



Wildlife Inventory and Proposal for

# SLOTH BEAR CONSERVATION RESERVE

in Marihan-Sukrit-Chunar Landscape of  
Mirzapur Forest Division, Uttar Pradesh

DEBADITYO SINHA & RAKESH CHAUDHARY

Foreword by Dr Asad Rahmani

<back of front cover>

My congratulations to the authors for this much needed landmark achievement. This is a great contribution to wildlife conservation which I am sure will open many doors to the little known and undiscovered part of Mirzapur jungles. The report exposes the status... the challenges... and the current state of this enigmatic region...sadly like many places in India...the diversity and rich wildlife of Mirzapur is facing threats of extinction.

There is an urgent need for protection and immediate action. The government and stakeholders need to come together and in a united effort to address the various issues. I am hopeful and confident that the efforts put into this study would be instrumental in preserving this landscape.

**-Mike H. Pandey**

**Brand Ambassador- Govt. of Uttar Pradesh (Wildlife and Environment)  
Chairperson, Earth Matters Foundation**

~

Much of the wildlife of Mirzapur has vanished...unsung. Once flush with cheetahs, tigers and caracals, this little known, threatened wilderness still harbours endangered animals like the sloth bear, Indian wolf, leopard, rusty-spotted cat among others. It is hoped that this well-researched and timely report of a neglected but important wildlife area, will lead to its protection for posterity.

**-Prerna Bindra**

**Wildlife Conservationist & Writer  
Former Member, Standing Committee on National Board of Wildlife**

~

The proposed area is rich in wildlife diversity and provides crucial habitat connectivity to maintain the genetic diversity between Protected Areas and other forests in the landscape. Considering the location of the proposed area, rich biodiversity and impending threats in due course of time the proposal offers an opportunity to policymakers to contemplate the issue in all sincerity which will not only secure wildlife in long run but also award local communities with a healthy environment, availability of water and future tourism opportunities.

**-Dr. Harendra Singh Bargali**

**Co-Chair, IUCN/BSG Sloth Bear Expert Team  
Deputy Director, The Corbett Foundation**

~

I congratulate the authors and the team for this much needed work. I am sure this work will fill the gaps of science based information on wildlife in underappreciated areas like Mirzapur. This information will be very helpful to us, the Bear Specialist Group of IUCN, while updating the sloth bear distribution map, where we do not have authentic information about the presence of sloth bear in many of the forest areas. The report reveals the needs for formulating science based conservation strategies for the wildlife and habitats in this area. I have no doubts that this report can be a model for other parts of India to unveil the ecological health and habitat condition of the forest.

**-Dr. Nishith Dharaiya**  
**Co-Chair, IUCN-SSC Sloth Bear Expert Team**  
**Associate Professor, HNG University, Patan (Gujarat)**

~

The dry tropical deciduous forest of Mirzapur is known to be dominated by *Anogeissus latifolia*, *Lagerstroemia parviflora*, *Terminalia tomentosa*, *Hardwickia binata*, *Boswellia serrata*, *Acacia catechu* etc. along with patches of *Shorea robusta* as major tree species, making three storey forests at some places. These forests have been home for most of the typical ungulates found in a dry deciduous forest along with many carnivores such as Leopards, Sloth bear and other lesser cats. I congratulate the team for bringing out a detailed report and providing much needed baseline data of this region. I am sure that the findings of the report shall be very useful for the Forest Department to prepare a long term conservation strategies of the region.

**Dr. Faiyaz A. Khudsar**  
**Scientist Incharge, Yamuna Biodiversity Park,**  
**CEMDE, University of Delhi**

~

One of the takeaways from the 21st International Conference on Bear Research & Management, November 2012, New Delhi was the lack of scientific research on four species of bear found in India despite being large charismatic mammals. Globally there are just eight species of bear. Thus, this report is an important milestone in highlighting a least studied species in an area off the conservation radar despite its rich ecological heritage.

**-Ananda Banerjee**  
**Wildlife Conservationist & Author**

# Wildlife Inventory and Proposal for SLOTH BEAR CONSERVATION RESERVE in Marihan-Sukrit-Chunar Landscape of Mirzapur Forest Division, Uttar Pradesh

Authored by Debadityo Sinha & Rakesh Chaudhary

Foreword by Dr Asad Rahmani



July 2019

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## DECLARATION FROM AUTHORS

This is to certify, that this report titled 'Wildlife Inventory and Proposal for Sloth Bear Conservation Reserve in Marihan-Sukrit-Chunar Landscape of Mirzapur Forest Division, Uttar Pradesh (2019)' including but not limited to the camera trap survey has been carried out in the Mirzapur Forest Division. The information given in this publication are true and correct to our best of knowledge and all the errors in the report are inadvertent and author's alone.

All the external sources from which the ideas and extracts have been taken are duly cited. The references to third party publications including link to websites given in this publication are for convenience and informational purposes only. The authors bear no responsibility for the accuracy, legality or content of all third party information cited.



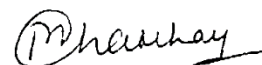
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-  
16 March 2019

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# ABBREVIATIONS

CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CR	Conservation Reserve
DSWF	David Shepherd Wildlife Foundation
ESZ	Ecosensitive Zone
FD	Forest Division
GPS	Global Positioning System
ISRO	Indian Space Research Organization
IUCN	International Union for Conservation of Nature
km	Kilometer
LULC	Land Use Land Cover
m	Meter
M.P.	Madhya Pradesh
mm	Millimeter
NT	Near Threatened
PA	Protected Area
Sch	Schedule
SH	State Highway
sq.km.	Square Kilometer
TDF	Tropical Deciduous Forest
U.P.	Uttar Pradesh
VENHF	Vindhyan Ecology and Natural History Foundation
VU	Vulnerable
WLS	Wildlife Sanctuary
WPA	Wildlife (Protection) Act, 1972
WTI	Wildlife Trust of India
WWF	Worldwide Fund for Nature

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## FOREWORD

I am delighted to write the foreword for the important report “Wildlife Inventory and Proposal for SLOTH BEAR CONSERVATION RESERVE in Marihan-Sukrit-Chunar Landscape of Mirzapur Forest Division, Uttar Pradesh”. I am always interested to work and study neglected ecosystems and neglected species. There is plethora of literature on well-known protected areas and almost hysterical concern for few mega-vertebrates but not many conservationists give attention to species like Sloth Bear and habitats like Mirzapur Forest landscape. I had the privilege to visit Mirzapur Forest a decade ago and was amazed to see that some good patches of tropical thorn and dry-deciduous forest still survive, despite huge population and mining pressures.

I am happy that the report is jointly written by Debadityo Sinha of Vindhyan Ecology and Natural History Foundation and Rakesh Chaudhary of the Forest Department – an exemplary combination of an NGO working closely with the government. This is the way forward for achieving conservation results. I am also happy that five organizations have come forward to jointly sponsor this report: Wildlife Trust of India, David Shepherd Wildlife Foundation, Earth Matters Foundation, Forest Department and Vindhyan Ecology and Natural History Foundation.

The report is very thoroughly researched and result well presented. Besides the two lead authors, the three contributors, Avinash Kushwaha, Mohit Chauhan and Sudhanshu Kumar, also need to be appreciated. Interestingly, they come from two leading institutions of our country: TERI School of Advanced Studies, New Delhi, and Banaras Hindu University.

The report proves the presence of rich biodiversity in this neglected region. I hope the concern authorities will take appropriate measures, as suggested in the report, and make Marihan-Sukrit-Chunar Landscape of Mirzapur Forest Division as Sloth Bear Conservation Reserve. It will be a fitting acknowledgement of the hard work that the Vindhyan Ecology and Natural History Foundation did for the last five years.

**Asad R. Rahmani**

Lucknow

2 July 2019

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The authors are thankful to Wildlife Trust of India, David Shepherd Wildlife Foundation, Earth Matters Foundation and Bitgiving for supporting this work.

We would also like to thank all those who could not be named here, our well-wishers, our nearest ones, family members and friends for their support.

**-The Authors**

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## EXECUTIVE SUMMARY

The forests of Mirzapur Forest Division of Uttar Pradesh is classified as Tropical Deciduous Forest (TDF) characterised by long and intensely hot summer, low rainfall and a short mild winter with attractions of waterfalls and short to medium height hills. The major part of this forest division comes under Vindhyan plateaus of Mirzapur, elevation ranging from approx. 70 meters near river Ganga to as high as 400 meters.

The summer temperature goes up to 48° C in May-June. The rainfall varies from 750 mm. to about 1200 mm. Many small rain fed streams and rivulets passes through the entire hilly terrains which are almost dry during the hot summer. It shows mixed type of forests, dominated by shrubs and medium height trees. The flora is dominated by tree species such as *Diospyros melanoxylon*, *Butea monosperma*, *Shorea robusta*, *Boswellia serrata*, *Acacia catechu*, *Zizyphus mauritiana* etc. According to a study by Allahabad University, there are 183 plant species belonging to 158 genera and 60 families in Mirzapur which are used by local tribes to treat various ailments.

There are very few records and literature on the wildlife of Mirzapur. Some of the historical record reveals about the pride hunting in this region. Percy Wyndham, who was District Collector of Mirzapur, and good friend of Jim Corbett is believed to have killed more than 500 tigers in his lifetime mostly in Mirzapur. Rough estimates of wildlife of Mirzapur published by regional forest offices from time to time give an indication of diverse wildlife and future prospects of discovering new species in this region. Sloth bears can be termed as the flagship species found in Mirzapur Forest Division. However, the overall trend of wildlife population shows a declining trend.

The wildlife richness of Mirzapur and the threat to their habitats can be understood from various incidents of human-animal conflicts which is very common in some areas. Wild animals like sloth bear, leopard, hyena, jackal, deer and mugger (crocodile) straying in villages are often reported by local newspapers. Trafficking and smuggling of animals and their parts have been reported from this region in past.

Some of the major threats are land use change and other anthropogenic disturbances in the region. Stone quarrying activities and encroachment of land within the forest areas has increased the porosity and disturbance in some portions.

Majority of the animals such as sloth bear, leopard, hyena, porcupine, civets, sambar are known to be nocturnal and elusive. They generally avoid movement during day time to avoid exposure to heat as well as human contact. Therefore, sighting of the wildlife during day-time is rare. Census data published by Mirzapur Forest Division provides a good inventory of wildlife in this region which is based on indirect evidences, and there is a possibility that several elusive animals may have not been recorded at all. Therefore, a camera trap study was undertaken in few selected forest ranges to collect objective and

direct evidences of sloth bears and other elusive wild animals inhabiting these forests. The camera trap survey was carried out in three forest ranges Marihan, Sukrit and Chunar between May 2018 and July 2018. A total of 15 camera traps were deployed at 50 different locations selected randomly covering different habitat types and at locations likely to be used by animals. The camera trap survey showed a very good variety of wild animals in the forests. The result indicates a very good representation of all trophic levels indicating a functional ecosystem in existence. Most of the camera trap images were captured after sunset, with few instances of daytime images indicating nocturnal movement of animals.

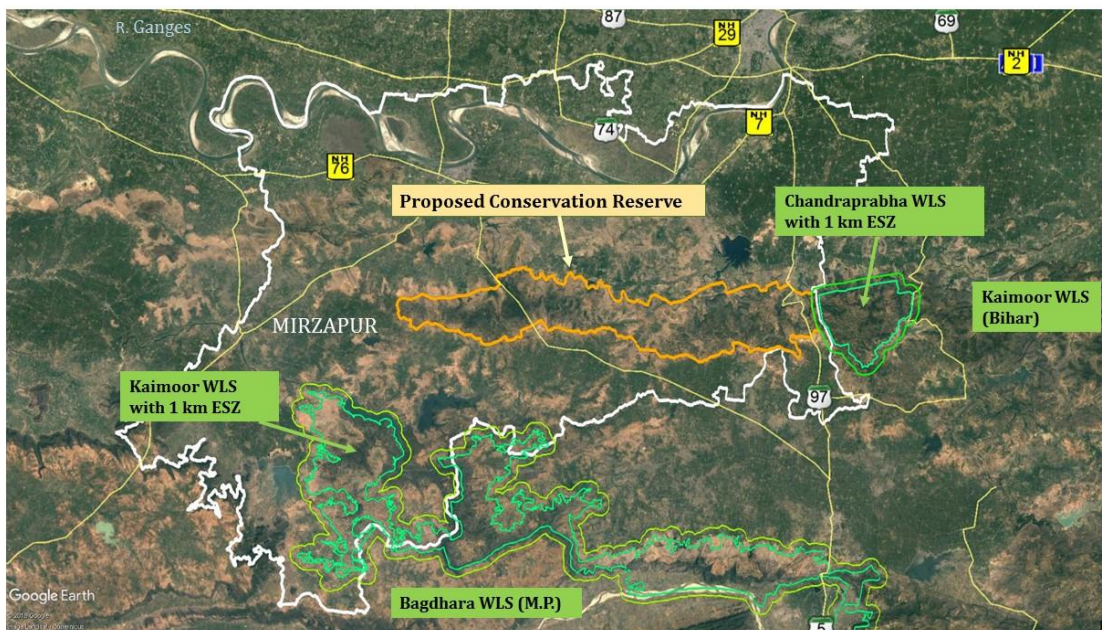
There are three cat species captured by the cameras: Asiatic Wild Cat, Rusty Spotted Cat and Leopard; all of which are first time record in this Forest Division and are all protected as Schedule I of WPA. However, the discovery of Asiatic Wild Cat is special as the known easternmost range of Asiatic Wild Cat has been up to Bagdhara Wildlife Sanctuary in Sidhi District of Madhya Pradesh which shares its border with Mirzapur at Kaimoor Wildlife Sanctuary's Halia range.

The Schedule I (WPA, 1972) animals recorded from these forest ranges are Sloth Bear (*Melursus ursinus*), Leopard (*Panthera pardus*), Asiatic Wild Cat (*Felis sylvestrisornata*), Rusty Spotted Cat (*Prionailurus rubiginosus*), Indian Wolf (*Canis lupus*), Indian Gazelle (*Gazella bennettii*), Blackbuck (*Antelope cervicapra*), Peafowl (*Pavo cristatus*), Bengal Monitor (*Varanus bengalensis*) and Mugger Crocodile (*Crocodylus palustris*) etc. Other important species recorded here are Striped Hyena (*Hyaena hyaena*), Jungle Cat (*Felis v chaus*), Red Fox (*Vulpes vulpes*), Golden Jackal (*Canis aureus*), Sambar Deer (*Rusa unicolor*), Spotted Deer (*Axis axis*), Ruddy Mongoose (*Herpestes smithii*), Grey Mongoose (*Herpes tesedwardsii*), Palm Civet (*Paradoxurus hemaphroditus*), Small Indian Civet (*Viverricula indica*), Bluebull (*Boselaphus tragocamelus*), Wild Boar (*Sus scrofa*), Indian Crested Porcupine (*Hystrix indica*), Indian Hare (*Lepus nigricollis*), Five-striped Palm Squirrel (*Funambulus pennantii*), Hanuman Langur (*Semnopithecus entellus*), Rhesus Macaque (*Macaca mulatta*), Painted Spur Fowl (*Galloperdix lunulata*), Red Jungle Fowl (*Gallus gallus*) and many other birds.

The forest ranges Marihan, Sukrit and Chunar is an ideal representation of the vindhyan landscape and connects *Eastern Kaimoor landscape* (Ranipur WLS in U.P. and Son Gharial WLS, Sanjay Dubri Tiger Reserve and Bagdhara WLS in M.P.) with *Western Kaimoor landscape* (Chandraprabha WLS of U.P. and Kaimur WLS of Bihar). There are several waterfalls namely Alopi Dari, Jogia Dari, Pahiti Dari, Panchsheel Dari, Chuna Dari, Lekhania dari and Siddhanath ki Dari which are places with exemplary natural beauty and locally popular sites for recreation and tourism. However, these forest ranges are also facing severe threats from activities like mining, logging, hunting, unsustainable construction and infrastructure development, encroachment of forests and watersheds and forest fires.

Therefore, a Conservation reserve is proposed in Mirzapur Forest division which will include Marihan, Sukrit and some parts of Chunar and Lalganj ranges with area of approx. 408 sq.km.

The location of the proposed conservation reserve is shown below.



**The proposed boundary of the Conservation Reserve and locations of adjacent PAs**

The majority of the land proposed for the conservation reserve are recorded as Reserve Forests of Mirzapur Forest Division with few rural agricultural settlements in between. By declaring these forests as Conservation Reserve, it will elicit responsibility and long-term participation of local people in conservation of this landscape.

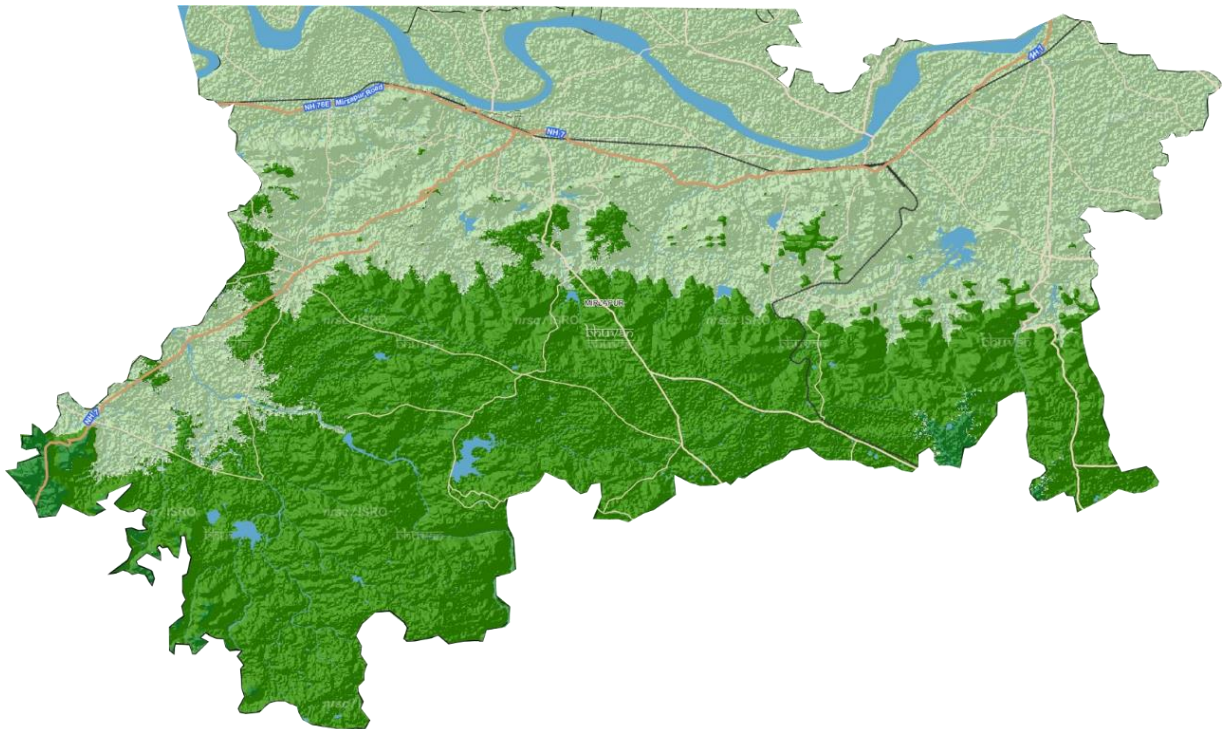
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# 1. INTRODUCTION

## 1.1 The Landscape

### A. Climate and Topography

Mirzapur district is surrounded by districts: Allahabad, Sant Ravidas Nagar, Chandauli, Varanasi, Sonbhadra of Uttar Pradesh and districts: Rewa and Siddhi of Madhya Pradesh. River Ganga flows through the northern boundary of the district. District Mirzapur is divided into two biogeographic zones- Gangetic plains in northern portion and Vindhyan mountain range which constitutes majority of the district. The Vindhyan plateaus of Mirzapur are known for their dry deciduous forests, waterfalls and wildlife. The elevation ranges from approx. 70m near river Ganga to as high as 400m near Dramadganj forest range. The terrain is undulating with small and medium height hills in between. There is rocky sandstone layer beneath the soil and in some places they are exposed to surface. Many small streams and rivulets passes through the entire hilly terrains.



*Map 1: Terrain Map of District Mirzapur (<http://bhuvan.nrsc.gov.in>)*

The forests of this region can be classified as tropical dry deciduous forest (Champion & Seth, 1968). According to the Champion and Seth's classification of forests types of India, the various types and sub-types of forests of Vindhyan region witness Southern and Northern Tropical Dry Deciduous Forests respectively (FRI, 2016).

The biogeographic sub-zone is called Vindhya under zone Deccan plateau. The climate of the area is characterized by long and intensely hot summer, low rainfall and a short mild winter. The summer temperature goes up to 48°C in May-June. The rainfall varies from 750 mm to about 1200 mm. Most of the rainfall occurs in the months of June, July and August. There are little winter rains, which occurs generally in January and February and are sometimes substantial, fairly regular as compared with other parts of Uttar Pradesh (FRI, 2016).

## B. Vegetation

These forests occur on underlying rocks, which are, generally, sand stone and shale (FRI, 2016). In some places old growth can be seen in the elevated areas (~200 m and above) with tree height reaching up to 10-15 m. The areas in elevations lower than 190 m shows mixed type of forests, dominated by shrubs and medium height trees. There are several patches where clearings of forests can be easily observed.

Most of the plant species are known for medicinal importance and have been traditionally used for treating ailments. Singh & Narain (2009) reported 183 plant species belonging to 158 genera and 60 families in Mirzapur which are used by local tribes to treat various ailments.

Some of the common plants reported by Forest Department, U.P. (FRI, 2016) are as follows:



**Image 1: Salai (*Boswellia serrata*) forest in Sukrit**

**Trees:** Dhau (*Anogeissus latifolia*), Asna (*Terminalia tomentosa*), Tendu (*Diospyros melanoxylon*), Jhingan (*Lanea coromandelica*), Kakor (*Zizyphus xylopyra*), Khair (*Acacia catechu*), Piyar (*Buchanania lanzan*), Siddha (*Lagerstromia parviflora*) and Salai (*Boswellia serrata*), in patches, is commonly noticeable feature. Other species found locally in irregular mixtures are- Kurraiya (*Holarrhena antidysentrica*), Amla (*Emblca officinalis*), Amaltas (*Cassia fistula*), Beejasal (*Pterocarpus marsupium*), Parsiddha (*Hardwickia binnata*), Palash/Dhak (*Butea monosperma*), Kardhai (*Anogeissus pendula*), Semal (*Bombax ceiba*), Arjun (*Terminalia arjuna*), Bahera (*Terminalia bellerica*), Papad (*Gardena latifolia*), Kurlu (*Sterculia urens*), Sal (*Shorea robusta*), Harr (*Terminalia chebula*), Jamun (*Syzygium cumini*), Neem (*Azadirachta indica*), Haldu (*Adina cordifolia*), Chilbil (*Holoptelia integrifolia*), Mamar (*Eleodendronglaucum*), Domsal (*Miliusavellutina*), Ber (*Zizyphus*

*mauritiana*), Kathmahuli (*Bauhinia racemosa*), Khaja (*Bridelia retusa*), Phaldu (*Mitragyna parviflora*), Dhusar (*Ficus ornotiana*), Galgal (*Kaklospermum religiosum*), Farhad (*Erythrina suberosa*) and Bel (*Aegle marmelos*) etc.

**Shrubs-** Kharhar (*Gardenia turgida*), Sehur (*Euphorbia nibulai*), Marorphali (*Helicteres isora*), Bhela (*Semecarpus anacadium*), Karaunda (*Carissa spinarum*), Kataiya (*Flacourtia indica*) etc. are found in preponderance.

**Grasses-** Churanth (*Heteropogon contortus*), Kans (*Sacchrum spontaneum*), Dhavlu (*Crysopogon fulvus*), Khus (*Vetiveria zizanooides*), Bagai (*Eulaliopsis binata*). Main climbers are- Makoi (*Zizyphus oenoplia*) and Kuchi (*Acacia piñata*).

### C. Socio-economic dependence

People living in and around these forests are dependent on the forests for fuelwood, grazing as well as a number of forest produce for their sustenance. There are number of commercially important fruit bearing trees which are found naturally growing in the forests such as *Buchanania lanzan* (Chiraunji) also known as Cuddaph Almond. The fruits of trees like *Madhuca longifolia* (Mahua) is traditionally harvested by tribal communities to produce an indigenous wine and is also dried for use as raisin. Leaves of *Diopsyros melanoxylon* (Tendu) is used for production of *bidi* (a type of indigenous cigarette).

## Photographs from the landscape



*Image 2: Bamboo thicket (left) and forests on hill-top (right) in Marihan forest range*



*Image 3: An access road in Sukrit range (left) and a Savannah ecosystem in Marihan range (right)*



*Image 4: Jogia Dari, Marihan range (left) and Lekhania Dari, Sukrit range (right) in dry season*



## 1.2 Wildlife Conservation in Mirzapur- Background and History

Most of the historical account of the wildlife distribution in Mirzapur region has been from the colonial era, all of which also gives a historical background of pride-hunting which has been prevalent here. Post-independence, there are very few literatures on wildlife of Mirzapur region except very few mentions in some policy reports and records of Forest Department.

### 20<sup>th</sup> Century- Legacy of Percy Wyndham

*"If one talked about Mirzapur one had to talk about Percy Wyndham"- Y.D. Gundevia*

When we talk of wildlife of Mirzapur, we cannot simply begin without the mention of Percy Wyndham- the District Collector and Magistrate of Mirzapur between 1901-1915 who was also a good friend of Jim Corbett. He is believed to have killed more than 500 tigers in his lifetime mostly in Mirzapur (Jaleel, 1997). Jim Corbett in his autobiography '*Man Eaters of Kumaon (Corbett, 1944)*' revered Percy Wyndham as the person who knows about tigers than any other man in India. Though criticized for his love for games, Wyndham during his tenure as District Collector initiated a series of rules for the preservation of game, which he himself strictly followed, and which eventually came to be accepted by the forest departments all over India that time. Some of his rules were prohibition on shooting the cheetal, or the sambar or the tiger and any other species of wild game in their prescribed mating season. The present day Mirzapur-Robertsganj Road and the district's first canal irrigation project-Dhanraul canal were work of '*Wyndham Saahib*', as he was popularly known by the villagers. The Wyndham fall, which is one of the district's popular water fall and major tourist attraction is named after him. (Gundevia, 1992)

A very good description of the wildlife heritage of Mirzapur can be seen in the book '*In the Districts of the Raj, 1992*'. The author *Y. D. Gundevia*, who was posted as District Collector of Mirzapur (October 1939- June 1942) gives a beautiful description of the wildlife of the district, an excerpt reproduced below:

*All over the Vindhyan plateau-if one traversed by car from Mirzapur to Robertsganj-there was plenty of game. There was any amount of sambar and cheetal, any amount of wild boar and everything else in the antelope family. As one reached the Kaimur ranges one even came upon the black sloth bear here and there."*

## Tiger, Cheetah and Caracal

Gundevia in his book claimed that the Mirzapur region had a very large population of tigers compared to other popular tiger areas in the country. Following is one of his statement from his book:

*“Jim Corbett had shot all his man-eaters in Nainital. But I am sure there must have been more tigers in and around Mirzapur than in all the tarai districts put together.....”*

There are several other documents and reports where tigers were specifically stated to be resident in Mirzapur and has been claimed to once support a very large number of tigers. One such report is of *IUCN Eleventh Technical Meeting-New Delhi, 1969* where the following excerpt gives a brief status of the tiger population in the forests of southern U.P. including Mirzapur:

*All along the base of the Vindhya plateau, there runs a bamboo belt about 50 meters wide. These bamboo thickets and the spaces between sandstone blocks, which remain shaded for the greater part of the day, are ideal habitats of tigers. The forest blocks of Mirzapur, which were once considered to be an inexhaustible source of tigers, support hardly ten tigers now.*

There are several other cats which used to be found in Mirzapur. While the Cheetah is now extinct, but the very elusive 'Caracal' is still believed to be possibly resident in the forests of Mirzapur. In the '*Journal of Bombay Natural History Society, 1918* (Allen, 1919)', presence of Caracal and Cheetahs in Mirzapur were explicitly described, an excerpt reproduced below:

*"The following notes on two uncommon mammals in Mirzapur District may perhaps be of interest in connection with the Survey. On 28th December 1912, during a sambhar beat in light jungle about 25 miles S. of the Ganges, a small animal that I did not recognize came out at very close range. I blew a large piece of its back away with a 500 Express but it made off and took refuge in a small nala where it was shortly afterwards despatched with a shotgun. It proved to be a female lynx (*F caracal*) My measurement maele it 34 inches long (body 27 and tail 7) apparently a rather small example. Unfortunately, the only memento I have of it are the claws, as shortly after I got the head mounted it was destroyed in a bungalow fire. This is considered locally a distinctly rare animal. I saw not long ago in the possession of a friend a very fine skin of a cheetah (*C. jubatus*) that had been killed in 1916 by villagers about 30 miles South of Mirzapur, which is on the Ganges near Benares. I think about 5 have been obtained in the last 25 years, one being shot while it was in the act of stalking a sambhar. The one whose skin I saw had been killed in the neighbourhood of a grassy plain which held some Black buck."*

Similar account of Cheetah can be found in the book *Sterndale's Mammalia of India*, by Frank Finn, 1929 where he writes:

*“One specimen, which from its skin must have been very old, was killed by villagers in the Mirzapur district (which borders on Rewah) about two years ago”*

According to wildlife historian Raza Kazmi, the Cheetahs must have been extinct from the district Mirzapur by circa 1930 (Kazmi, 2012).

## 21<sup>st</sup> Century- Recognition as Sloth Bear Habitat

Despite all these historical accounts of the rich wildlife presence in the district, there is hardly any scientific exercise ever taken to get into details of the faunal diversity in the district. Only source of wildlife presence in Mirzapur has been the wildlife censuses published by regional forest offices which provided rough estimates of their population giving an indication that the forests of Mirzapur has still lot of wildlife remaining and lot more to be discovered. However, the presence of wildlife in Mirzapur was never completely out of discussion, especially when it comes to Sloth Bears, which can be termed as the flagship species of this particularly unique dry deciduous vindhyan landscape. Occasional incidents of man-bear conflicts in the district and some estimates by forest department shows the district has one of the last remaining resident habitats of Sloth Bear, a species of bear endemic to Indian subcontinent and which is also protected under Schedule I of Wildlife (Protection) Act, 1972.

The **National Bear Conservation and Welfare Action Plan, published by Ministry of Environment and Forests, 2012** recognized Mirzapur Forest Division as an important sloth bear habitat. Following is one excerpt from the chapter on Uttar Pradesh:

*“Central Highland regions of U.P. hold scattered populations of sloth bear but are in continuous threat from mining activities and increasing anthropogenic pressures. Sloth Bear is reported to occur in good numbers in Kaimoor WS, Ranipur WS, Kashi WS, Chandraprabha WS and areas of Mirzapur FD.”*

The report identified 8 forest divisions in the state where sloth bears have been reported but it also acknowledged a drastic decrease in sloth bear population in the state.

Mirzapur Forest Division, in particular has undertaken several censuses of the wild animals in the district in past. Wildlife estimates for some of the important species obtained from the department for the years 2011 and 2013 is presented below:

<b>Species</b>	<b>2011</b>	<b>2013</b>	<b>% Decrease</b>
Chinkara	277	117	58
Blackbuck	129	82	36
Sloth Bear	211	114	46
Sambar	248	88	65
Chital	203	179	12

## The 2016 Sloth Bear Distribution Survey in Mirzapur

Vindhyan Ecology and Worldwide Fund for Nature-India conducted a sign based survey of sloth bears in five forest ranges of district Mirzapur. The results showed very good presence of sloth bears in the district and provided a first ever distribution map and assessment of the sloth bear habitats in the district Mirzapur which is shown on the map below:



**Map 2: Sloth Bear distribution in Reserve Forests of district Mirzapur (Sinha et.al. 2017)**

A total area of 1110 sq.km. in forest ranges-Marihan, Sukrit, Chunar, Patehara and Dramadganj were identified as areas with good wildlife presence and were suggested to be conserved by elevating the protection status.

Based on the wildlife presence, the district can be broadly divided into two landscapes. Forest ranges *Patehara* and *Dramadganj* which are continuous with the Kaimoor Wildlife Sanctuary is also part of a larger landscape contiguous with Bagdhara WLS, Son Gharial WLS, Sanjay Dubri Tiger Reserve (M.P.) which is further connected by forests till Ranipur WLS (U.P.) which can be termed as **Western Kaimoor Landscape**.

The remaining three forest ranges- *Marihan*, *Sukrit* and *Chunar* which are contiguous with another landscape is connected with Western Kaimoor landscape via the degraded forests of Lalganj Forest Range and some rural settlements and agricultural fields. Chandraprabha WLS lies on the east of Sukrit range but separated by four lane Varanasi-Robertsganj road (also known as SH-5A). The proposed eco-sensitive zone of Chandraprabha Wildlife Sanctuary includes a small area of Sukrit forest range on its western side. The Chandraprabha Wildlife Sanctuary is contiguous with Kaimur Wildlife Sanctuary of Bihar which can be referred as the **Eastern Kaimoor landscape**.

Thus, these 3 forest ranges-Marihan, Sukrit and Chunar serves as a very critical wildlife refuge and connecting forests between the Western Kaimoor Landscape and the Eastern Kaimoor Landscape.

### 1.3 Human-Animal Conflicts

Human-wildlife conflicts are frequently reported in regional newspapers. There have been several incidents of wild animals like sloth bear, leopard, hyena, jackal, deer and mugger crocodile straying in villages which often resulted into human-animal conflict situation. There are also reports of elephant and tigers straying into villages, however these incidents are rare and they are believed to be moving in from protected areas in neighbouring states. A list of dates when man-wildlife conflicts are reported by newspapers and available online for the year 2017 are provided below:

S. No.	Reported on	Name of Reported Animal (alphabetical order)	Village/Place	Source
1	27-03-2017	Hyena	Gorakhi	Daily Hunt
2	23-02-2017		Rehi	Amar Ujala
3	13-02-2017	Jackal	Ahraura	Hindustan
4	08-08-2017		Hamidpur	Amar Ujala
5	11-05-2017	Leopard	Manoharpur	Patrika
6	24-04-2017		Banjari	Nav Bharat Times, Mirzapur samachar
7	13-04-2017		Devhat	Amar Ujala
8	17-03-2017		Shishta Khurd	AmritPrabhat
9	20-02-2017		Badwar	Amar Ujala
10	16-12-2017		Mugger Crocodile	KonBharuhawa Rajgarh
11	28-11-2017	Nadihar		Patrika
12	15-11-2017	Harsad		Hindustan
13	11-09-2017	Sadar		Patrika
14	30-08-2017	Mirzapur		Daily Hunt
15	20-08-2017	Bhawa		Bhaskar
16	30-07-2017	Devpura		Hindustan, Mirzapur Samachar
17	21-07-2017	Nadihar Rajgarh		Akhand Bharat News
18	12-07-2017	SemraGaon		Patrika
19	14-01-2017	Lahangpur		Patrika
20	06-01-2017	Dhamauli	OneIndia	
21	06-12-2017	Nilgai	Jigna	Amar Ujala
22	18-11-2017		Vijaypur	Dainik Jagran
23	25-07-2017	Python	Lekhaniya dari Ahraura	Hindustan, Patrika, Amar Ujala
24	24-11-2017	Sambar deer	Dramadganj	Mirzapur Samachar

25	23-10-2017	Sloth Bear	Bhavanipur	Hindustan, Ahimsa Express
26	21-09-2017		Bhavanipur	Mirzapur Samachar
27	17-07-2017		Gahira Nakati	Raftaar, News 5, Amar Ujala
28	11-02-2017		Banjari	Patrika
29	05-02-2017		Songada	Amar Ujala
30	06-08-2017	Snakes(other than Python)	Bajhav	Mirzapur Samachar
31	26-07-2017		Negurajigna	Mirzapur Samachar
32	03-07-2017		Behranganj Chunar	Mirzapur Samachar, Political Punch
33	12-06-2017		Ganeshganj	Mirzapur Samachar
34	05-12-2017	Spotted Deer	Gadbada	Amar Ujala
35	18-03-2017	Tiger	Shishta Kala	Dainik Jagran, The Times of India, DainikBhaskar, Mirzapur Samachar, Navbharat Times, Amar Ujala
36	31-07-2017	Wild Boar	Ramgarh	Amar Ujala
37	06-07-2017		Bhagdeval	Mirzapur Samachar

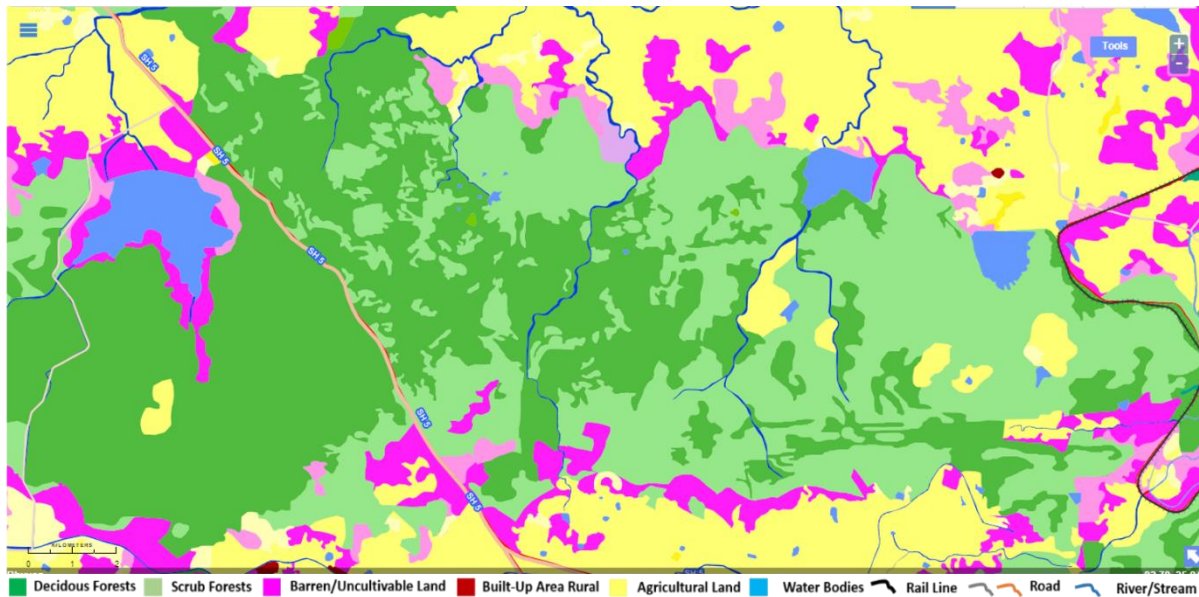
*The news articles related to human-animal conflicts in Mirzapur can be read from <https://goo.gl/4CgMLk>*

In the beginning of the year 2017, few smugglers were nabbed by local police transporting six wild cats, five of which were later identified by Forest Department with assistance of VENHF to be the rare cat species of India- 'Caracal'. There were high speculations that the cats were poached from forest areas in and around Mirzapur, but the exact origin of these cats remained uncertain. In another famous incident, in June 2016, a leopard was trapped inside a villager's house which was saved after 36 hours of rigorous rescue operation (Hindustan, 2016).

## 2. DESCRIPTION OF THE STUDY AREA

### 2.1 Marihan Forest Range

The forests of Marihan constitute a variety of habitats ranging from grassland, savannah, scrub forests, mixed deciduous forests and dense deciduous forests interspersed with short heighted hills and numerous rivers, some of which originate here. The total area under the Marihan forest range is 145 sq.km.



*Map 3: Land Use Land Cover Map of Marihan Forest Range (<http://bhuvan.nrsc.gov.in>)*

### A. Topography

This landscape has short to medium height hills, with less steep slopes. The elevation varies between 170-250 m. Though the sub-surface layer is rocky sandstone, but soil layer is still found intact in most places. Dense canopy can be seen in most of the hills. In some pockets, old growth forests are also found. Most of the plain areas in between the hills were found to be degraded/mixed deciduous forests interspersed with grasslands and scrub forests dominated by *Zizyphus*, *Acacia catechu* and bamboo. *Hyptis suaveolens* (bantulsi/bush mint) invasion is very common in this forest range.

### B. Sources of Water

There are several small order rain fed seasonal rivers, and naturally collected rainwater within the aquifers which flows year-round through some rock crevices, which serves the drinking water requirement of wild animals. The forest range forms important catchment and source of many such rivers. This landscape has several waterfalls and rivers which

stores water as series of ponds in dry seasons, and thus becomes very critical for survival of the wildlife. Some of the lesser known water falls/rivers found inside the forests are Jogia Dari, Alopi Dari, Jamithwa Dari, Pahiti dari, Nagari Jharna etc.

Several small check dams could be found in villages near the forests. Forest department staff has also created few small ponds and check dams to facilitate collection of rainwater for use in dry season by the wild animals. Dhekwah dam, Nanauti dam and Upper Khajuri dam are the major irrigation dams built in this forest range which are now integral part of the ecosystem and are important drinking water sources in dry seasons.

### C. Continuity

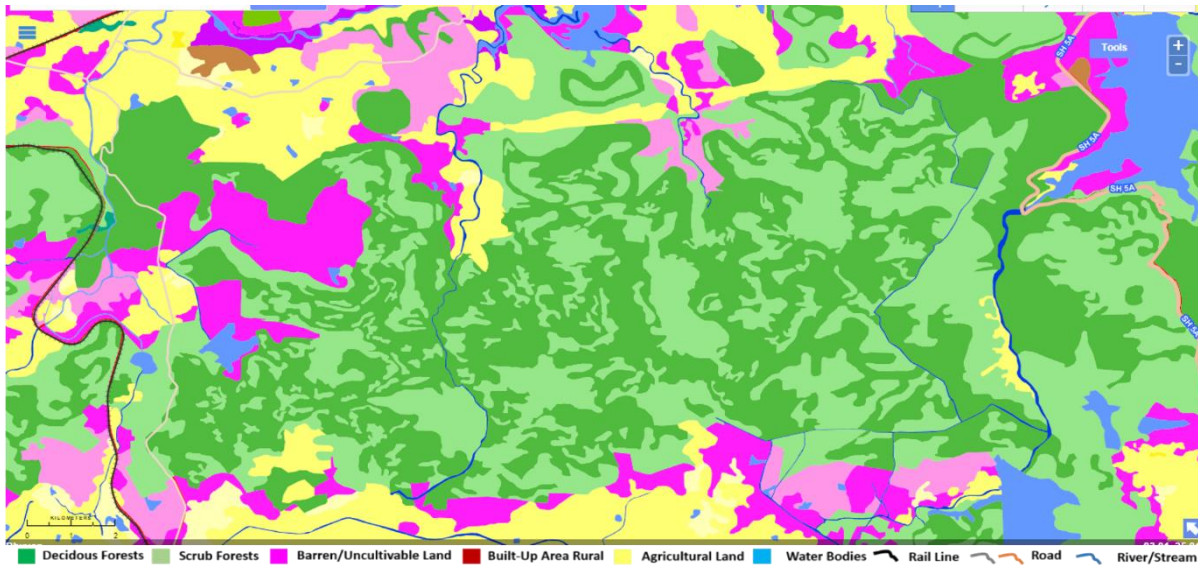
The Marihan forest range in itself is quite large in area, scattered with grasslands, scrub forests, hills and gorges. There are few agricultural fields and fallow lands near peripheral parts. In between the Darhiram beat and Sarson beat, there are few agricultural settlements with large fallow lands. The villages like Sarso, Semri and Rajapur, are infamous for man-bear conflicts.

There is a continuous stretch of hills with good forest cover in Darhiram, most of which are not easily accessible and which extends up to Sarso and Lahaura beat. This continuous stretch of forests seems to be the core wildlife habitat of Marihan range. This small area is naturally protected because of the difficult terrain and fear of wild animals. However, in recent times there has been increased human disturbances in this portion as well.

The northern side of the range is densely populated rural settlements and the under-construction Ban Sagar canal acts as the northern boundary of the forests. The south of the range is traversed through SH-5, beyond which there are forests of Patewar which runs alongside the Upper Khajuri reservoir. The forests of Patewar joins the forests of Lalganj range beyond which there are some human settlements. Towards south of Marihan range, the SH-5 bends towards south east from where it is joined by Chunar road which may be termed as eastern boundary of Marihan forest range. Towards east of Chunar road lies the Chunar range and Sukrit range. There is little vegetation cover on western side of Chunar road which are interspersed with agricultural settlements and villages. The forests of Chunar and Sukrit range shares boundary with Chunar road on eastern side, but they are disturbed by mining activities and the forests are degraded in peripheral areas. One railway line called Chunar-Churk link also goes through this range.



## 2.2 Chunar and Sukrit Forest Range



**Map 4: Land Use Land Cover Map of Chunar and Sukrit Forest Range (<http://bhuvan.nrsc.gov.in>)**

### A. Topography

Chunar and Sukrit are two contiguous forest ranges. Chunar range starts from the south of River Ganges and extends till forest ranges-Wyndham fall, Marihan and Sukrit. Sidhanath Dari, is a popular waterfall in this range due to religious beliefs. The elevation of the forest areas varies between 200-300 m. These two forest ranges are continuous chains of hills, some of which has very dense forest cover. The total area of Sukrit forest range is 125 sq.km. and that of Chunar forest range is 131 sq.km. in area.

The eastern side of Chunar and Sukrit forest ranges which adjoins SH-5A (Varanasi-Robertsganj road) is highly porous and disturbed due to stone quarrying activities and encroachment of land within the forest areas. *Lantana camara* is the major invasive species here, especially the areas near the mining stretch. Canopy cover increases while we move 6-7 km interior to forests from SH-5A. Salai (*Boswellia serrata*) trees are very common on the hills. Some patches of the forests were found to be less disturbed with very good quality of forests.

Unlike the southern portion of Chunar range which is continuous with Sukrit, the northern portion of Chunar forest range towards the river Ganges is disturbed by human activities like quarrying and logging.

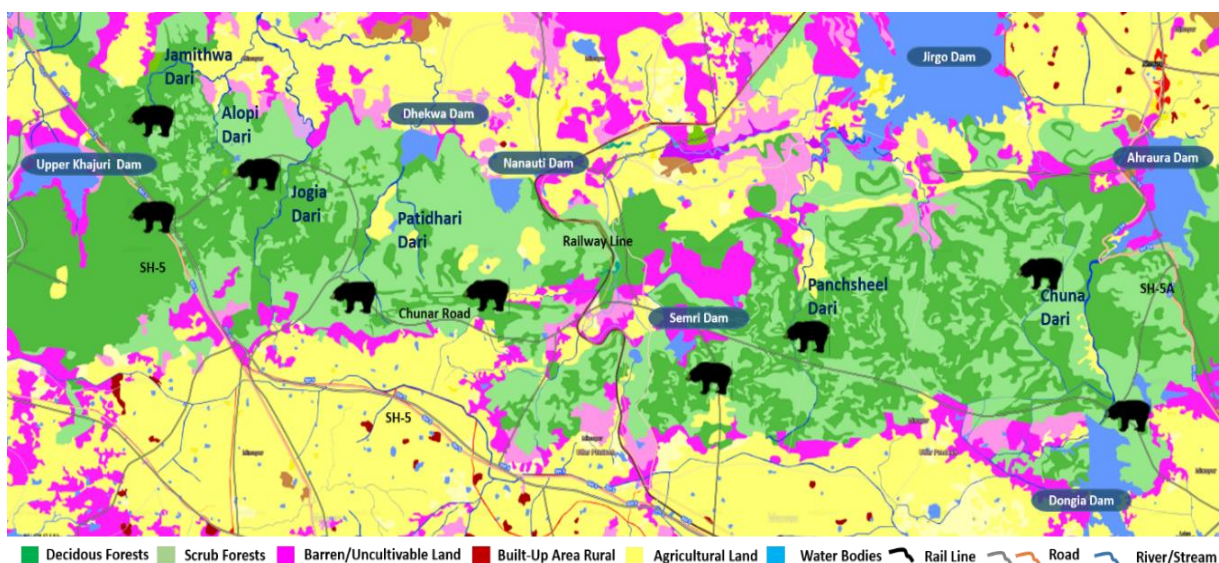
## B. Sources of Water

Jirgo dam and Ahraura dam are the major irrigation reservoirs in this region in northern side. Chuna Dari, Lekhania dari and Panchsheel Dari are some of the important natural waterfalls inside the forests. Dhanraul irrigation canal runs through Bhavanipur, which according to forest range officers is also connected with Panchsheel dari which helps maintaining availability of drinking water in forests around Panchsheel dari even during dry seasons. There are several small streams which impound water within their valleys in small ponds like structure. However, unlike Marihan forest range, in Sukrit range, most of them were dried up during our survey in May and June.

## C. Continuity

Southern portion of Chunar range is continuous with Sukrit forest range. There are several rural settlements in the periphery of the forest ranges. The Sukrit and Chunar forest range is bordered by SH-5A on eastern side and Chunar road on western side. There is a portion of the Sukrit range which is on the other eastern side of the SH-5A and extends till Chandraprabha WLS in district Chandauli. The proposed 1 km eco-sensitive zone of Chandraprabha Sanctuary includes a small portion of the eastern part of the Sukrit range (MoEFCC, 2018).

## 2.3 Map of Important Rivers and Dams in the landscape



**Map 5: Map showing different rivers and reservoirs in Marihan, Sukrit forest ranges (Sinha et.al. 2017)**

### 3. WILDLIFE INVENTORY OF MARIHAN AND SUKRIT LANDSCAPE

In human dominated dry forest landscapes of Mirzapur Forest Division, generally the wild animals avoid day time movement to avoid exposure to heat as well as human contact. Majority of the animals such as sloth bear, leopard, hyena, porcupine, civets, sambar are also known to be nocturnal and elusive. Therefore, sighting of the wildlife during day-time is rare.

The 2013 census data published by Mirzapur Forest Division which used information from Range Forest Offices provides a good inventory of the common wild animals found here. The 2016 sloth bear survey conducted by VENHF & WWF-India was also based on sign survey. All such information was based on indirect evidences, and there is a possibility that several elusive animals may have not be recorded at all. For instance, the wildlife censuses conducted before could not ascertain presence of leopards in the forest division although there were several reports of man-leopard conflicts from areas around the forests in the past. Therefore, a camera trap study was planned to collect objective and direct evidences of sloth bears and other elusive wild animals which are found in this area. This was not a census study to estimate the population, but to create an inventory of different small and medium sized animals occupying the forests of Marihan, Sukrit and Chunar.

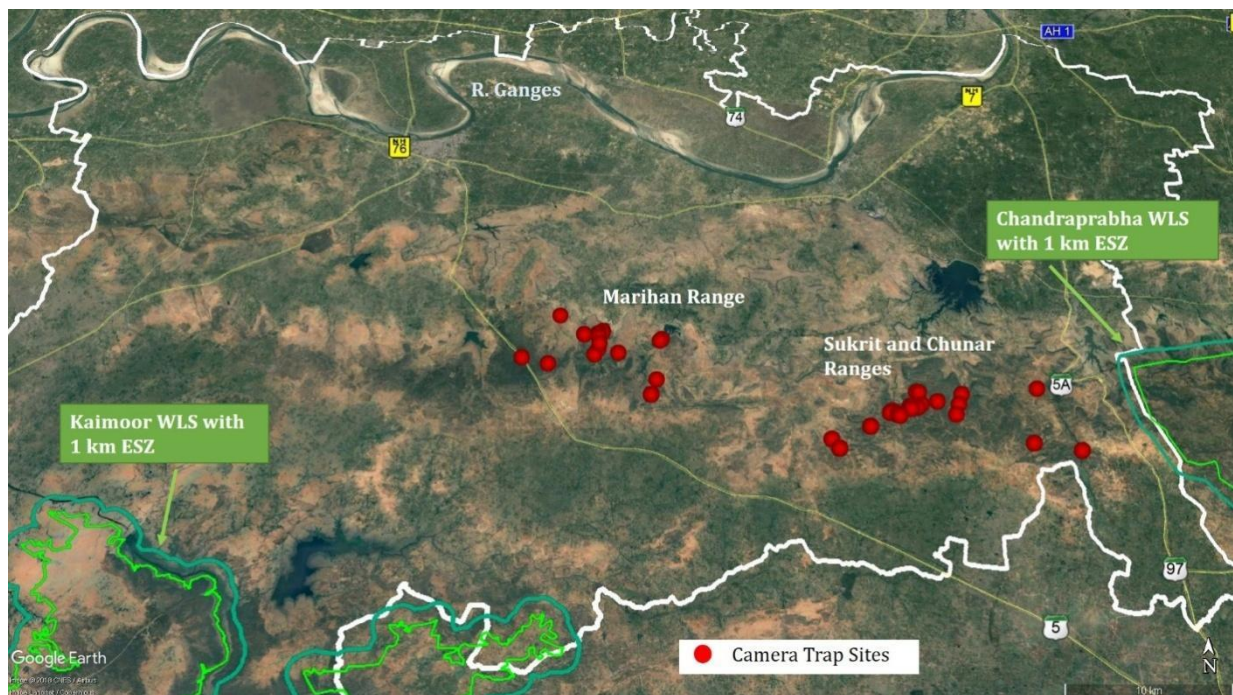
#### 3.1 Methodology

Camera trapping is one of the most reliable method of recording presence of animals which are not seen commonly. Camera traps causes minimum disturbance to the wildlife, and can be left unattended for several days which makes them ideal for capturing photographic evidences of elusive, and nocturnal animals which avoid human presence. Various studies show that camera trapping is an efficient method for inventorying the community of medium to large terrestrial mammals, with 57 to 86% of species detected using survey effort of 1035 to 3400 camera trap days (Rovero et.al., 2010). However, despite the relatively large proportion of species that can be recorded, some species may not be detected even after several thousands of camera trap days (Tobler et al., 2008). Other important considerations while conducting a camera trap exercise is that, large camera trap effort does not guarantee survey completeness, and failure to detect a species does not mean the species is absent (Rovero et.al., 2010).

For species inventories, spatial arrangement of camera traps is flexible and there are no requirements on minimum distances between camera traps or total survey area to be covered. Inventories can therefore be conducted in a relatively small area assuming this is representative of the total study area (Rovero et.al., 2010).

A rapid camera trap survey was carried out in selected areas of forest ranges Marihan, Sukrit and Chunar from 20 May 2018 till 14 July 2018. A total of 15 camera traps were deployed at 50 different locations covering different habitat types and at locations likely to be used by animals. One camera got stolen in June from Sukrit range, and thereafter the rest of the survey was carried out using 14 camera traps. The cameras (model: Cuddeback Silver Series) were equipped with passive infrared sensor system which gets triggered by body heat and movement as the animal passes in front of the sensor. The day time images were captured using natural light and therefore producing coloured images, while during night time the infrared red flash was used to illuminate the object capturing black and white images. The cameras were calibrated to record both images and video clips of the objects to help identify the species with greater certainty.

The camera trap survey was mainly carried out in Marihan and Sukrit forest ranges along with a small portion of Chunar forest range which is contiguous with Sukrit range. The location of the camera traps is shown in the map below.



**Map 6: Locations of Camera traps installed in Marihan, Sukrit and Chunar forest ranges on Google Earth**

### 3.2 Inventory of the Wild Animals in the Study Area

S. No.	Species	Scientific Name	WPA, 1972, IUCN Status	Camera Trap#	Mirzapur FD^
1	Asiatic Wild Cat	<i>Felis sylvestris ornata</i>	Sch I	Marihan & Sukrit	Not Listed
2	Bengal Monitor	<i>Varanus bengalensis</i>	Sch I	Marihan & Sukrit	All
3	Common Leopard	<i>Panthera pardus</i>	Sch I, VU	Sukrit	Not Listed
4	Indian Gazelle	<i>Gazella bennettii</i>	Sch I	Marihan & Sukrit	Chunar & Sukrit
5	Peafowl	<i>Pavo cristatus</i>	Sch I	Marihan & Sukrit	All
6	Rusty Spotted Cat	<i>Prionailurus rubiginosus</i>	Sch I, NT	Sukrit	Not Listed
7	Sloth Bear	<i>Melursus ursinus</i>	Sch I, VU	Marihan & Sukrit	All
8	Golden Jackal	<i>Canis aureus</i>	Sch II	Marihan & Sukrit	All
9	Grey Mongoose	<i>Herpestes edwardsii</i>	Sch II	Marihan & Sukrit	Not Listed
10	Hanuman Langur	<i>Semnopithecus entellus</i>	Sch II	Marihan & Sukrit	Chunar & Sukrit
11	Palm Civet	<i>Paradoxurus hemaphroditus</i>	Sch II	Marihan	Not Listed
12	Rhesus Macaque	<i>Macaca mulatta</i>	Sch II	Marihan & Sukrit	All
13	Ruddy Mongoose	<i>Herpestes smithii</i>	Sch II	Marihan & Sukrit	Not Listed
14	Small Indian Civet	<i>Viverricula indica</i>	Sch II	Marihan & Sukrit	Not Listed
15	Bluebull	<i>Boselaphus tragocamelus</i>	Sch III	Marihan & Sukrit	All
16	Indian Wild Boar	<i>Sus scrofa</i>	Sch III	Marihan & Sukrit	All
17	Sambar	<i>Rusa unicolor</i>	Sch III, VU	Marihan & Sukrit	All
18	Spotted Deer	<i>Axis axis</i>	Sch III	Marihan	All
19	Striped Hyena	<i>Hyaena hyaena</i>	Sch III, NT	Marihan & Sukrit	Chunar & Sukrit
20	Five-striped Palm Squirrel	<i>Funambulus pennantii</i>	Sch IV	Marihan & Sukrit	Not Listed
21	Indian Crested Porcupine	<i>Hystrix indica</i>	Sch IV	Marihan & Sukrit	All

22	Indian Hare	<i>Lepus nigricollis</i>	Sch IV	Marihan & Sukrit	<i>Not Listed</i>
23	Painted Spurfowl	<i>Galloperdix lunulata</i>	Sch IV	Marihan & Sukrit	<i>Not Listed</i>
24	Red Jungle Fowl	<i>Gallus gallus</i>	Sch IV	Sukrit	<i>Not Listed</i>
25	Blackbuck	<i>Antilope cervicapra</i>	<b>Sch I</b>	<i>Not Captured</i>	Marihan & Chunar
26	Mugger Crocodile	<i>Crocodylus palustris</i>	<b>Sch I, VU</b>	<i>Not Captured</i>	Marihan
27	Indian Wolf	<i>Canis lupus</i>	<b>Sch I</b>	<i>Not Captured</i>	Chunar & Sukrit
28	Red Fox	<i>Vulpes vulpes</i>	Sch II	<i>Not Captured</i>	All
29	Jungle Cat	<i>Felis chaus</i>	Sch II	<i>Not Captured</i>	Chunar & Sukrit

# For the purpose of camera trap, we have not listed Chunar as separate. Anything reported in Sukrit can be considered to be found in the areas of Chunar range (southern portion) adjoining Sukrit range.

^The data from Mirzapur Forest Division is listed for each ranges separately.

### 3.3 Images from Camera Trap

#### 1. Asiatic Wild Cat/ Desert Cat (*Felis sylvestris ornata*) | एशिआई जंगली बिल्ली



#### 2. Bengal Monitor (*Varanus bengalensis*) | गोह



#### 3. Common Leopard (*Panthera pardus*) | गुलदार/ तेंदुआ



4. Indian Gazelle (*Gazella bennettii*) | चिंकारा



5. Peafowl (*Pavo cristatus*) | मोर



6. Rusty Spotted Cat (*Prionailurus rubiginosus*) | रस्ती बिल्ली

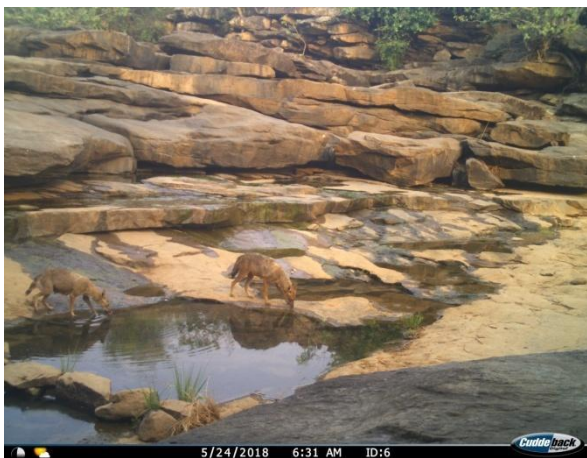




7. Sloth Bear (*Melursus ursinus*) | स्लॉथ भालू/रीछ



8. Golden Jackal (*Canis aureus*) | सियार/गीदड़



9. Grey Mongoose (*Herpestes edwardsii*) | धूसर नेवला



**10. Hanuman Langur (*Semnopithecus entellus*) | लंगूर**



**11. Palm Civet (*Paradoxurus hemaphroditus*) | काला मुश्कबिलाव**



**12. Rhesus Macaque (*Macaca mulatta*) | बंदर**



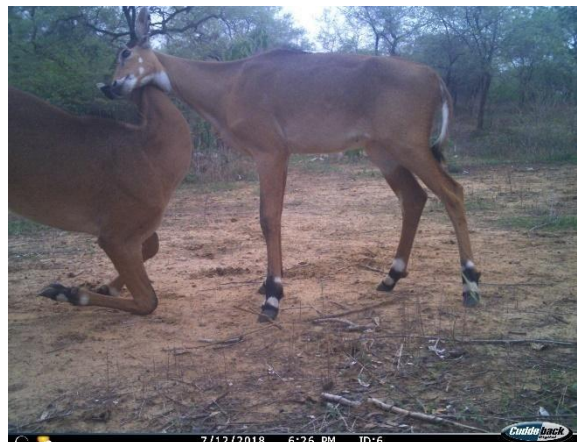
13. Ruddy Mongoose (*Herpestes smithii*) | सुर्ख नेवला



14. Small Indian Civet (*Viverricula indica*) | छोटे भारतीय मुश्कबिलाव



15. Bluebull (*Boselaphus tragocamelus*) | नीलगाय



**16. Indian Wild Boar (*Sus scrofa*) | जंगली सूअर**



**17. Sambar (*Rusa unicolor*) | सांभर**



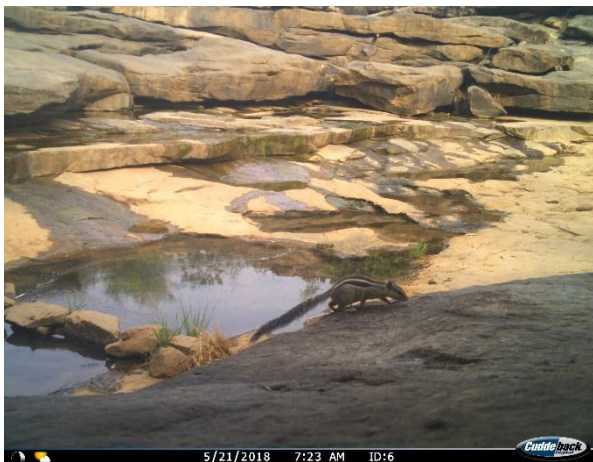
**18. Spotted Deer/Chital (*Axis axis*) | चीतल/ हिरण**



**19. Striped Hyena (*Hyaena hyaena*) | लकडबग्घा**



**20. Five Striped Palm Squirrel (*Funambulus pennantii*) | पांचधारीदार गिलहरी**



**21. Indian Crested Porcupine (*Hystrix indica*) | साही**



**22. Indian Hare (*Lepus nigricollis*) | खरहा**



**23. Painted Spur Fowl (*Galloperdix lunulata*) | पेंटेड जंगली मुर्गी**



**24. Red Jungle Fowl (*Gallus gallus*) | लाल जंगली मुर्गी**



### 3.4 Discussion on the Camera Trap Results

The camera trap survey showed a very good diversity of wild animals in the forests. This may not be considered as a complete list of wild animals found in this landscape as our camera trap exercise were greatly limited to some representative samples and there is high possibility that few species may not have been captured. However, we managed to get a very good diversity of wildlife in this rapid survey which was limited in terms of both time and resources. The result indicates a very good representation of all trophic levels indicating a functional ecosystem in existence.

There are three cat species captured by the cameras - **Asiatic Wild Cat**, **Rusty Spotted Cat** and **Leopard** all of which are photographed in wild for the first time in this Forest Division and are all protected as Schedule I of WPA. However, the discovery of Asiatic Wild Cat is very extraordinary as the known easternmost range of Asiatic Wild Cat has been up to Bagdhara Wildlife Sanctuary in Sidhi District of Madhya Pradesh which shares its border with Mirzapur at Kaimoor Wildlife Sanctuary. Similarly, this is also the first time record of Rusty Spotted Cat.

The **Asiatic Wild Cat** also known as Desert Cat (*Felis silvestris ornata*) is highly elusive and there has been photographic evidences from only Rajasthan and Madhya Pradesh in India (Pande et.al., 2013). The nearest range of Asiatic Wild Cat from Mirzapur Forest Division is Bagdhara Wildlife Sanctuary which borders Mirzapur district and is contiguous with Kaimoor Wildlife Sanctuary and Mirzapur Forest Division. We have got images of Asiatic Wild Cat from one location in Marihan forest range and two locations in Sukrit forest range. The location of the cameras from where the Asiatic Wild Cat was captured in Marihan range is approx. 16 km from boundary of Kaimoor Wildlife Sanctuary and approx. 30 km from boundary of Bagdhara Wildlife Sanctuary.

Asiatic Wild Cats are often mistaken as house cats as they both belong to same species, however, given its habitat preference, previously known areas from Kaimoor landscape of which Marihan and Sukrit ranges are part of- the Mirzapur Forest Division seems to be the probable easternmost range of this cat species.

Some other species reported for the first time in Mirzapur Forest Division are: Ruddy Mongoose, Grey Mongoose, Palm Civet, Small Indian Civet, Painted Spurfowl and Red Jungle Fowl. The main reason for so many species not being recorded earlier is because this was the first ever survey using camera trap carried out in the Division and all the previous surveys were based on indirect evidences.

### 3.5 Some Common Birds Observed

There is a very good diversity of birds in all the forest ranges. Some photographs of birds clicked by the researchers during the field survey are produced below:



Asian Paradise Flycatcher (male and female)  
(*Terpsiphone paradise*)



Ashy Crowned Sparrow  
(*Eremopterix griseus*)



House Sparrow  
(*Passer domesticus*)



Indian Pitta  
(*Pitta brachyuran*)



Common Hoopoe  
(*Upupa epops*)





Spotted Owlet  
(*Athene brama*)



Indian Eagle Owl  
(*Bubo bengalensis*)



Brown Fish Owl  
(*Ketupa zeylonensis*)



Bonelli's Eagle  
(*Aquila fasciata*)



Painted Spurfowl  
(*Galloperdix lunulata*)



Wire-tailed Swallow  
(*Hirundo smithii*)



**Common Hawk Cuckoo**  
(*Hierococcyx varius*)



**Jacobin Cuckoo**  
(*Clamator jacobinus*)



**Grey Bellied Cuckoo**  
(*Cacomantis passerinus*)



**Purple Sunbird**  
(*Cinnyris asiaticus*)



**Oriental White Eye**  
(*Zosterops palpebrosus*)



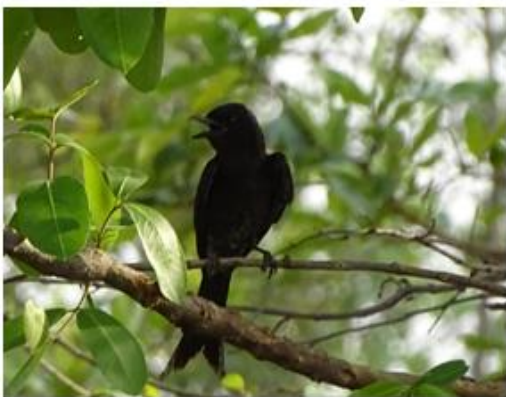
**Rufous Treepie**  
(*Dendrocitta vagabunda*)



Indian Roller  
(*Coracias benghalensis*)



Red Vented Bulbul  
(*Pycnonotus cafer*)



Black Drongo  
(*Dicrurus macrocercus*)



Grey Francolin  
(*Francolinus pondicerianus*)



Green Bee-eater  
(*Merops orientalis*)



Pied Bushchat  
(*Saxicola caprata*)



Jungle Babbler  
(*Argya striata*)



Common Babbler  
(*Argya caudata*)



Egyptian Vulture  
(*Neophron percnopterus*)



Shikra  
(*Accipiter badius*)



Tickell's Blue Flycatcher  
(*Cyornis tickelliae*)



Southern Coucal  
(*Centropus sinensis*)



Laughing Dove  
(*Spilopelia senegalensis*)



Eurasian Collared Dove  
(*Streptopelia decaocto*)



Asian Pied Starling  
(*Gracupica contra*)



Scaly Breasted Munia  
(*Lonchura punctulata*)



Striated Heron  
(*Butorides striata*)



White Browed Wagtail  
(*Motacilla maderaspatensis*)



Pied Kingfisher  
(*Ceryle rudis*)



Common Kingfisher  
(*Alcedo atthis*)



White throated Kingfisher  
(*Halcyon smyrnensis*)



Little Cormorant  
(*Microcarbo niger*)



Oriental Magpie Robin  
(*Copsychus saularis*)



Indian Robin  
(*Copsychus fulicatus*)

## 4. THREATS TO THE WILDLIFE

Human induced degradation and fragmentation of forests and wildlife habitat are the highest threat in all forest ranges of Mirzapur followed by other threats such as forest fires, replacement of native species by exotic and hunting.

Some of the major threats which are leading to loss of wildlife in forests of Mirzapur Division, especially the forest ranges Marihan, Sukrit and Chunar are discussed in the following sections.

### 4.1 Land Use & Land Cover Change

Landscape change is mainly induced by land use change driven by human activities. Land-use change is cited as the main driver of habitat loss and fragmentation (Sala et al. 2000; CBD 2010), thereby threatening many species (Barnosky 2008; Ehrlich and Pringle 2008; Vignieri 2014).

Whether by chance or design, small fragments of forest typically persist in the aftermath of deforestation, effectively islands within a sea of agriculture, urbanization, or other modified lands that are unsuitable for most forest species. Many of the species that originally occupied the forest will disappear from these isolated fragments, but this loss occurs over a relaxation period until a new, more depauperate equilibrium community is reached (Gibson et.al., 2013).

When large contiguous forests are perforated by small holes or broken up into edges and smaller patches to form a non-forested matrix of open spaces, the wild animals which have evolved within the ecosystems of large intact forests find it very difficult to survive in such disturbed ecosystem. Populations thus isolated face survival pressures through increased competition for food and space and face much greater threat from epidemic, natural calamities and human activities. (Olf and Ritchie, 2002; Fahrig, 2003). While some species can persist in fragmented landscapes, or even benefit from fragmentation, many species become more vulnerable because their populations are smaller (Cagnolo et al. 2006), they are more prone to overexploitation (Michalski and Peres 2005; Bennett and Saunders 2010) and edge effects (de Casenave et al. 1995; Gascon et al. 2000), and their capacity to adapt to environmental change is lower (Travis 2003; Brook et al. 2008).

The damages caused by habitat fragmentation are irreversible in nature and it may reach the upper limit of the intermediate disturbance hypothesis, where most species may go locally extinct (Anitha et.al., 2008).

Isolation of forests is one of the major factor of local extinction of sloth bears in other forest areas of India. It was found that 69% of the extirpated areas are highly isolated (>20 km) or moderately (5-20 km) isolated. Isolation results into decline or extirpation of sloth bear population due to several induced impacts such as human caused habitat degradation and

killing, and by limiting growth of populations and immigration of Sloth Bears from adjacent areas (Yoganand et.al. 2006).

The main drivers of land use changes in Mirzapur has changed in recent years, where outside drivers are now more dominant than internal drivers. Since last decade this region is undergoing phenomenal change and rapid developmental pressures. There has been considerable land use/land cover change in Mirzapur. Increasing urbanization and agricultural expansion have been the main reasons and have increased pressure on the forests of Mirzapur (Goparaju & Sinha, 2015).

The main reasons for landscape change in this forest division are further explained below.

## A. Mining

Mining causes irreversible damage to the forests by creating permanent scar on land by removing vegetation and topsoil from a site and also affecting the hydrology. The noise pollution from open-cast mining activities has also significant impact on the biophonical soundscape of a neighbouring forest.

High sound pressure levels through exploratory and production drilling, blasting, cutting, handling of materials, ventilation, crushing, conveying, ore processing and transportation (Donoghue, 2004). Many species exhibit behavioural changes including avoiding noisy areas during foraging (Miksis-Olds et al., 2007; Schaub et al., 2008) and other daily activities (Sousa-Lima and Clark, 2009; Duarte et al., 2011). Area avoidance and acoustic compensatory mechanisms to reduce or offset the effects of noise may alter the acoustic complexity of a community in a given location, resulting in a decrease in species' abundance (Bayne et al., 2008) and/or diversity (Proppe et al., 2013) at noise-polluted sites.

Illegal mining was once very much common in all across the district. After a massive campaign by Police and Forest Department in recent years, the intensity has been significantly reduced. Due to no barriers at the entry and exit points on forest roads, and shortage of forest staff in range offices-round the clock monitoring is a great challenge.

Following are satellite images from Marihan and Sukrit areas to show damage caused by stone quarrying.



Google Earth Images showing mining induced land use land cover changes:



*Image 5: Location: Near SH-5, Marihan; 24°56'46.91"N82°40'20.50"E*



*Image 6: Location: Near SH-5A, Sukrit; 24°54'59.97"N83° 2'42.02"E*



*Image 7: Remains of stone quarry near Khoradih, Sukrit forest range*

## B. Encroachments of Forests for Agriculture and Infrastructure

Encroachment of forests is one of the serious problem in Mirzapur, particularly in the scrub forests, grasslands and near rivers and reservoirs.

As the forest land is fertile and in some areas year round water is available in streams, local people often engage in activities of clearing the forests for cultivation of crops. These activities have a great cascading effect on forests, as these agricultural farms soon turns into human settlements after which the natural resources in surrounding areas are also encroached by people. There are several initiatives taken by the Forest Department to vacate these encroachments; but due to limited monitoring capacity of the forest department and political pressures, the areas are often reclaimed by the encroachers.

Such encroachments have many cumulative impact- first it comes after clearing forests and wildlife habitats, which is followed by mass exploitation of natural resources from surrounding forests creating more pressure on remaining forests & water streams and thereafter causing high degree of disturbance to wildlife by creating new roads, air and noise pollution by vehicles & generator sets etc.

During post-monsoon seasons, often it is observed that people from nearby villages shift to areas bordering the forests, stay there in a temporary hut for few months to graze their cattle herds. These camps often have several domestic dogs accompanying them, which further aggravates the disturbance to free ranging wild animals. There are also instances where forest like areas near forest boundaries which serves as wildlife corridors are cleared without any consideration of impact on wild animals and their movements. Some of the examples are Shine City, Spazio Smart City, Mulayam Singh Yadav University and several other institutes along the boundary of Marihan Forest Range and adjoining SH-5 near Marihan.



***Image 8: The under construction veterinary department of Banaras Hindu University***

Such exurban development and associated infrastructure can lead to habitat fragmentation, homogenization of animal and plant communities, and increased human-wildlife conflict (McKinney, 2006). Habitat fragmentation from dispersed housing development can alter animal movement patterns and behaviour, cause “pileup” or overlap of home ranges, and reduce animal fitness by intensifying inter- and intra-specific interactions (Riley, 2006). In addition, exurban development may also disproportionately impact protected lands and could decrease their conservation value (Knight et al., 1995; Leinwand et al., 2010; Radeloff et al., 2010).

Exurban development is one of the greatest threat because of the commercial stake involved of the people who often have deep political roots, administrative influence and sometimes linking them with development for national importance. Poor planning, inaccurate demarcation of forest lands, outdated revenue records, corruption, poor knowledge of ecology and pressures from regional political leaders poses a great challenge in regulating such activities in and around the forest areas. The effects of such activities are often irreversible and cause irreparable damage to the landscape leading to local extinction of wild animals.



*Image 9: The under construction Shine city on SH-5 surrounded by Marihan forest range*

### C. Linear Constructions

Linear constructions such as roads cause great damage to the wildlife. Most studies on the effects of roads on wildlife focus upon animal-vehicle collisions (Forman et al. 2003). However, it has also been suggested that roads act as complete or partial barriers to movement for some species (e.g. Oxley et al. 1974; Mader 1984; Swihart & Slade 1984; Brody & Pelton 1989; Burnett 1992; Rondinini & Doncaster 2002; Shine et al. 2004; Whittington et al. 2004). Such a barrier effect could fragment habitat and reduce population persistence by reducing recolonization of empty habitats and/or limiting immigration (McGregor et.al., 2008).

Jaeger et al. (2005) discussed three types of possible road avoidance and argued that the type of avoidance largely determines the mechanism and strength of road effects on a population. The three types of avoidance behaviour are:

- (i) animals may avoid the road itself as it is a hostile environment onto which they will not venture (called 'road surface avoidance');
- (ii) animals may avoid emissions from traffic such as fumes or noise, keeping them some distance away from the road ('general traffic avoidance' or 'noise avoidance');
- (iii) animals may avoid individual vehicles, waiting for a break in traffic before attempting to cross the road ('car avoidance').

The impact of roads cannot be attributed just to the road itself, but it also kick-starts a series of clearing of forest areas alongside the roads, for infrastructural developments, often by illegally encroaching the forest lands to set up shops, dhabas, institutes, townships etc. Thus, cumulatively the roads cause far greater damage to the wildlife connectivity than just being a linear disturbance.

While SH-5 (Mirzapur-Robertsganj) and Chunar road has severely impaired the landscape connectivity of the continuous forests of Marihan range, the SH-5A is the another linear disturbance between Chandraprabha Wildlife Sanctuary and Sukrit Range. The under construction Bansagar canal on northern and eastern side of the Marihan range will further limit the range's free connectivity with other forest ranges.

Sometimes it is argued by developers that there are so many natural rivers in the area, then how canals are causing damage? It is important to understand that the natural rivers flowing through the forests do not hinder wildlife movement as the river beds are not very deep and they often have rocky escarpments which does not obstruct movement of animals. Unlike natural streams, constructed canals not only have significant water depth round the year but they also have very steep and plain cemented banks which does not allow free movement of animals across the stream and often act as a trap if any animal falls inside them.

## 4.2 Hunting/Poaching

There are several instances in the past when the forest staff have successfully nabbed poachers in forests of Mirzapur. However, due to lack of resources and man power, the range offices faces lot of limitations in efficient monitoring of the forests. In nearly all the forest areas surveyed, evidences of hunting such as traps, hiding places and wire were observed. In one of the camera trap image, a Hyena's leg was found to be injured. Some of the images are shown below.



**Image 10: Remains of trap**



**Image 11: A Hyena with injured leg**



**Image 12: Traps found during the survey.**

## 4.3 Deforestation

Deforestation is one of the major threats to wildlife today. Not only deforestation causes opening up forests to many abiotic and biotic influences, but it also leads to fragmentation of forests which can affect species dispersal and migration through its effects on forest connectivity. Having evolved within the ecosystems of large intact forests, many species are ill-adapted to life outside the forest interior, either in forest edges or in the patches carved from it (Tole, 2006). Apart from household fuelwood use, the supply of woods to commercial vendors are the major cause of deforestation here. According to local journalists, the woods logged from forests in and around Mirzapur are supplied to various traders outside the district as well as for use as fuelwood in restaurants, hotels and preparation of charcoal. Bicycles and camels are the two most commonly used transportation system for transporting the logged material from the forest interiors to outside.

Full time monitoring of the forests is limited due to lack of adequate forest staff. To control free access to wood mafia and poachers, there is an urgent need to increase check points on forest roads and the capacity of range offices.

## 4.4 Replacement of Native Species of Trees

Loss of native trees is a very serious concern for the health of the forest ecosystems. This change in floral species composition has numerous cascading effect on the entire food web, thus affecting survival of many wild animals. While deforestation is the main underlying cause of loss of native species, the two main driving factors leading to their replacement by new and exotic species are- plantation of non-local species and colonization by invasive alien species in open forest areas.

### A. Plantation of Non-Native Trees

Katsagon (*Haplophragma adenophylla*) is the most preferred tree for plantation in Mirzapur which is followed by trees like Kassod (*Cassia siamea*), Chinaberry (*Melia azedarach*), White Siris (*Albizia procera*), Teak (*Tectona Grandis*), Tamarind (*Tamarindus indica*), Auri (*Acacia Auriculiformis*), Chilbil (*Holoptelia integrifolia*) and Arjun (*Terminalia arjuna*). These trees are preferred due to their resilience and quick growth potential. However, except Arjuna and Chilbil all other trees species are non-native and has very low ecological value. The non-native tree varieties might be beneficial for social forestry purpose in villages and agricultural settlements-but these trees are not suitable to be planted within the forest areas. It is particularly important to select only native and keystone species while conducting the plantations because wild animals including the Sloth Bear are highly dependent on the fruiting for their survival. Also, planting trees which have high wood demand, but less popular for minor forest produce will make them more

vulnerable to logging activities than the trees with potential to provide minor forest produce.

Some of the native trees, which are economical, easy to grow, useful to local people as well as suitable for wildlife are: Mahua (*Madhuca longifolia*), Jamun (*Syzygiumcumini*), Ber (*Zizyphus mauritiana*), Tendu (*Diospyros melanoxylon*), Amaltas (*Cassia fistula*), Bel (*Aegle marmelos*), Piyar (*Buchanania lanzan*) and Fig trees (*Ficus arnotiana*, *F. benghalensis*, *F. religiosa*).

## **B. Natural Invasion by Lantana and Hyptis**

Invasion of species may lead to local declines (Islam, 2001) and even extinction of native species (Pimm, 1986) thus altering species richness in the forest fragment (Carey et al., 1996). Invasive species can alter ecosystem function by changing disturbance frequency or intensity (D'Antonio and Vitousek, 1992; Smith, 1994; Mullett and Simmons, 1995), altering trophic structure (Cross, 1982; Hobbs and Mooney, 1986; Braithwaite et al., 1989) and changing resource availability (Vivrette and Muller, 1977; Boswell and Espie, 1998). Among these factors, disturbance may favour invasions by disrupting strong competitive-species interactions (Fox and Fox, 1986; Crawley, 1987) and locally increasing different limiting resources (Hobbs, 1989). Lantana and Hyptis are two major invasive species in Mirzapur Forest Division.

### **Lantana camara**

It has been ranked as the highest impacting invasive species (Batianoff and Butler, 2003), because it possesses great potential to escape cultivation and have deleterious effect on species richness (Islam, 2001). In India it was introduced in early nineteenth century as an ornamental plant (Sharma, 1988), but now it is growing densely throughout India (Sharma et al., 2005 a, b).

Lantana has spread in almost all the fragmented areas in the Vindhyan dry deciduous forest including the forest ranges Marihan, Sukrit and Chunar. The dense cover created by vertical stratification of lantana may reduce the intensity or duration of light under its canopy and thus decrease the herbaceous cover. *Sharma and Raghubanshi (2011)* reported that Lantana is not found in forests where the canopy cover was at least 63%. *Sharma and Raghubanshi, 2006 & 2007* discussed that the growth architecture pattern of lantana is such that it prevents the light penetration to the forest floor, leading to the decline of tree seedlings and possibly the herb flora.

Lantana also possesses the capability to trap wind-blown litter. This trapping of litter is also dependent on lantana cover, as denser the lantana cover, greater the trapping potential. So, more organic matter accumulates/builds up with increasing lantana cover.

## *Hyptis suaveolens*

It is considered as one among the world's most noxious weeds, which are invading natural ecosystems across tropical and sub-tropical regions of the world (Sarmiento, 1984; Wulff and Medina, 1971). It is a native of tropical America. Because of its widespread occurrence in the tropics, it is now regarded as a pan-tropical weed. In India, Bushmint occurrence is reported from North-East India, Vindhya, Deccan Peninsula, and Andaman and Nicobar Islands (Wealth of India, 1959; Yoganasimhan, 2000).



**Image 13: *Hyptis* invasion in Marihan forest range**

Locally known as *Bantulsi*, it is an erect annual woody herb, commonly 1 m in height (maximum height = 1.5 m), and reproduces by seed (Willis, 1973). *Hyptis suaveolens* is a prolific seed producer and dense infestations can yield up to ~3000 seeds m<sup>-2</sup>, forming persistent propagule banks within a short period. The seeds are slightly notched and they are protected by

spined burrs that help in the seeds' dispersal through animal fur (Stone 1970; Parsons & Cuthbertson 2000). It is found on a variety of habitats, like railway tracks, roadsides, foothills of open forests, and forest clearings, and can heavily invade wastelands, particularly on arid and rocky substrates (Verma & Mishra 1992; Mudgal et al. 1997).

Raizada (2006) suggested that species loss in the area occupied by *H. suaveolens* was related to its unpalatability to livestock and, thus, selective avoidance, resulting in other species being heavily used as fodder by livestock. (Sharma et.al., 2009)

In its native range, the local dominance of bushmint in savannahs was associated with the anthropogenic disturbances viz., removal of vegetation, fire, over-grazing, and tillage (Holmes 1969; Wulff 1987). In the invaded range, it is commonly found alongside roads and water courses, open forests, and the over-grazed pastures.

Bushmint forms large thickets and is believed to produce allelochemicals, which impede seed germination of native species. The traits which make bushmint a potent invader are: prolific seed production (Raizada 2006), high dispersal ability (Parsons and Cuthbertson 2000), phenotypic plasticity to a variety of habitats (Sharma and Raghubanshi 2009), proliferation from perennial rootstocks (Raizada 2006), unpalatability to livestock (Holmes 1969), and probable allelopathy effects on native species (Raizada 2006).

## 4.5 Over-grazing

Chaturvedi et al., 2012 carried out a study on effect of grazing and harvesting on forests in this landscape and found that number of newly damaged juveniles was greatest in June and lowest in September. They reported that in the TDF found in this region, grazing/browsing by livestock and harvesting by humans are the major causes of damage to juvenile trees, in addition to the long drought periods within the annual cycle. The site which had the greatest level of disturbance in terms of damaged juveniles, also contained the lowest number of species and juvenile stems.

Grazing also leads to higher soil compaction and erosion of topsoil further deteriorating the soil conditions which won't support natural regeneration of forests. The conversion of forest to pasture causes changes in topsoil morphology, increased water erosion, mass movements, soil compaction by trampling and alteration of the hydrologic cycle, among others (Oram, 1990). Trampling causes changes in physical soil properties. Infiltration is reduced, while runoff, erosion and bulk density increase (Rouzi and Hanson, 1966; Van Haveren, 1983; McCalla et al., 1984; Reátegui et al., 1990). The subsurface layer (usually at 5–10/15 cm depth) can be also affected by compaction, as reported for grazed pastures in tropical conditions (Chauvel et al., 1999).

The development of tree seedlings to maturity or attaining canopy status is prevented by grazing (Hester et al., 2000), adversely affecting the continuity of entire forest ecosystems (Pulido et al., 2001; Mountford and Peterken, 2003; Plieninger et al., 2004; Dufour-Dror, 2007). According to *Pulido and Díaz (2005)*, the main direct damage seems to occur at the 'seedling emergence and establishment stage' when livestock graze, browse or trample the seedlings. This prevents recruitment of juveniles (Hester et al., 2000). When the regeneration process is continuously hampered, it may then lead to progressive decay of the forest cover (Leiva and Fernandez-Ales, 2003; Quézel and Médail, 2003; Plieninger et al., 2004; Dufour-Dror, 2007). Unlike seedlings, juveniles may not be killed straightway when browsed, however, their development can be severely hampered as the maximum efficiency of photosynthesis is reduced by having insufficient leaf area of photosynthetic tissue (Putman, 1996).

As per 19th National Livestock Census (2012) the total number of livestock in district Mirzapur is reported to be 956259 which was reported in 18th National Livestock census (2007) as 898232. This means every year 11,605 livestock are added. With increasing number livestock population and reduction in forest quality and quantity, it is imperative that the remaining forests are highly susceptible to impacts from excessive grazing.



## 4.7 Encroachment of Watersheds

In nearly all forest ranges we surveyed, agricultural encroachments were observed near streams and rivers. All of such encroachments observed had diesel generators to pump water from the streams. In Mirzapur, months April-June are the driest period of the year. During this time, there are only few places on the streams where water gets accumulated and provide drinking water to wild animals. Water availability in such water sources inside the forests are very limited and are not favourable to support water intensive activities like agriculture. Such encroachment and clearing of forests around the water sources also damage the right of way of the wild animals. These illegal settlements also keep domestic dogs to guard their fields and these dogs create more problem for the animals to reach those areas; and even if they succeed they become easy target of being hunted or injured. The problem does not stop only there, as the water which is meant for year round drinking water supply to wild animals are exhausted much before, forcing dispersal of animals to nearby villages in search of water, which results into conflict situations.



***Image 14: Abstraction of water from Nagri Jharna (top) and obstruction created on Jogia dari with attached pump (above) in Marihan forest range***

## 4.8 Forest Fire

Forest fires are common in the forests of Mirzapur. The forest fires occur mostly in dry seasons. In several cases the fires get accidentally ignited from the bidi/cigarette smoked by the villagers. Forest fires are also used as one of the quickest way to clear forests for putting the same to agricultural uses. Human induced forest fires is common in most tropical dry forests. Many scientists agree that almost all of them are caused by humans (Brandis 1897; Pyne 1994; Bahuguna and Upadhyay 2002; Semwal et al. 2003), some unintentionally, but the majority are assumed intentional. 95% of forest fires are caused either by negligence or unknowingly by the human being (Satyendra & Kaushik, 2014).

One of the dominant motivations to ignite fire in Indian TDFs is to increase the availability and quality of grasses for pasture use. Possibly of equal importance on a global level is the utilization of fire to facilitate hunting. Hunters use fire in two ways: (i) to drive prey to

where it can be easily killed (Lewis 1989) and (ii) to prepare hunting grounds by attracting prey to the fresh flush of grasses (Laris 2002; Mistry et al. 2005). Moreover, burned sites make hunting easier because the animals are easier to see. Fire was used by early inhabitants of India for hunting (Goldammer 1993; Satyendra & Kaushik, 2014).

The most famous and often-cited example is the use of *Diospyros melanoxylon* tree leaves (tendu leaves) that function as cigarette paper for the small Indian cigarettes called “beedis” (Saigal 1990; Goldammer 1993). Fire is applied to the forest in the dry season (mainly April–May) so that the trees produce new leaves which can be harvested once they are fully green (Hunter 1981).



**Image 15: A forest fire in Marihan range observed during the survey.**

There is abundant evidence that high fire frequency hinders woody plants from establishing in savannah and TDF ecosystems (e.g., Hopkins 1992; Setterfield 2002; Favier et al. 2004; Sankaran et al. 2008; Ratnam et al. 2011) while the season in which fire occurs influences the density and composition of the regenerating species (e.g., Bond and van Wilgen 1996).

Frequent fires seem to maintain a soil seed bank of short term plant species (Graminoids) over life forms with a longer-term life cycles like broad-leaved herbs and woody plants (Gashaw et al. 2002). Fire also promotes fire-tolerant species (Furley et al. 2008). This selective attribute of fire also reduces tree seedling species diversity as Saha and Howe (2003) found in a TDF in central India and Verma and Jayakumar (2015) as well as Kodandapani et al. (2009) report from TDF of the Western Ghats.

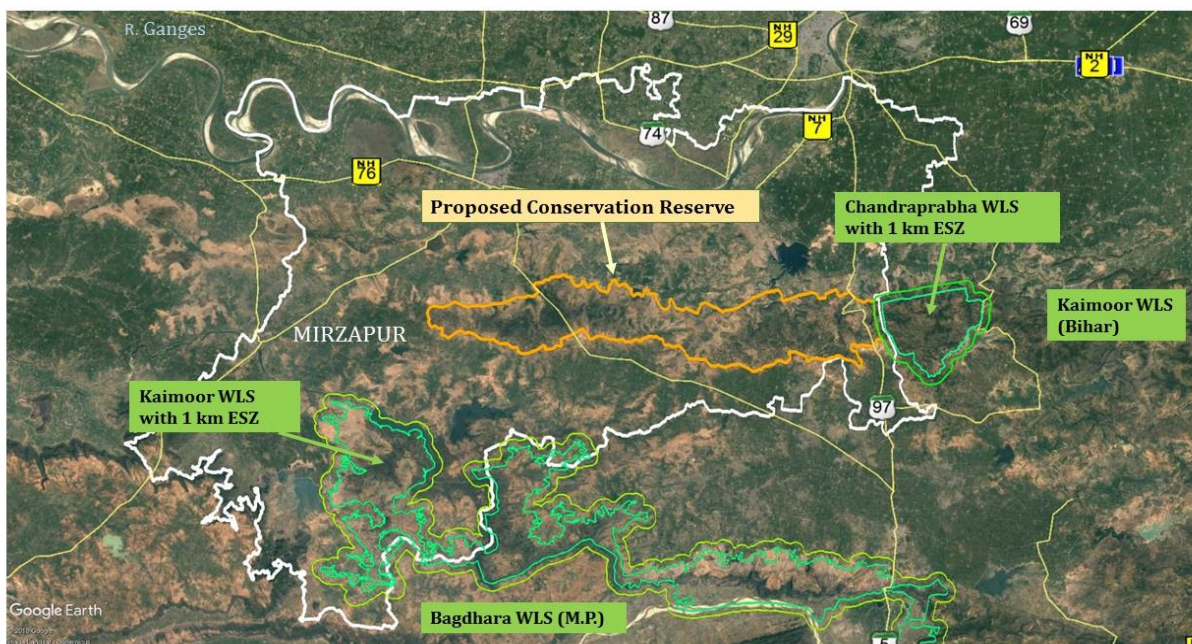
An increase in fire intensity and frequency leads to the transformation of forests to savannah or grasslands. An area locally affected by wildfires may substantially lose short-term water retention if heavy rainfall occurs after the dry period. Fire also affects the biodiversity and therefore the functions of ecosystems, especially those depending on species interaction like pollination and dispersal.

## 5. THE PROPOSED CONSERVATION RESERVE

Conservation Reserves are declared for the purpose of protecting landscapes, flora and fauna and their habitat outside protected areas. The main purpose is to elicit sensitivity of people towards the wildlife present in the area without affecting their rights. Conservation Reserves are often declared with a focus on flagship species such as Elephant, Tiger, Leopard etc.

Such areas are designated as conservation areas if they are uninhabited and completely owned by the Government of India but used for subsistence by communities and community areas if part of the lands are privately owned. These protected area categories were first introduced in the Wildlife (Protection) Amendment Act of 2002 – the amendment to the Wildlife Protection Act of 1972. These categories were added because of reduced protection in and around existing or proposed protected areas due to private ownership of land, and land use. There are 76 Conservation Reserves in India. The top 5 states are Jammu & Kashmir-34, Karnataka-14, Rajasthan-10, Uttarakhand-4, Punjab-4 and Himachal Pradesh-3 (WII ENVIS, 2018).

We are proposing the Conservation Reserve in Mirzapur Division which includes Marihan, Sukrit, Chunar and some parts of Lalganj forest range. The total area of the Reserve is approx. 408 sq.km. The location map on Google Earth image is shown below. Details of the boundary is discussed in following section.



**Map 7: The proposed boundary of the Conservation Reserve and locations of adjacent PAs on Google Earth**

## 5.1 Description of the Proposed Boundary of CR

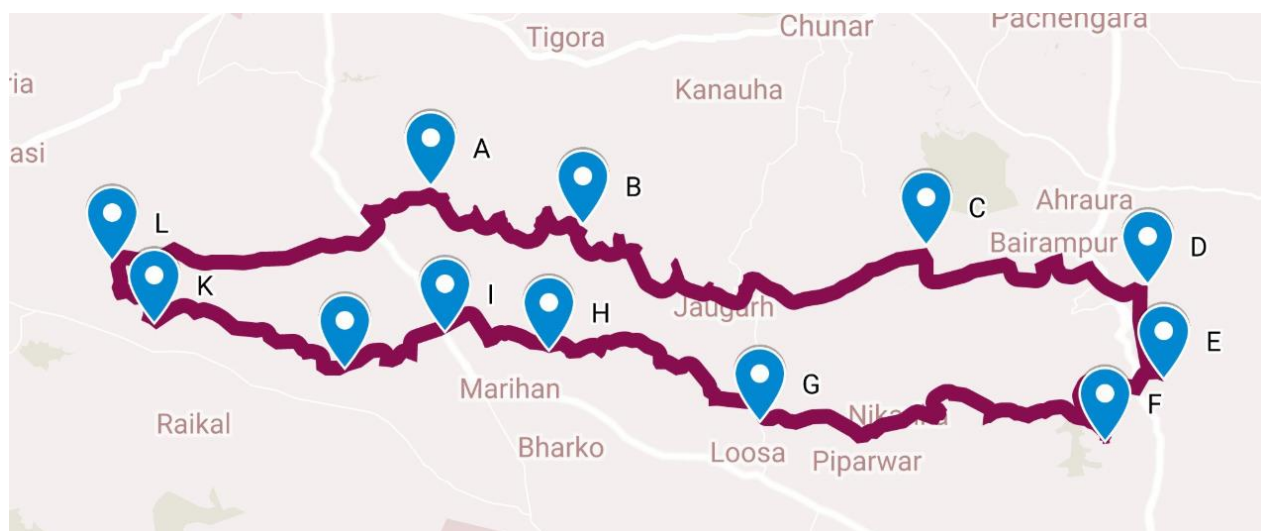
**North:** The northern extreme of the CR is situated in Marihan Forest Range at the newly constructed Bansagar canal near SH-5 at the GPS point  $25^{\circ} 1'19.77''N82^{\circ}39'11.73''E$  (**A**) from where it extends alongside continues with the canal till Dhekwa Dam near Pahiti dari at GPS point  $25^{\circ} 0'9.88''N82^{\circ}44'15.88''E$  (**B**). From there the CR extends alongwith the hills near Jirgo Reservoir at GPS point (**C**) till the boundary of the proposed Ecosensitive zone of Chandraprabha WS near Ahraura reservoir at GPS point  $24^{\circ}58'21.61''N83^{\circ} 3'4.17''E$  (**D**).

**East:** The eastern boundary runs alongside the ESZ boundary of Chandraprabha WS near Sukrit village from point **D** till  $24^{\circ}55'30.16''N83^{\circ} 3'36.09''E$  (**E**).

**South:** The southern boundary of the CR runs through the southern border of Sukrit forest range near the Dongia reservoir at GPS point  $24^{\circ}53'37.04''N 83^{\circ} 1'38.70''E$  (**F**), the Chunar road at GPS point  $24^{\circ}54'13.06''N82^{\circ}50'9.21''E$  (**G**), near village Rajapur at GPS point  $24^{\circ}56'21.43''N 82^{\circ}43'8.22''E$  (**H**) and extends all over the southern boundary of Marihan forest range till SH-5 at GPS Point  $24^{\circ}56'55.38''N 82^{\circ}39'39.78''E$  (**I**).

**West:** The boundary of the CR extends from the point **I** at SH-5 through the border of the forests lying in south of Upper Khajuri Reservoir at GPS point  $24^{\circ}55'49.35''N 82^{\circ}36'20.03''E$  (**J**) and till the forest boundary at the west of the Upper Khajuri Reservoir at GPS point  $24^{\circ}57'11.49''N 82^{\circ}29'58.63''E$  (**K**). The westernmost boundary of the CR is in Lalganj range at GPS point  $24^{\circ}59'3.65''N 82^{\circ}28'35.73''E$  (**L**).

Please see the map below for the geospatial marked map of the CR. The Google Earth file (.kml) can be downloaded from <https://goo.gl/wfnpdb>.



**Map 8: Map showing the GPS coordinates of the proposed Conservation Reserve**

Points	Latitude	Longitude	Points	Latitude	Longitude
A	25.02216	82.65326	G	24.903628	82.835892
B	25.002744	82.737744	H	24.939286	82.71895
C	24.992136	82.928231	I	24.948717	82.66105
D	24.972669	83.051158	J	24.930375	82.605564
E	24.925044	83.060025	K	24.953192	82.499619
F	24.893622	83.027417	L	24.984347	82.476592

## 5.3 Justification

The conditions and procedure for declaring a Conservation Reserve is explained in **Section 36A in The Wild Life (Protection) Act, 1972** which states:

*36A. Declaration and management of a conservation reserve. —*

*(1) The State Government may, after having consultations with the local communities, declare any area owned by the Government, particularly the areas adjacent to National Parks and Sanctuaries and those areas which link one protected area with another, as a conservation reserve for protecting landscapes, seascapes, flora and fauna and their habitat: Provided that where the conservation reserve includes any land owned by the Central Government, its prior concurrence shall be obtained before making such declaration.*

The forest ranges Marihan, Sukrit and Chunar is an ideal representation of the vindhyan landscape and connects Eastern Kaimoor landscape consisting of Ranipur WLS in U.P. and Son Gharial WLS, Sanjay Dubri Tiger Reserve and Bagdhara WLS in M.P. with Western Kaimoor landscape consisting of Chandraprabha WLS of U.P. and Kaimur WLS of Bihar (see Map 7: The proposed boundary of the Conservation Reserve and locations of adjacent PAs on Google Earth) These forest ranges are also habitat of several wild animals and are known for medicinal plants. There are several waterfalls namely Alopi Dari, Jogia Dari, Pahiti Dari, Panchsheel Dari, Chuna Dari, Lekhania dari and Siddhanath ki Dari. Lekhania Dari is one of the most popular tourism destination in this region due to its natural beauty attracting tourists from nearby towns. Alopi Dari and Siddhanath ki Dari are other important tourism places from religious point of view.

The **Schedule I** (WPA, 1972) animals recorded from these forest ranges are: Sloth Bear (*Melursus ursinus*), Leopard (*Panthera pardus*), Asiatic Wild Cat (*Felis sylvestris ornata*), Rusty Spotted Cat (*Prionailurus rubiginosus*), Indian Wolf (*Canis lupus*), Indian Gazelle (*Gazella bennettii*), Blackbuck (*Antelope cervicapra*), Peafowl (*Pavo cristatus*), Bengal Monitor (*Varanus bengalensis*) and Mugger Crocodile (*Crocodylus palustris*).

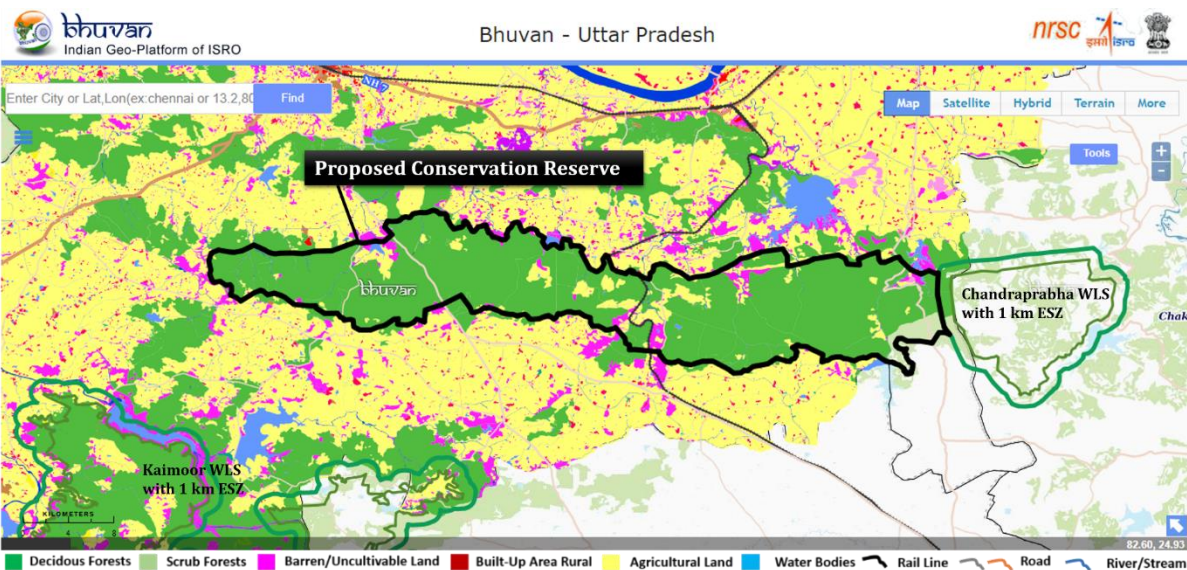
Other important species recorded here are Striped Hyena (*Hyaena hyaena*), Jungle Cat (*Felis chaus*), Red Fox (*Vulpes vulpes*), Golden Jackal (*Canis aureus*), Sambar Deer (*Rusa unicolor*), Spotted Deer (*Axis axis*), Ruddy Mongoose (*Herpestes smithii*), Grey Mongoose (*Herpestes edwardsii*), Palm Civet (*Paradoxurus hemaphroditus*), Small Indian Civet (*Viverricula indica*), Bluebull (*Boselaphus tragocamelus*), Wild Boar (*Sus scrofa*), Indian Crested Porcupine (*Hystrix indica*), Indian Hare (*Lepus nigricollis*), Five-striped Palm Squirrel (*Funambulus pennantii*), Hanuman Langur (*Semnopithecus entellus*), Rhesus Macaque (*Macaca mulatta*), Painted Spur Fowl (*Galloperdix lunulata*), Red Jungle Fowl (*Gallus gallus*) and many other birds.

These three forest ranges are also facing severe threats from activities like mining, logging, hunting, unsustainable construction and infrastructure development, encroachment of forests and watersheds and forest fires. A majority of the proposed Conservation Reserve is already Reserve Forests of Uttar Pradesh Government, and by declaring these forests as Conservation Reserve, it will elicit the people's responsibility and participation in conservation of wildlife without affecting their rights.

This rocky landscape with short heighted hills are particularly suitable habitat for Sloth Bears and their presence is recorded in all forest ranges surveyed in this work. Sloth Bears are endemic to Indian subcontinent and in Uttar Pradesh, Mirzapur Forest Division is one of the remaining sloth bear habitats. They are protected as Schedule-I of Wildlife (Protection) Act, 1972 and also listed in CITES Appendix-I. Therefore, it is suggested to use 'Sloth Bears' as the flagship species for the purpose of the Conservation Reserve.

## 5.2 Land Use and Settlement of Rights

Geospatial drawings were created using Google Earth Pro and overlaid on the LULC map (1:10,000) of District Mirzapur using ISRO's BHUVAN geo-platform. Most of the area under the proposed Conservation Reserve are 'Dry Deciduous Forests' and is recorded as Reserve Forests. There are few villages and agricultural settlements in some areas which can be also seen on the LULC map as yellow patches. This also includes some portions of SH-5, SH-5A, Chunar Road, Kotwa-Patehara Road and Chunar-Churk railway line. The Conservation Reserve is proposed only in the areas already recorded as Reserve Forests and the villages in and around these RFs. No resettlement or rehabilitation of existing villages are recommended and the Forest Division will involve the people dependent on forests for better management of forests and ensuring that the rights of people traditionally dependent on forests for livelihood are least affected. Views and concerns of different stakeholders will be duly addressed through the public consultation before finalization of the Conservation Reserve.



**Map 9: The proposed Conservation Reserve on LULC map of district Mirzapur.**  
 (<http://bhuvan.nrsc.gov.in>)

## 6. THE WAY FORWARD

The forest areas in Marihan, Sukrit and Chunar are undoubtedly one of the most wildlife rich forest ranges in Mirzapur division. These forest ranges are also of strategic importance for conservation of wildlife and maintaining the genetic diversity as they are contiguous with protected areas and are part of a larger landscape used by a variety of wild fauna as habitat and meeting their resource needs. These forests also act as a huge catchment of different rivers and streams which helps in maintaining the water levels and providing water to many reservoirs and dams in this region which are critical for sustaining agriculture and other drinking water needs. However, in recent years there is increased disturbance to the forests from human activities which includes conversion of forests for infrastructure development, mining, agricultural expansion, logging etc. The losing of connectivity between different forest ranges are a matter of deep concern. Declaration of conservation reserve will be the first step towards a landscape based conservation approach and eliciting people's sensitivity towards the need of wild animals living here. A comprehensive conservation action plan shall be prepared in consultation with experts and local people to help natural restoration of the degraded forests and wildlife corridors with keeping species specific needs in primary focus. Activities such as grazing, developmental activities and other human disturbances need to be regulated in certain areas to limit impact on the indigenous and threatened flora and fauna of this region. Strict monitoring of the forests by increasing the capacity of range offices are need of the hour to control logging, poaching and activities leading to land cover land use changes such as encroachments and mining.



## 7. REFERENCES

- Allen GO (1919) Caracal (*Felis caracal*) and Hunting Leopard (*Cynaelurus jubatus*) in Mirzapur, U.P., *Journal of the Bombay Natural History Society* 26: 1041.
- Amar Ujala (2017) मिर्जापुर एक गांव में बाघ के आने से मचा हड़कंप, अंधेड़ को किया जख्मी, 17 March. Available at: <https://www.amarujala.com/uttar-pradesh/varanasi/tiger-enter-into-village-of-mirzapur-by-attack-one-person-inj> (accessed 18/08/18).
- Bahuguna V and Upadhyay A (2002) Forest fires in India: policy initiatives for community participation. *International Forestry Review* 4(2): 122–127.
- Barnosky AD (2008) Megafauna biomass tradeoff as a driver of Quaternary and future extinctions. *Proceedings of the National Academy of Sciences* 105(Supplement 1): 11543–11548.
- Batianoff GN and Butler DW (2003) Impact assessment and analysis of sixty-six priority invasive weeds in south-east Queensland. *Plant Protection Quarterly* 18(1): 11–15.
- Bayne EM, Habib L and Boutin S (2008) Impacts of Chronic Anthropogenic Noise from Energy-Sector Activity on Abundance of Songbirds in the Boreal Forest. *Conservation Biology* 22(5): 1186–1193.
- Bennett AF and Saunders DA (2010) Habitat fragmentation and landscape change. *Conservation Biology for All* 88–106.
- Bond, William J. & Van Wilgen, B. W. (1996). Fire and plants. London: Chapman & Hall
- Boswell CC and Espie PR (1998) Uptake of moisture and nutrients by *Hieracium pilosella* and effects on soil in a dry sub-humid grassland. *New Zealand Journal of Agricultural Research* 41(2): 251–261.
- Braithwaite R, Lonsdale W and Estbergs J (1989) Alien vegetation and native biota in tropical Australia: the impact of *Mimosa pigra*. *Biological Conservation* 48(3): 189–210.
- Brandis D (1994) *Forestry in India: origins & early developments*. Natraj Publishers.

- Brook B, Sodhi N and Bradshaw C (2008) Synergies among extinction drivers under global change. *Trends in Ecology & Evolution* 23(8): 453–460.
- Burnett S (1992) Effects of a Rainforest Road on Movements of Small Mammals: Mechanisms and Implications. *Wildlife Research* 19(1): 95.
- Cagnolo L, Cabido M and Valladares G (2006) Plant species richness in the Chaco Serrano Woodland from central Argentina: Ecological traits and habitat fragmentation effects. *Biological Conservation* 132(4): 510–519.
- Carey J, Moyle P, Rejmánek M and Vermeij G (1996) Preface. *Biological Conservation* 78(1-2): 1–2.
- Casenave JLD, Pelotto JP and Protomastro J (1995) Edge-interior differences in vegetation structure and composition in a Chaco semi-arid forest, Argentina. *Forest Ecology and Management* 72(1): 61–69.
- CBD (2010) Global Biodiversity Outlook 3. Available at: <https://www.cbd.int/gbo3/> (accessed 19/08/18).
- Champion HG and Seth SK (1968). *A revised survey of the forest types of India*. Delhi: Manager of Publications.
- Chaturvedi R, Raghubanshi A and Singh J (2011) Carbon density and accumulation in woody species of tropical dry forest in India. *Forest Ecology and Management* 262(8): 1576–1588.
- Chaturvedi R, Raghubanshi A and Singh J (2012) Effect of grazing and harvesting on diversity, recruitment and carbon accumulation of juvenile trees in tropical dry forests. *Forest Ecology and Management* 284: 152–162.
- Chauvel A, Grimaldi M, Barros E, Blanchart E, Desjardins T, Sarrazin M and Lavelle P (1999) Pasture damage by an Amazonian earthworm. *Nature* 398(6722): 32–33.
- Corbett J (1944) *Man-eaters of Kumaon*. Oxford University Press.
- Crawly MJ (1987) What makes community invisable? In: Gray AJ, Crawley MJ and Edwards PJ (1991) *Colonization, succession, and stability: the 26th Symposium of the British Ecological Society held jointly with the Linnean Society of London*. Blackwell Scientific Publications.

- D'antonio CM and Vitousek PM (1992) Biological Invasions by Exotic Grasses, the Grass/Fire Cycle, and Global Change. *Annual Review of Ecology and Systematics* 23(1): 63–87.
- Department of Animal Husbandry & Dairying (2007, 2012) Livestock Census. Available at: <http://www.dahd.nic.in/documents/statistics/livestock-census> (accessed 12/05/2019)
- Dainik Jagran (2017) Tiger terror : मीरजापुर में बाघ की दहाड़ से फैल रही दहशत, दो घायल (Mirzapur.). , 17 March. Available at: <https://www.jagran.com/uttar-pradesh/lucknow-city-terror-of-tiger-create-panic-in-mirzapur-two-injured-15694991.html> (accessed 18/08/18).
- Donoghue AM (2004) Occupational health hazards in mining: an overview. *Occupational Medicine* 54(5): 283–289.
- Duarte MHL, Vecci MA, Hirsch A and Young RJ (2011) Noisy human neighbours affect where urban monkeys live. *Biology Letters* 7(6): 840–842.
- Dufour-Dror J-M (2007) Influence of cattle grazing on the density of oak seedlings and saplings in a Tabor oak forest in Israel. *ActaOecologica* 31(2): 223–228.
- Ehrlich PR and Pringle RM (2008) Where does biodiversity go from here? A grim business-as-usual forecast and a hopeful portfolio of partial solutions. *Proceedings of the National Academy of Sciences* 105(Supplement 1): 11579–11586.
- Fahrig L (2003) Effects of Habitat Fragmentation on Biodiversity. *Annual Review of Ecology, Evolution, and Systematics* 34(1): 487–515.
- Favier C, Chave J, Fabing A, Schwartz D and Dubois MA (2004) Modelling forest–savanna mosaic dynamics in man-influenced environments: effects of fire, climate and soil heterogeneity. *Ecological Modelling* 171(1-2): 85–102.
- Fox MD and Fox BJ (1986) The susceptibility of natural communities to invasion. In: Groves RH (1986) *Ecology of biological invasions*. Cambridge University Press.

- Furley PA, Rees RM, Ryan CM and Saiz G (2008) Savanna burning and the assessment of long-term fire experiments with particular reference to Zimbabwe. *Progress in Physical Geography* 32(6): 611–634.
- Gascon C (2000) ECOLOGY:Receding Forest Edges and Vanishing Reserves. *Science* 288(5470): 1356–1358.
- Gashaw M, Michelsen A, Jensen M and Friis I (2002) Soil seed bank dynamics of fire-prone wooded grassland, woodland and dry forest ecosystems in Ethiopia. *Nordic Journal of Botany* 22(1): 5–17.
- Gibson L, Lynam AJ, Bradshaw CJA, He F, Bickford DP, Woodruff DS, Bumrungsri S and Laurance WF (2013) Near-Complete Extinction of Native Small Mammal Fauna 25 Years After Forest Fragmentation. *Science* 341(6153): 1508–1510.
- Goparaju L and Sinha D (2016) Forest cover change analysis of dry tropical forests of Vindhyan highlands in Mirzapur district, Uttar Pradesh using satellite remote sensing and GIS. *Ecological Questions* 22: 23.
- Haveren BPV (1983) Soil Bulk Density as Influenced by Grazing Intensity and Soil Type on a Shortgrass Prairie Site. *Journal of Range Management* 36(5): 586.
- Hindustan (2016) अंततः 36 घंटे बाद शिकंजे में आया तेंदुआ. , 1 June. Available at: <https://www.livehindustan.com/news/uttarpradesh/article1-mirzapur-sonapur-village-leopard-tree-forest-department-police-team-537048.html> (accessed 18/08/18).
- Hobbs R.J. (1989) The nature and effects of disturbance relative to invasions. In: Drake JA and International Council of Scientific Unions. Scientific Committee on Problems of the Environment (1989) Biological invasions : a global perspective. Published on behalf of the *Scientific Committee on Problems of the Environment (SCOPE)* of the International Council of Scientific Unions (ICSU) by Wiley.
- Hobbs RJ and Mooney HA (1986) Community changes following shrub invasion of grassland. *Oecologia* 70(4): 508–513.

- Hunter JR (1981) Tendu (*Diospyros melanoxylon*) leaves, bidi cigarettes, and resource management. *Economic Botany* 35(4): 450–459.
- Islam KR, Ahmed MR, Bhuiyan MK and Badruddin A (2001) Deforestation effects on vegetative regeneration and soil quality in tropical semi-evergreen degraded and protected forests of Bangladesh. *Land Degradation & Development* 12(1): 45–56.
- IUCN (1969) IUCN Eleventh Technical Meeting Papers and Proceedings-Third Session: Survival Service Commission. *IUCN Publications new series* 18. Available at: <https://portals.iucn.org/library/sites/library/files/documents/NS-018.pdf> (accessed 18/08/18).
- Jaeger JA, Bowman J, Brennan J, Fahrig L, Bert D, Bouchard J, Charbonneau N, Frank K, Gruber B and Toschanowitz KTV (2005) Predicting when animal populations are at risk from roads: an interactive model of road avoidance behavior. *Ecological Modelling* 185(2-4): 329–348.
- Kazmi R (2012) Jharkhand's Last 'hunting-leopards'. *Zoo's Print* XXVII(4): 36.
- Knight RL, Wallace GN and Riebsame WE (1995) Ranching the View: Subdivisions versus Agriculture. *Conservation Biology* 9(2): 459–461.
- Leinwand II, Theobald DM, Mitchell J and Knight RL (2010) Landscape dynamics at the public–private interface: A case study in Colorado. *Landscape and Urban Planning* 97(3): 182–193.
- Leiva MJ and Fernández-Alés Rocío (2003) Post-dispersive losses of acorns from Mediterranean savannah-like forests and shrublands. *Forest Ecology and Management* 176(1-3): 265–271.
- Lewis HT (1989) Ecological and Technological Knowledge of Fire: Aborigines Versus Park Rangers in Northern Australia. *American Anthropologist* 91(4): 940–961.
- Mader H-J (1984) Animal habitat isolation by roads and agricultural fields. *Biological Conservation* 29(1): 81–96.
- Mccalla GR, Blackburn WH and Merrill LB (1984) Effects of Livestock Grazing on Infiltration Rates, Edwards Plateau of Texas. *Journal of Range Management* 37(3): 265.

- Mcgregor RL, Bender DJ and Fahrig L (2007) Do small mammals avoid roads because of the traffic? *Journal of Applied Ecology* 45(1): 117–123.
- Mckinney ML (2006) Urbanization as a major cause of biotic homogenization. *Biological Conservation* 127(3): 247–260.
- Michalski F and Peres CA (2005) Anthropogenic determinants of primate and carnivore local extinctions in a fragmented forest landscape of southern Amazonia. *Biological Conservation* 124(3): 383–396.
- Miksis-Olds JL, Donaghy PL, Miller JH, Tyack PL and Nystuen JA (2007) Noise level correlates with manatee use of foraging habitats. *The Journal of the Acoustical Society of America* 121(5): 3011–3020.
- Mirzapur News (2017) बाघ पहुंचा जमालपुर-मिर्जापुर. , 26 March. Available at: <http://mirzapurnews.com/news/6644> (accessed 18/08/18).
- Mistry J, Berardi A, Andrade V, Krahô T, Krahô P and Leonardos O (2005) Indigenous Fire Management in the cerrado of Brazil: The Case of the Krahô of Tocantins. *Human Ecology* 33(3): 365–386.
- MoEFCC (2018) Draft notification declaring Eco-Sensitive Zone around Chandraprabha Wildlife Sanctuary, Uttar Pradesh. The Gazette of India. Available at: <http://www.moef.gov.in/sites/default/files/chandraprabha.pdf> (accessed 18/08/2018).
- Mountford EP (2003) Long-term change and implications for the management of wood-pastures: experience over 40 years from Denny Wood, New Forest. *Forestry* 76(1): 19–43.
- Olf H and Ritchie ME (2002) Fragmented nature: consequences for biodiversity. *Landscape and Urban Planning* 58(2-4): 83–92.
- Oxley DJ, Fenton MB and Carmody GR (1974) The Effects of Roads on Populations of Small Mammals. *The Journal of Applied Ecology* 11(1): 51.
- Pande A, Vasava A, Solanki R, Bipin C and Jhala Y (2013) Photographic records of the Asiatic Wildcat from two states of India. *Journal of Threatened Taxa* 5(17): 5283–5287.

- Plieninger T, Pulido FJ and Schaich H (2004) Effects of land-use and landscape structure on holm oak recruitment and regeneration at farm level in *Quercus ilex* L. dehesas. *Journal of Arid Environments* 57(3): 345–364.
- Proppe DS, Sturdy CB and Clair CCS (2013) Anthropogenic noise decreases urban songbird diversity and may contribute to homogenization. *Global Change Biology* 19(4): 1075–1084.
- Pulido F and Díaz M (2005) Recruitment of a Mediterranean oak: a whole-cycle approach. *Ecoscience* 12: 99–112.
- Pulido FJ, Díaz Mario and Trucios SJHD (2001) Size structure and regeneration of Spanish holm oak *Quercus ilex* forests and dehesas: effects of agroforestry use on their long-term sustainability. *Forest Ecology and Management* 146(1-3): 1–13.
- Putman R (1996) Ungulates in temperate forest ecosystems: perspectives and recommendations for future research. *Forest Ecology and Management* 88(1-2): 205–214.
- Pyne SJ (1994) Nataraja: India's Cycle of Fire. *Environmental History Review* 18(3): 1–20.
- Radeloff VC, Stewart SI, Hawbaker TJ, Gimmi U, Pidgeon AM, Flather CH, Hammer RB and Helmers DP (2009) Housing growth in and near United States protected areas limits their conservation value. *Proceedings of the National Academy of Sciences* 107(2): 940–945.
- Rauzi F and Hanson CL (1966) Water Intake and Runoff as Affected by Intensity of Grazing. *Journal of Range Management* 19(6): 351.
- Riley SPD (2006) Spatial Ecology of Bobcats and Gray Foxes in Urban and Rural Zones of a National Park. *Journal of Wildlife Management* 70(5): 1425–1435.
- Rondinini C and Doncaster CP (2002) Roads as barriers to movement for hedgehogs. *Functional Ecology* 16(4): 504–509.
- Sala OE (2000) Global Biodiversity Scenarios for the Year 2100. *Science* 287(5459): 1770–1774.
- Sankaran M, Ratnam J and Hanan N (2008) Woody cover in African savannas: the role of resources, fire and herbivory. *Global Ecology and Biogeography* 17(2): 236–245.

- Schaub A, Ostwald J and Siemers BM (2008) Foraging bats avoid noise. *Journal of Experimental Biology* 211(19): 3174–3180.
- Setterfield SA (2002) Seedling establishment in an Australian tropical savanna: effects of seed supply, soil disturbance and fire. *Journal of Applied Ecology* 39(6): 949–959.
- Sharma GP and Raghubanshi AS (2011) Invasive species: ecology and impact of *Lantana camara* invasions. *Invasive alien plants: an ecological appraisal for the Indian subcontinent* 19–42.
- Sharma G (2011) *Lantana Camara* L. Invasion and Impact On Herb Layer Diversity And Soil Properties In A Dry Deciduous Forest Of India. *Applied Ecology and Environmental Research* 9(3): 253–264.
- Sharma GP (2007) Effect Of *Lantana Camara* L. Cover On Local Depletion Of Tree Population In The Vindhyan Tropical Dry Deciduous Forest Of India. *Applied Ecology and Environmental Research* 5(1): 109–121.
- Sharma GP, Raizada P and Raghubanshi AS (2009) *Hyptissuaveolens*: An emerging invader of Vindhyan plateau, India. *Weed Biology and Management* 9(3): 185–191.
- Sharma GP, Raghubanshi AS and Singh JS (2005) *Lantana* invasion: An overview. *Weed Biology and Management* 5(4): 157–165.
- Shine R, Lemaster M, Wall M, Langkilde T and Mason R (2004) Why Did the Snake Cross the Road? Effects of Roads on Movement and Location of Mates by Garter Snakes (*Thamnophis sirtalisparietalis*). *Ecology and Society* 9(1).
- Sinha D, Goparaju L, Upadhyaya SK, Kumar M and Rexwal O (2017) Sloth Bears of Mirzapur. Vindhyan Ecology and Natural History Foundation and Worldwide Fund for Nature India. Available at: [https://vindhyabachao.org/embeds/reports/Sloth\\_Bears\\_of\\_Mirzapur\\_VENHF\\_2017.pdf](https://vindhyabachao.org/embeds/reports/Sloth_Bears_of_Mirzapur_VENHF_2017.pdf) (accessed 18/08/18).



- Sterndale RA and Finn F (1929) *Sterndale's Mammalia of India. A new and abridged edition ... revised and with an appendix on the reptilia, by Frank Finn.* Calcutta & Simla; London printed.
- Stott P (1986) Guillermo Sarmiento: The ecology of neotropicalsavannas. Transl. by Otto Solbrig. xii, 235 pp. Cambridge, Mass., and London: Harvard University Press, 1984. £18. *Bulletin of the School of Oriental and African Studies* 49(03): 630.
- Tole L (2006) Measurement and Management of Human-Induced Patterns of Forest Fragmentation: A Case Study. *Environmental Management* 37(6): 788–801.
- Tole L (2006) Measurement and Management of Human-Induced Patterns of Forest Fragmentation: A Case Study. *Environmental Management* 37(6): 788–801.
- Travis MJM (2003) Climate change and habitat destruction: a deadly anthropogenic cocktail. *Proceedings of the Royal Society B: Biological Sciences* 270(1514): 467–473.
- Verma S and Jayakumar S (2015) Post-fire regeneration dynamics of tree species in a tropical dry deciduous forest, Western Ghats, India. *Forest Ecology and Management* 341: 75–82.
- Vignieri S (2014) Vanishing fauna. *Science* 345(6195): 392–395.
- Vivrette NJ and Muller CH (1977) Mechanism of Invasion and Dominance of Coastal Grassland by *Mesembryanthemum crystallinum*. *Ecological Monographs* 47(3): 301–318.
- Whittington J, Clair CCS and Mercer G (2004) Path Tortuosity and the Permeability of Roads and Trails to Wolf Movement. *Ecology and Society* 9(1).

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