of an area of localisation. Members of the capture team should be waiting with syringe projectors at strategic locations to dart the animal as soon as it gets entangled in the net. In cases where a tiger has taken refuge behind opaque materials like hay bales or old furniture in an open shed, nets can be cautiously erected on the periphery to prevent the animal from escaping.

Nets are also sometimes used to physically restrain partially sedated tigers or leopards, which is not a good practice. Partly sedated tigers should receive a top-up dose of the anaesthetic, and the team should approach the animal only after it is completely immobilised. If a Ketamine-Xylazine combination is used, Ketamine alone should be used for the supplementary dose as repeated administration of Xylazine would unnecessarily complicate the recovery process, even if its antidote Yohimbine is used.

(vii) Dealing with Cubs

Dependent tiger cubs rarely stray from their mother in the wild and the displacement of tiger cubs is less common than that of leopard cubs. Instances of tiger cubs being unnecessarily picked up by forest department staff or members of the public are also rare. Dependent cubs are left behind following the mother's death, or when the mother ventures out for hunting. Since tigers mostly inhabit forested areas that humans do not normally frequent, the cubs are less likely to be picked up by trespassers[4].

Dealing with helpless cubs
(less than 3 months of age)

» Identify the location from where the cubs have been picked up
» Look for pugmarks of the mother at the site of capture
» Attempt to reunite if there is no evidence of the mother having been killed. Leave the cubs in a cage, or even under an upturned basket that can provide some protection from weather and predators. Place camera traps (preferably with infra-red flashes) nearby to document the possible reunion.
» If the reunion fails, the cubs should be taken to captivity for nursing. The option of rehabilitating such hand-raised cubs exists, and has been achieved with varying degrees of success in India. However, it is beyond the scope of this protocol to provide the guidelines for rehabilitation of orphaned tiger cubs.

Dealing with half-grown cubs
(3-6 months of age)

» Orphaned cubs less than six months old may starve to death if not supported
» They can also fall victim to dogs and humans when they wander into human areas looking for easy prey
» Providing them sustenance *in situ* is an option that can be tried until they are ready to fend for themselves (till they are about 8-10 months of age). Habituation can be avoided by changing the feeding locations every now and then. The food provided could be meat in the beginning, and lambs, piglets, or wild prey cadavers subsequently.
» Any attempt to bring the cubs to captivity would reduce their rehabilitation potential[5]. The trouble of supporting the cubs *in situ* is therefore worth the effort.

[4] Among the 31 tiger cases handled by WTI, 25% were cubs; the percentage of cubs was 36% in the case of leopards.
[5] In Anini, Arunachal Pradesh, 3-4 orphaned cubs, about four months old, resorted to killing poultry and piglets. One died of starvation moments before capture while the rest were captured in the hope of rehabilitation and release, which however never materialised.

Dealing with grown-up cubs
(6-13 months of age)

» The mother may have been killed, forcing the cubs to target easy prey like livestock. There have been incidents of the mother also being party to such attacks on livestock in fringe villages[6]. The mother's presence can be ascertained through secondary signs (such as pugmarks) and the use of camera traps.
» If the mother is not detected with the cubs, the situation becomes tricky as the cubs may not yet be trained to hunt independently. Such cubs may be captured only if they go on livestock killing sprees. Such sprees are generally transient and the situation eases after some time.
» Holding cubs in an enclosure *in situ* and providing supplementary feed until they are one-and-a-half years old before releasing them is a possibility. As this method has not been attempted, it would be premature to predict its success or failure.

(viii) Translocation and Release

If the tiger is not a man-eater and is found to be capable of surviving in the wild, it should be released near the site of capture – unless it has moved far from its source habitat. If a new release site is chosen, it must have an adequate prey-base and a low density of resident tigers.

For transportation, specially made crates should be used instead of the traditional metal trap cages. An ideal transportation crate is covered on all sides and has holes for ventilation (*Plate 40*). This helps in keeping the captured tiger quiet and de-stressed during transportation, thus avoiding the need for sedation. When such covered crates are not available, a sheet (canvas or tarpaulin) should be used to cover the cage and keep the animal calm.

A radio or satellite transmitter should be fitted to the tiger before it is released into a new site. Satellite collars are preferred as hard-released tigers tend to move extensively, which makes tracking difficult with simple VHF radio transmitters. Details of radio-collaring procedures and post-release monitoring methods are beyond the scope of this protocol. Separate guidelines are available for the same from various sources.

If transmitters cannnot be deployed, released tigers can be tracked through the routine camera trapping operations of the relevant state forest department, based on their unique stripes-pattern recorded beforehand. Multiple camera traps can be deployed across a 10-20 sq km area on animal trails as well as near water bodies in the release area, as tigers typically prefer walking on open trails and will invariably seek out water sources.

Plate 40: An ideal tiger transportation crate

[6] In 2004, two tiger cubs killed five cattle in a village near Kaziranga National Park. The cubs were chemically captured from elephant back, examined and released back into the nearby forests the next day. The mother had not left the area and was hiding in the rice fields when an attempt to dart her provoked her to pounce on a 10 -foot tall elephant, injuring the mahout.

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25. The Rehmankhera tiger after being tranquilised *(left)*, and the tiger being transferred to a transportation cage prior to being taken to the release site on April 25, 2012 **(page 77)**
26. The Rehmankhera tiger being transported to a release site in Dudhwa NP amidst crowds of local villagers **(page 78)**
27. The Rehmankhera tiger being fitted with a satellite collar, ensuring an adequate gap to allow for the growth of its neck till adulthood *(left)*, and the tiger after release into Dudhwa NP **(page 78)**
28. Tracking the radio-collared tiger in Dudhwa from a watch tower (left), and from a vehicle **(page 79)**
29. Latest photograph of the radio-collared Rehmankhera tiger taken on December 19, 2014 **(page 81)**
30. Habitat of the site where the Puranpur tiger was located **(page 82)**
31. Live bait tied outside a trap cage to attract the Puranpur tiger **(page 82)**
32. The sedated Puranpur tiger *(left)*; and the tiger being taken to the release site **(page 83)**
33. Person attacked by the tigress *(left)*; and pugmarks at the site of attack **(page 84)**
34. *(clockwise from upper left)* Tranquilisation teams on elephant back searching for the tiger; the tranquilised tigress being checked by the project veterinarian; the tranquilised tigress being carried to the transportation cage; a wildlife veterinarian checking the size of canines to determine the tigress' age **(page 85)**
35. (clockwise from top left) Villagers crowd around the site where the leopard was reportedly hiding; the RRT team atop a JCB attempting to dart the leopard; the leopard after tranquilisation with the jaw trap still attached to its leg; and the right forepaw of the leopard being examined by the project veterinarian after the jaw trap had been removed **(page 86)**
36. Livestock immunisation and health check-up camps organsied in Surma village **(page 91)**
37. The introduction of mechanical harvesters can greatly reduce attacks on humans during harvesting of sugarcane **(page 98)**
38. A traditional trap cage *(inset)*; and a modern lightweight fiberglass trap cage **(page 105)**
39. Netting placed around an open shed in Meerut in 2016, to confine a leopard before its capture *(left)*; and netting placed on the sides of a sugarcane field *(right)* **(page 110)**
40. An ideal tiger transportation crate **(page 112)**

ANNEXURE

Conflict Mitigation Datasheets

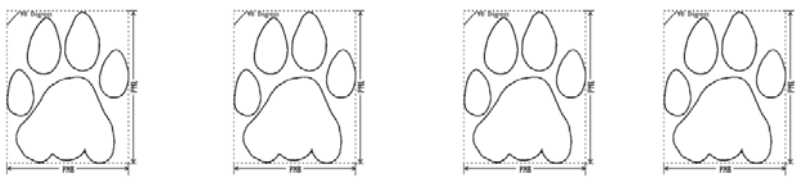
Case Number: ..... Date of Case: ..... Date of Investigation: ..... Name of Investigator.....

Name of Respondent: ..... **Respondent is(Please Tick✓): Victim/Relative of the Victim/Eyewitness/other**
Village coordinates (degree decimal): Lat .....**Long**..... / **District Name:**..... /
Village Name: .....**Closest Protected Area:** .....

Village Infrastructure							Dependence Forest (% HH)		
% of households with electricity	Is street lighting present in village (%)	% of households with sanitation	% of households with water supply	Major source of drinking water	Major source of fuel for cooking	Disposal of dead livestock (1. Buried in own land; 2. Buried in forest; 3. Dumped outside village; 4. Dumped in forest; 5. Others (specify)	Fuelwood	Grazing cattle	Other NTFPs (Specify)

Victim/Respondent Info (Please Tick ✓)											
Name of Victim (if different from respondent)	Sex of Victim	Age of Victim	Per Capita household income	Dependent family members (Males/Females)		Primary family occupation	Education level of victim	No of livestock owned by family		Type of house	
				M	F			Cattle	Sheep/ Goats	Kuchha	Pukka

Livestock Depredation Cases							
Livestock type	No of livestock owned	Nos. lost	Animal evidence (sign type, sighting)	Location of attack		Animal responsible	Details of attack/depredation.....
				Lat	Long		While Grazing in forests (supervised/unsupervised)
							While Grazing in farmland (supervised/unsupervised)
							Tethered in village (but outside homestead)
							Tethered inside homestead
							No. of people present with cattle



Stride Length: ...../...../.....

Case Number: …… Date of Case: …… Date of Investigation: …… Name of Investigator……

Attack on humans	**Time:**	Death/Injury	Animal:
Details of attack:_____			

Inside home/village	GPS Coordinates	Activity of victim (Working/ sleeping, etc.)	No. of people present	Position of victim (squat/bent/standing, etc.)	Type of injury (describe..bite wound location etc.	Body dragged (Mtrs)	Body consumed (% and which part)	Time taken to recover body	Body recovered by whom (villagers /police/FD)	Type of animal evidence (pugmark, scat, sighting, etc.)
In Agricultural Field	Lat									
Inside Forest	Long					Dragged where				

Post mortem conducted (Y/N):……

Whether Police or FD was contacted?(Y/N)…… ;***If Yes, action taken***……

Attitude of villagers towards wildlife issues on a scale of 5: …… (1 = Cognisant; 5 = Ignorant)

Intolerance towards FD on a scale of 5: …… (1 = Tolerant; 5 = No tolerance)

Main Greivances……

Compensation filed (Y/N)……; ***When (Date)***:……; ***Compensated Amount:*** ……; ***When compensated:***……

PRT ***Engaged: Y/N; PRT Name***:……

What did the PRT do?: Crowd Control/Organise village meeting/spread awareness/provided first-aid to victim/helped drive back animal

……

NOTES (Note down any other details here that couldn't be captured anywhere above; or a detailed narrative of incident)

Stride Length: ……/……/……

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Wildlife Trust of India

उत्तर प्रदेश सरकार

AIRCEL SAVE OUR TIGERS