Integrated wildlife plan of Singrauli Region

प्रगतेः मूलं प्रकृतिः

Indian Institute of Forest Management

Bhopal – 462003, MP, India

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Team

Dr. Pankaj Srivastava

Dr. Yogesh K Dubey

Dr. Ashish David

Dr. Advait Edgaonkar

Researcher

Dr. Arijit Pal

Mr. Azim Mujawar

For

Northern Coal Fields Limited (NCL) Singrauli

By

Indian Institute of Forest Management

Bhopal – 462003, MP, India

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Chapter 1 Introduction

Singrauli Coalfield has an area of 2202 Km^2 It has been divided into two basins; Moher Sub-basin with an area of 312 Km^2 and Singrauli Main basin with an area of 1890 Km^2. Moher Sub-basin lies in the eastern part of Singrauli Coalfield while Singrauli Main Basin is the western part and is unexplored. The total coal reserve of Singrauli Coalfield is of 10.06 BT; 6.83 BT is present in Moher Sub-basin and 3.23 BT in Singrauli Main Basin. Till March 2019, 1.7 BT of coal has been extracted by Northern Coalfields Limited from Moher Sub-basin. At present all the coal mining activities of NCL are active in 10 opencast mines of Moher Sub-basin.

Dudhichua expansion project has received Environment clearance for 25 MTPA coal production from its existing capacity of 17.5 MTPA and would require an additional 638.722 hectares ofarea.

Dudhichua Opencast Project is located on the east of Jayant Opencast Mine and on the west of Khadia Opencast Mine in Singrauli Coalfield. The inter-state boundary between MP and UP passes through the existing project area and thus project is partly in the district of Singrauli in MP and partly in the district of Sonebhadra in UP. The expansion proposal is totally in Singrauli district of Madhya Pradesh.

The total forest land required for the project is 1217.589 Ha (555.00Ha in UP side and 662.589 in MP side). This comprises of already acquired existing 749.78 Ha (555.00Ha in UP side and 194.78 Ha MP side) of diverted forest land. Additional 467.809 Ha forest land is required from MP side. Stage-I FC clearance of the additional 467.809 Ha forest land has been received on 19.04.2018. Approval of Stage -II FC is under process.

1.1 Ecological Implications

Mineral production is often not in consonance with conservation of forests and wildlife. Since at many places commercial reserves exist below thick forests, minerals are taken out from the earth using appropriate mining method. Most of the time to reach the ore

body/ coal seams, huge quantum of overburden is removed. There are large numbers of environmental issues associated with mining. The existing terrestrial configuration gets disturbed and the magnitude of disturbance depends on surface topography, depth of deposit, size of operation, excavation technology, beneficiation process etc.

A major conflict arises between development and biodiversity conservation when projects are located in the wilderness areas. Losses are incurred due to decimation of forest and loss of biodiversity, change in drainage pattern, displacement of people, soil erosion, dust, noise, water pollution and health and safety aspects. Usually with the implementation of such projects the migratory tract may come under greater pressure, compounding the impacts upon conservation of flora and fauna.

1.2 Need for the wildlife conservation plan

As per the Environmental Impact Assessment Notification (2006, revised) and Forest Conservation Act 1980 of Govt. of India mining projects have been classified as A category projects. Under this notification no new developmental projects can be undertaken in any part of India unless environmental clearance has been accorded by the Central Government. The proposed mining project falls under the category "A" and under the FCA 1980, the Proponent has been asked to get an Integrated Wildlife plan for the area as per F. No. 8-57/2017-FC dated 19th April 2018 (Annexure I).

1.3 Role of Indian Institute of Forest Management

Indian Institute of Forest Management (IIFM), Bhopal has been requested by the Northern Coal Fields Limited, Singrauli to prepare an integrated wildlife plan for the area as per the Work order NCL/FOREST/IIFM/20/163 dated 14.01.2020.

1.4 Scope of Work

The following is the scope of work in brief:

- For strengthening wildlife animal habitats, the said plan should cover additional area outside 5 km radius of Moher sub basin.

- The area between 5 km to 10 km of periphery of the Moher Sub basin will be used to educate human habitats because during migration of wild animal there is every chance of conflict between man and animal.

The 0-5 and 5-10 Km radius area from moher sub basic were demarcated and provided by NCL in form of a KML File.

Figure 1. 1 Moher Sub basin with mine locations and Dudhichua expansion area

Chapter 2 Study Area

2.1 Location

Dudhichua Opencast Project is located on the east of Jayant Opencast Mine and on the west of Khadia Opencast Mine in Singrauli Coalfield. The inter-state boundary between MP and UP passes through the existing project area and thus project is partly in the district of Singrauli in MP and partly in the district of Sonebhadra in UP. The expansion proposal is totally in Singrauli district of Madhya Pradesh.

2.2 Communication, physiography, drainage and climate

The project is well connected by both road and rail. Nearest railway station, Shaktinagar is at a distance of about 5 km and approachable by all-weather metaled road. The project is at a distance of 63 km by road from Renukut in UP and 18 km from Waidhan in MP by Ranchi-Rewa highway.

Dudhichua Opencast Block stands out on a plateau above plains on its south-east part of Singrauli coalfield. The average elevation at the foot of the plateau is 325 m above MSL. The highest elevation reaches about 504 m.The plateau is defined by a steep escarpment (facing south-west), rising from the elevation of 320-430m. The escarpment is characterized by thick growth of vegetation rolled-boulders and is dissected by numerous small seasonal streams. The area on the top of the plateau is undulating with elevation varying from 375-430 m with occasional high hills rising to 504m.

The most important stream in around is Ballia Nalla. The drainage of the area is controlled by seasonal streams which discharge into Ballia Nalla, which ultimately drains into Govind Ballabh Pant Sagar in the south. Similarly, towards north, the drainage is through seasonal streams which ultimately join Bijul Nalla.

The climate of the area is tropical. This zone falls under the influence of South- west monsoon. The climate of the Singrauli area is tropical with three seasons summer (March to June), monsoon (July to October), and winter (November to February). The climate of this area is tropical with severe summer. The temperature in summer rises as high as 48^{o}C

in May and June. In winter, temperature comes down to 4^{o}C and varies up to 21^{o}C. The rainy season is generally from July to September with average rainfall around 1132.70 mm, out of which about 88% precipitation is during rainy season from June to September only. The percentage of days is the highest for wind blowing in ESE direction and lowest in south direction. The average wind velocity is around 5 Km per hour.

The study area is demarcated by a 0-5 km radius and 5-10 Km radius from the boundary of Moher Sub-basin mining area for the purpose of this study (Figure 2.1). Some parts of forests outside this boundary have also been sampled to get better knowledge about the corridors and connectivity of the study area to adjoining forests and protected areas. The study area is spread over two districts; Singrauli district of Madhya Pradesh and Sonebhadra district of Uttar Pradesh. Major part of study area lies in Singrauli district while a small portion lies in Sonebhadra district. Bargawan, Gorbi, Waidhan and East Sarai are four ranges from Singrauli forest division that fall under study area while a small portion of Anpara range from Renukoot forest division also comes under study area.

The topography of the study area is hilly as well as plain. Anthropogenic activities like habitations, agriculture, industrial areas are concentrated in the plains. Forests are mostly found to be restricted to hills only. The major river of the study area is Rihand. A dam was constructed on this river in 1962 for hydro power generation. Other rivers traversing this region are Kanchan, Chalki, Mayar, Kanjas and Bijul.

The total area under 10 Km radius is 1264.3 sq.km of which 861.83 of terrestrial area in in Madhya Pradesh (MP), 190.73 sq.km of terrestrial area under Uttar Pradesh(UP) and 211.74 sq.km area is under Rihand Sagar Dam (Fig 2.1). The major part of the Rihand Sagar reservoir falls in Uttar Pradesh and a small part falls in the Madhya Pradesh. Of the total terrestrial area in 10 km radius approximately 81% falls in Madhya Pradesh and 19% falls in Uttar Pradesh.

The details of the total mine lease hold area under NCL in the Moher Sub Basin and the forest land involved is shown in table 2.1. It is observed from the table 2.1 that alomsot

75% of the mine lease hold area in Madhya Pradesh and 25% is in Uttar Pradesh. The Forest area involved in mining is 77.98% in MP and 22.07% in UP.

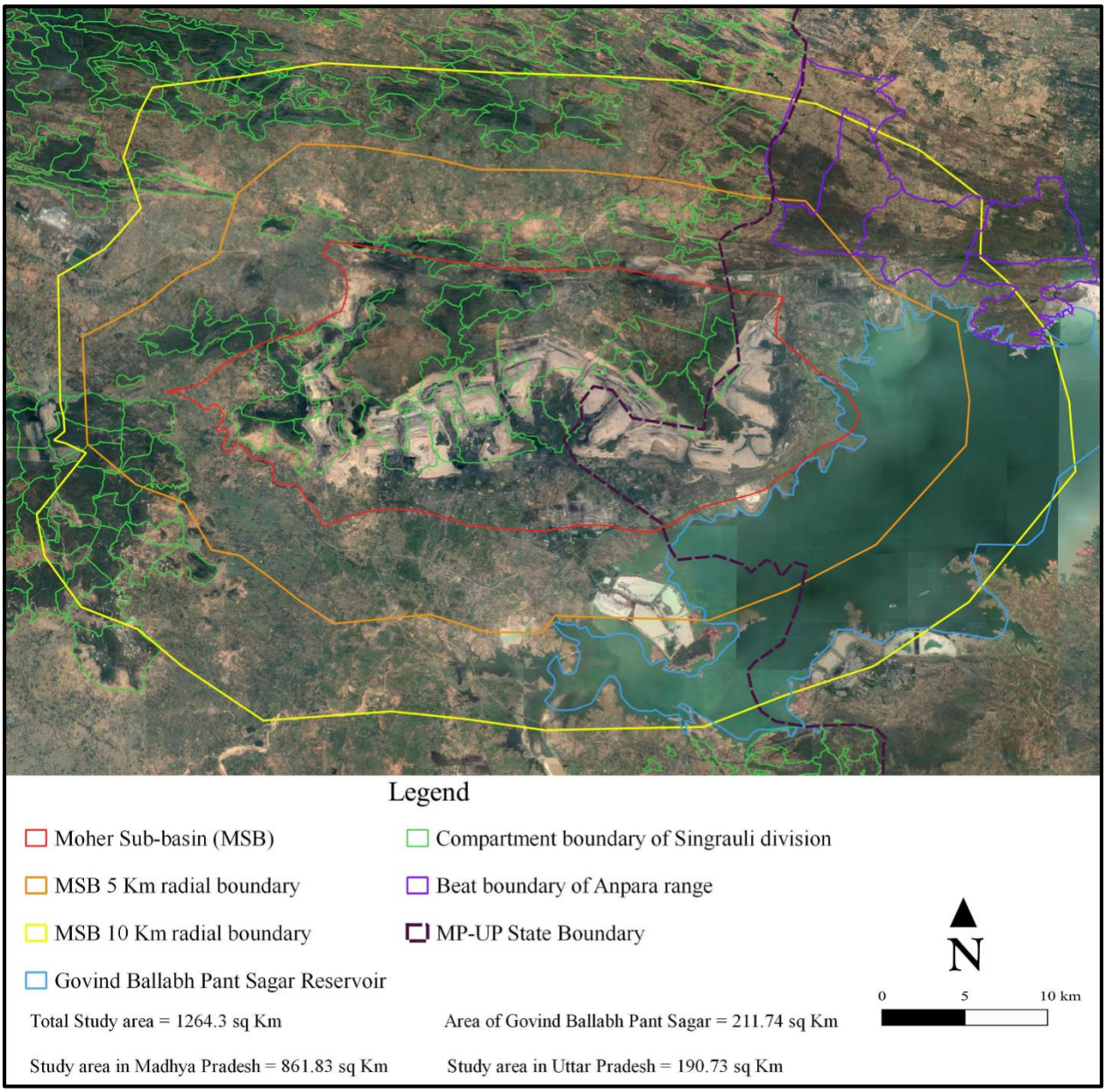

Figure 2. 1 Map showing 5 and 10 km radius areas and state boundary

Table 2. 1 Mine Lease Hold area and Forest area involved in MP and UP State

Name of Project	Mine Lease Hold Area (Ha.)		Total ML area (Ha.)	Forest Land Involved (Ha.)		Total Forest Land (Ha.)
	MP (a)	UP (b)	C=a+b	MP (d)	UP (e)	F=d+e
Amlohri OCP	2383	0	2383	1195	0	1195
Nigahi OCP	3018.4	0	3018.4	1280.517	0	1280.517
Block-B Expn. OCP	2257.17	0	2257.17	1069.783	0	1069.783
Jayant OCP	3177.171	0	3177.171	1180.171	0	1180.171
Jhingurda OCP	1200	0	1200	748	0	748
Semaria OCP (Upcoming project)	419.155	0	419.155	333.155	0	333.155
Dudhichua Expn. OCP	1835.722	555	2390.722	662.589	555	1217.589
Khadia OCP	180	1460	1640	180	750	930
Krishnashila OCP	0	851.78	851.78	493.99	0	493.99
Bina OCP	378.935	1419.065	1798	378.935	708.89	1087.825
Kakri OCP	0	828	828	0	185.84	185.84
Bina-Kakri Amalgamation OCP (Upcoming project))	0	0	0	353.764	30.50	384.264
Total	14849.553	5113.845	**19963.398**	7875.904	2230.23	**10106.134**
% of land State wise	74.38 %	25.62%	**100%**	77.93%	22.07%	**100%**

Source: NCL Singrauli, Office of the GM Forest

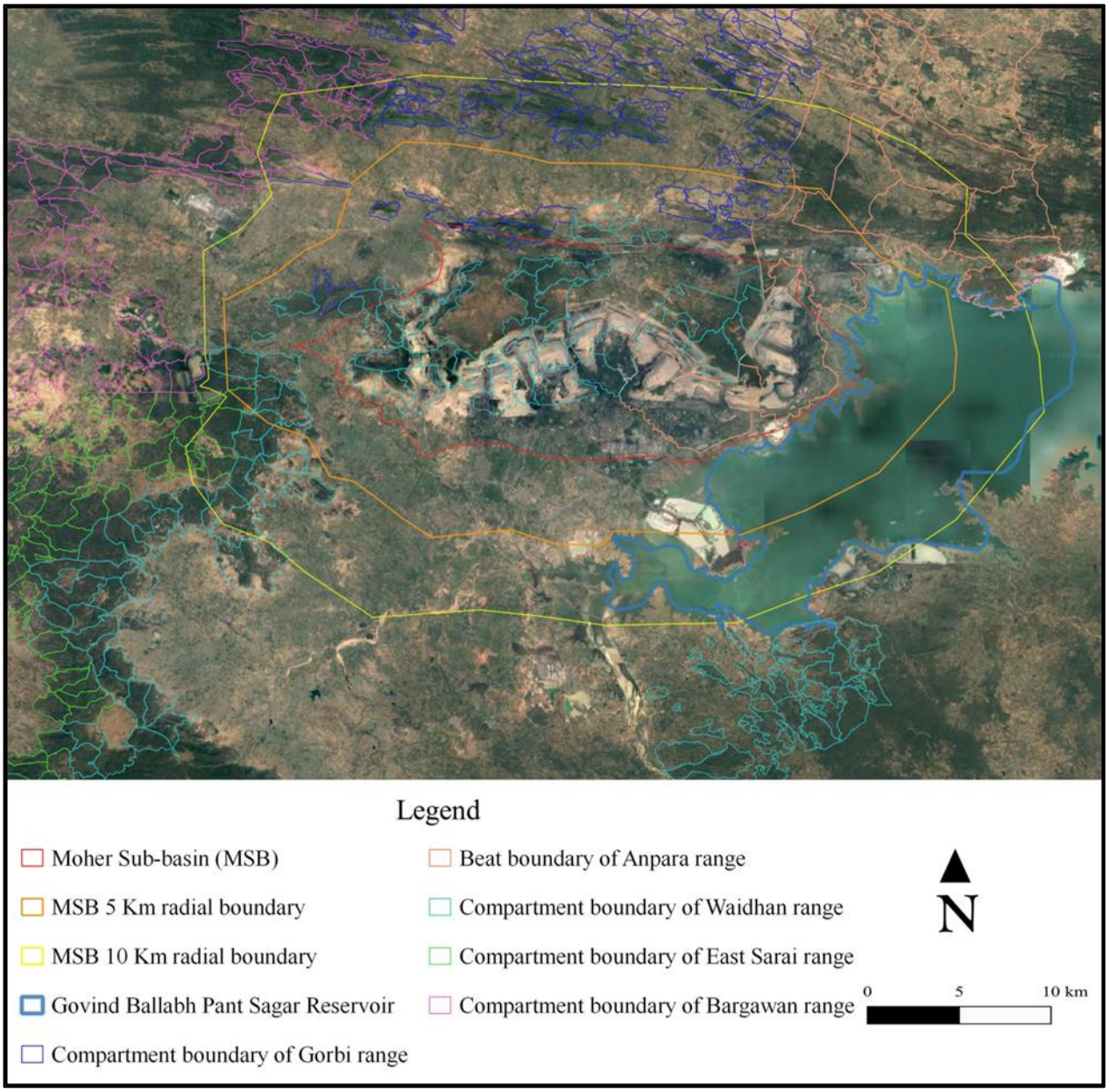

Figure 2. 2 Map showing MSB & forest ranges in 0-5 & 5-10 km radius areas

The forest of this division can be further grouped into various forest types as identified by ***Champion and Seth.*** The forest types chiefly found in Singrauli coal field are categorized under; Dry peninsular sal forest (5B/C1-c), Northern tropical dry deciduous forest (5B/C2), Boswellia forest (5B/E9) and Dry Bamboo brakes 5B/E9.

Accessibility to study area is comparatively poor. Nearest railway station is Singrauli and Shaktinagar. Nearest airport is at Varanasi which is 250 km from Singrauli. National highway 39 traverses the study area.

The study area lies in warm tropical belt of India and experiences hot summers and chilly winters. Monsoon in this region starts in June and ends in September. This region receives 1025 mm of annual rainfall, 92% of which comes from south west monsoon. Some winter rains are also received in this area. The mean maximum temperature ranges between 21℃ in January and 45℃ in May. The mean minimum temperature is 5℃ in January and 31℃ in June.

The forests of study area are primarily Sal forests. The study area has mainly reserved forests and few protected forests. North tropical dry mixed deciduous forests are prominently found in the study area while some parts have dry peninsular Sal forest. The forests of study area are mostly degraded due to large scale mining going on in the area for a very long period of time.

Secondary forests of immature ages are found in this region. Originally, this region had good forests with rich wildlife, but anthropogenic and industrial activities have led to degradation of forests. Further, activities like grazing, deforestation for agriculture, timber collection, NTFP collection, encroachment have caused more damage to the forests leading to depredation in habitat quality and decline in wildlife density and diversity. Some parts have mature rich forests and provide good quality of habitat for wildlife but human interference in form of grazing, timber logging, and encroachment is observed in these regions too. The dominant species of these forests were *Shorea robusta, Diospyros melanoxylon, Lagerstromia parviflora, Wrightia tinctoria*, *Madhuca longifolia, Butea Monosperma*, and *Holoptelea integrifolia.*

Plate 2. 1 Stream habitat and Sal plantation in study area

Plate 2. 2 Caves and water hole in study area

Plate 2. 3 Mix plantation and cattle grazing in study area

Chapter 3 Methodology

3.1 Methodology

Data of floral and faunal species plays a crucial role in determining strategies for wildlife management and conservation. Data from field surveys aids to recognize important habitats and their characteristics; like corridors and nesting sites of threatened and endangered species. Such parts of study area can be prioritized to conserve threatened and endangered species. The methodology employed for collecting the data on required parameters of study area is given below.

The study area spreads over part of Singrauli district in Madhya Pradesh and some part of Sonebhadra district in Uttar Pradesh. In Madhya Pradesh part of study area, forest compartment was considered as sampling unit while in Uttar Pradesh the forest patches of Anpara range that were part of study area was considered as sampling unit. The study area was divided into two parts; 0-5 km radius boundary and 5-10 km radius boundary from Moher Sub-basin. In Singrauli district a total of 84 forest compartments were sampled around Moher Sub-basin. In Sonebhadra district 5 beats of Anpara range were sampled which were inside the 5-10 km boundary of Moher Sub-basin. During sampling, diversity of flora and fauna of the region was assessed. In each compartment the natural forest trails were sampled for mammalian, avian and reptilian and lepidopteran fauna. A total of 89 trails of varying lengths ranging from 3 to 5 kms were walked to assess fauna diversity of the study area. 10 m radius circular plots were laid in each compartment to sample the vegetation of the compartment. A total of 229 plots were laid for sampling vegetation of the study area.

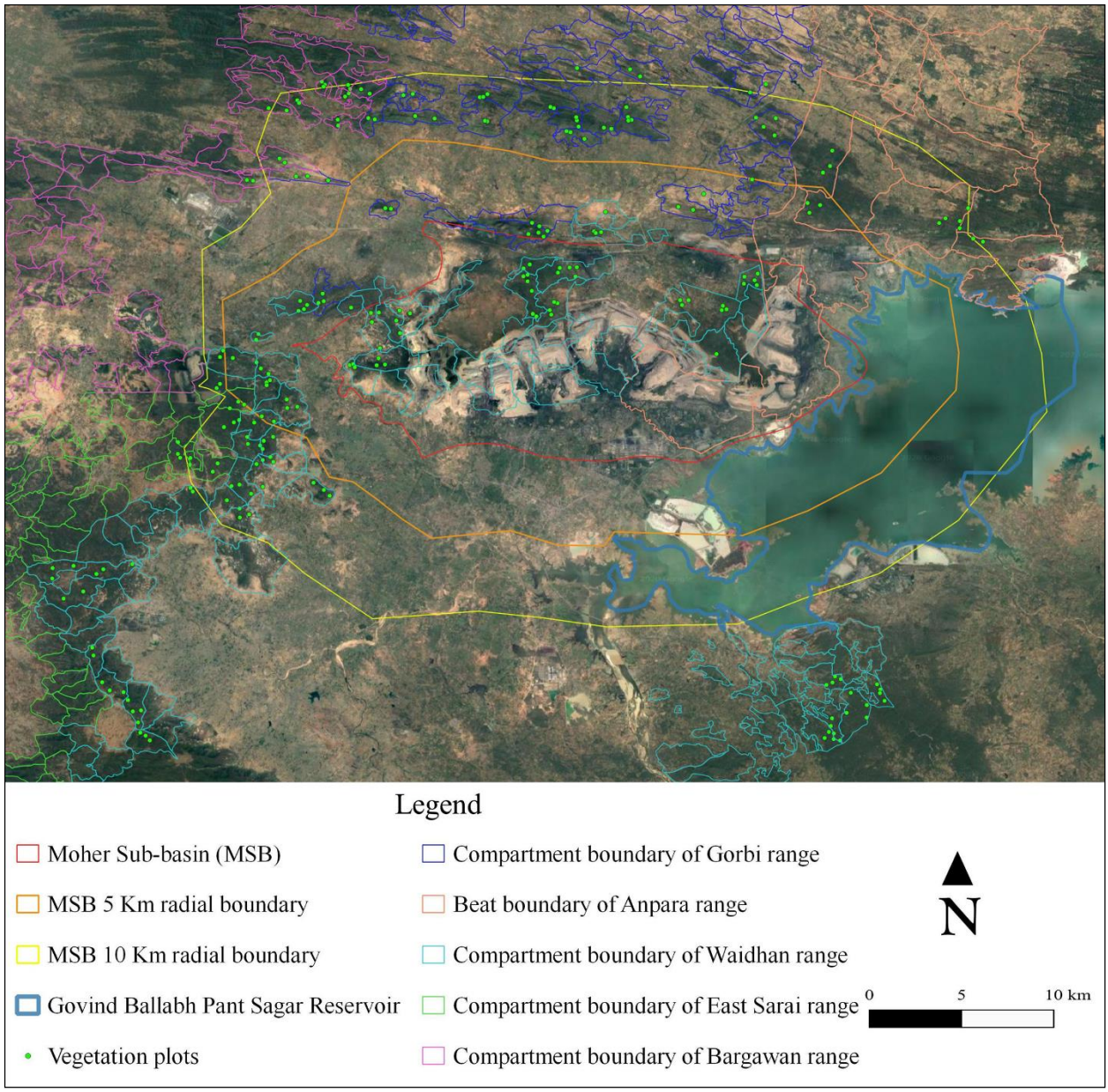

Figure 3. 1 Map showing sampled vegetation plots in study area

3.2 Methods for Ecological Observations

Field surveys were conducted from August 2019 to February 2020 in the study area. Field surveys aid to recognize significant characteristics and parameters of the habitat. The study area was traversed on foot to conduct extensive sampling, covering the entire study area to record data on floral and faunal diversity. The objective was to generate information regarding presence/absence of fauna and diversity and composition of flora.

Trail based transect surveys were conducted to get basic ecological understanding of the study area. The landscape, vegetation parameters and crucial features of study area like corridors, nesting sites of endangered and threatened species were also identified and recorded while walking the trail transects. Local people adept in identifying local flora and fauna were hired as field assistant to aid in field surveys. Standard field guides were used to identify the species encountered.

Plate 3. 1 Sampling of vegetation plots

3.3 Habitat Assessment

The term habitat has been used here in a broader sense for general land cover rather than for a particular species. A rapid habitat assessment was carried out in core and buffer zones of the proposed coal block. Rapid surveys were carried out for overall assessment and characterization of landscape of the study area. Based on the interpretation of

landscape and habitat assessment, key habitat areas as well as significant landscape elements were identified. The extensive network of roads and trails were used for the rapid assessment of habitat in the study area.

3.4 Flora

To understand the floristic composition, diversity and distribution of floral species in study area vegetation surveys were conducted throughout the study area. Extensive surveys were conducted in study area in various habitats, altitudes and terrain types.

For sampling and systematically surveying the project area, the entire area was surveyed for understanding the patterns in vegetation distribution and the current status of floristic diversity.

Extensive floral surveys were carried out in the study area. Systematic surveys of plant species were conducted in the proposed project area covering various microhabitats, altitudes, aspects and terrain types. Field identification of plants was made with the help of relevant flora such as, D.O witt and Haynes Flora.

The quantitative survey of flora was carried out using the line transect sampling method. Line transects and plot sampling was used in the entire study area to collect data on vegetation. Standard field guides were used to aid in the identification and gather more information of the floral diversity along the designated transects. Specimens of doubtful species were collected for further validation and verification. The detailed analysis of flora was attempted based on literature consultation on the rare, threatened and endemic plants of the region.

An ethonobotanical survey was conducted eliciting information through personal interview of villagers with the help of local assistants and also through direct and indirect observations made during the field surveys. Locals who practice traditional medical practices and local traders were interviewed for more information on medicinal plants, uses and availability of various medicinal plants within the project area. Plot sampling was used to gather information on different vegetation forms. For Tree, Shrub and Herb

study. Circular plot sampling method was used along the trails of all sampled forest compartments to collect data of vegetation type, diversity and terrain type of the landscape of study area. A total of 229 vegetation plots were sampled (plate 3.1) throughout the study area to collect data on vegetation type of each compartment and beat. Assessment of vegetation was also done to record data on forest type and canopy cover of the area. Standard field guides were used to identify all the floral species recorded on the vegetation plots sampled.

3.5 Fauna

Faunal surveys were conducted through trail transects. Mammals, birds, reptiles and butterflies were included in faunal surveys. The forest compartments of study area were extensively and meticulously sampled for all the above mentioned faunal groups. A total of 89 trails were walked to assess the diversity and composition of faunal species in the study area. Direct and indirect evidences like tracks, scrap marks, dung, pellets, scat, rake marks, calls and sightings were recorded while walking on trial transects to collect data on presence/absence of faunal species. As an addition to the primary data, secondary data on presence/absence of faunal species in the study area was also collected through published or unpublished reports, records from Forest Department, informal interviews with officials of Forest Department and local public in the villages of the study area. A local person well versed with forest areas and good knowledge about forest and wildlife was hired as field assistant to aid in field surveys.

Standard field guides were used for identification and verification of faunal species recorded during trail surveys.

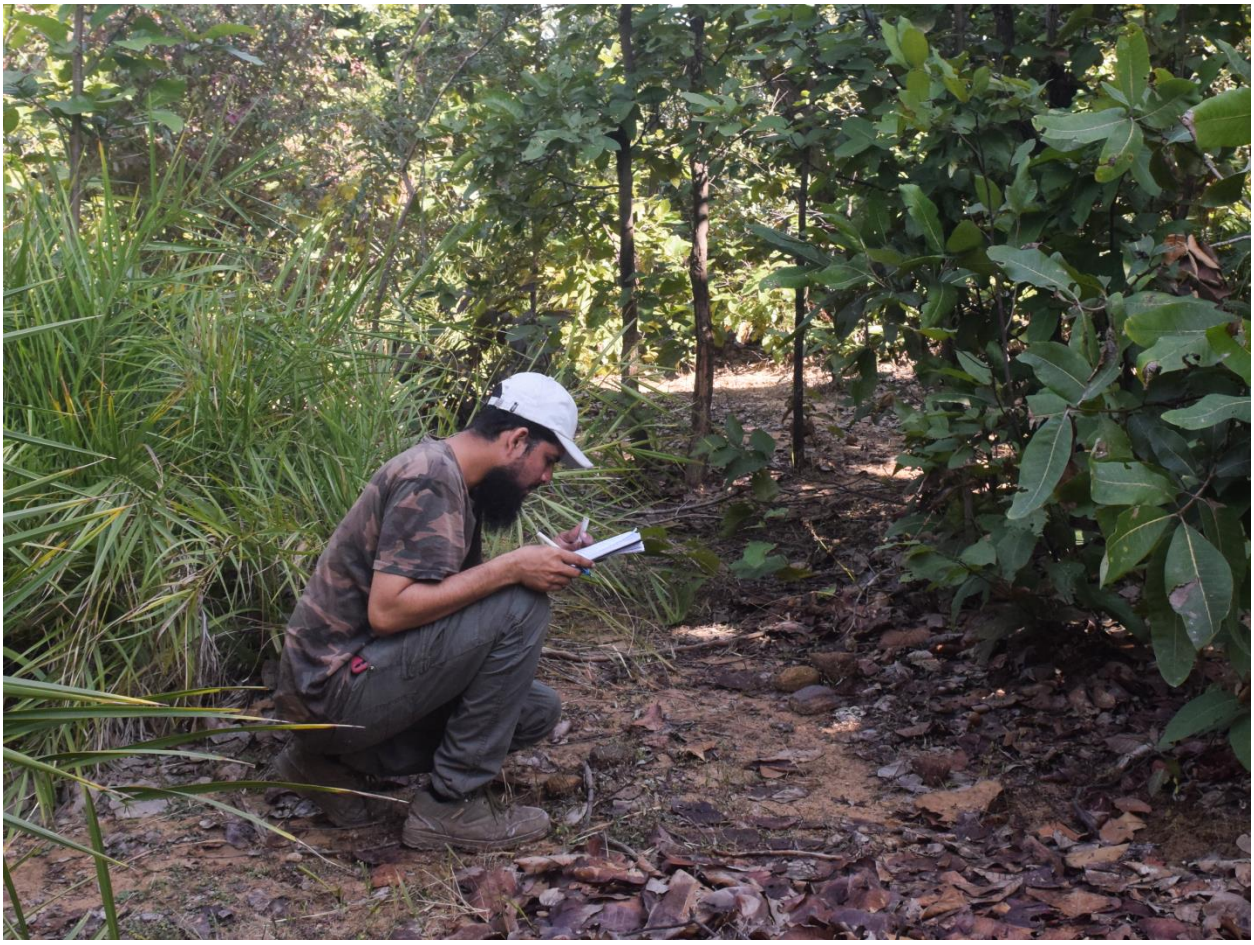

Plate 3. 2 Conducting sign survey for mammals

3.5.1 Mammals

The presence/absence information of mammalian fauna was generated through trail transect surveys conducted in the study area. Direct and indirect signs like tracks, scat, pellet, scrap marks, rake marks, calls and direct sightings were recorded during the field surveys. In addition to this secondary information was also collected from reports and informal interviews as mentioned above.

3.5.2 Birds

Direct sightings of avifauna species were recorded during trail transect surveys. Bird calls were also used to determine the presence of birds in the study area. Any other sign that could confirm the presence of the species was also recorded. Early morning and evening

surveys were conducted to collect the data on avifauna as most of the birds are active during these periods of day.

3.5.3 Butterflies

Lepidopteran surveys were also conducted in the study area. Trail transects were walked to record the presence of lepidopteran species. Trail transects traversed through all types of habitats and terrains to have a complete coverage of habitat and terrain types. All the species encountered were recorded and 8X40 binocular was used to identify unapproachable species.

3.5.4 Reptiles

Reptiles were surveyed in the study area during trail transects. Each site was searched for reptiles. Microhabitats like streams, boulders, wood logs, tree holes, leaf litter were physically moved and searched for the presence of reptilian species. The villagers and Forest Department officials were also interviewed informally to get secondary evidences of presence of reptiles.

Plate 3. 3 Field Surveys being conducted through different habitat types

Chapter 4 Ecological Baseline - Flora

The study area has following types of forests according to Champion and Seth's system of classification:

1. 5B/C1C - Dry Peninsular Sal

2. 5B/C2 - North Tropical Dry Mixed Deciduous Forest

(Source: Working Plan of Singrauli Forest Division 2009-10 to 2018-19)

4.1 Floral Diversity

During assessment of flora we recorded 62 species of vascular plants in the study area. The list of floral species recorded in study area is given below in Table 4.1. These species were represented by 32 families and categorized in different categories of plants which are – tree, shrub, herb and grass. Out of 62 species found, 42 species were trees, 6 were shrubs, 8 were herbs and 6 were grasses.

52 species of plants (83.87% of species recorded in whole study area) from 29 families (90.62% of families recorded in whole study area) were recorded in 5 km radius of Moher Sub-basin; 35 were trees, 6 were shrubs, 6 were herbs and 5 were grasses. Floral inventory found in 0-5 Km radius of Moher Sub-basin is given below in Table 4.2.

Flora of 5-10 km radius of Moher Sub-basin was found to be more diverse in terms of both species and family. Comparatively more number of species and families were recorded in 5-10 km radius than those recorded in 0-5 km radius of Moher Sub-basin. 57 species (91.93% of species recorded in whole study area) of plants represented by 31 families (96.87% of families recorded in whole study area) were recorded in the 5-10 km radius of Moher Sub-basin, of which 37 were trees, 6 were shrubs, 8 were herbs and 6 were grasses. The species record of 5-10 Km radius of Moher Sub-basin is given in **Table 4.4**.

Table 4. 1 List of plants recorded in the study area

Scientific Name	Common Name	Category	Family
Acanthospermum hispidum	Chipki	Herb	*Asteraceae*
Acrachne racemosa	Jaura	Grass	*Poaceae*
Aegle marmelos	Beel	Tree	*Rutaceae*
Aeschynomene indica	Katsola	Herb	*Fabaceae*
Ageratum conyzoides	Goat weed	Herb	*Asteraceae*
Albizia odoratissima	Bersa	Tree	*Mimosaceae*
Anogeissus latifolia	Dhawra	Tree	*Combretaceae*
Asparagus racemosus	Shatavar	Shrub	*Asparagaceae*
Azadiracta indica	Neem	Tree	*Meliaceae*
Bergia ammannioides	Ammannia waterwort	Herb	*Elatinaceae*
Blumea lacera	Lettuce leaf blumea	Herb	*Asteraceae*
Bombax ceiba	Semal	Tree	*Malvaceae*
Boswellia serrata	Saleha/Salaya	Tree	*Burseraceae*
Bridelia retusa	Kasai	Tree	*Phyllanthaceae*
Buchanania cochinchinensis	Chaar	Tree	*Anacardiaceae*
Butea monosperma	Palas	Tree	*Fabaceae*
Careya arborea	Kumbhi	Tree	*Lecythidaceae*
Casearia elliptica	Bherri	Tree	*Salicaceae*
Cassia fistula	Amaltas	Tree	*Fabaceae*
Cassia pumila	Chakoda	Herb	*Caesalpiniaceae*
Catunaregam nilotica	Kharhar	Tree	*Rubiaceae*
Chloris virgata	Feather finger grass	Grass	*Poaceae*
Chloroxylon swietenia	Bharvi	Tree	*Rutaceae*
Colebrookea oppositifolia	Gandhraula	Shrub	*Lamiaceae*
Cymbopogon martinii	Musel	Grass	*Poaceae*

Dendrocalamus strictus	Baans	Grass	*Poaceae*
Digitaria bicornis	Asian crabgrass	Grass	*Poaceae*
Diospyros melanoxylon	Tendu	Tree	*Ebenaceae*
Ficus reliogosa	Peepal	Tree	*Moraceae*
Gardenia latifolia	Papra	Tree	*Rubiaceae*
Haldina cordifolia	Haldu	Tree	*Rubiaceae*
Helicteres isora	Ainth	Tree	*Malvaceae*
Holarrhena pubescens	Samoka	Tree	*Apocynaceae*
Holoptelea integrifolia	Chirol	Tree	*Ulmaceae*
Isachne globosa	Kaseli	Grass	*Poaceae*
Lagerstromia parviflora	Seedha	Tree	*Lythraceae*
Lannea coromandelica	Goonja	Tree	*Anacardiaceae*
Lantana camara	Gulmehnda	Shrub	*Verbenaceae*
Madhuca longifolia	Mahua	Tree	*Sapotaceae*
Mallotus philippensis	Rori	Tree	*Euphorbiaceae*
Mangifera indica	Aam	Tree	*Anacardiaceae*
Manilkara hexandra	Khinni	Tree	*Sapotaceae*
Mesosphaerum suaveolens	Vantulas	Shrub	*Lamiaceae*
Miliusa tomentosa	Kari	Tree	*Annonaceae*
Mitragyna parvifolia	Kaihma	Tree	*Rubiaceae*
Phoenix acaulis	Leaf broom	Herb	*Arecaceae*
Phyllanthus emblica	Amla	Tree	*Phyllanthaceae*
Premna lucidula	Kamar	Tree	*Lamiaceae*
Schleichera oleosa	Kosam	Tree	*Sapindaceae*
Semecarpus anacardium	Bhela	Tree	*Anacardiaceae*
Shorea robusta	Saal	Tree	*Dipterocarpaceae*
Syzygium cumini	Jamun	Tree	*Myrtaceae*

Tectona grandis	Sagwan	Tree	*Lamiaceae*
Terminalia arjuna	Arjun	Tree	*Combretaceae*
Terminalia bellirica	Bahera	Tree	*Combretaceae*
Terminalia chebula	Harra	Tree	*Combretaceae*
Terminallia elliptica	Saja	Tree	*Combretaceae*
Woodfordia fruticosa	Dhawai	Tree	*Lythraceae*
Wrightia tinctoria	Doodhi	Tree	*Apocynaceae*
Xanthium indicum	Rough cocklebur	Herb	*Asteraceae*
Ziziphus mauritiana	Ber	Shrub	*Rhamnaceae*
Ziziphus oenoplia	Macau	Shrub	*Rhamnaceae*

Table 4. 2 List of plants species recorded in 0-5 km radius of Moher Sub-basin

Scientific Name	**Common Name**	**Category**	**Family**
Acanthospermum hispidum	Chipki	Herb	*Asteraceae*
Acrachne racemosa	Jaura	Grass	*Poaceae*
Aegle marmelos	Beel	Tree	*Rutaceae*
Aeschynomene indica	Katsola	Herb	*Fabaceae*
Albizia odoratissima	Bersa	Tree	*Mimosaceae*
Anogeissus latifolia	Dhawra	Tree	*Combretaceae*
Asparagus racemosus	Shatavar	Shrub	*Asparagaceae*
Azadiracta indica	Neem	Tree	*Meliaceae*
Bergia ammannioides	Ammannia waterwort	Herb	*Elatinaceae*
Blumea lacera	Lettuce leaf blumea	Herb	*Asteraceae*
Bombax ceiba	Semal	Tree	*Malvaceae*
Boswellia serrata	Saleha/Salaya	Tree	*Burseraceae*
Bridelia retusa	Kasai	Tree	*Phyllanthaceae*
Buchanania cochinchinensis	Chaar	Tree	*Anacardiaceae*

Butea monosperma	Palas	Tree	*Fabaceae*
Casearia elliptica	Bherri	Tree	*Salicaceae*
Cassia pumila	Chakoda	Herb	*Caesalpiniaceae*
Chloris virgate	Feather finger grass	Grass	*Poaceae*
Chloroxylon swietenia	Bharvi	Tree	*Rutaceae*
Colebrookea oppositifolia	Gandhraula	Shrub	*Lamiaceae*
Cymbopogon martinii	Musel	Grass	*Poaceae*
Dendrocalamus strictus	Baans	Grass	*Poaceae*
Digitaria bicornis	Asian crabgrass	Grass	*Poaceae*
Diospyros melanoxylon	Tendu	Tree	*Ebenaceae*
Ficus reliogosa	Peepal	Tree	*Moraceae*
Gardenia latifolia	Papra	Tree	*Rubiaceae*
Haldina cordifolia	Haldu	Tree	*Rubiaceae*
Holarrhena pubescens	Samoka	Tree	*Apocynaceae*
Holoptelea integrifolia	Chirol	Tree	*Ulmaceae*
Lagerstromia parviflora	Seedha	Tree	*Lythraceae*
Lannea coromandelica	Goonja	Tree	*Anacardiaceae*
Lantana camara	Gulmehnda	Shrub	*Verbenaceae*
Madhuca longifolia	Mahua	Tree	*Sapotaceae*
Mangifera indica	Aam	Tree	*Anacardiaceae*
Mesosphaerum suaveolens	Vantulas	Shrub	*Lamiaceae*
Miliusa tomentosa	Kari	Tree	*Annonaceae*
Mitragyna parvifolia	Kaihma	Tree	*Rubiaceae*
Premna lucidula	Kamar	Tree	*Lamiaceae*
Schleichera oleosa	Kosam	Tree	*Sapindaceae*
Semecarpus anacardium	Bhela	Tree	*Anacardiaceae*
Shorea robusta	Saal	Tree	*Dipterocarpaceae*

Syzygium cumini	Jamun	Tree	*Myrtaceae*
Tectona grandis	Sagwan	Tree	*Lamiaceae*
Terminalia bellirica	Bahera	Tree	*Combretaceae*
Terminalia chebula	Harra	Tree	*Combretaceae*
Terminallia arjuna	Arjun	Tree	*Combretaceae*
Terminallia elliptica	Saja	Tree	*Combretaceae*
Woodfordia fruticosa	Dhawai	Tree	*Lythraceae*
Wrightia tinctoria	Doodhi	Tree	*Apocynaceae*
Xanthium indicum	Rough cocklebur	Herb	*Asteraceae*
Ziziphus mauritiana	Ber	Shrub	*Rhamnaceae*
Ziziphus oenoplia	Macau	Shrub	*Rhamnaceae*

Table 4. 3 Familywise species recorded in 0-5 km radius of Moher Sub-basin

Sr. No.	Family	Number of Species
1	*Anacardiaceae*	4
2	*Annonaceae*	1
3	*Apocynaceae*	2
4	*Asparagaceae*	1
5	*Asteraceae*	3
6	*Burseraceae*	1
7	*Caesalpiniaceae*	1
8	*Combretaceae*	5
9	*Dipterocarpaceae*	1
10	*Ebenaceae*	1

11	*Elatinaceae*	1
12	*Fabaceae*	2
13	*Lamiaceae*	4
14	*Lythraceae*	2
15	*Malvaceae*	1
16	*Meliaceae*	1
17	*Mimosaceae*	1
18	*Moraceae*	1
19	*Myrtaceae*	1
20	*Phyllanthaceae*	1
21	*Poaceae*	5
22	*Rhamnaceae*	2
23	*Rubiaceae*	3
24	*Rutaceae*	2
25	*Salicaceae*	1
26	*Sapindaceae*	1
27	*Sapotaceae*	1
28	*Ulmaceae*	1
29	*Verbenaceae*	1

Table 4. 4 Plant species recorded in 5-10 km radius of Moher Sub-basin

S.No	Scientific Name	Common Name	Category	Family
1.	*Acanthospermum hispidum*	Chipki	Herb	*Asteraceae*
2.	*Acrachne racemosa*	Jaura	Grass	*Poaceae*
3.	*Aeschynomene indica*	Katsola	Herb	*Fabaceae*
4.	*Ageratum conyzoides*	Goat weed	Herb	*Asteraceae*
5.	*Anogeissus latifolia*	Dhawra	Tree	*Combretaceae*
6.	*Asparagus racemosus*	Shatavar	Shrub	*Asparagaceae*
7.	*Azadiracta indica*	Neem	Tree	*Meliaceae*
8.	*Bergia ammannioides*	Ammannia waterwort	Herb	*Elatinaceae*
9.	*Blumea lacera*	Lettuce leaf blumea	Herb	*Asteraceae*
10	*Bombax ceiba*	Semal	Tree	*Malvaceae*
11	*Boswellia serrata*	Saleha/Salaya	Tree	*Burseraceae*
12	*Bridelia retusa*	Kasai	Tree	*Phyllanthaceae*
13	*Buchanania cochinchinensis*	Chaar	Tree	*Anacardiaceae*
14	*Butea monosperma*	Palas	Tree	*Fabaceae*
15	*Careya arborea*	Kumbhi	Tree	*Lecythidaceae*
16	*Casearia elliptica*	Bherri	Tree	*Salicaceae*
17	*Cassia fistula*	Amaltas	Tree	*Fabaceae*
18	*Cassia pumila*	Chakoda	Herb	*Caesalpiniaceae*
19	*Catunaregam nilotica*	Kharhar	Tree	*Rubiaceae*
20	*Chloris virgate*	Feather finger grass	Grass	*Poaceae*
21	*Chloroxylon swietenia*	Bharvi	Tree	*Rutaceae*
22	*Colebrookea oppositifolia*	Gandhraula	Shrub	*Lamiaceae*
23	*Cymbopogon martinii*	Musel	Grass	*Poaceae*
24	*Dendrocalamus strictus*	Baans	Grass	*Poaceae*
25	*Digitaria bicornis*	Asian crabgrass	Grass	*Poaceae*

26	*Diospyros melanoxylon*	Tendu	Tree	*Ebenaceae*
27	*Ficus reliogosa*	Peepal	Tree	*Moraceae*
28	*Gardenia latifolia*	Papra	Tree	*Rubiaceae*
29	*Haldina cordifolia*	Haldu	Tree	*Rubiaceae*
30	*Helicteres isora*	Ainth	Tree	*Malvaceae*
31	*Holoptelea integrifolia*	Chirol	Tree	*Ulmaceae*
32	*Isachne globose*	Kaseli	Grass	*Poaceae*
33	*Lagerstromia parviflora*	Seedha	Tree	*Lythraceae*
34	*Lannea coromandelica*	Goonja	Tree	*Anacardiaceae*
35	*Lantana camara*	Gulmehnda	Shrub	*Verbenaceae*
36	*Madhuca longifolia*	Mahua	Tree	*Sapotaceae*
37	*Mallotus philippensis*	Rori	Tree	*Euphorbiaceae*
38	*Manilkara hexandra*	Khinni	Tree	*Sapotaceae*
39	*Mesosphaerum suaveolens*	Vantulas	Shrub	*Lamiaceae*
40	*Miliusa tomentosa*	Kari	Tree	*Annonaceae*
41	*Mitragyna parvifolia*	Kaihma	Tree	*Rubiaceae*
42	*Phoenix acaulis*	Leaf broom	Herb	*Arecaceae*
43	*Phyllanthus emblica*	Amla	Tree	*Phyllanthaceae*
44	*Premna lucidula*	Kamar	Tree	*Lamiaceae*
45	*Schleichera oleosa*	Kosam	Tree	*Sapindaceae*
46	*Semecarpus anacardium*	Bhela	Tree	*Anacardiaceae*
47	*Shorea robusta*	Saal	Tree	*Dipterocarpaceae*
48	*Syzygium cumini*	Jamun	Tree	*Myrtaceae*
49	*Tectona grandis*	Sagwan	Tree	*Lamiaceae*
50	*Terminalia arjuna*	Arjun	Tree	*Combretaceae*
51	*Terminalia bellirica*	Bahera	Tree	*Combretaceae*
52	*Terminallia elliptica*	Saja	Tree	*Combretaceae*

53	*Woodfordia fruticosa*	Dhawai	Tree	*Lythraceae*
54	*Wrightia tinctoria*	Doodhi	Tree	*Apocynaceae*
55	*Xanthium indicum*	Rough cocklebur	Herb	*Asteraceae*
56	*Ziziphus mauritiana*	Ber	Shrub	*Rhamnaceae*
57	*Ziziphus oenoplia*	Macau	Shrub	*Rhamnaceae*

Table 4. 5 Familywise species recorded in 5-10 Km radius of Moher Sub-basin

Sr. No.	Family	Number of Species
1	*Anacardiaceae*	3
2	*Annonaceae*	1
3	*Apocynaceae*	1
4	*Arecaceae*	1
5	*Asparagaceae*	1
6	*Asteraceae*	4
7	*Burseraceae*	1
8	*Caesalpiniaceae*	1
9	*Combretaceae*	4
10	*Dipterocarpaceae*	1
11	*Ebenaceae*	1
12	*Elatinaceae*	1
13	*Euphorbiaceae*	1
14	*Fabaceae*	3
15	*Lamiaceae*	4
16	*Lecythidaceae*	1
17	*Lythraceae*	2
18	*Malvaceae*	2
19	*Meliaceae*	1

20	*Moraceae*	1
21	*Myrtaceae*	1
22	*Phyllanthaceae*	2
23	*Poaceae*	6
24	*Rhamnaceae*	2
25	*Rubiaceae*	4
26	*Rutaceae*	1
27	*Salicaceae*	1
28	*Sapindaceae*	1
29	*Sapotaceae*	2
30	*Ulmaceae*	1
31	*Verbenaceae*	1

In the entire study area Poaceae was found to be the most dominant family with 6 species, followed by Combretaceae and Rubiaceae; both with 5 species each. Anacardiaceae, Asteraceae and Lamiaceae were some other dominant families in the study area with 4 species each. The details of family wise number of species recorded in study area are given below in **Table 4.7**.

In the entire study area Poaceae family was dominant in both 0-5 km radius and 5-10 km radius of Moher Sub-basin with 5 and 6 species respectively. In 0-5 km radius Poaceae was followed by Anacardiaceae, Combretaceae, Lamiaceae with 4 species each and Asteraceae and Rubiaceae with 3 species each. The family wise number of species recorded in 0-5 Km radius of Moher Sub-basin is given in **Table 4.3**.

As compared to 0-5 km radius, in 5-10 km radius family Poaceae was followed by Rubiaceae with 5 species, Asteraceae, Combretaceae and Lamiaceae with 4 species each. The details of species recorded family wise in 10 Km radius of Moher Sub-basin are listed below in **Table 4.4**.

Table 4. 6 Distribution of plant forms in different categories in study area

Category of Plant	0-5 km radius	5-10 km radius	Whole study area
Tree	35	37	42
Shrub	6	6	6
Herb	6	8	8
Grass	5	6	6
Total	**52**	**57**	**62**

Table 4. 7 Comparison of distribution of number of plant species in different families in 0-5 km radius and 5-10 km radius of Moher Sub-basin

Family	Number of Species in 5 km radius	Number of Species in 10 km radius
Anacardiaceae	4	3
Annonaceae	1	1
Apocynaceae	2	1
Arecaceae	0	1
Asparagaceae	1	1
Asteraceae	3	4
Burseraceae	1	1
Caesalpiniaceae	1	1
Combretaceae	5	4
Dipterocarpaceae	1	1
Ebenaceae	1	1
Elatinaceae	1	1
Euphorbiaceae	0	1
Fabaceae	2	3
Lamiaceae	4	4

Lecythidaceae	0	1
Lythraceae	2	2
Malvaceae	1	2
Meliaceae	1	1
Mimosaceae	1	0
Moraceae	1	1
Myrtaceae	1	1
Phyllanthaceae	1	2
Poaceae	5	6
Rhamnaceae	2	2
Rubiaceae	3	4
Rutaceae	2	1
Salicaceae	1	1
Sapindaceae	1	1
Sapotaceae	1	2
Ulmaceae	1	1
Verbenaceae	1	1

4.2 Status of ethnobotanical species

Of the total plant species, 44 species distributed over 27 families were used by local people for food, medicine, timber, fibre etc. The ethnobotanical species available in the study area and used by the local people occupied various life forms, of which 6 were herbaceous species, 28 were tree species, and 10 were shrub species **(Table 4.8)**. Combretaceae and Euphorbiaceae had the highest number of species used as ethnobotanical species, followed by Apocynaceae, Poaceae, and Verbenaceae.

Different plant parts of these species such as root, tuber, leaf, fruit, bark, resin, seed, latex etc. were used as food, fodder, fuelwood, timber and medicine. A total 17 ethnobotanical

species were used for curing various ailments such as dysentery, skin diseases, cut and wounds, stomachache, scorpion bite and snake bite. The bark of tree species such as *Buchanania lanzan, Holarrhena antidysenterica, Wrightia tinctoria, Azadarachta indica*, and *Bauhinia variegata* was used for curing diseases. A total of 16 species were used as food and mostly fruits of these plant species were edible. Shrubs like *Ipomoea carnea* were used as bio fencing.

Table 4. 8.Status of ethnobotanical species & its use by local peoplein study area

Sl. No	Botanical Name	Local Name	Habit	Family	Uses
1	Achyranthus aspera L.	Gathiya, Aghada	Herb	Amaranthaceae	Scorpion bite
2	Adina cordifolia Hook. f.	Karmi, Haldu	Tree	Rubiaceae	Timber
3	Aegle marmelos Correa.	Bel	Tree	Rutaceae	Fruit – edible, medicine
4	Annona squamosa L.	Sharifa	Tree	Annonaceae	Fruit - edible
5	Anogeissus latifolia Wall.	Dahu, Dho, Dhaura	Tree	Combretaceae	Timber
6	Asparagus racemosus Willd.	Satawari	Shrub	Liliaceae	Tuber - medcine
7	Azadarachta indica A.H.L. Juss.	Neem	Tree	Meliaceae	Bark, leaf - medicine
8	Bauhinia variegata L.	Champa	Tree	Caesalpiniaceae	Bark –cut and wounds, skin diseases
9	Bombax malabaricum DC.	Semer, semal	Tree	Malvaceae	Flower - edible
10	Boswellia serrata Roxb.	Saliha	Tree	Burseraceae	Match stick
11	Buchanania lanzan Spr. Syn: B. latifolia Roxb.	Char	Tree	Anacardiaceae	Bark – snake bite, dysentery
12	Carissa carandus L.	Karonda	Shrub	Apocynaceae	Fruit – edible
13	Chloroxylon swietenia DC.	Bhirra, bharahi	Tree	Meliaceae	Mosquito repallent
14	Cynodon dactylon Pers.	Doob	Grass	Poaceae	Medicine

Sl. No	Botanical Name	Local Name	Habit	Family	Uses
15	Datura metel L.	Dhatura	Shrub	Solanaceae	Flower - religious
16	Dalbergia paniculata Roxb.	Dhobin	Tree	Leguminoceae	Timber
17	Dendrocalamus strictus Nees	Bans	Grass	Poaceae	
18	Euphorbia hirta L.	Dudhi bel	Herb	Euphorbiaceae	Snake bite
19	Ficus bengalensis L.	Bargad	Tree	Moraceae	Religious
20	Ficus religiosa L.	Pipal	Tree	Moraceae	Religious
21	Holarrhena antidysenterica Wall.	Koriya	Tree	Apocynaceae	Bark – dysentery
22	Indigofera pulchella Roxb.	Bhul bhuli, Ghirhul	Shrub	Leguminoceae	Nutritious vegetable
23	Ipomoea carnea Jacq.	Besaram	Herb	Convolvulaceae	Biofencing
24	Lantana camara L.	Barmasi	Shrub	Verbinaceae	Fuelwood
25	Madhuca indica Gmel	Mahuwa	Tree	Sapotaceae	Flower - Liquor
26	Mangifera indica L.	Aam	Tree	Anacardiaceae	Fruit - edible
27	Mitragyna parviflora (Roxb.) Korth.	Mundi, Karam, Kadamb	Tree	Rubiaceae	Religious
28	Moringa oleifera Lam.	Sahjan	Tree	Moringaceae	Leaf - vegetable
29	Ocimum gratissimum L.	Bantulsi	Shrub	Lamiaceae	Leaf- headache, cough
30	Ocimum sanctum L.	Tulsi	Shrub	Lamiaceae	Medicine
31	Phoenix sylvestris Roxb.	Khajoor	Tree	Palmaceae	Fruit - edible
32	Phoenix acaulis Buch	Chind	Herb	Palmaceae	Leaf - broom
33	Phyllanthus emblica L.	Awala	Tree	Euphorbiaceae	Fruit – edible, medicine
34	Ricinus communis L.	Arandi	Shrub	Euphorbiaceae	Seed – Dandruff
35	Shorea robusta Gaertn.	Sal, sarayi	Tree	Dipterocarpaceae	Timber, gum used in worship (havan)
36	Solanum indicum L.	Bhatkataya	Shrub	Solanaceae	Fruit - edible
37	Syzygium cuminii (L.)	Jamun	Tree	Myrteceae	Fruit - edible

Sl. No	Botanical Name	Local Name	Habit	Family	Uses
	Skeels				
38	Tamarindus indica L.	Imli	Tree	Caesalpiniaceae	Edible
39	Tectona grandis L.	Sajwan, Sagwan	Tree	Verbenaceae	Timber
40	Terminalia arjuna Bedd.	Kahua, arjun	Tree	Combretaceae	Medicine
41	Terminalia bellerica Roxb.	Baira	Tree	Combretaceae	Medicine
42	Terminalia chebula Retz.	Harra	Tree	Combretaceae	Medicine
43	Wrightia tinctoria A. Br.	Dudhiya, Dudhi	Tree	Apocynaceae	Bark, medicine, stomachache
44	Zizyphus mauritiana Lamk.	Ber	Shrub	Rhamnaceae	Fruit - Edible

4.3 Vegetation in Forest Ranges of study area

5 forest ranges fall in the study area, 4 of which are under Singrauli division (Madhya Pradesh part of study area) namely - Waidhan Gorbi, Bargawan and East Sarai while1 is under Renukoot division (Uttar Pradesh part of study area) namely - Anpara. The vegetation of these forest ranges is described below.

4.3.1 Waidhan Range

Waidhan range lies in the southern part of study area. Waidhan range is one of the largest range of study area. It shows diverse forms of topography and vegetation. It is mostly hilly. Forests in Waidhan range are mostly primary open and dense forests. Dominant species among trees in this range are *Shorea robusta, Diospyros melanoxylon, Lagerstromia parviflora, Wrightia tinctoria* and *Madhuca longifolia*. Patches of plantation of *Tectona grandis* and *Dendrocalamus strictus* werealso present. Shrublands were dominated by *Woodfordia fruticosa* and *Mesosphaerum suaveolens*. Anthropogenic activities like fuelwood collection and livestock grazing were observed.

4.3.2 Gorbi Range

This range is situated in the northern part of study area. Topography of this range is hilly with very few plains. Open and scrub forests dominate this range, with few small

grassland patches. Forests of this range are secondary forests. Dominant trees of these open and scrub forests are *Lagerstromia parviflora, Diospyros melanoxylon, Shorea robusta, Butea Monosperma*, and *Holoptelea integrifolia*. The shrublands are dominated by *Mesosphaerum suaveolens, Lantana camara, Ziziphus oenoplia* and *Colebrookea oppositifolia*. Fuelwood collection and livestock grazing were observed in Gorbi range too.

4.3.3 Bargawan Range

Bargawan range forms the north western part of study area. The sampled area of Bargawan range is hilly. Scrub forests are prominent in this area with patches of open forests. Grasslands are found in some areas of this range. *Lagerstromia parviflora, Shorea robusta, Diospyros melanoxylon, Anogeissus latifolia* and *Wrightia tinctoria* are dominant tree species of forests of Bargawan range. Common shrubs found in this range are *Mesosphaerum suaveolens* and *Colebrookea oppositifolia*. Very few patches of mix plantation are also present. Fuelwood collection and livestock grazing is common in Bargawan range too.

4.3.4 East Sarai

A small portion of this range falls in study area. This range falls in the south western part of study area. This part is mostly constituted by highland areas. Primary open and dense forests are prevalent in this region. Few small patches of grasslands and plantation of *Tectona grandis* are also present. The primary forests of these highlands are dominated by *Shorea robusta, Diospyros melanoxylon, Buchanania cochinchinensis, Madhuca longifolia* and *Wrightia tinctoria*; while the shrublands were dominated by *Woodfordia fruticosa*. Anthropogenic activities of fuelwood collection and cattle grazing were found to occur in East Sarai range.

4.3.5 Anpara

Anpara range is the only range that falls in the Uttar Pradesh part of study area. It lies in the north eastern part of study area. The sampled area of this range is mostly hilly with few plains. Primary open and dense as well as scrub forests are found in the sampled part

of study area. Tree species dominating these forests are *Shorea robusta*, *Diospyros melanoxylon, Anogeissus latifolia, Lagerstromia parviflora* and *Casearia elliptica*. Shrubs species found to be dominant in these regions are *Mesosphaerum suaveolens* and *Lantana camara*. Small patch of mix plantation was seen. Fuelwood collection and livestock grazing was observed in this range.

Plate 4. 1 Forests of Waidhan Range

Plate 4. 2 Forests of Gorbi Range

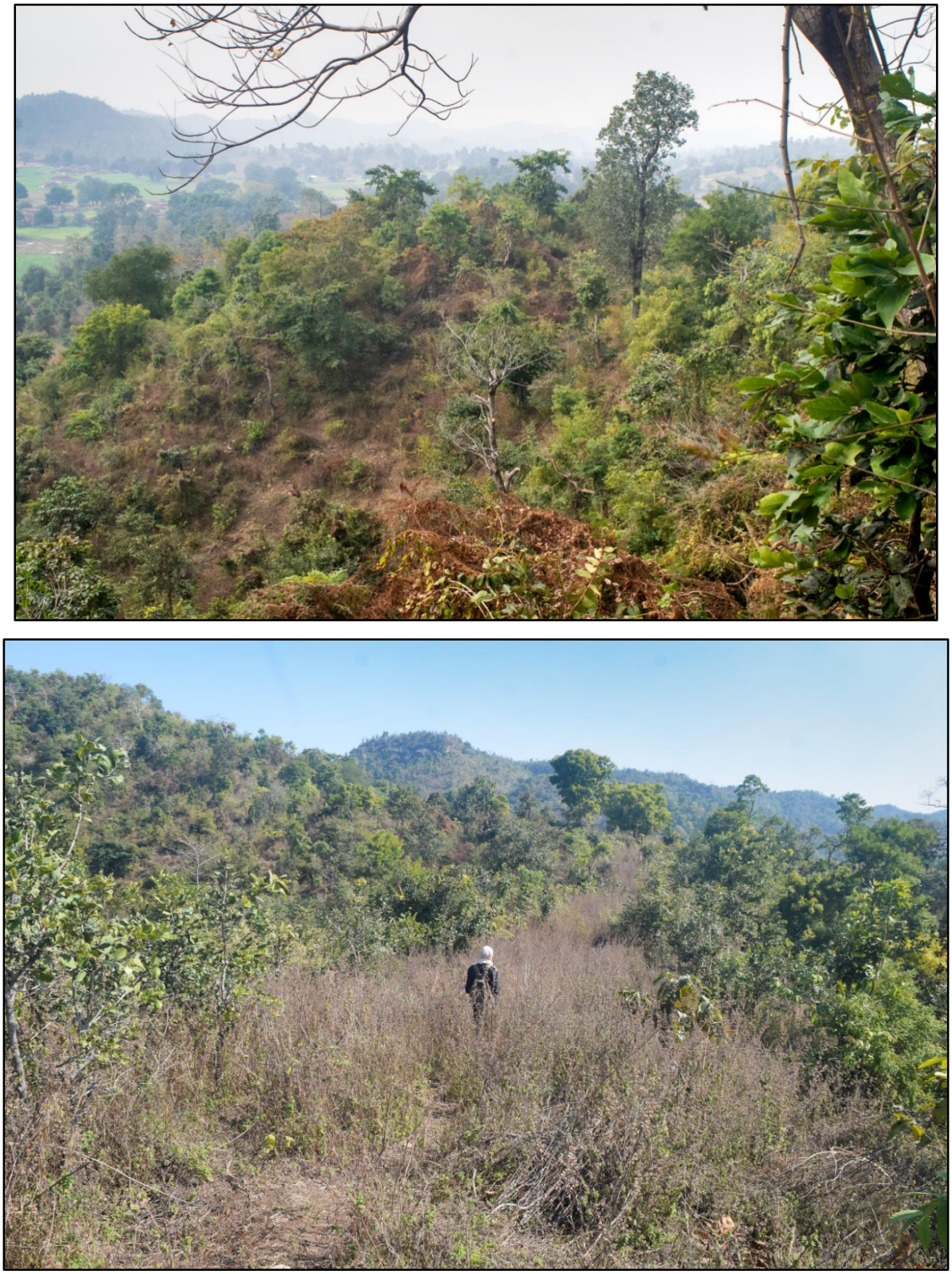

Plate 4. 3 Forests of Bargawan Range

Plate 4. 4 Forests of East Sarai Range

Plate 4. 5 Forests of Anpara Range

Chapter 5 Biodiversity – Fauna

The trail transect surveys generated an inventory of faunal species in the study area and their presence/absence data which is imperative for preparing the wildlife management plan as discussed earlier. The status and diversity of faunal species is being discussed in detail in this chapter.

The study area falls in Singrauli forest division of Madhya Pradesh and Renukoot forest division of Uttar Pradesh. This area is mostly hilly and harbors fairly good diversity of fauna. Direct evidences, indirect evidences primary data, secondary published or unpublished data were used to assess the status of fauna in the study area.

Status of different faunal groups is given in Table 5.1

Table 5. 1 Number of species recorded in each group of fauna in study area.

Faunal group	Number of species recorded
Mammals	24
Birds	104
Reptiles	11
Butterflies	59
Spiders	23
Fishes	11

5.1 Mammals

In spite of high degree of anthropogenic pressure, the study area has resonably good diversity of mammalian species. Comparatively more mammal species were found to be present in 5-10 km radius (23 species) of that those found in 0-5 km radius (21 species) of Moher Sub-basin.

Presence of six ungulate species were found in 0-5 km radius of Moher Sub-basin whereas; presence of 8 ungulate species was recorded in 5-10 km radius of Moher Sub-basin. Wild pig (*Sus scrofa*) and nilgai (*Boselaphus tragocamelus*) were the most common ungulate species recorded in the study area. Chinkara (*Gazella bennettii*) was the next common ungulate species found in study area. Spotted deer (*Axis axis*), Four horned antelope (*Tetracerus quadricornis*) and Barking deer (*Muntiacus muntjak*) showed least frequent evidences of presence in the study area. All the ungulates were recorded in 0-5 km radius of Moher Sub-basin except Elephant (*Elephas* maximus) and Sambar (*Cervus unicolor*). Elephant (*Elephas* maximus) and Sambar (*Cervus unicolor*) presence was recorded in 5-10 km radius of Moher Sub-basin. Elephant (*Elephas* maximus) records were reported from Bargawan, Waidhan and Gorbi ranges of Singrauli division. Elephants (*Elephas* maximus) from Guru Ghasidas National Park of Chhattisgarh and Sanjay Dubri Tiger Reserve of Madhya Pradesh use these forest patches as corridor. Though there was no direct sighting of elephant in the study area during the period of study but secondary data did indicate the presence of elephants in 0-5 km and 5-10 km radius area from moher sub basin (Figure 5.8)

Sambar (*Cervus unicolor*) was reported from rich continuous forest patches of Gova and Karsua forests of Waidhan range which lie to the extreme southeast and south west of study area. These areas however are not part of 0-5 km and 5-10 km radius area of Moher Sub-basin. In the south east these forest patches are connected to Sanjay Dubari Tiger Reserve of Madhya Pradesh and Guru Ghasidas National Park of Chhattisgarh. In south west they are connected to Tamor Pingla Wildlife Sanctuary.

The presence of carnivore species were recorded in both parts of study area. There were no direct sightings of any carnivore species in 0-5 km radius of Moher Sub-basin. In 5-10 km radius of Moher Sub-basin only Jackal (*Canis aureus*) and Jungle cat (*Felis chaus*) were sighted. Both these species were common in study area. Presence of striped hyaena (*Hyaena hyaena*) was recorded in both the parts of study area. It was found to be more frequent in 5-10 km radius of Moher Sub-basin, in forests of Waidhan and East Sarai

ranges. Evidences of grey wolf (*Canis lupus*) were very rare in both parts of study area. Leopard (*Panthera pardus*) signs were more prevalent in 5-10 km radius of Moher Sub-basin than in 5 km radius of Moher Sub-basin. However, the sightings of leopard are also not very common in the study area. A tentative population of approximately 14 leopards has been reported as per the 2018 wildlife census for the entire Singrauli forest division. Leopard being an opportunistic cat, can survive in all types sub-optimal and marginal habitats also.

Evidence of tiger (*Panthera tigris*) presence was recorded in 0-5 km as well as 5-10 km radius zone. Tigers are quite uncommon and rare in the area. The evidence seen by the researcher was also only at one place in East Sarai range where a very old scratch mark was seen on Boswellia tree in Pidarwah beat compartment number 288 (Plate 5.1). Interaction with villagers and forest staff indicated that tiger have not been seen in the area since 2017. Interaction with the Forest staff indicated that these are some rare incidences of straying of some animal. The 2018 wild animal tiger census data of Singrauli Forest division also did not reveal the either the presence or any information on population status of tigers in the area.

Sloth bear (*Melursus ursinus*) presence was also recorded in both the parts of study area. Evidences of tiger and sloth bear were recorded from forests of Waidhan and East Sarai ranges which were used as corridors by these species to move between source populations. Sloth bear signs were fairly common in these forests, suggesting more frequent use of these forests by sloth bears than tigers. A population of approximately 57 sloth bears is reported as per the 2018 wildlife census of Singrauli forest division.

Among primates only Hanuman langur (*Semnopithecus entellus*) was recorded in 0-5 km radius of Moher Sub-basin while in 5-10 km radius of Moher Sub-basin 2 primate species were found to be present, namely; Hanuman langur (*Semnopithecus entellus*) and rhesus macaque (*Macaca mulatta*).

Plate 5. 1 Tiger scratch marks on Boswelia tree in East Sarai Range

Of the 8 total species of Schedule I of Wildlife Protection Act 1972, 7 species were recorded in both parts of study area. Indian pangolin (*Manis crassicaudata*) was recorded from 0-5 km radius of Moher Sub-basin and was not found in 5-10 km radius of Moher Sub-basin. Presence of pangolin was confirmed by the digging signs seen in the East Sarai area by the researcher (Plate 5.2). Local people however were not aware about the presence of pangolins in the area. This could primarily be due of the nocturnal nature of the species.

Direct and indirect evidences of mammals were more common and frequent in 5-10 km radius than in 0-5 km radius of Moher Sub-basin. Direct sightings of mammals was no so common in both the parts of study area. Jackal (*Canis aureus*), Jungle cat (*Felis chaus*), Chinkara (*Gazella bennettii*), and Wild pig (*Sus scrofa*) were common species which were sighted during surveys. These sightings were more common in 5-10 km radius than in 0-5 km radius of Moher Sub-basin. Among ungulates chinkara (*Gazella bennettii*) was the most sighted species. It was sighted 5 times, once in 0-5 km radius and 4 times in 5-

10 km radius of Moher Sub-basin. Wild pig (*Sus scrofa*) was seen twice and spotted deer (*Axis axis*) was sighted only once in 5-10 km radius of Moher Sub-basin.

Plate 5. 2 Digging signs by Pangolin in East Sarai Forest Range

The differences in mammal abundance and diversity in 5 km radius and 10 km radius of Moher Sub-basin can be linked to comparatively less fragmentation of forests in 10 km radius area, which ensures fairly good habitat and connectivity for mammals; even though the degree of anthropogenic pressure in form of extraction of timber, encroachment, grazing, NTFP collection, fire incidences is fairly similar in both the parts of study area. Road network and traffic density is another factor that may affect the abundance and diversity of mammals in two parts of study area. Major roads pass through 5 km radius of study area due to which vehicular traffic density is also high in this area compared to 10 km radius of Moher Sub-basin.

Table 5. 2 Mammalian species recorded in 5 km radius of Moher Sub-basin

S.No	Scientific Name	Common Name	WPA Status
1.	*Axis axis*	Spotted deer	Schedule III
2.	*Boselaphus tragocamelus*	Nilgai	Schedule III
3.	*Canis aureus*	Golden jackal	Schedule II
4.	*Canis lupus*	Grey wolf	Schedule I
5.	*Felis chaus*	Jungle cat	Schedule II
6.	*Funambulus pennantii*	Five striped squirrel	Schedule IV
7.	*Gazella bennettii*	Chinkara	Schedule I
8.	*Herpsetes edwardsii*	Grey mongoose	Schedule II
9.	*Hyaena hyaena*	Striped hyaena	Schedule III
10.	*Hystrix indica*	Indian crested porcupine	Schedule IV
11.	*Lepus nigricoolis*	Hare	Schedule IV
12.	*Manis crassicaudata*	Indian pangolin	Schedule I
13.	*Metursus ursinus*	Sloth bear	Schedule I
14.	*Muntiacus muntjak*	Barking deer	Schedule III
15.	*Panthera pardus*	Leopard	Schedule I
16.	*Panthera tigris*	Tiger	Schedule I
17.	*Semnopithecus entellus*	Hanuman langur	Schedule II
18.	*Sus scrofa*	Wild pig	Schedule III
19.	*Tetracerus quadricornis*	Four horned antelope	Schedule I
20.	*Viverricula indica*	Small Indian civet	Schedule II
21.	*Vulpes bengalensis*	Indian fox	Schedule II

Table 5. 3 Mammalian species recorded in 5-10 km radius of Moher Sub-basin

S.No	Scientific Name	Common Name	WPA Status
1.	*Axis axis*	Spotted deer	Schedule III
2.	*Boselaphus tragocamelus*	Nilgai	Schedule III
3.	*Canis aureus*	Golden jackal	Schedule II
4.	*Canis lupus*	Grey wolf	Schedule I
5.	*Cervus unicolor*	Sambar	Schedule III
6.	*Elephas maximus*	Elephant	Schedule I
7.	*Felis chaus*	Jungle cat	Schedule II
8.	*Funambulus pennantii*	Five striped squirrel	Schedule IV
9.	*Gazella bennettii*	Chinkara	Schedule I
10.	*Herpsetes edwardsii*	Grey mongoose	Schedule II
11.	*Hyaena hyaena*	Striped hyaena	Schedule III
12.	*Hystrix indica*	Indian crested porcupine	Schedule IV
13.	*Lepus nigricoolis*	Hare	Schedule IV
14.	*Macaca mulatta*	Rhesus macaque	Schedule II
15.	*Metursus ursinus*	Sloth bear	Schedule I
16.	*Muntiacus muntjak*	Barking deer	Schedule III
17.	*Panthera pardus*	Leopard	Schedule I
18.	*Panthera tigris*	Tiger	Schedule I
19.	*Semnopithecus entellus*	Hanuman langur	Schedule II
20.	*Sus scrofa*	Wild pig	Schedule III
21.	*Tetracerus quadricornis*	Four horned antelope	Schedule I
22.	*Viverricula indica*	Small Indian civet	Schedule II
23.	*Vulpes bengalensis*	Indian fox	Schedule II

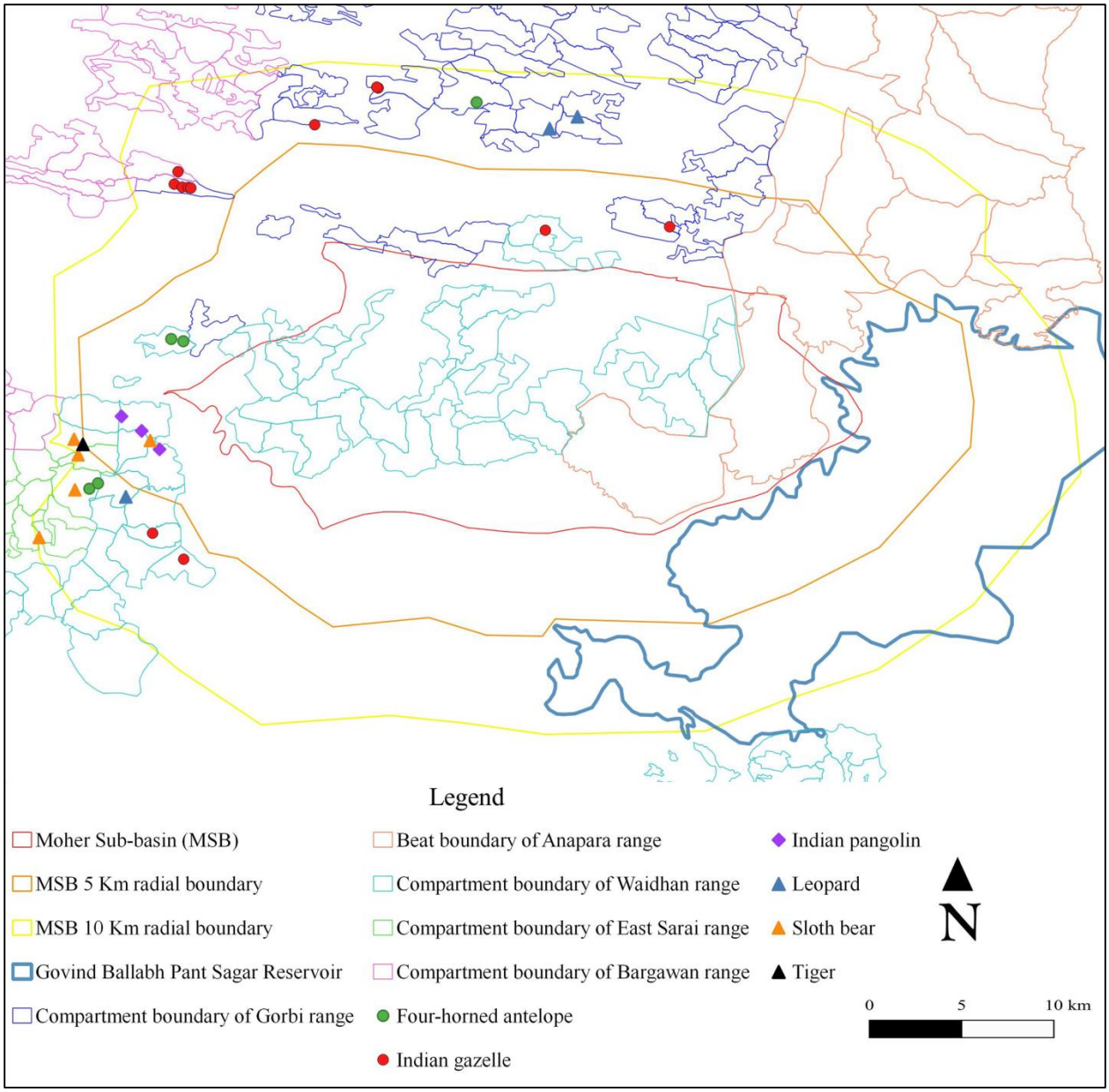

Figure 5. 1 showing presence of Schedule I mammals in study area

Table 5. 4 Range wise presence of mammals in study area

S.No	Scientific Name	Common name	Bargawan	East Sarai	Gorbi	Waidhan	Anpara
1.	Axis axis	Spotted deer	P	P	P	PS	A
2.	Boselaphus tragocamelus	Nilgai	PS	P	P	P	P
3.	Canis aureus	Golden jackal	P	P	P	P	PS
4.	Canis lupus	Grey wolf	PS	PS	PS	PS	PS
5.	Cervus unicolor	Sambar	A	A	A	P	A
6.	Elephas maximus	Elephant	PS	A	PS	PS	A
7.	Felis chaus	Jungle cat	PS	P	P	P	P
8.	Funambulus pennantii	Five striped squirrel	P	P	P	P	P
9.	Gazella bennettii	Chinkara	P	A	P	P	A
10.	Herpsetes edwardsii	Grey mongoose	P	P	P	P	PS
11.	Hyaena hyaena	Striped hyaena	PS	P	PS	P	PS
12.	Hystrix indica	Indian crested porcupine	A	P	P	P	P
13.	Lepus nigricoolis	Hare	P	P	P	P	PS
14.	Macaca mulatta	Rhesus macaque	A	P	A	PS	A
15.	Manis crassicaudata	Indian pangolin	A	A	A	P	A
16.	Metursus ursinus	Sloth bear	PS	P	PS	P	A
17.	Muntiacus muntjak	Barking deer	A	A	A	PS	A
18.	Panthera pardus	Leopard	PS	PS	P	P	PS
19.	Panthera tigris	Tiger	A	P	A	PS	A
20.	Semnopithecus entellus	Hanuman langur	P	P	P	P	P
21.	Sus scrofa	Wild pig	P	P	P	P	P

22.	Tetracerus quadricornis	Four horned antelope	PS	P	P	P	A
23.	Viverricula indica	Small Indian civet	PS	PS	P	P	A
24.	Vulpes bengalensis	Indian Fox	A	P	P	PS	A

P = Presence ascertained through primary data, PS = Presence ascertained through secondary data and A = Absent.

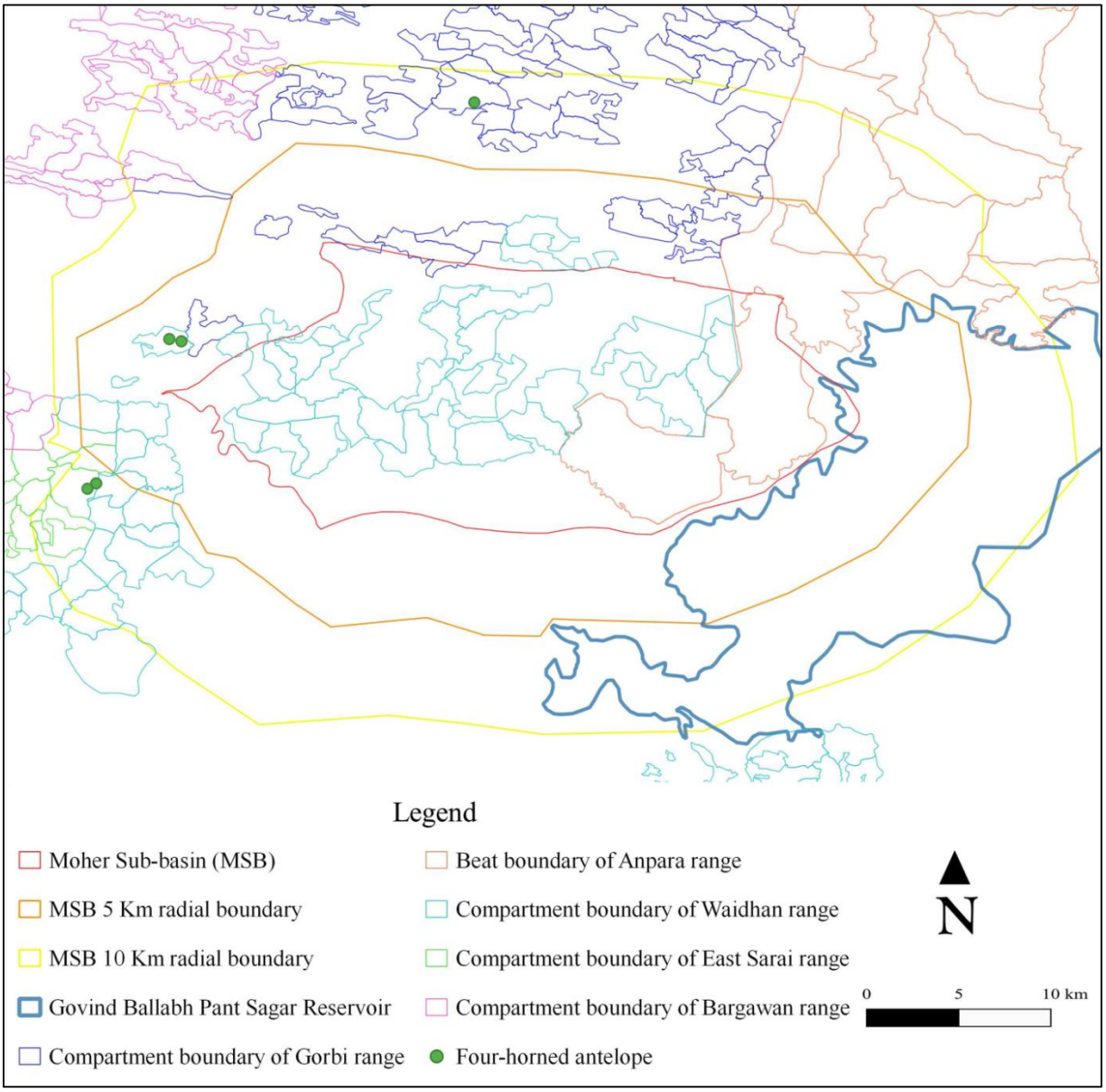

Figure 5. 2 Map showing presence of Four-horned antelope in study area

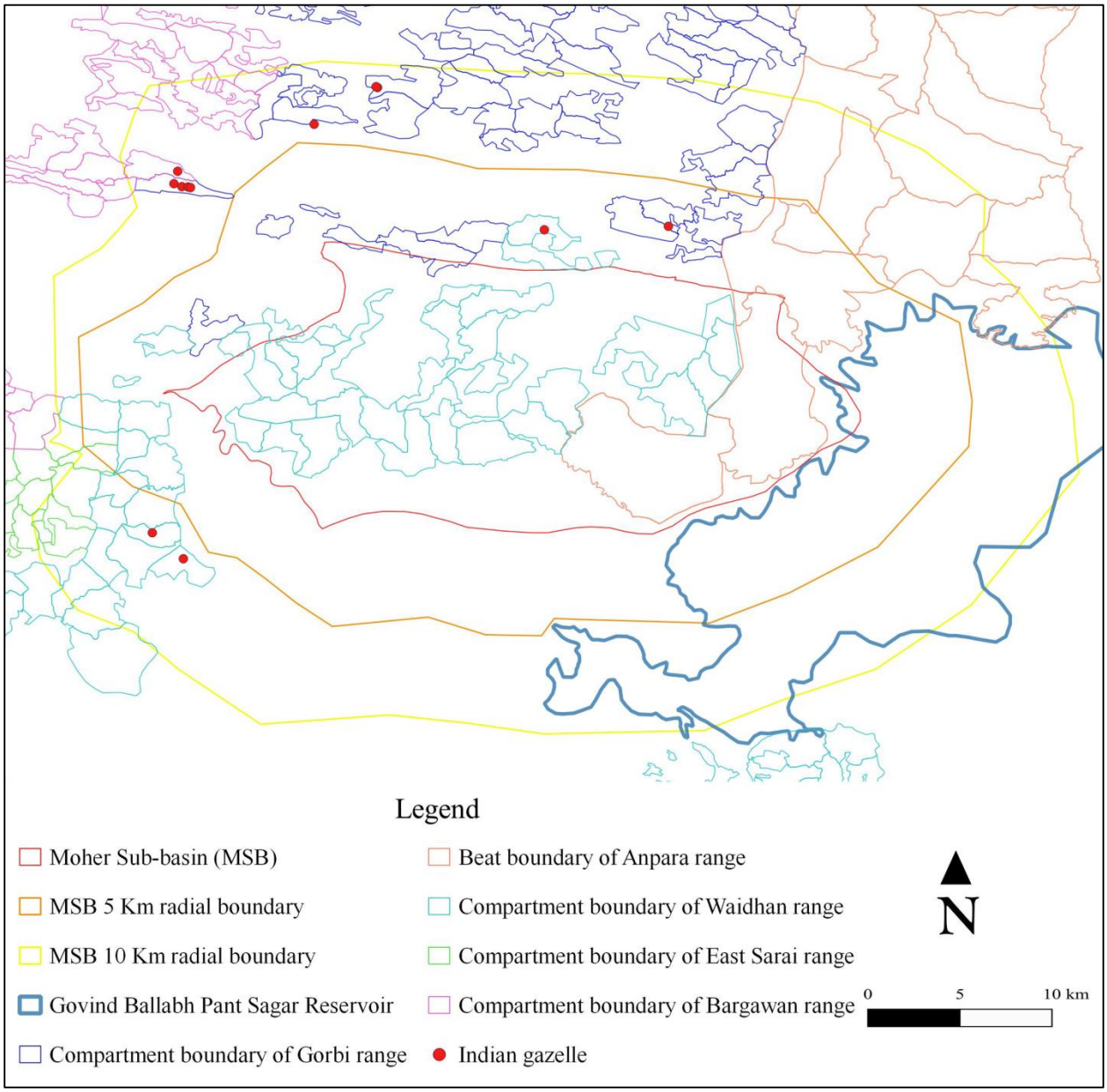

Figure 5. 3 Map showing presence of Indian gazelle in study area

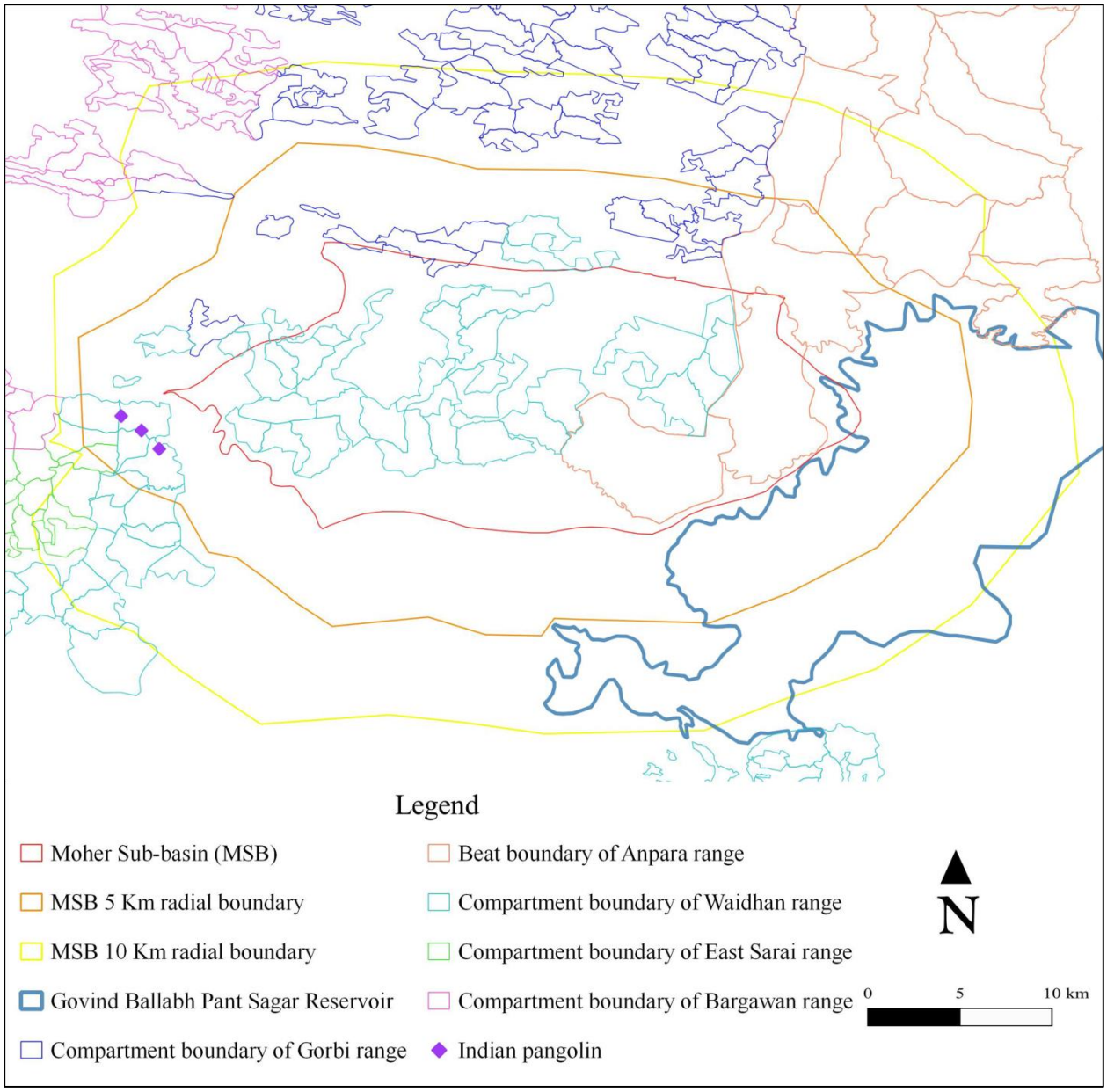

Figure 5. 4 Map showing presence of Indian pangolin in study area

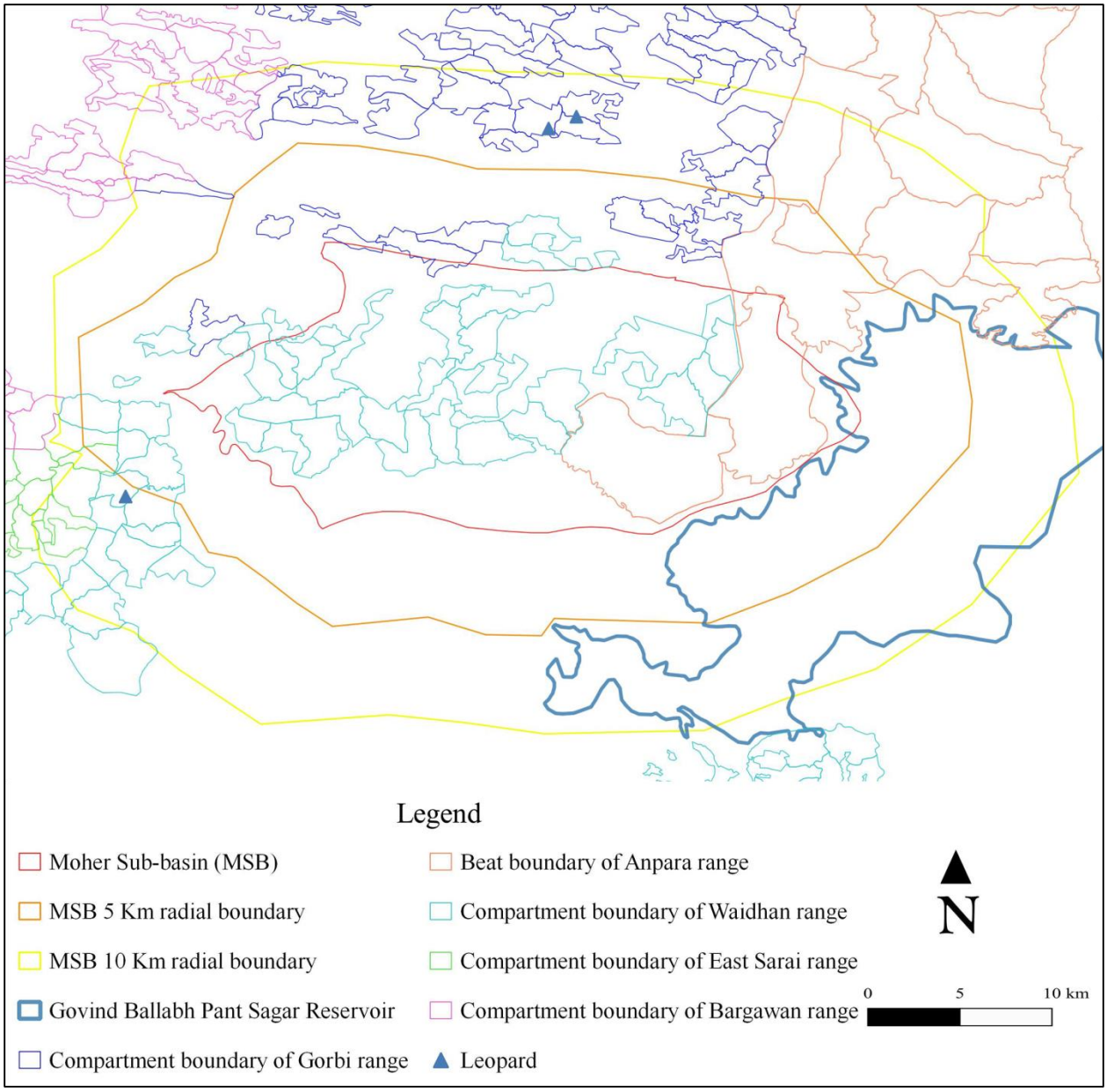

Figure 5. 5 Map showing presence of Leopard in study area

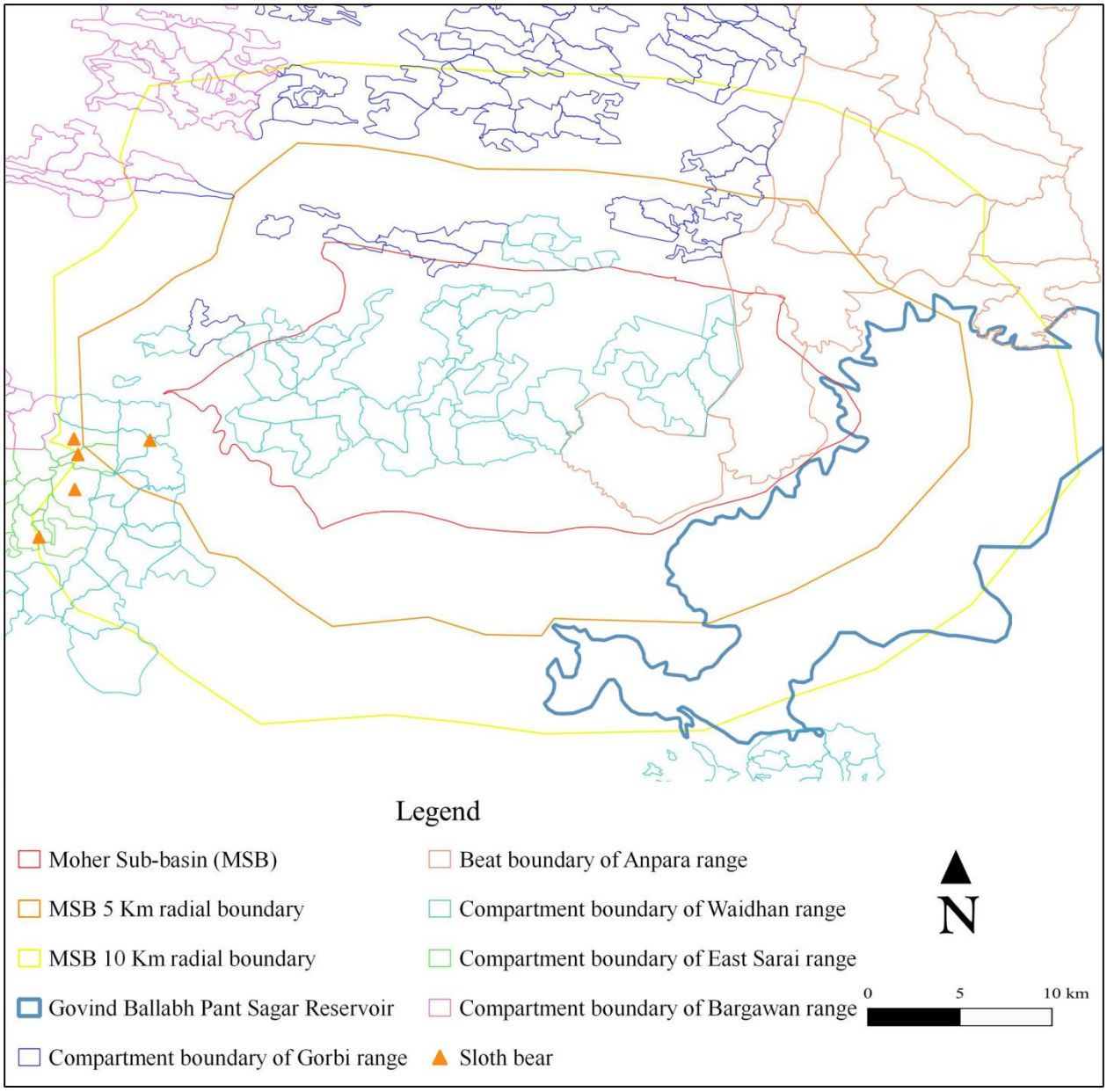

Figure 5. 6 Map showing presence of Sloth bear in study area

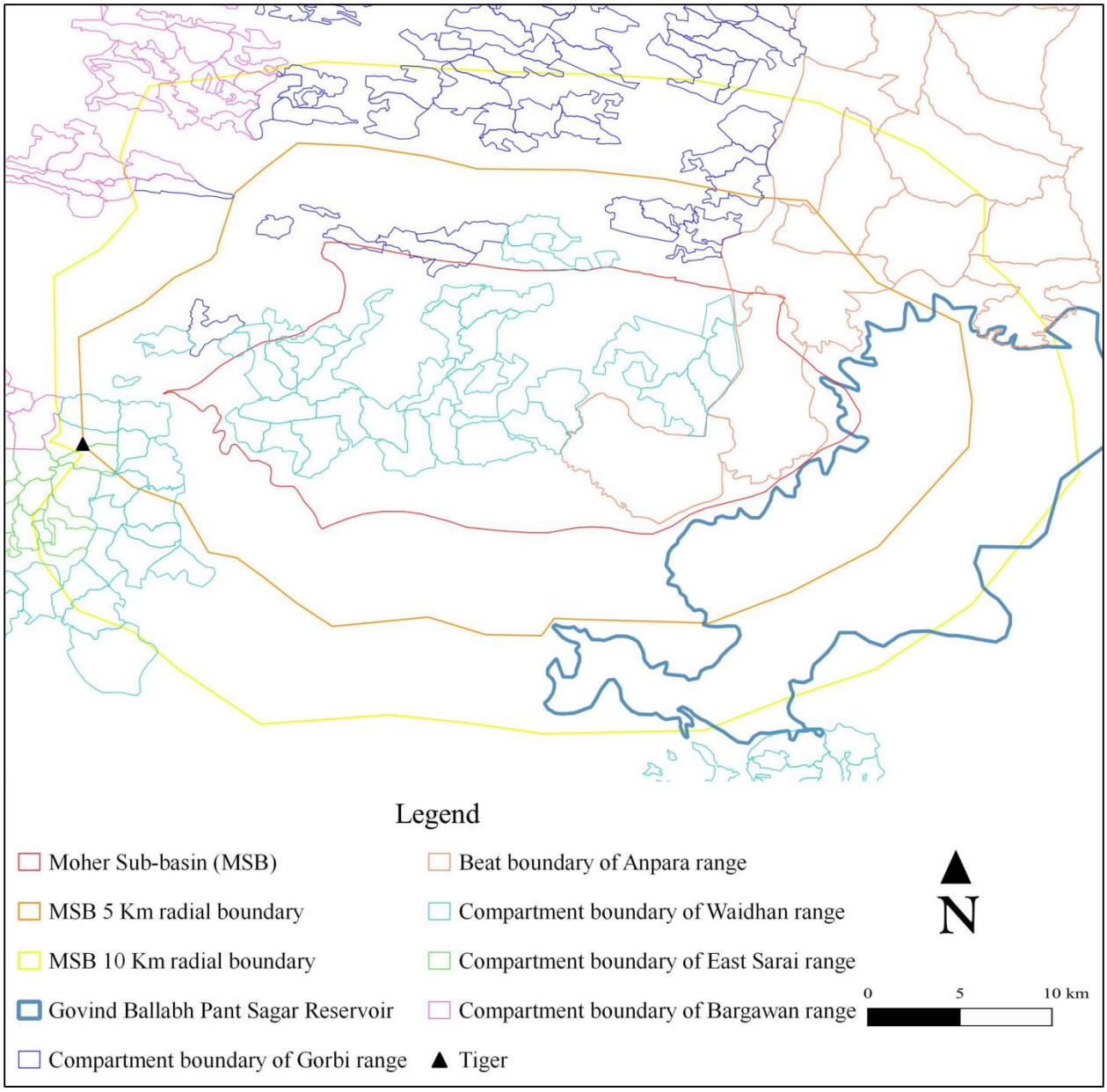

Figure 5. 7 Map showing presence of Tiger in study area

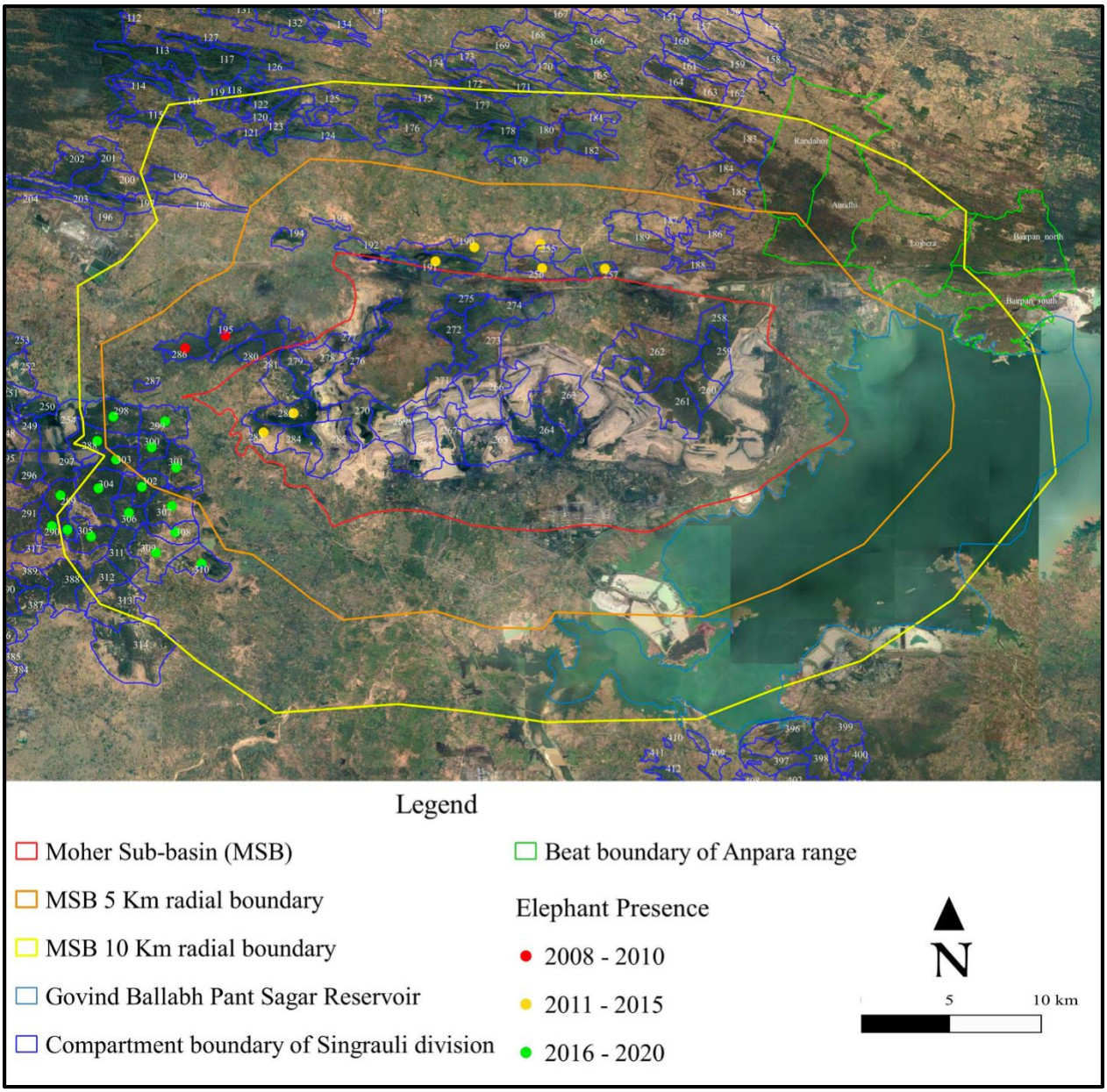

Figure 5. 8 Elephant presence as ascertained through secondary data in the study area

Plate 5. 3 Pugmarks of Sloth bear and pellets of Indian gazelle from study area

Plate 5. 4 Pugmarks of Leopard and Hyaena from study area

5.2 Status of Mammals and their Habitat

As discussed above 5-10 km radius of Moher Sub-basin shows more diversity in species inventory of mammals. 5-10 km radius of Moher Sub-basin might be harboring good population of mammals as the evidences and sightings of mammals were more common and frequent in this part of study area; this may be due to fairly better habitat quality in 5-10 km radius of Moher Sub-basin. The reason could be increased distance from the mining areas and reduced disturbance.

The northern part of 5-10 km radius of Moher Sub-basin was dominated by degraded secondary forests which harbored species adapted to survive in forests near human habitations; with high level of anthropogenic pressure. Nilgai (*Boselaphus tragocamelus*), chinkara (*Gazella bennettii*) and jackal (*Canis aureus*) were common in the northern part of 5-10 km radius of Moher Sub-basin. The southern part of 5-10 km radius of Moher Sub-basin have fairly rich primary forests providing comparatively good habitat quality, hence, species which avoid human and are more shy were common in these forests. Tiger (*Panthera* tigris), sloth bear (*Metursus ursinus*) and Sambar (*Cervus unicolor*) were predominantly recorded in this part of study area.

0-5 km radius of Moher Sub-basin showed less diverse and less frequent evidences of mammals. Most of the area of 5 km radius of Moher Sub-basin is covered by human habitations, agricultural fields and mines. The small non contiguous and fragmented forest patches of this part of study area were degraded and of poor quality. Grazing and illicit felling activitescould be the reason of less usage of this part by mammals. Higher density of road network and traffic due to high industrial and other anthropogenic activities further affects the mammalian activities in this area. Forests of 5-10 km radius of Moher Sub-basin are comparatively rich and primary forest with less fragmentation. Though illicit felling, grazing, NTFP collection is higher, traffic density is lower in this part of study area. All these factors contribute to better habitat quality for mammals in these forests of 5-10 km radius of Moher Sub-basin. The photographs of road kills

encountered in study area are shown in **Plate 5.3** while the road network of some major roads in study area is shown in **Figure 5.9**

Plate 5. 5 Jackal and Indian roller hit by vehicle in study area

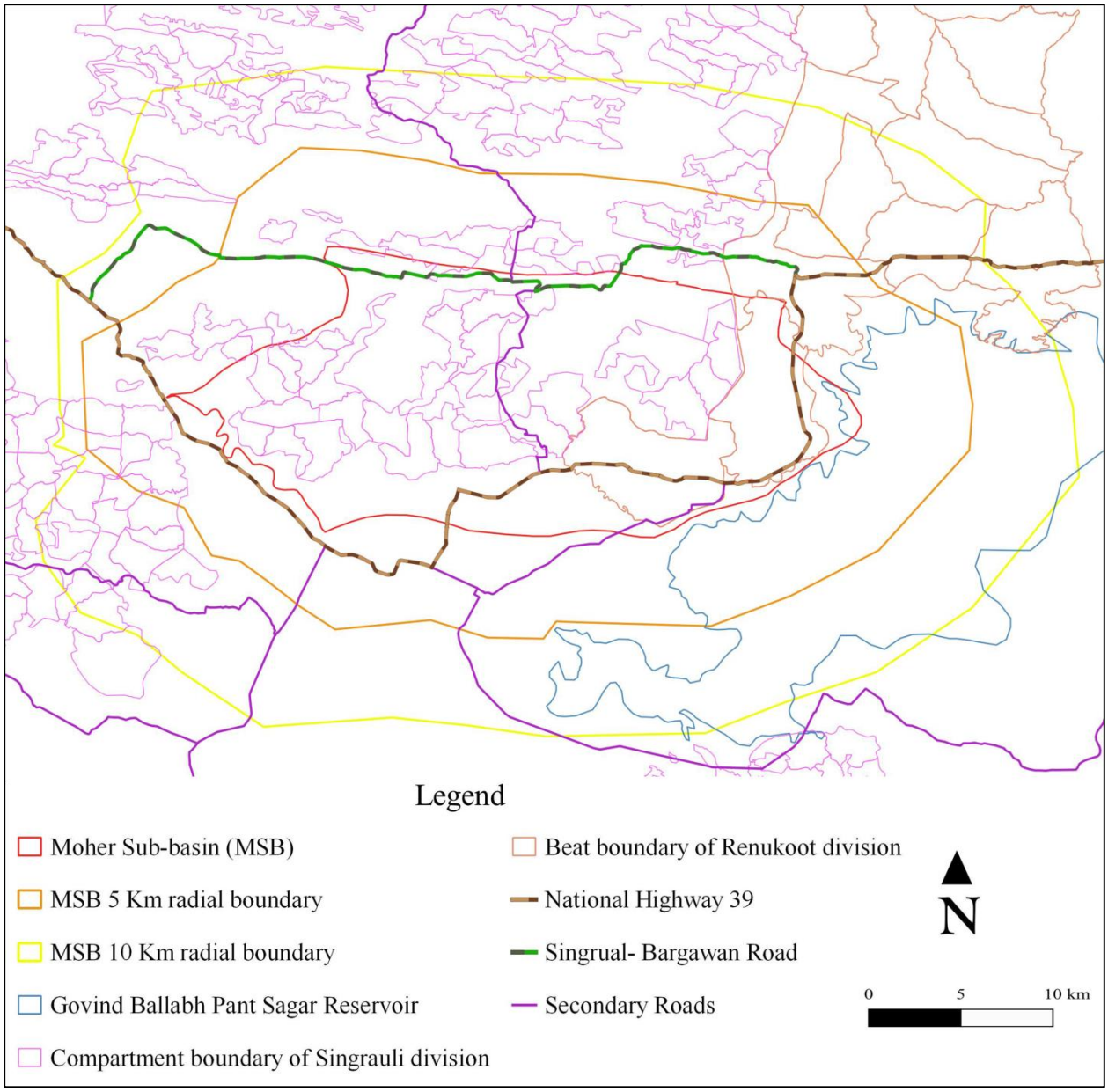

Figure 5. 9 Map showing National highway and major roads in study area

The study area is surrounded by 3 tiger reserves. Bandhavgarh Tiger Reserve is approximately 122 Km towards west, Sanjay Dubri Tiger Reserve is approximately 24 Km towards south-west, Guru Ghasidas National at 23 km in south and Palamau Tiger Reserve is approximately 108 Km in North-east direction. A map depicting tiger reserves surrounding the study area is given below in **Figure 5.10**

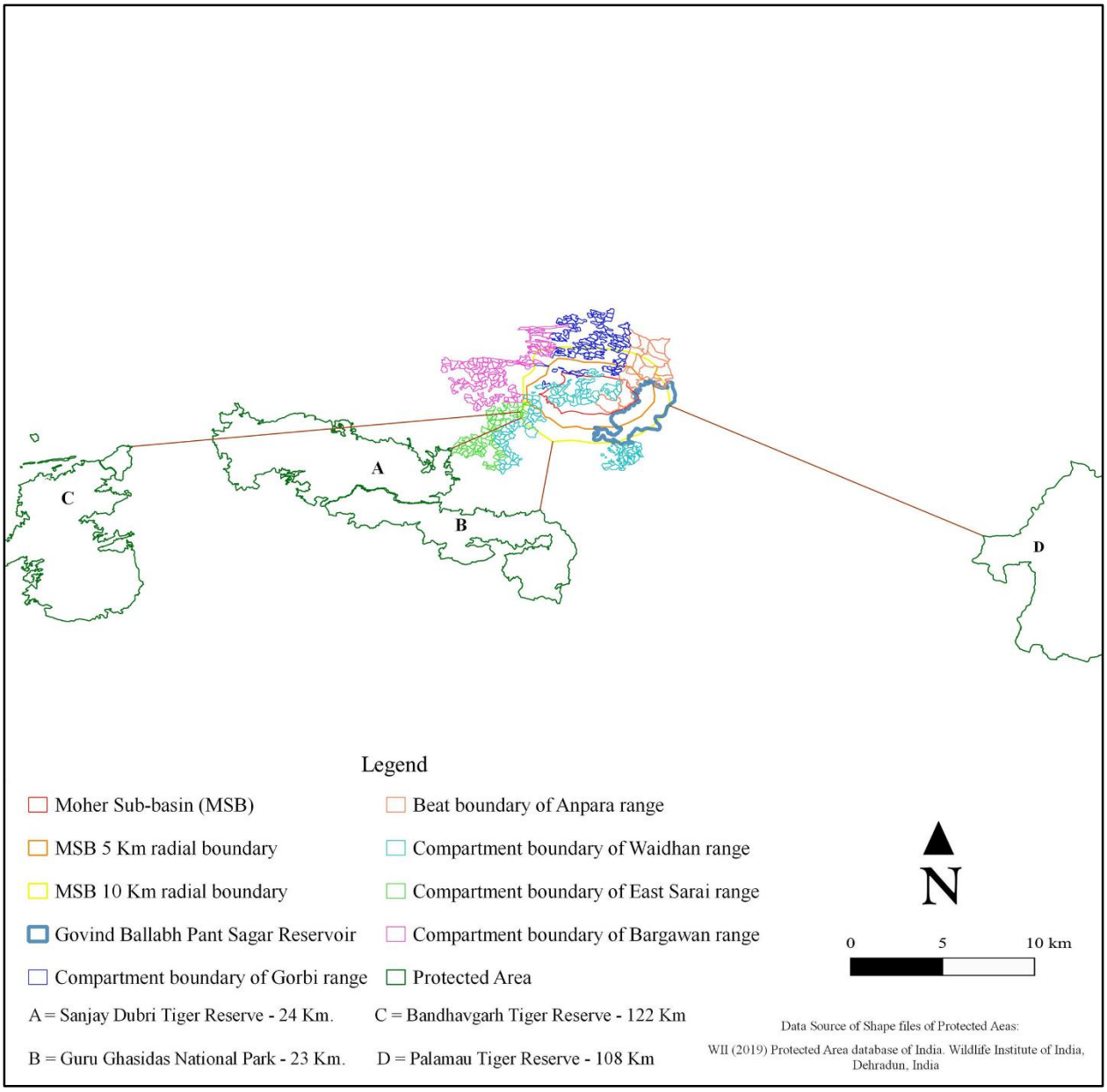

Figure 5. 10 Map showing Tiger Reserves around study area

5.3 Avifauna

The study area showed poor diversity in avian species. Only generalist species were recorded in the study area. Bird species which occur around human habitations and are adapted to withstand high anthropogenic pressure were commonly recorded. 104 avian species were recorded in the study area, 9 of which were from Schedule I of Wildlife

Protection Act. List and details of birds recorded in the study area are given in **Table5.5** and **Table 5.6**.

Table 5. 5 List of birds recorded in 0-5 km radius of Moher Sub-basin

S.No	Common name	Scientific Name	WPA Status
1.	Asian koel	*Eudynamys scolopacea*	Schedule IV
2.	Asian openbill	*Anastomus oscitans*	Schedule-IV
3.	Asian palm swift	*Cypsiurus balasiensis*	Schedule-IV
4.	Asian pied starling	*Gracupica contra*	Schedule-IV
5.	Bay-backed shrike	*Lanius vittatus*	Schedule-IV
6.	Baya weaver	*Ploceus philippinus*	Schedule-IV
7.	Black drongo	*Dicrurus macrocercus*	Schedule-IV
8.	Black-hooded oriole	*Oriolus xanthornus*	Schedule-IV
9.	Black kite	*Milvus migrans*	-
10.	Black-shouldered kite	*Elanus caeruleus*	-
11.	Brahminy kite	*Halsitur indus*	-
12.	Brahminy starling	*Sturnia pagodarum*	Schedule-IV
13.	Bronze-winged Jacana	*Metopidius indicus*	Schedule-IV
14.	Brown-headed barbet	*Psilopogon zeylanicus*	Schedule-IV
15.	Cattle egret	*Bubulcus ibis*	Schedule IV
16.	Chestnut-tailed starling	*Sturnia malabarica*	Schedule IV
17.	Common babbler	*Argya caudata*	Schedule-IV

18.	Common hawk cuckoo	*Hierococcyx varius*	Schedule-IV
19.	Common hoopoe	*Upupa epops*	Schedule IV
20.	Common iora	*Aegithina tiphia*	Schedule-IV
21.	Common kestrel	*Falco tinnunculus*	Schedule-IV
22.	Common kingfisher	*Alcedo atthis*	Schedule-IV
23.	Common myna	*Acridotheres tristis*	Schedule IV
24.	Common moorhen	*Gallinula chloropus*	Schedule-IV
25.	Common pigeon	*Columba livia*	Schedule IV
26.	Common quail	*Coturnix coturnix*	Schedule IV
27.	Common tailor bird	*Orthotomus sutorius*	Schedule-IV
28.	Common woodshrike	*Tephrodornis pondicerianus*	Schedule-IV
29.	Coppersmith barbet	*Psilopogon haemacephalus*	Schedule-IV
30.	Crested serpent eagle	*Spilornis cheela*	-
31.	Eurasian eagle owl	*Bubo bubo*	Schedule-IV
32.	Euresian-collered dove	*Streptopelia decaocto*	Schedule-IV
33.	Great egret	*Ardea alba*	Schedule-IV
34.	Great tit	*Parus major*	Schedule-IV
35.	Greater racket-tailed drongo	*Dicrurus paradiseus*	Schedule-IV
36.	Greater short-toed lark	*Calandrella brachydactyla*	Schedule-IV
37.	Green bee-eater	*Merops orientalis*	Schedule-IV

38.	Green sandpiper	*Tringa ochropus*	Schedule-IV
39.	Grey-breasted prinia	*Prinia hodgsonii*	Schedule-IV
40.	Grey francolin	*Francolinus pondicerianus*	Schedule-IV
41.	Grey junglefowl	*Gallus sonneratii*	Schedule-IV
42.	Grey wagtail	*Motacilla cinerea*	Schedule-IV
43.	House crow	*Corvus splendens*	Schedule-V
44.	House sparrow	*Passer domesticus*	Schedule-IV
45.	Indain silverbill	*Euodice malabarica*	Schedule-IV
46.	Indian bushlark	*Mirafra erythroptera*	Schedule-IV
47.	Indian grey hornbill	*Ocyceros birostris*	Schedule-IV
48.	Indian nightjar	*Caprimulgus asiaticus*	Schedule-IV
49.	Indian peafowl	*Pavo cristatus*	Schedule-I
50.	Indian pond heron	*Ardeola grayii*	Schedule IV
51.	Indian robin	*Saxicoloides fulicatus*	Schedule-IV
52.	Indian roller	*Coracias benghalensis*	Schedule-IV
53.	Jungle babbler	*Turdoides striata*	Schedule-IV
54.	Jungle owlet	*Glaucidium radiatum*	Schedule-IV
55.	Laughing dove	*Streptopelia senegalensis*	Schedule-IV
56.	Lesser golden-backed woodpecker	*Dinopium benghalense*	Schedule-IV
57.	Lesser racket-tailed drongo	*Dicrurus remifer*	Schedule-IV

58.	Little cormorant	*Microcarbo niger*	Schedule-IV
59.	Little grebe	*Tachybaptus ruficollis*	Schedule-IV
60.	Little ringed plover	*Charadrius dubius*	Schedule-IV
61.	Long-tailed shrike	*Lanius schach*	Schedule-IV
62.	Olive-backed pipit	*Anthus hodgsoni*	Schedule-IV
63.	Oriental magpie robin	*Copsychus saularis*	Schedule-IV
64.	Paddyfield pipit	*Anthus rufulus*	Schedule-IV
65.	Pied bushchat	*Saxicola caprata*	Schedule-IV
66.	Plain prinia	*Prinia inornata*	Schedule-IV
67.	Plum-headed parakeet	*Psittacula cyanocephala*	Schedule-IV
68.	Purple sunbird	*Cinnyris asiaticus*	Schedule-IV
69.	Red munia	*Amandava amandava*	Schedule-IV
70.	Red-breasted flycatcher	*Ficedula parva*	Schedule-IV
71.	Red-naped ibis	*Pseudibis papillosa*	Schedule-IV
72.	Red-rumped swallow	*Cecropis daurica*	Schedule-IV
73.	Red-vented bulbul	*Pycnonotus cafer*	Schedule-IV
74.	Red-wattled lapwing	*Vanellus indicus*	Schedule-IV
75.	Rose-ringed parakeet	*Psittacula krameri*	Schedule-IV
76.	Rufous-tailed lark	*Ammomanes phoenicura*	Schedule-IV
77.	Rufous treepie	*Dendrocitta vagabunda*	Schedule-IV

78.	Scaly-breasted munia	*Lonchura punctulata*	Schedule-IV
79.	Shikra	*Accipiter badius*	-
80.	Southern coucal	*Centropus sinensis*	Schedule-IV
81.	Spotted dove	*Streptopelia chinensis*	Schedule-IV
82.	Spotted owlet	*Athene brama*	Schedule-IV
83.	Sulphur-bellied warbler	*Phylloscopus griseolus*	Schedule-IV
84.	White-bellied drongo	*Dicrurus caerulescens*	Schedule-IV
85.	White-breasted waterhen	*Amaurornis phoenicurus*	Schedule-IV
86.	White-browed fantail	*Rhipidura aureola*	Schedule-IV
87.	White-browed wagtail	*Motacilla maderaspatensis*	Schedule-IV
88.	White-naped woodpecker	*Chrysocolaptes festivus*	Schedule-IV
89.	White wagtail	*Motacilla alba*	Schedule-IV
90.	White-throated kingfisher	*Halcyon smyrnensis*	Schedule-IV
91.	Woolly-necked stork	*Ciconia episcopus*	Schedule-IV
92.	Yellow-crowned woodpecker	*Leiopicus mahrattensis*	Schedule-IV
93.	Yellow-eyed babbler	*Chrysomma sinense*	Schedule-IV
94.	Western yellow wagtail	*Motacilla flava*	Schedule-IV
95.	Yellow-wattled lapwing	*Vanellus malabaricus*	Schedule-IV

Out of 104 species of birds recorded in the study area 95 were found to be present in 5 km radius of Moher Sub-basin and 6 species were from Schedule I of Wildlife Protection Act.

Table 5. 6 List of birds recorded in 5-10 km radius of Moher Sub-basin

S.No	Common name	Scientific Name	WPA Status
1.	Asian koel	*Eudynamys scolopacea*	Schedule IV
2.	Asian openbill	*Anastomus oscitans*	Schedule-IV
3.	Asian palm swift	*Cypsiurus balasiensis*	Schedule-IV
4.	Asian pied starling	*Gracupica contra*	Schedule-IV
5.	Bay-backed shrike	*Lanius vittatus*	Schedule-IV
6.	Baya weaver	*Ploceus philippinus*	Schedule-IV
7.	Black drongo	*Dicrurus macrocercus*	Schedule-IV
8.	Black Eagle	*Ictinaetus malaiensis*	-
9.	Black-hooded oriole	*Oriolus xanthornus*	Schedule-IV
10.	Black kite	*Milvus migrans*	-
11.	Black-shouldered kite	*Elanus caeruleus*	-
12.	Brahminy kite	*Halsitur indus*	-
13.	Brahminy starling	*Sturnia pagodarum*	Schedule-IV
14.	Bronze-winged Jacana	*Metopidius indicus*	Schedule-IV
15.	Brown-capped pygmy woodpecker	*Dendrocopos nanus*	Schedule-IV
16.	Brown-headed barbet	*Psilopogon zeylanicus*	Schedule-IV

17.	Cattle egret	*Bubulcus ibis*	Schedule IV
18.	Chestnut-tailed starling	*Sturnia malabarica*	Schedule IV
19.	Common babbler	*Argya caudata*	Schedule-IV
20.	Common hawk cuckoo	*Hierococcyx varius*	Schedule-IV
21.	Common hoopoe	*Upupa epops*	Schedule IV
22.	Common iora	*Aegithina tiphia*	Schedule-IV
23.	Common kestrel	*Falco tinnunculus*	Schedule-IV
24.	Common kingfisher	*Alcedo atthis*	Schedule-IV
25.	Common myna	*Acridotheres tristis*	Schedule IV
26.	Common moorhen	*Gallinula chloropus*	Schedule-IV
27.	Common pigeon	*Columba livia*	Schedule IV
28.	Common quail	*Coturnix coturnix*	Schedule IV
29.	Common tailor bird	*Orthotomus sutorius*	Schedule-IV
30.	Common woodshrike	*Tephrodornis pondicerianus*	Schedule-IV
31.	Coppersmith barbet	*Psilopogon haemacephalus*	Schedule-IV
32.	Crested serpent eagle	*Spilornis cheela*	-
33.	Egyptian vulture	*Neophron percnopterus*	Schedule-IV
34.	Eurasian eagle owl	*Bubo bubo*	Schedule-IV
35.	Euresian-collered dove	*Streptopelia decaocto*	Schedule-IV
36.	Great egret	*Ardea alba*	Schedule-IV

37.	Great tit	*Parus major*	Schedule-IV
38.	Greater racket-tailed drongo	*Dicrurus paradiseus*	Schedule-IV
39.	Greater short-toed lark	*Calandrella brachydactyla*	Schedule-IV
40.	Green bee-eater	*Merops orientalis*	Schedule-IV
41.	Green sandpiper	*Tringa ochropus*	Schedule-IV
42.	Grey-breasted prinia	*Prinia hodgsonii*	Schedule-IV
43.	Grey francolin	*Francolinus pondicerianus*	Schedule-IV
44.	Grey junglefowl	*Gallus sonneratii*	Schedule-IV
45.	Grey wagtail	*Motacilla cinerea*	Schedule-IV
46.	House crow	*Corvus splendens*	Schedule-V
47.	House sparrow	*Passer domesticus*	Schedule-IV
48.	Indain silverbill	*Euodice malabarica*	Schedule-IV
49.	Indian bushlark	*Mirafra erythroptera*	Schedule-IV
50.	Indian grey hornbill	*Ocyceros birostris*	Schedule-IV
51.	Indian nightjar	*Caprimulgus asiaticus*	Schedule-IV
52.	Indian peafowl	*Pavo cristatus*	Schedule-I
53.	Indian pond heron	*Ardeola grayii*	Schedule IV
54.	Indian robin	*Saxicoloides fulicatus*	Schedule-IV
55.	Indian roller	*Coracias benghalensis*	Schedule-IV
56.	Indian scops owl	*Otus bakkamoena*	Schedule-IV

57.	Jerdon's leafbird	*Chloropsis jerdoni*	Schedule-IV
58.	Jungle babbler	*Turdoides striata*	Schedule-IV
59.	Jungle owlet	*Glaucidium radiatum*	Schedule-IV
60.	Laughing dove	*Streptopelia senegalensis*	Schedule-IV
61.	Lesser golden-backed woodpecker	*Dinopium benghalense*	Schedule-IV
62.	Lesser racket-tailed drongo	*Dicrurus remifer*	Schedule-IV
63.	Little cormorant	*Microcarbo niger*	Schedule-IV
64.	Little grebe	*Tachybaptus ruficollis*	Schedule-IV
65.	Little ringed plover	*Charadrius dubius*	Schedule-IV
66.	Long-tailed shrike	*Lanius schach*	Schedule-IV
67.	Olive-backed pipit	*Anthus hodgsoni*	Schedule-IV
68.	Oriental honey buzzard	*Pernis ptilorhynchus*	-
69.	Oriental magpie robin	*Copsychus saularis*	Schedule-IV
70.	Paddy field pipit	*Anthus rufulus*	Schedule-IV
71.	Pied bushchat	*Saxicola caprata*	Schedule-IV
72.	Plain prinia	*Prinia inornata*	Schedule-IV
73.	Plum-headed parakeet	*Psittacula cyanocephala*	Schedule-IV
74.	Purple sunbird	*Cinnyris asiaticus*	Schedule-IV
75.	Red munia	*Amandava amandava*	Schedule-IV
76.	Red-breasted flycatcher	*Ficedula parva*	Schedule-IV

77.	Red-naped ibis	*Pseudibis papillosa*	Schedule-IV
78.	Red-rumped swallow	*Cecropis daurica*	Schedule-IV
79.	Red-vented bulbul	*Pycnonotus cafer*	Schedule-IV
80.	Red-wattled lapwing	*Vanellus indicus*	Schedule-IV
81.	Rose-ringed parakeet	*Psittacula krameri*	Schedule-IV
82.	Rufous-tailed lark	*Ammomanes phoenicura*	Schedule-IV
83.	Rufous treepie	*Dendrocitta vagabunda*	Schedule-IV
84.	Scaly-breasted munia	*Lonchura punctulata*	Schedule-IV
85.	Shikra	*Accipiter badius*	-
86.	Southern coucal	*Centropus sinensis*	Schedule-IV
87.	Spotted dove	*Streptopelia chinensis*	Schedule-IV
88.	Spotted owlet	*Athene brama*	Schedule-IV
89.	Sulphur-bellied warbler	*Phylloscopus griseolus*	Schedule-IV
90.	Verditer flycatcher	*Eumyias thalassinus*	Schedule-IV
91.	White-bellied drongo	*Dicrurus caerulescens*	Schedule-IV
92.	White-breasted waterhen	*Amaurornis phoenicurus*	Schedule-IV
93.	White-browed fantail	*Rhipidura aureola*	Schedule-IV
94.	White-browed wagtail	*Motacilla maderaspatensis*	Schedule-IV
95.	White-eyed buzzard	*Butastur teesa*	-
96.	White-naped woodpecker	*Chrysocolaptes festivus*	Schedule-IV

97.	White wagtail	*Motacilla alba*	Schedule-IV
98.	White-throated kingfisher	*Halcyon smyrnensis*	Schedule-IV
99.	Woolly-necked stork	*Ciconia episcopus*	Schedule-IV
100.	Yellow-crowned woodpecker	*Leiopicus mahrattensis*	Schedule-IV
101.	Yellow-eyed babbler	*Chrysomma sinense*	Schedule-IV
102.	Western yellow wagtail	*Motacilla flava*	Schedule-IV
103.	Yellow-footed green pegion	*Treron phoenicopterus*	Schedule-IV
104.	Yellow-wattled lapwing	*Vanellus malabaricus*	Schedule-IV

As found in other taxa, avian species also showed more diversity in 10 km radius of Moher Sub-basin compared to 5 km radius of Moher Sub-basin. All 104 species of birds recorded in the study area were found to be present in 10 km radius of Moher Sub-basin.

Table 5. 7 Range wise presence of avian species in Schedule I of Wildlife Protection Act 1972

Common name	Scientific Name	Bargawan	East Sarai	Gorbi	Waidhan	Anpara
Indian Peafowl	Pavo cristatus	P	PS	P	P	P

P = Presence ascertained through primary data, PS = Presence ascertained through secondary data.

Indian peafowl was sighted four times in the study area. In Gorbi range it was seen twice in the forest area during survey, in Waidhan range it was sighted once in the forest area, while in Anpara range it was seen once at the forest edge near the village. Indirect

evidences and secondary data revealed presence of Indian peafowl in Bargwan and East Sarai.

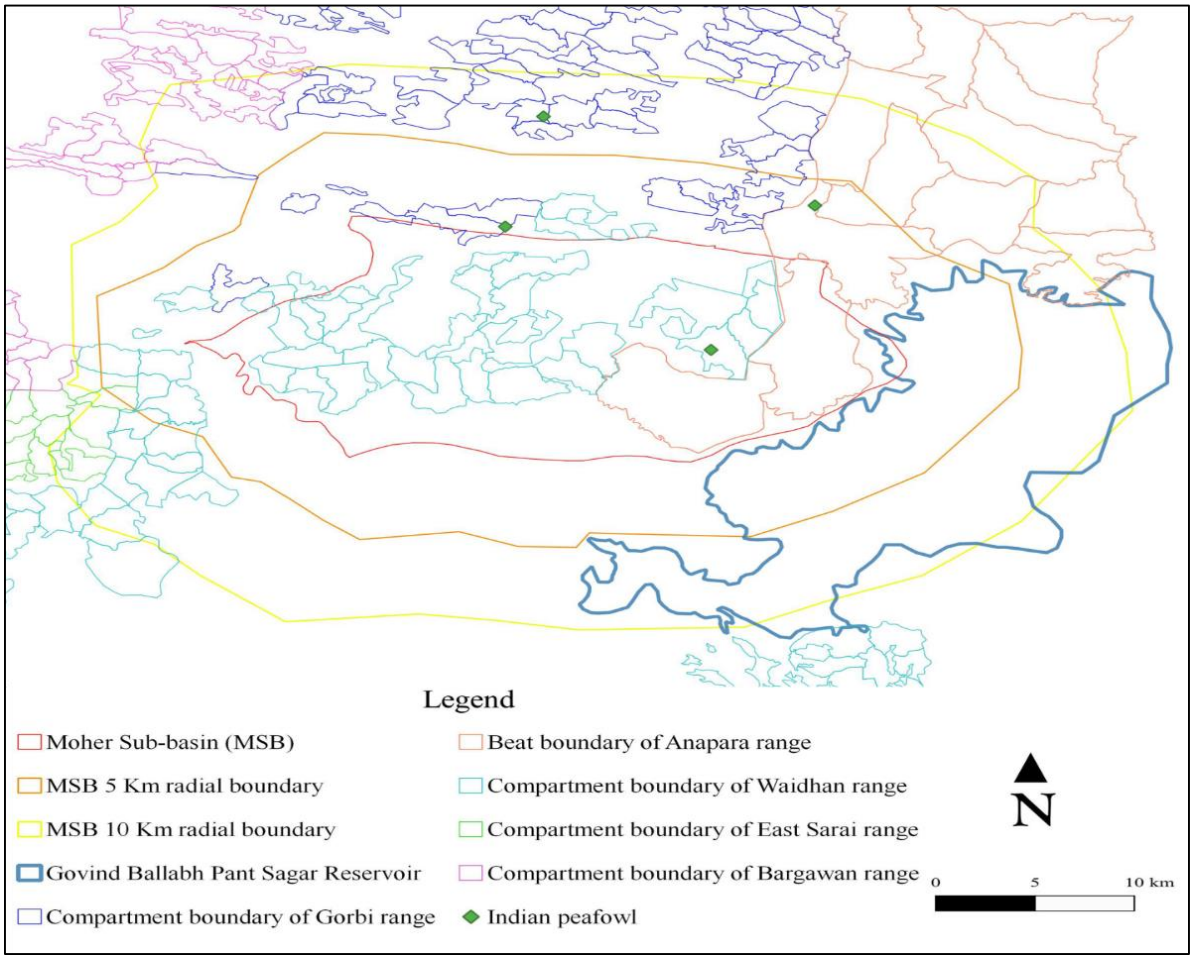

Figure 5. 11 Map showing presence of Indian peafowl in study area

5.4 Reptiles

Reptile sightings were very scarce in the study area. 11 species of reptiles were recorded during the surveys conducted in study area. Out of these 2 species were from Schedule I of Wildlife Protection Act. All the 11 species were found in both the parts of study area. The details of inventory of reptiles are given in **Table 5.8**.

Table 5. 8 List of reptilian species recorded in study area

S.No	Common name	Scientific Name	WPA Status
1	Buff striped keelback	*Amphiesma stolata*	Schedule IV
2	Spectacled cobra	*Naja naja*	Schedule II
3	Russel's viper	*Doboia russellii*	Schedule II
4	Bengal monitor lizard	*Varanus bengalensis*	Schedule I
5	Indian rock python	*Python molurus*	Schedule I
6	Garden lizard	*Calotes versicolor*	-
7	Common skink	*Mabuya carinata*	-
8	Rat snake	*Ptyas mucosus*	Schedule II
9	Bronzeback tree snake	*Dendrelaphis tristis*	Schedule IV
10	Checkered keelback	*Xenochrophis piscator*	Schedule II
11	Indian saw scaled viper	*Echis carinatus*	Schedule IV

Buff striped keelback, spectacled cobra, russel's viper and bronzeback tree snake were sighted in Waidhan range, rat snake in Bargawan, and checkered keelback in Gorbi were seen. Garden lizard and common skink were sighted in all five ranges. No snakes were sighted in Anapara range.

Presence of reptiles was also confirmed through informal interviews with forest department staff and villagers. During interviews it was found that forest department staff and villagers too have rarely seen snakes.

Table 5. 9 Range wise list of reptilian species recorded in study area

Common name	Scientific Name	Bargawan	East Sarai	Gorbi	Waidhan	Anpara	WPA Status
Buff striped keelback	Amphiesma stolata	PS	PS	PS	P	PS	Schedule IV

Spectacled cobra	Naja naja	PS	PS	PS	PD	PS	Schedule II
Russel's viper	Doboia russellii	PS	PS	PS	PD	PS	Schedule II
Bengal monitor lizard	Varanus bengalensis	PS	PS	PS	PS	PS	Schedule I
Indian rock python	Python molurus	A	PS	PS	PS	PS	Schedule I
Garden lizard	Calotes versicolor	P	P	P	P	P	-
Common skink	Mabuya carinata	P	P	P	P	P	-
Rat snake	Ptyas mucosus	P	PS	PS	PS	PS	Schedule II
Bronze back tree snake	Dendrelaphis tristis	A	A	A	P	A	Schedule IV
Checkered keelback	Xenochrophis piscator	PS	PS	P	PS	PS	Schedule II
Indian saw scaled viper	Echis carinatus	PS	PS	PS	PS	PS	Schedule IV

P = Presence ascertained through primary data, PS = Presence ascertained through secondary data and A = Absent.

5.5 Butterflies

The study area showed poor diversity of lepidopteran species. 59 species of butterflies from 5 families were recorded in during trail surveys. Butterflies generally prefer open habitats in forests with good food availability. Clearing of canopy in disturbed forests creates such open patches which are rich in flowering plants. Such patches also provide sunlight for basking. Some natural open patches are also perfect habitats for butterflies.

Moreover, riverine and stream areas provide moist ground for mud puddling in forests, which is a primary source of minerals for butterflies. Such areas harbor good number of butterflies as they provide excellent habitat for feeding and breeding for butterflies. The inventory of lepidopteran species recorded in study area is given in **Table 5.10**.

Table 5. 10 List of butterfly species from study area

S.No	Name	Scientific name	Status
	PAPILIONIDAE		
1	Spot Swordtail	*Pathysa nimius*	NR
2	Tailed Jay	*Graphium agammemnon*	NR
3	Crimson Rose	*pachliopta hector*	NR
4	Common Mime	*Chilasa clytia clytia*	NR
5	Lime Butterfly	*Princeps demoleus*	NR
6	Common Mormon	*Princeps polytes romulus*	NR
7	Psyche	*Leptosia nina nina*	NR
8	Indian Cabbage white	*Pieris canidia indica*	C
9	Pioneer	*Anapheis aurota aurota*	NR
10	Chocolate Albatross	*Appias lyncida elenora*	NR
11	Yellow Orange Tip	*Ixias pyrene familiaris*	NR
12	Great orange Tip	*Hebomoia glaucippe glaucippe*	NR
13	Common Jezebel	*Delias eucharis*	C
	COLIADINAE		
14	Common Emigrant	*Catopsilia pomona*	C
15	Mottled Emigramt	*Catopsilia pyranthe*	NR
16	Tailed Sulphur	*Dercas verhuelli*	NR
17	Spotless Grass Yellow	*Eurema laeta*	NR
18	Common Grass Yellow	*Eurema hecabe*	C
	MILETINAE		
19	Forest Pierrot	*Taraka hamada*	NR

	CURETINAE		
20	Common Acacia Blue	*Surendra todara*	NR
21	Common Leaf Blue	*Amblypodia anita*	NR
22	Common Silverline	*Spindasis vulcans*	NR
23	Cornelian	*Deudorix epijarbus*	NR
	POLYOMMATINAE		
24	Common Cerulean	*Jamides celeno*	NR
25	Peablue	*Lampides boeticus*	NR
26	Dark Cerulean	*Jamides bochus*	NR
27	Zebra Blue	*Syntarucus plinius*	NR
28	Common Pierrot	*Castalius rosimon*	R
29	Grass Jewel	*Zizeeria trochilus*	NR
30	Pale Grass Blue	*Pseudozizeeria maha*	C
31	Bright babul Blue	*Azanus ubaldus*	NR
32	Common Hedge Blue	*Acetolepis puspa*	NR
	SATYRINAE		
33	Common Evening Brown	*Melanitis leda*	R
34	Dark Evening Brown	*Melanitis phedima*	C
35	Common Bushbrown	*Mycalesis perseus*	C
36	Common Four-Ring	*Ypthima hubenri*	NR
	CHARAXINAE		
37	Tawny Rajah	*Charaxes polyxena*	NR
38	Common Nawab	*Polyura athamas*	NR
	NYMPHALINAE		
39	Common Leopard	*Phalanta phalanta*	NR
40	Yellow Pansy	*Precis hierta*	NR
41	Blue Pansy	*Precis orithya*	NR
42	Lemon Pansy	*Precis lemonias*	NR

43	Peacock Pansy	*Precis almana*	NR
44	Grey Pansy	*Precis atlites*	NR
45	Chocolate Soldier	*Precis iphita*	NR
44	Painted Lady	*Cynthia cardui*	U
45	Indian Tortoiseshell	*Aglais cachmirensis*	U
46	Danaid Eggfly	*Hypolimnas misippus*	NR
47	Great Eggfly	*Hypolimnas bolina*	NR
48	Common Sailer	*Neptis hylas*	NR
	HELICONIINAE		
49	Tawny Coster	*Acraea violae*	NR
	DANAINAE		
50	Blue Tiger	*Tirumala limniace*	NR
51	Glassy Tiger	*Parantica aglea*	NR
52	Common Tiger	*Danaus genutia*	NR
53	Plain Tiger	*Danaus chrysippus*	C
54	Common Crow	*Euploea core*	-
	HESPERIIDAE		
55	Common Awl	*Hasora badra*	U
	HESPERIINAE		
56	Grass Demon	*Udaspes folus*	NR
57	Common Redeye	*Matapa aria*	NR
58	Dark palm Dart	*Telicota ancilla*	U
59	Blank Swift	*Caltoris kumara*	U

NR – Not Rare, C – Common, U – Unknown

The most dominant family with respect to number of species recorded was found to be Nymphalidae with 19 species, Pieridae was second dominant family with 7 species, Lycaenidae was the next dominant family with 5 species, Papilionidae and Hesperiidae were least dominant with 4 and 1 species each.

Plate 5. 6 Butterfly diversity in the study area

5.6 Spiders

A total of 23 species of spiders were recorded from the study area during the survey period. Spiders were seen all over the project area as well as the buffer zone. Spiders are voracious predators of insects and because they are able to survive the periods of low food availability and take advantage of periods of abundance they are well adapted to variety of habitat types. The orb making spiders were more common in areas where there

were clearly marked aerial galleries for insect movement. These spiders were commonly seen in the all forest area which had tall Sal trees and large aerial galleries required for making orbs. The detailed list of spiders recorded during the survey period is given below in **Table 5.8**.

Table 5. 11 List of spiders recorded in the study area

S.No.	Common name	Scientific name	Sighting Core/Buffer
1	Coin trapdoor	*Sason cinctipes*	Core, Buffer
2	Brown funnel web spider	*Plesiophrictus collinus*	Core, Buffer
3	Wall orb	*Araneus bilunifer*	Buffer
4	Speckled band four leg	*Argiope anasuja*	Buffer
5	Long orb	*Cyclosa confraga*	Core
6	Fluted orb	*Herennia ornatissima*	Buffer
7	Leaf retreat orb	*Neoscona rumfi*	Buffer
8	Gaint wood spider	*Nephila maculata*	Buffer
9	Yellow club	*Chiracanthium melanostoma*	Core, Buffer
10	Ashy social spider	*Stegodyphus sarasinorum*	Core, Buffer
11	Common two-tail	*Hersilia savigyni*	Buffer
12	Gaint crab spider	*Heteropoda venatoria*	Buffer
13	Tube wolf	*Hippasa greenalliae*	Buffer
14	Funnel wolf	*Hippasa agelenoides*	Core, Buffer
15	Tunnel wolf	*Lycosa indagatrix*	Core, Buffer
16	Green lynx	*Peucetia viridana*	Core, Buffer
17	Brown lynx	*Oxyopes rufisternum*	Core, Buffer
18	Box longlegs	*Crossopriza lyonii*	Core, Buffer

S.No.	Common name	Scientific name	Sighting Core/Buffer
19	Round longlegs	*Artema atlanta*	Core, Buffer
20	Zebra jumper	*Plexippus paykulli*	Core, Buffer
21	Common big-jaw	*Tetragnatha mandibulata*	Core, Buffer
22	Long-legged straw	*Eucta javana*	Core, Buffer
23	Garden spider	*Areneus diadematus*	Core, Buffer

5.7 Fish

A total of 11 fish species were recorded based on the interviews and information given by the local fisherman. Most of the fish species reported are from the Rihand dam and the local streams and rivulets in the area.

Table 5. 12 List of fish Species reported from the study area

S.No	Common name	Scientific name
1	Catla	*Catla Catla*
2	Mrigal	*Cirrhina mrigala*
3	Mongri Rou	*Labeo fimbriatus*
4	Magur	*Clarias magur*
5	Singhara	*Mystus vittatus*
6	Dingra	*Mystus aor*
7	Bam	*Mastocemlelus pancalus*
8	Dukkar	*Nandus nandus*
9	Murrel	*Channa straitus*
10	Gungara	*Ompak bimaculatus*
11	Fresh water catfish	*Mystus seenghala*

5.8 Overall Habitat Status

Most forests of study area are degraded secondary forests. Few parts show rich forests with fairly better habitat, harboring good wildlife. Evidences of anthropogenic activities like fuel wood collection, timber logging and cattle grazing were observed in forests of all parts of study area. South western part of study area which includes East Sarai and Wadihan ranges showed good quality forests. Sal forests with various landscape features like caves, streams, valleys and habitat types that provide refuge to wildlife are characteristic to these parts. Abundant seasonal streams are present in study area but water availability for wildlife in late winter and summer was found to be scarce. Most of the Schedule I species were present in Waidhan, East Sarai and Gorbi ranges as these ranges provide better habitat for Schedule I species.

Chapter 6 Socio-economic profile

A total of 179 habitation units have been delineated from the available buffer of 10 kilometers around the Moher sub-basin demarcated as the study area. At the outset it is clarified that the source of all the demographic figures is the Census of 2011 (GoI, 2015), being the latest data available. There being 179 habitation units in the study area, 144 in Madhya Pradesh and 35 in Uttar Pradesh respectively, the total human population in 10 km radius area is 590,344 persons with 431,447 in MP and 158,897 in UP respectively. Let us now look at the rural demographic profile that might be more pertinent to a consideration of human wildlife relations.

6.1 Demographic Profile of Rural areas

There are a total of 170 villages within two districts of Madhya Pradesh and Uttar Pradesh namely Singrauli and Sonbhadra respectively. The tehsils within the demarcated study area of MP include Chitrangi, Deosar and Singrauli and the lone tehsil of UP is Dudhi.

Table 6. 1 Breakup of Villages in the study area

District Name	Tehsil				Total
	Chitrangi	Deosar	Dudhi	Singrauli	
Singrauli (MP)	48	12	0	82	142
Sonbhadra (UP)	0	0	28	0	28
Total	48	12	28	82	170

Out of the 170 villages 28 are in UP and 142 lie in MP. Let us now look at several demographic parameters in greater detail in Table 6.2.

Table 6. 2 Rural Households and Population Profile

Demographic Parameters	Tehsil							
	Chitrangi		Deosar		Dudhi		Singrauli	
	Mean	Total	Mean	Total	Mean	Total	Mean	Total
Households	279	13394	542	6505	428	11984	266	21782
Population	1438	69026	2572	30859	2518	70498	1278	104776
Males	743	35686	1400	16803	1328	37182	660	54102
Females	695	33340	1171	14056	1190	33316	618	50674
Child (<=6)	283	13580	468	5613	440	12318	226	18572
SC	205	9832	557	6684	604	16914	193	15853
ST	505	24239	548	6576	536	15003	181	14856

As is evident from the Table 6.2 above the rural population is approximately 2,75,159 with 2,04,661 in MP and 70498 in UP respectively. The highest average households (thereby indicating demographic size) are in Deosar Tehsil (542) and the lowest average is that of Singrauli Tehsil (266). The high mean number of households in Deosar tehsil could be on account of the villages within the study area being only 12 with relatively higher household numbers. Singrauli Tehsil having the highest number of villages (82) then would have a higher variation in household size that gets averaged out to the mean figure of 266 households.

A consideration of the ratio of number of females per thousand males is indicative of the relative demographic change due to several factors such as presence of large number of

single males or high male households due to the proximity of the areas to male dominated mining work. A closer look at the rural ratios of MP reveals that the lowest ratio is that of Deosar Tehsil at 836 females per thousand males and the highest is that of Singrauli Tehsil at 936 females per thousand males. These ratios for the respective tehsil rural populations are 904 and 949 for Deosar and Singrauli respectively. While the female to male ratio for Singrauli part of the study area may be closer to the entire rural population ratio (lesser by 13 in the study area), the ratio for Deosar is lesser by 68. The specific factors leading to this variation in the study area of Deosar could be attributed to the villages in the Deosar part of the study area being more closely associated with mining related activities (especially daily wage labour) in the North western and South western parts of the study area as compared to the rest of the Tehsil (study area being a relatively smaller part of the wider tehsil). We shall examine this is greater detail in a subsequent section.

The social composition of the rural population is indicative of the heterogeneity and presence of relatively marginalized groups such as the Scheduled Tribes (ST) in the study area. The proportion of ST in the study area villages is highest for Chitrangi (35.11%) and lowest for Singrauli (14.17%). The difference in proportion of rural population belonging to ST groups is highest in part of Deosar study area as compared to the proportion of ST in the rural population of Deosar Tehsil as a whole (the difference being 20.19 percentage points). This again reinforces the idea that while the other tehsils may be closer to the composition and demographic profile of the larger tehsils population, Deosar study area deviated the most from the Deosar Tehsil composition as a whole. A similar trend is seen in the difference between Deosar study area Scheduled Caste (SC) population (21.65%) and Deosar Tehsil as a whole being 10.08%, there being larger proportion of SC communities in the study area. The rest of the study areas and tehsil figures are more comparable or similar. The rural literacy rates of the tehsils ranges from 64% for Singrauli to 56.2% for Chitrangi.

6.2 Demographic Profile of Urban areas

A total of 9 towns and municipal areas are recorded from Singrauli and Sonbhadra districts. Naudhia Census Town (CT) and Singrauli Municipal Corporation are within the Singrauli district of Madhya Pradesh (MP) while the remaining CTs are located within Sonbhadra district of Uttar Pradesh.

Table 6. 3 Urban Households and Population Profile

Census Town / Municipal Corporation	Households	Population	Males	Females	Child<=6	SC	ST
Anpara (CT)	3758	17978	9651	8327	1928	2480	367
Bijpur (CT)	2151	9420	5060	4360	1076	688	345
Jamshila (CT)	1606	7923	4208	3715	704	953	136
Kakari (CT)	1043	5221	2807	2414	430	1038	124
Khariya (CT)	2001	10482	5615	4867	1006	1230	182
Kota (CT)	2936	13409	7164	6245	1347	1637	360
Naudhia (CT)	1341	6529	3446	3083	725	673	767
Parasi (CT)	4817	23966	12780	11186	2655	2706	245
Singrauli (M Corp.)	44682	220257	116867	103390	30079	29531	21925

As is evident from the table above the largest habitation center amongst the urban areas is Singrauli Municipal Corporation with a total of 44682 households and a total of 220257

persons. Parasai and Anpara are the notable Census Town (CT) areas in the UP part of the study area. While the female to 1000 male ratio is similar in most of the urban study areas it is noteworthy that the highest ratios are found in the MP urban areas namely Naudhia (894) and Singrauli (884) respectively. A similar trend is seen in the proportion of ST being highest in Naudhia (11.74%) and Singrauli (9.95%). However, in the case of SC a more or less even distribution of 7 to 13% is seen across the nine urban centers.

6.3 Livelihoods and the Human-Wildlife Interface

We now turn to a perusal of the occupational profile of the study area as gleaned from the Census Data of 2011. While it is generally understood that rural areas will have a preponderance of agriculture related occupations being reported there is a variation to be expected within the study area on account of the proximity to mining and power generation centers. Let us examine this more closely through a perusal of the table below:

Table 6. 4 Proportion of Agriculture related jobs by Tehsil

Tehsil	Mean	Minimum	Maximum
Chitrangi	0.58	0.04	1.00
Deosar	0.46	0.14	0.69
Dudhi	0.22	0.00	0.95
Singrauli	0.44	0.00	1.00

In the table above we can observe that while Dudhi Tehsil of UP has the widest variation in proportion of workers (main and marginal) reporting their occupation as cultivator or agricultural laborers along with Chitrangi Tehsil of MP. The average proportion is lowest for villages of Dudhi (22%) and Highest for Chitrangi 58%). It is interesting to see the occupations in relation to the proportion of land irrigated to total arable land in the village.

Table 6. 5 Proportion of arable land irrigated

Tehsil	Mean	Minimum	Maximum
Chitrangi	0.15	0.00	0.43
Deosar	0.18	0.07	0.39
Dudhi	0.38	0.00	1.00
Singrauli	0.46	0.01	0.93

Singrauli Tehsil has the highest mean of proportion of land irrigated (46%) but also with a wide variation from 1% to 93%. While Chitrangi and Deosar do not have such wide variation, one can only infer that the situation varies widely from village to village in each of these tehsils.

Table 6. 6 Non-agricultural land in Hectares (Ha)

Tehsil	Mean	Minimum	Maximum
Chitrangi	97.84	0.00	529.60
Deosar	144.13	5.43	354.84
Dudhi	248.79	0.00	2018.00
Singrauli	46.93	0.00	543.38

In trying to understand the linkage to the land, a perusal of Table 6.6 reveals that Dudhi has the highest average of 248.79 Ha available with the lowest average reported by Singrauli. The category non-agricultural land here includes all revenue forest, grazing lands, cultureable waste and fallows.

Table 6. 7 Non-agricultural land per capita in Hectares (Ha)

Tehsil	Mean	Minimum	Maximum
Chitrangi	0.07	0.00	0.45

Deosar	0.08	0.01	0.37
Dudhi	0.15	0.00	1.74
Waidhan	0.05	0.00	0.26

A better understanding of the availability of forage and fuelwood is obtained from a consideration of per capita availability of non-agricultural land. Dudhi Tehsil has the highest average availability of 0.15 ha per person whereas Singrauli Tehsil has the lowest availability of 0.05 ha per person. This along with the agricultural fields would provide the fuel requirements for cooking and heating. The Census 2011 (GoI, 2015) data for the tehsils reveals that 90.85% of households in Chitrangi Tehsil utilize fuelwood, 96.39% in Deosar, while in Singrauli rural there are 82.97% of households reporting fuelwood as the main cooking source. As expected, in the urban areas of Singrauli LPG (46.31%) and Coal (9.36%) is reported by households. Households have reported collecting MFP such as Mahua, Sal Leaf, Chironji, Tendu and mushrooms during the surveys. Livestock depredation was also reported from some compartments.

Thus, with the widespread reliance on fuelwood and the ubiquitous nature of agriculture related livelihoods, human – wildlife interface then is expected to be high for areas having significant wild species such as wild pig and nilgai. Any plan for conservation of natural resources and more so in this case for according protection to wild species of faunal importance should take into consideration especially the rural socio-economic context. Measures that could benefit both wildlife and humans have a higher chance of acceptance among the rural populations. These could include augmentation of water resources, weed eradication programmes, fire management etc. Of special importance would be inoculation of domestic livestock and prompt payment of compensation in the case of livestock depredation. All these measures can only be initiated and sustained with active participation of the local youth and women of the area.

Chapter 7 Conservation Issues

Overall habitat condition in the study area is generally good, and supports variety of wildlife in most of the patches in the Singrauli Forest Division except for forest patches in vicinity to Moher Sub basin owing to large scale open cast mining by 10 NCL mines, one reliance, one Jaypee along with five super thermal power plants also in the area. This is couple with other anthropogenic pressures and disturbance all over the area. The disturbance signs are prevalent and can be seen in almost the entire stretch of the forest range which are part of 0-5 km and 5-10 kn radius area of Moher sub-basin.

7.1 Degradation of habitat

Rich forests with good quality of habitat are not only a perfect refuge for wildlife but they also provide various ecosystem services which are crucial for survival of human beings. Conservation of natural habitats thus ensures better quality of life for humans too. The visual surveys and secondary data indicate moderate to high degradation of habitat in the study area. The northern part of the study area, occupied by Gorbi, Bargwan and Anpara ranges have secondary forests and scrublands with very few isolated patches of primary forests. Some compartments of Waidhan and East Sarai range which lie in the south western part of study area show considerably good forest patches. But habitat degradation is fairly common in all parts of study area. Streams near mines are polluted by mining waste. Dust accumulation on vegetation hampers growth of trees and plants. Grazing, fire, fuel wood collection, etc. further hamper ecological processes.

7.2 Poaching

Poaching for bush meat has been observed in all the ranges of study area. Some direct and indirect evidences of poaching were observed during surveys. Informal interviews with forest department staff and local people also confirmed poaching at various sites. All taxa of animals are targeted by poachers. Several small mammals, large mammals like wild pig and leopard are poached in the study area. Birds like jungle fowls, peafowls,

quails are also frequently hunted by the local people. Two reports of poaching were observed in Gaderia beat of Waidhan range; a group of poachers was seen during field survey in compartment no. 299 with bow and arrow and a report of leopard poached by Baiga community near Teldah village was also recorded. In compartment no. 116 of Parihasi beat of Bargawan range a spotted deer was trapped in a snare set by poachers. In another incident, 16 people were caught by frontline staff in a poaching case of wild pig in compartment no. 177 of Peperkhad beat in Gorbi range. A huge pitfall was dug at the entrance of a den which was large enough to capture mammals like hyena in forest of East Sarai range. Few more direct and indirect evidences of poaching were recorded during field surveys in the study area (Plate 7.1).

7.3 Invasive species

Invasive species are a disaster for any ecosystem. They cause substantial impact on ecosystem by competing with native species for space and other resources and hampering their growth. Once these species start invading any region they interfere with regeneration of native species. As the structural components of the ecosystem are altered functional efficiency of the ecosystem is also hampered. Weeds like *Mesosphaerum, Acanthospermum, Aeschynomene, Lantana* and *Ageratum* are some of the weeds found in the study area. Most of the forests are heavily infested by *Mesosphaerum* species. Few compartments in East Sarai range are less affected by invasive species. Degraded forests and open scrublands are severely infested by invasive species. Opening of canopy, deforestation and fire are major reasons for invasion of weeds in the study area.

Plate 7. 1 Signs of hunting and poaching from the study area

7.4 Fuelwood collection and Illegal tree felling

Collection of fuelwood and illegal tree felling are very common throughout the study area. These are very serious issues of study area leading to habitat fragmentation, degradation and deforestation in the study area. It also creates space for invasive species which further engulf the remaining forests. Villagers dependency on forests for fuelwood is very high. Use of gas stoves or other alternatives for fuel wood is not affordable to the villagers and they are reluctant to use alternatives which demand expenditure of money when they can get fuel wood for free and much easier from the nearby forest. Mostly women are involved in this activity, so frontline staff of Forest department have limitation in dealing with such cases of fuelwood collection. These cases are quite prevalent in all beats of Gorbi and Bargawan range; all beats of Anpara range; Badanwada beat of East Sarai and adjoining areas; Chaura and South Amelia beats of Waidhan range.

Many villagers have adopted illegal tree felling as their business. Villagers cut trees from forests and sell the timber in nearby villages and towns. Tree felling occurs at an alarming rate in most of the parts of study area. People from long distant villages also come to forests to cut trees and sell them in other villages or towns. This is also observed in all the forests of study area. All the beats of study area which have good forests face similar issues. The list of such beats is given in Table 7.3 Some of compartments which have lost their forests considerably due to fuelwood collection and tree felling and are listed below in Table 7.1.

Some of the compartments where forests have been degraded are listed below in Table 7.2.While Awareness programs, implementation of schemes under which some alternatives can be arranged for fuel wood and employment when coupled with strict actions against illegal fuel wood collectors and tree cutters may help control the deforestation caused in study area.

Plate 7. 2 Grazing & Firewood Collection from the study area

Table 7. 1 List of Compartments which have lost forests to considerable amount

Range	Beat	Compartment No
Gorbi	Parsohar	125
Gorbi	Silphori	162
Gorbi	Bagaiya	165
Gorbi	Ajgurh	171
Gorbi	Ajgurh	172
Gorbi	Ajgurh	176
Gorbi	Peperkhad	181
Gorbi	Peperkhad	182
Gorbi	Churki	185
Gorbi	Churki	186
Gorbi	Churki	187
Gorbi	Churki	189
Gorbi	Gobi	190
Gorbi	Ramgarh	194
Gorbi	Ramgarh	198
Waidhan	Gadaria	287
Waidhan	Morba	256

Table 7. 2 List of Forest Compartments which have degraded forests

Range	Beat	Compartment No
Bargawan	Parihasi	115
Bargawan	Parihasi	116
Bargawan	Bagdari	118
Bargawan	Bagdari	119
Bargawan	Pokhara	120

Bargawan	Pokhara	121
Bargawan	Pokhara	122
Gorbi	Parsohar	123
Gorbi	Parsohar	124
Gorbi	Ajgurh	175
Gorbi	Peperkhad	177
Gorbi	Peperkhad	178
Gorbi	Peperkhad	179
Gorbi	Peperkhad	180
Gorbi	Churki	183
Gorbi	Churki	184
Gorbi	Churki	188
Gorbi	Gobi	191
Gorbi	Gobi	192
Gorbi	Ramgarh	193
Gorbi	Ramgarh	195
Bargawan	Badokhar	197
Bargawan	Badokhar	199
Waidhan	Padari	280
Waidhan	Padari	281
Waidhan	Amlori	282
Waidhan	Amlori	283
Waidhan	Amlori	284
Waidhan	Gadaria	286
Waidhan	Gadaria	299
Waidhan	Gadaria	301
Waidhan	Pipra	307

Waidhan	Khutar	308
Waidhan	Khutar	309
Waidhan	Khutar	311
Waidhan	Chaura	313
Anpara	Aundhi	-
Anpara	Randahor	-
Anpara	Lojhera	-
Anpara	Bairpan North	-
Anpara	Bairpan South	-

Table 7. 3 List of beats with good forest facing problem of tree felling

Range	Beat
Waidhan	Pipra
Waidhan	Morba
Waidhan	Padari
Waidhan	Gadaria
Waidhan	Chaura
East Sarai	Badanwada
East Sarai	Pidarwah

7.5 Encroachment

Encroachment on forest land is mostly done by tribal people. Forests are cleared by tree felling and the land is acquired for agriculture or building temporary houses. Frontline staff of forest department is helpless due to sensitivity of the area. The most affected ranges are Gorbi and Bargawan. Peperkhad, Ajgurh, Silphori, Parsohar, Ramgarh and Bagaiya are the beats which show heavy encroachment in Gorbi range while Parihasi,

Bagdari, Badokhar and Pokhara beats of Bargawan range are affected by encroachment. Other ranges do not show serious encroachments.

7.6 Livestock grazing

Livestock rearing is one of the important occupations of people living near forests. They use forests as grazing grounds for their livestock. Herds of goats and cattle were seen in forests during field surveys. The shepherds not only graze their goats in forests but they also cut trees completely so the leaves can be fed to their goats. In many places people also cut trees, shrubs and carry the fodder to their homes to feed their cattle or goats. This causes degradation of habitat quality and cattle being voracious feeders consume large amount of grass and fodder from the forests leaving behind very little or no fodder for wild ungulates which causes decline in the population of wild ungulates. Livestock grazing was common throughout the study area.

7.7 Wildlife mortality on roads

Roads passing through forests are one of the biggest threats to wildlife. Such roads take a major toll on lives of wild animals. Two major highways; NH 39 and Singrauli-Bargawan road shown in Figure 5.8in chapter 5, have heavy traffic coming from mines. Other roads had moderate traffic. Wildlife mortalities by vehicular traffic were recorded on both highways and secondary roads. 1 jackal was found to be hit by vehicle on Parsauna-Mada road, other jackal was reported to be hit by a truck near Bargawan. Some birds were also hit by vehicles. A coucal and dove were hit by vehicles in Gorbi range while a babbler was hit by a vehicle in Waidhan range on NH 39. Wildlife mortality usually is point of concern in almost all developmental projects where large scale movement of vehicles is in use. It is very important that this issues is addressed properly and timely by appropriately using speek breakers, propoer sinages and running an awareness program for driving staff of mines and other civillians driving on those road.

Plate 7. 3 Livestock grazing in the study area

7.8 Water scarcity

Forests of study area have very few perennial water sources. Overall status of water resources in study area is poor. Water scarcity directly affects population density of wildlife in the area. Some beats show presence of moderately good water resources in few compartments but remaining compartments of these beats are devoid of any water bodies. These beats are - Silphori, Ramgarh and Churki of Gorbi range; Bairpan North, Lojhera, Randahor of Anpara range; Medhuli, Pipra of Waidhan range and Pidarwah of East Sarai range.

Other beats where water resources are very poor and need immediate actions of water resource management are - Gobi, Ajgurh Peperkhad, Parsohar, Bagaiya of Gorbi range; Bagdari, Badokhar, Parihasi and Pokhara of Bargawan range; Morba, Amlori, Gadaria, Padari, Khutar, Chaura and South Amilia of Waidhan range; Badanwada of East Sarai range and Bairpan South and Aundhi of Anpara range.

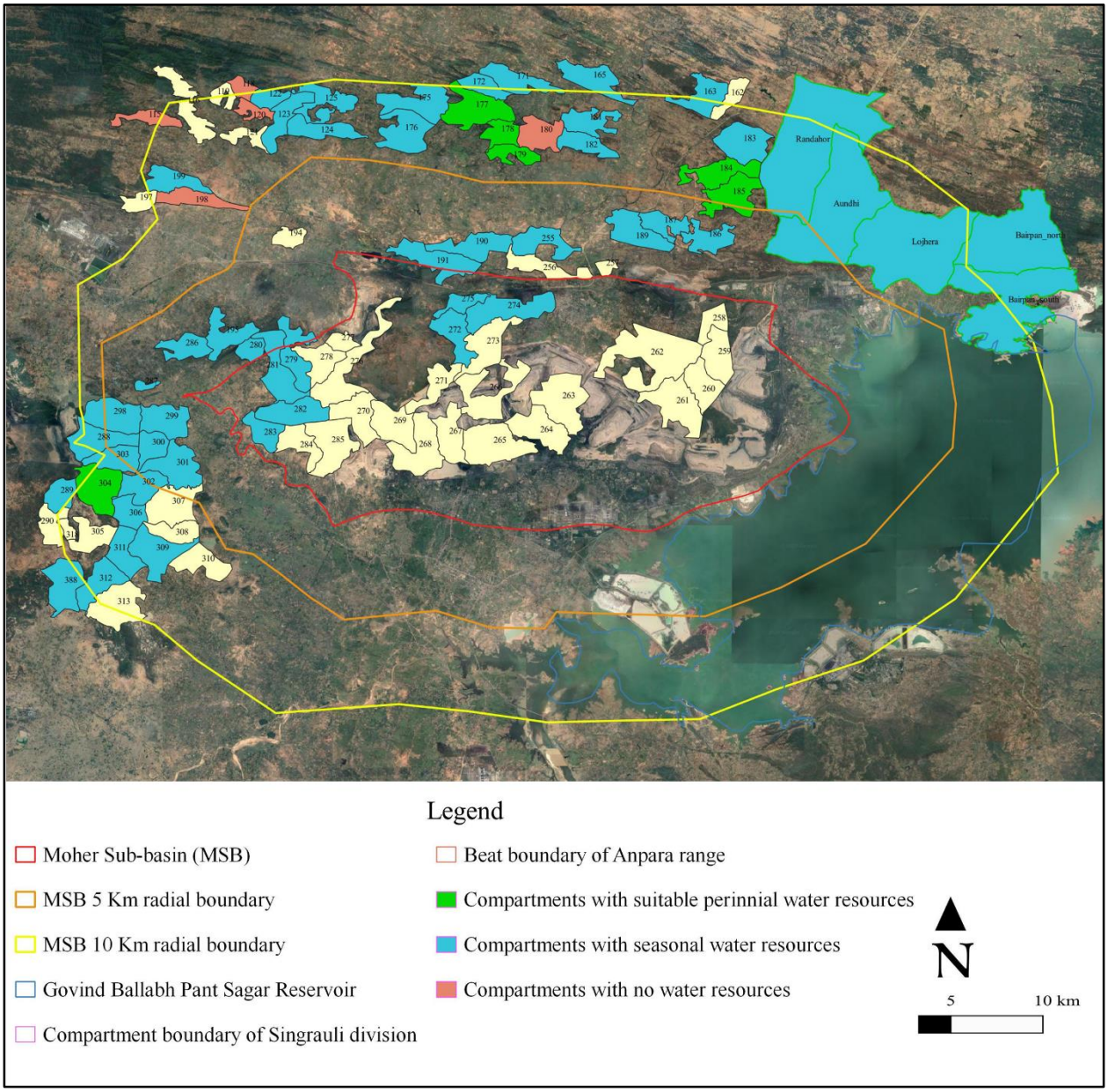

Figure 7. 1 Water availability in 0-5 and 5-10 km radius area from Moher sub basin

7.9 Pollution

Air, water, noise and light pollution cause adverse effect on humans as well as on wildlife and forests. Major source of air pollution in the study area is mines, transportation related to mines and power plants. Road transportation is primary reason of dust pollution in the area. Soil surfaced and bad condition roads make it worst. NH 39, Singrauli-Bargawan

and Jaynat-Morba roads contribute to major air pollution. Vegetation around these roadsides is covered with thick layer of dust. In villages plastic and other dry waste is collected and burnt which is another source of air pollution. Water pollution is more acute in areas near mines. Streams, lakes, ponds and even dams are contaminated with mining residues when rain water runs into these water bodies from mines or dumping areas. This drastically degrades the quality of water causing bioaccumulation of harmful chemicals in wildlife, domestic animals and humans also.

The main sources of noise pollution are heavy equipment and machineries, transportation, blasting in mines. Wildlife is very sensitive to unnatural noise and usually avoids noisy areas causing unnatural aggregation of wildlife which increases competition for resources. Wildlife generally depends a lot on vocal signals for locating mates, finding parents, communicating with rivals, generating alarm calls, etc. Noise pollution interferes with these activities of wildlife causing disturbance to wildlife. Migratory routes of wildlife are also altered due to noise pollution. Mental and physical health of humans and domestic animals is also affected adversely by noise pollution. In villages and towns use of dolby systems for functions, religious rituals or domestic parties also adds to the source of noise pollution.

Light pollution caused by large lights in mining areas or human habitations spreads out in atmosphere affecting the wildlife activities in night. Nocturnal animals are adapted to live their life in dark. Animals which hunt other animals, ambush in dark to catch their prey. Light pollution hinders such activities of wildlife.

Plate 7. 4 Air and dust pollution in the forested area in close vicinity of mines

7.10 Municipal Waste Dumping

During the Course of study, it was noticed that in the forested areas in the fringe of mine a lots of municipal solid waste is being dumped by the Singrauli City. Plate 6.1 shoes such dumping sites in compartment number 261 and 274. With the wind this plastic and other domestic household waste of varying nature litters in the adjoining forested areas.

Such a practice can lead to significant health related issues to the wildlife if they ingest this waste. A group of wild pigs was seen from a distance trying to scavenge through the heaps of such waste. By the time the research team reached the close to the site the group ran into the nearby patch with the cover.

The effect of plastic in forests and wildlife can be devastating. Large scale accumulation of plastic waste in forested habitats can result in the widespread destruction of terrestrial wildlife and forests. Most of the animals sense the presence of food in such dumps and end up eating plastic considering it as food item. When enquired with a local person about bears coming and scavenging such areas, he could not say this with certainty but did say that people have sighted sloth bears in these area. Most probably the bears must be visiting these areas to scavenge in search of food.

One of the ways in which plastic waste affects our wildlife and forests is through increasing the concentration of microplastics in food chains. These concentrated microplastics release additives like phthalates and Bisphenol A (widely known as BPA), which can result in the disruption of the hormone system of vertebrates and invertebrates alike.

Plastics can leach different chemicals such a fire-retardants, parabens, artificial dyes, and much more into soil and water systems and bind to different particles, which makes them persistent and lasting in those ecosystems.

7.11 Human Settlements

The study area comprises of Mining area of Moher sub-basin along with the forested area and large number of villages in the 10 km radius. There are 179villages in 10 km radius, 144 in Madhya Pradesh and 35 in Uttar Pradesh respectively. The total human population in 10 km radius area is 590,344 people with 431,447 in MP and 158,897 in UP respectively. This however includes the urban and rural population of Singrauli, Waidhan, Anpara including the mining and thermal power plant townships. The rural population is approximately 2,75,159 with 2,04,661 in MP and 70498 in UP respectively. The forests of the study area are already under tremendous disturbance owing to such large human populations and associated anthropogenic disturbances.

Plate 7. 5 Municipal solid waste dumped in Forest Compartment 261 & 274

7.12 Human-Wildlife Conflict

Human-wildlife conflict is common in areas near forests. Crop depredation by wild pigs was common and severe throughout the study area. Crop depredation by nilgai is also common, except in north western part of study area comprising of Parihasi, Bagdari, Badokhar and Pokhara beats of Bargawan range; Churki, and Silphori beats of Gorbi range. But the crops near these beats were depredated by other ungulates like chital, four-horned antelope and Indian gazelle. It was observed that crop depredation was common throughout the study area. Similar was the case with livestock depredation. Livestock depredation by jackal was most in all the ranges, followed by hyenas, leopard and wolf. Cattle, goats and sheep were all depredated by carnivores. Livestock depredation by tiger was recorded in 2012 from Bargawan and West Sarai ranges; in 2014 and 2017 from West Sarai range.

Attacks by jackal on humans were also very common throughout the study area. In one incident a jackals entered in home and tried to pick up a child near Khutar beat. Gorbi range also reported many jackal attacks. Sloth bear attacks were reported from Pidarwah beat of East Sarai; Medhuli, South Amilia and Khutar beat of Waidhan. Medhuli, Waidhan and Morba beats of Waidhan range had reports of attack by hanuman langur. Wild pig attacks on humans were reported from Morba, Pipra, Chaura, Gadaria and Amlori beats in Waidhan range; Churki beat of Gorbi range. Hyaena attacks were reported from Amlori and Gadaria beats of Waidhan range. Leopard attack was also reported in Peperkhad beat of Gorbi range. Discussions with the locals revealed that due to perpetual mining activity going on for last few years and disturbance caused, many wild animals have moved to the neighbouring forested patches and hence the occurrence of man animal conflict incidences have also increased.

Tiger attacks were reported outside the study area in West Sarai range. Elephant attack on an old man was reported near Urti village in Waidhan range in 2019, which also occurred outside the study area.

Table 7. 4 Human injury data by wild animals in 10 km radius of Moher Sub basin

Sr. No.	Date	Range	Beat	Wild animal involved	Affected person	
					Dead	Injured
1	13.05.2010	Bargawan	Pokhara	Jackal	0	1
2	15.01.2012	Bargawan	Pokhara	Jackal	0	1
6	7.5.2010	Waidhan	Khutar	Jackal	0	1
7	7.5.2010	Waidhan	Waidhan	Jackal	0	1
8	7.5.2010	Waidhan	Khutar	Jackal	0	1
9	27.4.2010	Waidhan	Amlori	Jackal	0	1
10	01.5.2010	Waidhan	Khutar	Jackal	0	1
11	01.5.2010	Waidhan	Khutar	Jackal	0	1
12	01.5.2010	Waidhan	Khutar	Jackal	0	1
13	01.5.2010	Waidhan	Khutar	Jackal	0	1
14	14.8.2010	Waidhan	South Amilia	Sloth bear	0	1
15	05.3.2010	Waidhan	Khutar	Jackal	0	1
16	05.3.2010	Waidhan	Khutar	Jackal	0	1
17	18.7.2010	Waidhan	South Amilia	Jackal	0	1
18	4.10.2010	Waidhan	Chaura	Jackal	0	1
23	17.10.2010	Waidhan	Khutar	Jackal	0	1
19	29.5.2010	Waidhan	Khutar	Jackal	0	1
20	31.12.2010	Waidhan	Waidhan	Jackal	0	1
21	7.3.2011	Waidhan	Chaura	Jackal	0	1
22	29.3.2011	Waidhan	Medhuli	Langur	0	1
24	25.5.2011	Waidhan	Amlori	Hyaena	0	1
25	05.2.2011	Waidhan	Morba	Wild pig	0	1
26	05.2.2011	Waidhan	Morba	Wild pig	0	1

27	24.3.2011	Waidhan	Morba	Langur	0	1
28	26.3.2011	Waidhan	Morba	Langur	0	1
29	29.1.2012	Waidhan	Morba	Langur	0	1
30	29.1.2012	Waidhan	Waidhan	Langur	0	1
31	10.3.2012	Waidhan	Chaura	Wild pig	0	1
32	11.4.2012	Waidhan	Waidhan	Jackal	0	1
33	29.8.2012	Waidhan	Khutar	Jackal	0	1
34	29.8.2012	Waidhan	Khutar	Jackal	0	1
35	13.1.2013	Waidhan	Waidhan	Jackal	0	1
36	17.2.2013	Waidhan	Morba	Wild pig	0	1
37	26.2.2014	Waidhan	Gadaria	Wild pig	0	1
39	28.12.2014	Waidhan	Gadaria	Hyaena	0	1
40	24.1.2015	Waidhan	Khutar	Jackal	0	1
41	22.2.2016	Waidhan	Amlori	Wild pig	0	1
42	28.3.2016	Waidhan	Morba	Jackal	0	1
43	16.5.2017	Waidhan	Pipra	Wild pig	0	1
44	3.2.2017	Waidhan	Khutar	Sloth bear	0	1
45	23.7.2017	Waidhan	Khutar	Sloth bear	0	1

Table 7. 5 Crop depredation information for the year 2011-12

Sr. No	Year of Loss	Range name	Wild animal involved in depredation	Depredated Area (Hect.)	Percentage of loss
1	2011-12	East Sarai	Elephant	0.25	12.15%
2	2011-12	East Sarai	Elephant	0.35	20.11%
3	2011-12	East Sarai	Elephant	0.22	15.05%
4	2011-12	East Sarai	Elephant	0.25	14.25%
5	2011-12	East Sarai	Elephant	0.10	10.00%

6	2011-12	East Sarai	Elephant	0.16	12.25%
7	2011-12	East Sarai	Elephant	0.15	15.05%
8	2011-12	East Sarai	Elephant	0.16	14.25%
9	2011-12	East Sarai	Elephant	0.06	12.15%
10	2011-12	East Sarai	Elephant	0.18	20.11%
11	2011-12	East Sarai	Elephant	0.25	15.05%
12	2011-12	East Sarai	Elephant	0.25	15.05%
13	2011-12	East Sarai	Elephant	0.16	14.25%
14	2011-12	East Sarai	Elephant	0.20	15.00%
15	2011-12	East Sarai	Elephant	0.20	12.15%
16	2011-12	East Sarai	Elephant	0.17	18.21%
17	2011-12	East Sarai	Elephant	0.45	12.15%
18	2011-12	East Sarai	Elephant	0.65	25.00%
19	2011-12	East Sarai	Elephant	0.15	20.11%
20	2011-12	East Sarai	Elephant	0.25	15.05%
21	2011-12	East Sarai	Elephant	0.27	15.05%
22	2011-12	East Sarai	Elephant	0.15	14.25%
23	2011-12	East Sarai	Elephant	0.60	12.15%
24	2011-12	East Sarai	Elephant	0.10	18.21%
25	2011-12	East Sarai	Elephant	0.40	12.15%
26	2011-12	East Sarai	Elephant	1.10	25.00%
27	2011-12	East Sarai	Elephant	0.45	20.11%
28	2011-12	East Sarai	Elephant	0.05	15.05%
29	2011-12	East Sarai	Elephant	0.12	15.05%
30	2011-12	East Sarai	Elephant	0.14	14.25%
31	2011-12	East Sarai	Elephant	0.06	15.00%
32	2011-12	East Sarai	Elephant	0.65	10.00%
33	2011-12	East Sarai	Elephant	0.22	12.25%

34	2011-12	East Sarai	Elephant	0.15	15.05%
35	2011-12	East Sarai	Elephant	1.00	14.25%
36	2011-12	East Sarai	Elephant	0.20	12.15%
37	2011-12	East Sarai	Elephant	0.12	20.11%
38	2011-12	East Sarai	Elephant	0.27	15.05%
39	2011-12	East Sarai	Elephant	0.17	14.25%
40	2011-12	East Sarai	Elephant	0.08	10.00%
41	2011-12	East Sarai	Elephant	0.23	12.25%
42	2011-12	East Sarai	Elephant	0.10	15.05%
43	2011-12	East Sarai	Elephant	0.50	14.25%
44	2011-12	East Sarai	Elephant	0.15	12.15%
45	2011-12	East Sarai	Elephant	0.56	20.11%
46	2011-12	East Sarai	Elephant	0.62	15.05%
47	2011-12	East Sarai	Elephant	0.69	15.05%
48	2011-12	East Sarai	Elephant	0.69	14.25%
49	2011-12	East Sarai	Elephant	0.17	15.00%
50	2011-12	East Sarai	Elephant	0.29	10.00%
51	2011-12	East Sarai	Elephant	0.09	12.25%
52	2011-12	East Sarai	Elephant	0.15	15.45%
53	2011-12	Bargawan	Nilgai	1	10
54	2011-12	Bargawan	Nilgai	1	10
55	2011-12	Bargawan	Nilgai	0.75	8
56	2011-12	Bargawan	Nilgai	0.4	5
57	2011-12	Bargawan	Nilgai	0.4	5
58	2011-12	Waidhan	Elephant	0.03	30%
59	2011-12	Waidhan	Elephant	0.04	32%
60	2011-12	Waidhan	Elephant	0.5	29%
61	2011-12	Waidhan	Elephant	0.03	30%

62	2011-12	Waidhan	Elephant	0.04	35%
63	2011-12	Waidhan	Elephant	0.001	46%
64	2011-12	Waidhan	Elephant	0.03	35%
65	2011-12	Waidhan	Elephant	0.01	38%
66	2011-12	Waidhan	Elephant	0.01	32%
67	2011-12	Waidhan	Elephant	0.01	32%
68	2011-12	Waidhan	Elephant	0.01	35%
69	2011-12	Waidhan	Elephant	0.01	28%
70	2011-12	Waidhan	Elephant	0.01	29%
71	2011-12	Waidhan	Elephant	0.01	32%
72	2011-12	Waidhan	Elephant	0.01	31%
73	2011-12	Waidhan	Elephant	0.01	36%
74	2011-12	Waidhan	Elephant	0.01	32%
75	2011-12	Waidhan	Elephant	0.01	28%
76	2011-12	Waidhan	Elephant	0.01	29%
77	2011-12	Waidhan	Elephant	0.01	43%
78	2011-12	Waidhan	Elephant	0.3	39%
79	2011-12	Waidhan	Nilgai	0.02	30%
80	2011-12	Waidhan	Nilgai	0.5	43%
81	2011-12	Waidhan	Nilgai	0.02	34%
82	2011-12	Waidhan	Nilgai	0.03	36%
83	2011-12	Waidhan	Nilgai	0.5	48%
84	2011-12	Waidhan	Nilgai	0.02	31%
85	2011-12	Waidhan	Nilgai	0.01	30%

As indicated in table 7.5 during the year 2011-12 there were increased incidences of crop depredation by elephants. For some reason either due to the increased disturbance due to the ongoing mining and associated activities, the occurrence of elephants has

significantly reduced in the area. However, the secondary data and the discussions with the local people did reveal that occasionally elephants do venture out in the areas in and around the mining zones though in last 7 to 8 years there are no incidences of elephants being see in these area. There were few records to elephants coming in East Sarai range and few pockets of Gorbi range. Perhaps due to new mining projects in the vicinity of the existing mines could be one of the reasons that elephants have started showing the tendency to avoid these areas. Although there are instances when the stray presence of elephants is reported from few part of the 5 km and 10 km radius zones.

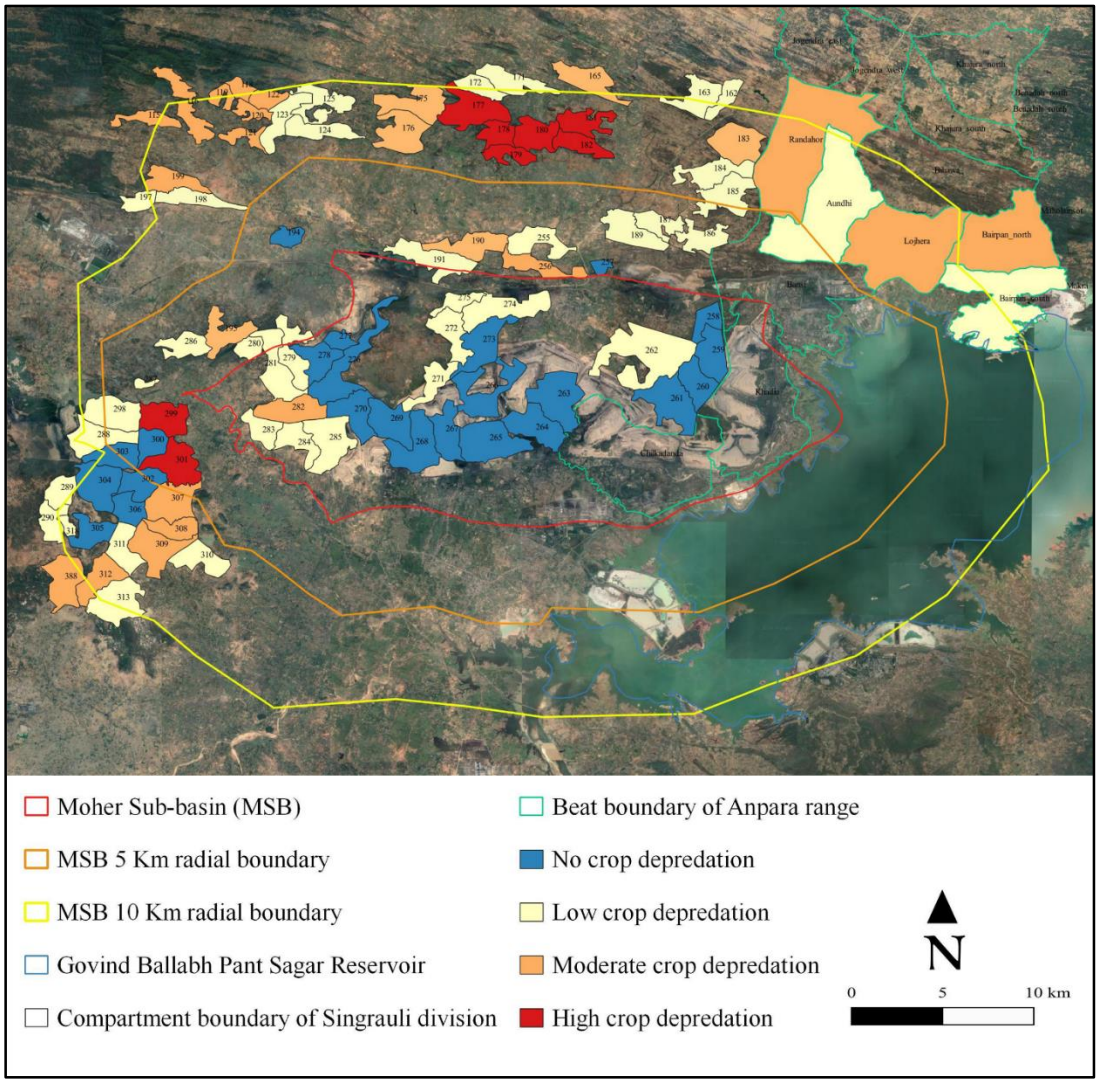

Figure 7. 2 Map showing the crop depredation intensity in the study area.

Table 7. 6 Livestock Kill data from the study area

Sr. No.	Date	Range	Beat	Conflict animal		Livestock killed	
						Species	No.
1	10.23.2012	Gorbi	Peperkhad		Jackal	Buffallo	
2	12.15.2012	Gorbi	Peperkhad		Leopard	Cow	1
3	2.3.2018	Gorbi	Gorbi		Jackal	Bull	1
4	10.14.2018	Gorbi	Silphori		Jackal	Buffallo	1
5	17.11.2012	Bargawan	Pokhara		Leopard	Cow	1
6	13.4.2010	Waidhan	Chaura		Hyaena	Buffallo	1
7	10.5.2010	Waidhan	Khutar		Jackal	Cow	1
8	4.5.2010	Waidhan	Amlori		Hyaena	Goat	9
9	30.10.2010	Waidhan	Chaura		Hyaena	Goat	1
10	19.1.2011	Waidhan	Amlori		Hyaena	Cow	1
11	27.2.2012	Waidhan	Khutar		Jackal	Goat	2
12	7.9.2012	Waidhan	Chaura		Jackal	Buffallo	1
13	2.10.2012	Waidhan	Padari		Wolf	Goat	2
14	4.10.2012	Waidhan	Padari		Leopard	Cow	1
15	8.2.2013	Waidhan	Pipra		Hyaena	Bull	1
16	17.2.2013	Waidhan	Gadaria		Hyaena	Goat	1
17	10.3.2013	Waidhan	Padari		Hyaena	Cow	1
18	16.3.2013	Waidhan	Pipra		Hyaena	Goat	1
19	22.3.2013	Waidhan	Gadaria		Hyaena	Goat	1
20	24.3.2013	Waidhan	Pipara		Hyaena	Cow	2
21	14.4.2013	Waidhan	Waidhan		Hyaena	Goat	5
22	28.1.2014	Waidhan	Khutar		Hyaena	Cow	1
23	22.2.2014	Waidhan	Chaura		Hyaena	Goat	1
24	12.1.2015	Waidhan	Padari		Leopard	Goat	1
25	16.3.2015	Waidhan	Padari		Leopard	Cow	1
26	31.3.2015	Waidhan	Padari		Leopard	Cow	1

27	20.4.2015	Waidhan	Pipra		Hyaena	Bull	1
28	25.4.2015	Waidhan	Pipra		Hyaena	Cow	1
29	20.6.2015	Waidhan	Pipra		Hyaena	Buffallo	1
30	15.6.2015	Waidhan	Gadaria		Leopard	Buffallo	1
31	1.9.2015	Waidhan	Khutar		Hyaena	Bull	1
32	18.9.2015	Waidhan	Amlori		Hyaena	Goat	1
33	30.11.2015	Waidhan	Khutar		Hyaena	Buffallo	1
34	21.1.2017	Waidhan	Khutar		Leopard	Cow	1
35	25.9.2017	Waidhan	Pipra		Leopard	Goat	1
36	16.12.2017	Waidhan	Khutar		Hyaena	Buffallo	1
37	30.11.2017	Waidhan	Gadaria		Leopard	Buffallo	1
38	13.1.2018	Waidhan	Amlori		Leopard	Buffallo	1
39	26.3.2019	Waidhan	Khutar		Leopard	Goat	1

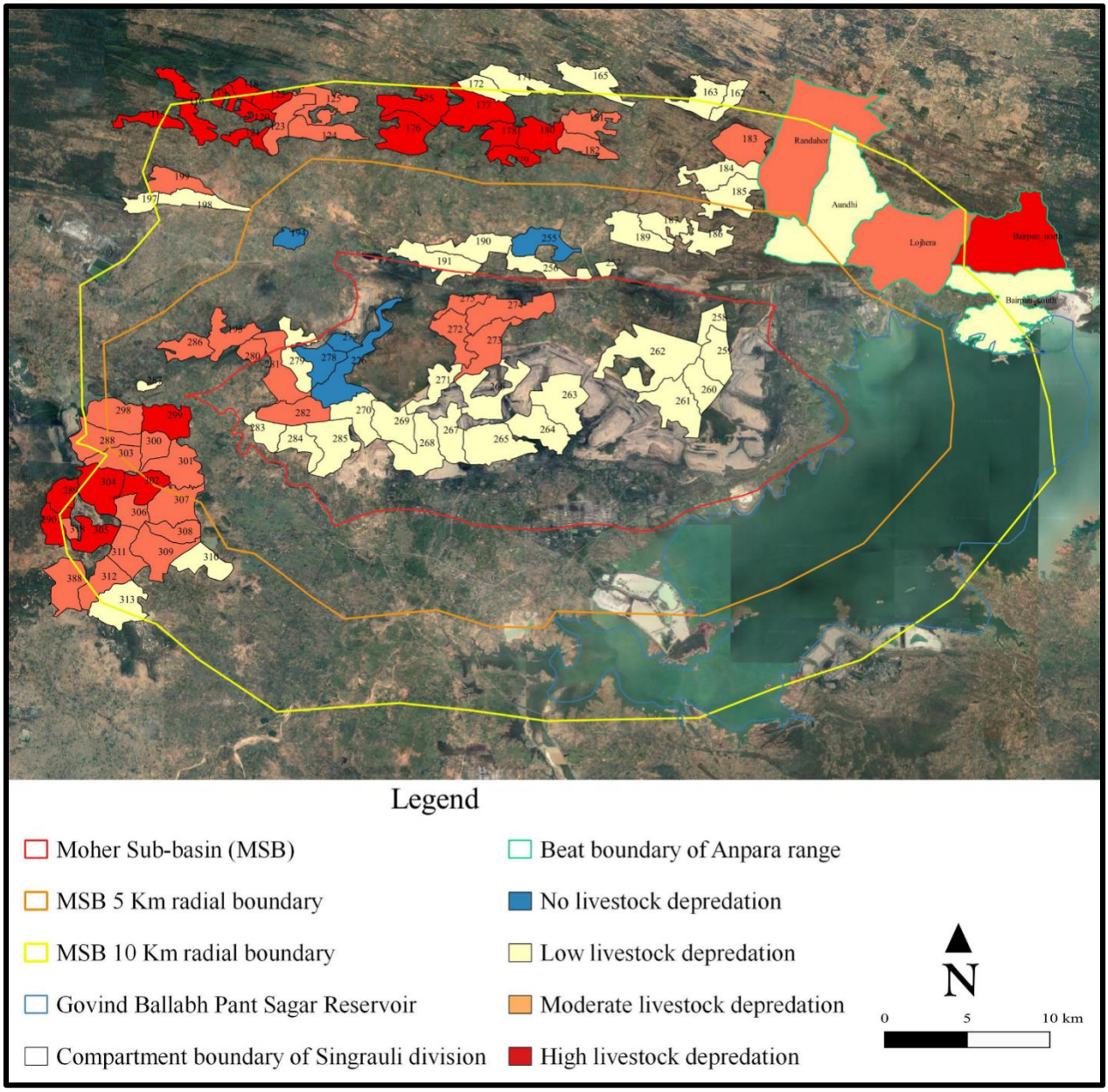

Figure 7. 3 Map showing the areas of Livestock depredation by Wildlife

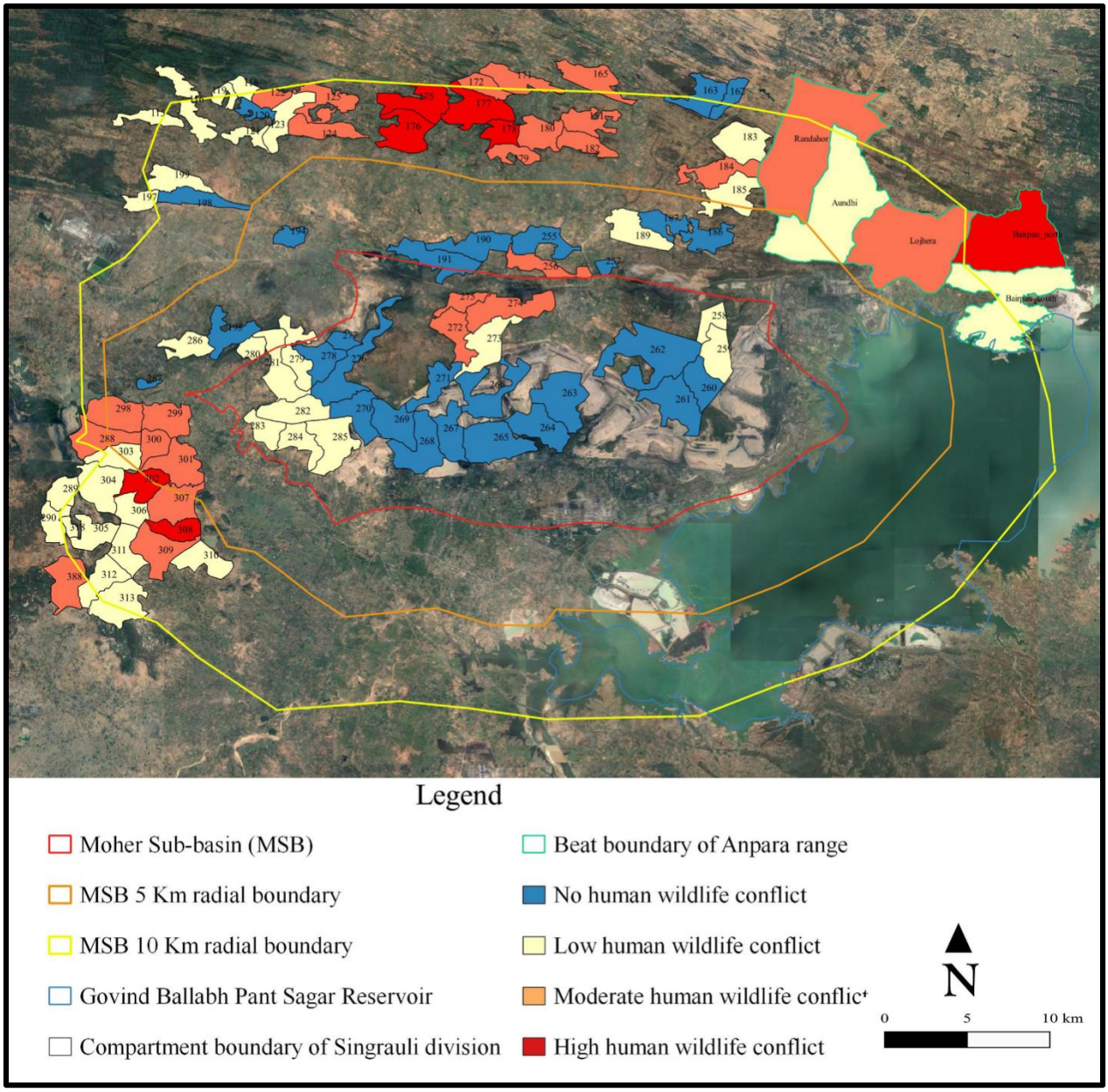

Figure 7. 4 Map Showing the areas of Human Wildlife Conflict intensity

7.13 Fire

Fire is an issue which detriments the habitat of wildlife to an extreme degree. Fire poses a serious threat to native flora as it creates conditions suitable for invasive species. It also kills slow moving wildlife like snakes, small mammals, young ones of all wildlife, insects, eggs of reptiles and birds. In the study area fire is exclusively man-made. The

major reasons for forest fire in study area is fire set by mahua collectors, tree fellers who set fire in forest during winter season to get warmth.

All five ranges have problems of fire in the forest. The northern part of study area, which comprises of Gorbi and Bargawan ranges face serious issue of fire; while the southeastern part of study area comprising of parts of East Sarai and Waidhan range do not have severe fire incidents. Parts of Anpara range falling in 5-10 km radius also fall in high impact zone.

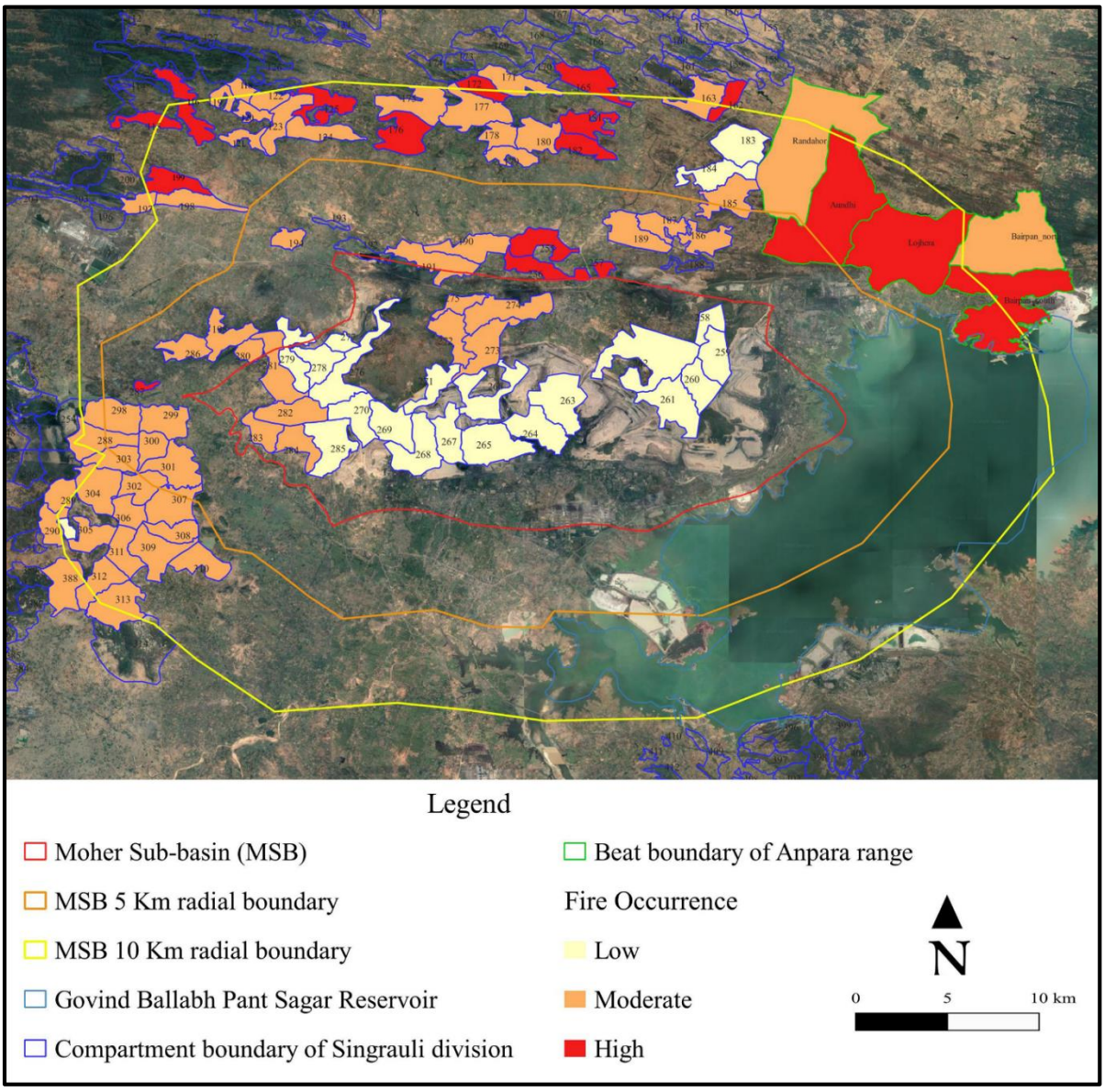

Figure 7. 5 Map showing fire occurrences in the study area

7.14 NTFP Collection

The people in living in the vicinity of the forested areas venture out inside to forest and collect varied kinds of products ranging from mushrooms, Sal seeds, Mahua flowers and variety of tubers that they extract from the forest and sell it in local markets.

7.14.1 Fuelwood

Villagers of forest adjoining are completely depended on the fuelwood as domestic energy, and almost all of this are procured/collected from nearby forest only. Throughout the year local people collect fuelwood from forest. Generally, people collect dried wood, cut shrub like Khirna during this process. However, often people were seen to illegally cut wood tree and kept it inside forest to dry, and later collect is as fuelwood. Therefore, collection of fuel wood also increase chance of illegal tree falling in the entire forest. Close intensive monitoring of fuel wood is an immediate requirement.

7.14.2 Mahua

Mahua is one of the dominant tree in this forest (except Gova range), and it is also the most economic important NTFP collected from the forest. Both Mahua flower and seed are collected from the forest. Flower is collected in the month of April, and seed is collected in the month of June-July. Before Mahua flower collection season people clear the ground under tree by fire. This is the main cause of forest fire in this region. Most sloth bear attack are occurred in Mahua flower collection season. Local market price: Mahua flower (dry)- Rs. 50/Kg, Fruit (dehusked) – Rs. 40/Kg. Local people consume Mahua flower and also use it to prepare country wine. Mahua oil, extracted from seed (1 lit oil from 3 Kg seed), is consumed by local people. Mahua Khole is one of the major source of organic fertilizer for villagers.

7.14.3 Tendu

Tendu is another dominant plant of this forest. Tendu leaves are collected in March month. Generally, Samitee formed by Forest Department are involved in this collection. However, people also independently collect Tendu leafs. Local price: 100 bundle (50 leafs/bundle) price is Rs. 250 [Rs. 2.50/50 Leafs].

7.14.4 Chironji

Local people also collect Chironji seed. It's the fruit of *Buchanania lanzan*. It is a high value NTFP and is in great demand in the local as well regional markets as it falls in the category of dry fruits. It is in demand from sweets makers as well used in the house holds as an add on supplement in porridges and other homemade sweets. It can fetch upto Rs. 1000/kg in the local markets.

7.14.5 Sal leaf

In some places people collect Sal leafs. Which are used to prepare disposable plate and raw leafs also use as packing material in pan shop.

7.14.6 Mushroom

In monsoon season generally two type of mushrooms are collected from forest just next day after heavy rain. (1) Putu or Sarai Putu: This mushroom is generally found under Sal tree. Local Market price: 50-150/Kg. (2) Khurkhut: This mushroom is found on termite mounds. Local market price: 250-500/Kg.

Plate 7. 6 KhuKhur a variety of mushroom extracted from the forest

Plate 7. 7 Sarai Puttu another variety of mushroom extracted from the Forest

Plate 7. 8 Forest produce being sold in Local market in Waidhan

7.15 Mining development related disturbance

The entire belt of singrauli is extremely rich in coal deposits and as the demand for electricity increases more mines will probably come up in the area to meet the fuel requirements of thermal power plants. Apart from 10 NCL mines in the area there are a few more like one at Sasan by reliance, JP coal mines and a mining block allotted to THDCL. These projects are in close vicinity of the same landscape where NCL mines are operating. These existing and new mines would constantly create and accentuate the fragmentation effect and will create the barrier effect for whatever little wildlife is left in the area. Increasing number of mining projects shall also force animals to move from their current habitats into new areas and can result in increase of human wildlife interaction.

Proposed Amelia coal mines by THDCL shall involve compartment number 289, 290, 291 (part), 296 (part), 304 (part), 305 (part), 388 (part), 389 (part), 317 (part) and 318. This area falls in East Sarai range of Singrauli Division. East sarai has connectivity with Sanjay Dubri Tiger Reserve.

Apart from mining there are a five Thermal power stations also in the area contributing to air and water pollution in the area.

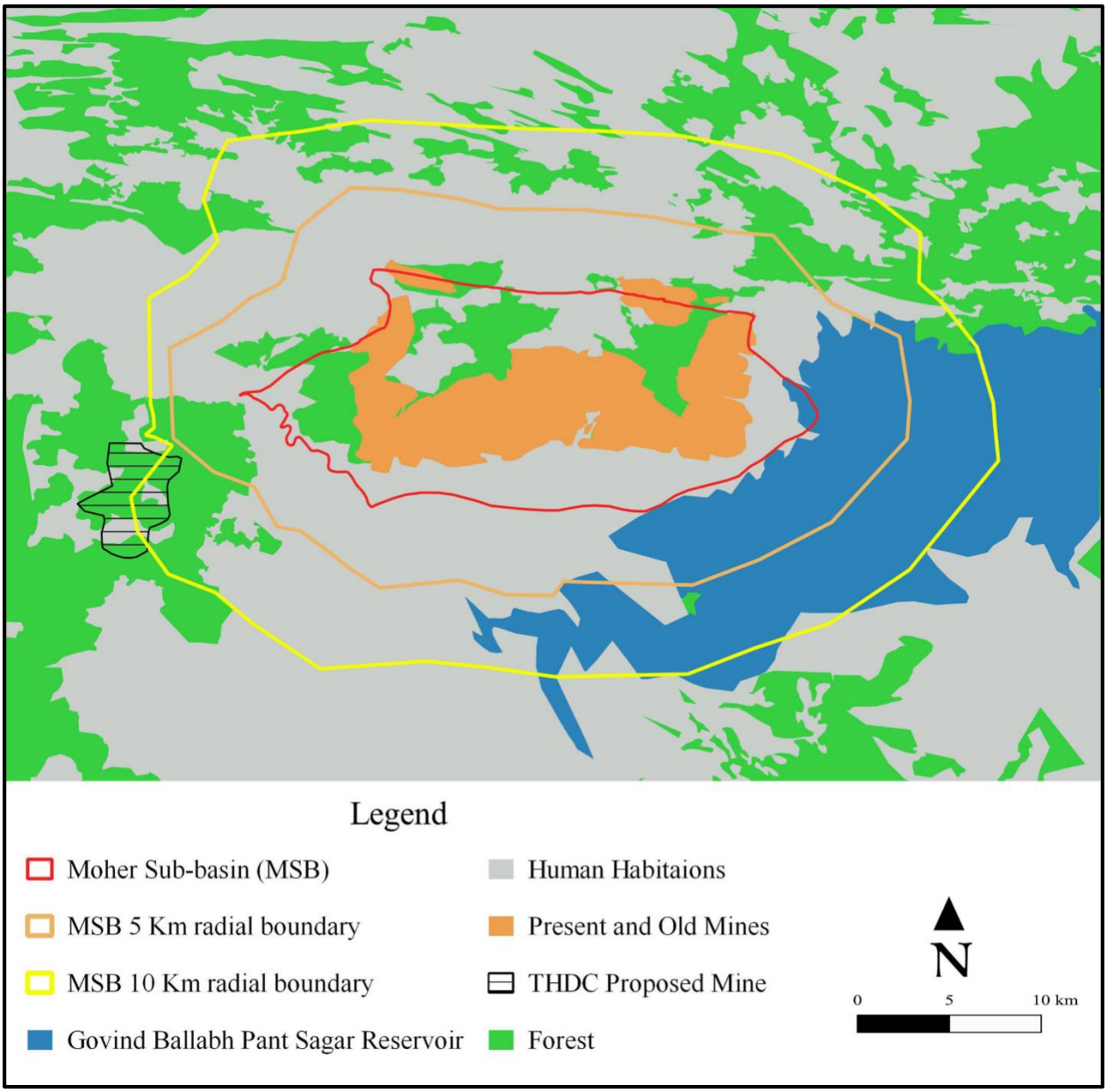

Figure 7. 6 Land use map showing the distribution of mines, forest and habitation

Chapter 8 Wildlife Conservation Plan

8.1 Introduction- Brief Description of the study area

Northern Coalfields Limited (NCL) proposes to expand its already existing Dudhichua mine. As per the recommendation of the FAC an integrated wildlife plan needs to be prepared for the singrauli region.

The study area mainly comprises of Sal forest and falls manly under the Singrauli Forest Division, MP and a small area of Anpara range under Renukoot forest division of UP. The forest is mainly reserve forest and some parts are protected forest. The major forest type observed in the project and the study area is northern dry mixed deciduous forest. The forest density is fairly degraded and open in certain areas and some of the areas bear good quality forest. In areas close to human interferences forests are affected as a result of grazing. Trees of mature ages are observed in the forest patches in 0- 5 km radius and 5-10 km radius area around moher sub basin. The major tree species reported in the study area including buffer zone are Sal (*Shorea robusta*), Salai (*Boswellia serrata*), Saja (*Terminalia tomentosa*), Kusum (*Scheichesia oleosa*), Tendu (*Dinsopyros melanoxylon*), Char (*Buchnania lanzan*), Dhaura, (*Anogeissus latifolia*) Saliha (*Boswellia serrata*) Jamti (*Eugenia heyneana*) and Bhilwa (*Semicarpus anarcardiun*). Bamboo (*Dendro calamus strictus*) is also seen in abundance in some of the areas.

The forest area in immediate vicinity is fairly degraded and is not so rich in wildlife. It is open and disturbed due to five thermal power plants & extensive mining related activities, which are carried out on 24 hours basis across three shifts.

There are reserve forests (RF) and protected Forests (PF) in the 0-10 km radius zone which are mostly part of Waidhan, Gorbi, East Sarai, Bargawan in MP and few patches of Anpara forest range of Renukoot Division in UP. Some of these patches are rich in wildlife and support good habitat conditions for wildlife.

8.2 Coverage and Period of this Wildlife Conservation Plan

This Wildlife Conservation Plan is applicable to the area within 10 km from the boundary of Moher Sub basin. The Plan is limited to the forested area in 10 km radius of Moher sub-basin, which may be reviewed at the end of a period of 10 years and revised, if needed.

8.3 Need for Environmental and Conservation Policy

The **Northern Coal Fields limited** (NCL) needs to evolve a clear environmental and wildlife conservation policy. The environmental & conservation policy apart from highlighting the commitment of the management to environmental and social issues will enshrine core operating principles that value sustainability and environmental and conservation stewardship. Once a sound environmental & conservation policy is adopted, all actions of project authorities can be in consonance with the policy trying to promote environmental and wildlife conservation in core and buffer areas. Important core values that can guide the project's environmental policy may be based on two widely acclaimed sustainability paradigms, namely, *The Natural Step* and the *Precautionary Principle*. A brief description of these two paradigms is presented below.

8.3.1 The Natural Step (TNS)

TNS identifies three ways by which life-supporting structures and functions are altered. Based on this understanding, TNS enunciates the following:

"In a sustainable society, nature is not subject to systematically increasing:

1. Concentrations of substances extracted from the earth's crust;
2. Concentrations of substances produced by society;
3. Degradation by physical means and, in that society. . .
4. Human needs are met worldwide."

In summary, TNS believes that it is social and economic dynamics that fundamentally drive the actions that lead to ecosystem changes. The fourth principle which articulates the importance of meeting human needs worldwide is considered by TNS as an integral

and essential part of sustainability. TNS has developed a four phase methodology for initiating, managing and improving sustainability education, strategies and initiatives within organizations.

8.3.2 The Precautionary Principle

The precautionary principle is an environmental instrument which articulates caution when there is insufficient scientific proof that human activities will not be damaging to the natural environment and human health. The precautionary principal importantly shifts the responsibility of proof of the 'harmlessness' of an activity to be undertaken on the proponent rather than the impacted people. The precautionary principle focuses on *risk prevention; cost effectiveness, ethical responsibilities towards maintaining the integrity of natural systems, and the fallibility of human understanding*.

Principle 15 of The Rio declaration (1992) on Environment and Development provides an excellent practical framework to include precautionary principle based thinking in a policy statement. Principle 15 states that:

'In order to protect the environment, the precautionary approach will be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty will not be used as a reason for postponing cost-effective measures to prevent environmental degradation.'

8.3.3 Agenda for an Environmental and wildlife conservation Policy

The Proponent's environmental and wildlife conservation policy, amongst other things, should contain clear articulation on the following:

a. Sustainable energy use and conservation
b. Sustainable water use and conservation
c. Waste management and recycling
d. Interaction with local communities and cultures
e. Conservation of flora and fauna (wildlife)

f. Habitat conservation and improvement

g. Environmental awareness and education

Chapter 9 Habits and Habitat of Schedule I Species

9.0 Status of Schedule I species in the study area

There are a total of total of 10 species reported from the 0-5 km and 5-10 km radius of the Moher sub basin area that fall under the schedule I category of the Wildlife Protection Act (1972). The species falling in schedule I are listed below.

1. Tiger
2. Leopard
3. Sloth bear
4. Grey Wolf
5. Indian Pangolin
6. Chinkara
7. Four horned antelope
8. Indian Peafowl.
9. Bengal Monitor Lizard
10. Indian rock Python

The sighting distribution maps for Schedule I mammals and birds in the 10 km radius area in the buffer zone are shown on plate 5.4 and 5.8 respectively.

9.1 Habits and Habitat of Tiger

Tiger is the rarest of all the large cats found in India and is also the national animal of the country. It is widely distributed over the forests of India ranging from the sub-alpine Himalayas to down south and across east-west, but excluding Kashmir valley and the desert and arid portions of Rajasthan and Kutch.

The tiger (*Panthera tigris*) is one of the biggest and most fearsome predators in the world. The body bears black stripes against a brownish yellow to rufous background with a white underside. The adult animal is solitary and strongly territorial when inhabiting better habitats having fair prey density. The territory of the male in such cases encompasses smaller territories of two or more females. The distinctive colour scheme of the tiger allows it to camouflage unseen in the forest.

The life span of tigers in the wild on an average is around 8 to 15 years. Tigers in zoos live longer (between 16 and 20 years). Mating follows a definite courtship period, the mother carries total responsibility of bringing up the young. Cubs stay with their mother for as long as 18-30 months. Males are generally intolerant of cubs, though exceptions are there. Stripes act as camouflage, and help tigers hide from their prey. Tigers can virtually survive in all kinds of habitats provided they are free from human interference and disturbance.

9.2 Habits and Habitat of leopard

Leopards are big cats known for their golden, spotted bodies and graceful, yet ferocious hunting techniques. They are often thought of as an African animal, but leopards live all over the world. Though their reach is vast, their numbers are declining.

Leopards are larger than a house cat, but leopards are the smallest members of the large cat category. They grow to only 3 to 6.2 feet (92 to 190 cm) long. Their tail adds another 25 to 39 inches (64 to 99 cm) to their length. Males and females vary in weight. Females typically weigh 46 to 132 pounds (21 to 60 kilograms) and males usually weigh around 80 to 165 lbs. (36 to 75 kg).

The leopard is very adaptable and can live in many different places across the globe. Leopards are found in sub-Saharan Africa, the Arabian Peninsula, south-western and eastern Turkey, in the Sinai/Judean Desert of Southwest Asia, the Himalayan foothills, India, Russia, China and the islands of Java and Sri Lanka, according to the International Union for Conservation of Nature (IUCN). These large cats can live in almost any type of habitat, including rainforests, deserts, woodlands, grassland savannas, forests, mountain

habitats, coastal scrubs, shrub lands and swampy areas. In fact, leopards live in more diversified places than any other large cat.

Leopards are solitary creatures that only spend time with others when they are mating or raising young. They are also nocturnal and spend their nights hunting instead of sleeping.

Leopards spend a lot of their time in trees. Their spotted coat camouflages them, making them blend in with the leaves of the tree. They will often drag their prey into trees to keep it from being taken by other animals. Leopards are carnivores, but they aren't picky eaters. They will prey on any animal that comes across their path, such as chital, Langur, barking deer, rodents, monkeys, snakes, large birds, amphibians, fish, antelopes, Pangolins and porcupines.

9.3 Habit and Habitat of Sloth bear

Sloth bears have long snout and their lips are detached from the gum. Mobile and protrusible, lips are well adapted to the forceful intake and expulsion of air. Bears have a large protrusible tongue. The claws are longer in the fore feet than the hind and are good digging implements. The bear’s palate is deeply concave. The gap between the teeth permits the passage of air as middle pair of incisors in the upper jaw is absent. The animal produces enough suction force to suck out termites from mounds. Sloth bears are mainly nocturnal. Their sense of smell is well developed but their sight and hearing usually poor. They run away with human smell. But during accidental confrontation they defend and can cause nasty injuries by its claws and teeth. Not much is known about social life of bears. Sightings indicate that they are either solitary, in pairs with opposite sex or mother with cubs. Sloth bears are usually restrictive in their movement during the rains as insect food is plentiful. Mating occurs mostly in June and 1-2 cubs, sometimes 3 are born 6-7 months later. Most cubs are dropped between December-January. Birth and rearing takes place in a cave or climber thickets. Cubs are blind for about 3 weeks. The cubs leave the den when about 2 months old and trail the mother. Males do not participate in parental care. Sloth bear leaves up to 40 years.

Bears frequent drier and secondary forests but also found in dense forests. Rocky outcrops and grass lands are also preferred. The dentition indicates that bears are more herbivores and there is a departure from carnivory. In fact, they are omnivorous. Their diet includes largely insects and grubs which can be dug out from the ground or from the underneath of bark of standing trees or fallen logs. They eat termite and bee nests by suction and creating a vacuum in the nest by keeping snout close to the mound. Leaves, root, honey flowers (Mahua, Semul) and fruits (Ber, Tendu, Jamun, Baheda, Amla etc.) in season. Bears sometimes raid sugarcane and maize crop.

Several human casualties or grievous injury occur due to bear attack. Bears disperse forest seeds from the fruit they eat and keep a control over termite population. In quest of food, bears may travel several km. Bears are endangered for their gall bladder and bile to which medicinal properties are attributed.

9.4 Habit and habitat of Indian Grey Wolf

The Indian wolf is a subspecies of the Grey wolf that ranges from Southwest Asia to the Indian Subcontinent. It is medium in size and lacks a luxuriant winter coat due to it living in warmer conditions. Indian wolves have short, thin fur in summer, though the hair on the back remains long even in summer. The fur is generally greyish-red to reddish-white with grey tones. The hairs are grizzled with black, particularly on the back, which sports a dark V-shaped patch around the shoulders.

The wolves in India are known to be present in almost all parts of the Indian peninsula. They live in open grasslands, thorn forests, and scrublands. Indian wolves generally live in smaller packs. Indian wolves are territorial and hunt during the night. Each member of the pack will hunt for its own food, however, when targeting big prey such as antelopes, they prefer to hunt in pairs.

Indian wolves are monogamous and mate for life. They tend to breed from mid-October to late December. Females give birth to 5-6 pups in holes or ravines. The gestation period usually lasts around 62-75 days. The pups are born blind and their eyes open after 9-12

days of birth. The entire pack usually helps in caring for newborns. Indian wolves become reproductively mature after around 2 years of age.

Main threats to Indian wolves include habitat loss, unregulated hunting, and loss of prey. Even though these animals are protected, they still are frequently killed due to being considered as livestock predators. Indian wolves also may attack humans and it is believed this is due to the lack of food in their natural environment.

9.5 Habit and habitat of Indian pangolin

The Indian pangolin's armor is amongst the most effective in the mammalian world. It has rows of moveable sharp scales covering its body, which are shed periodically. Its snout, the inside of its legs and the underparts of its body are unprotected, but it can roll into a tight ball during times of danger, leaving only its scales exposed. It also has several hairs in between each scale, to protect against its primary prey – termites and ants.

The Indian pangolin lives in Bangladesh, Southern Nepal, Sri Lanka, India (south of the Himalayas), and small parts of Pakistan. It inhabits rainforest, grasslands, and barren hilly areas. It can live in modified habitats, wherever there are termites and ants in abundance.

Indian pangolins are nocturnal, and spend most of their day among rocks or in their burrows. At night they leave their burrows to search for food. Most of the time they live alone, except during the mating season, when a male and a female are found living in the same burrow. Burrows range in depth, depending on soil and substratum type: as deep as 6 m in soft soil and usually about 2 m in rocky hard soil. They usually close the burrow's entrance with loose soil to conceal it from predators. These animals use their forelegs to climb, and their prehensile tail and legs for a better grip. Most of them live and feed on the ground. Their vocalizations are limited to loud hissing when agitated, so instead they use their keen sense of smell for communication.

The Indian pangolin is almost entirely insectivorous and more specifically a myrmecophage - this species mainly eats ants, termites, and their eggs, though one has been recorded as eating beetle wing sheaths, skins of worms, and cockroaches.

Not much is available about the mating patterns of the pangolin. Births have been known to occur in January, March, July, and November. Gestation is for about 65-70 days. A single young is usually born, occasionally two. Newborns weigh 200-500 grams. At birth their scales are soft, their eyes are functional, but they can crawl. At about 1 month old they are carried on the base of their mother's tail when she is foraging.

The main threat to this species is hunting, and this is probably causing a decline in its numbers. It is killed for its scales, believed to have medicinal and aphrodisiac properties.

9.6 Habit and habitat of Chinkara

The Chinkara is a type of gazelle species that are native to southern Asia. They have a reddish-buff summer coat with smooth, glossy fur. In winter, their coat becomes lighter, almost white. The reddish color of their coat helps them to hide better in the grassland from predators. The sides of their face have dark chestnut stripes from the corner of the eye to the muzzle, bordered by white stripes.

Chinkara are native to Iran, Afghanistan, Pakistan, and India. They live in arid plains and hills, deserts, dry scrub, and light forests. Chinkara are very shy creatures and avoid human habitation. Most of the time they spend alone, however, can sometimes gather in small groups of up to four animals. Males are territorial and will chase other males away from their territory. Chinkara prefer to feed at night time and are most active just before the sunset and during the night.

Chinkara are herbivores (folivores, frugivores). They feed on grasses, different leaves, and fruits (melon, pumpkin). These gazelles can go without water for many days and can get fluids from plants the feed on and dew.

9.7 Habit and Habitat of Four Horned Antelope

The Four-horned antelope is one of the smallest Asian bovids. These antelopes have four horns, which distinguish them from most other bovids,. Only males in this species grow horns. One pair of horns is located between the ears, and the other on the forehead. Four-horned antelopes have a slender body with thin legs and a short tail. Their coat is

yellowish brown to reddish in color. The underparts and the insides of the legs are white. Facial features include black markings on the muzzle and behind the ears. A black stripe marks the outer surface of each leg.

Four-horned antelopes are found in India and Nepal. In India, they range from the foothills of the Himalayas in the north to the Deccan Plateau in the south. These antelopes inhabit areas with significant cover from grasses or heavy undergrowth, and close to water bodies. They try to stay away from human-inhabited areas. Four-horned antelopes mostly occur in open, dry, deciduous forests in hilly terrain.

Four-horned antelopes are active mainly during the day. They are solitary by nature but may form loose groups of 3 to 5 animals. These groups consist of one or more adults, sometimes accompanied by juveniles. Males and females interact only in the mating season. These antelope are shy and elusive.

Adults mark vegetation in their territories with a secretion of preorbital glands and maintain multiple latrine sites. These animals also communicate with the help of submissive display which consists of shrinking the body, lowering the head and pulling the ears back.

Four-horned antelopes are threatened by the loss of their natural habitat due to agricultural expansion. Moreover, the unusual four-horned skull of these antelope and the horns have been a popular target for trophy hunters.

9.8 Habit and habitat of Indian Peafowl

Indian blue peafowl, *Pavo cristatus*, (also known as peacock) are native to Sri Lanka and India, but can also be found naturally in Pakistan, Kashmir, Nepal, Assam, Nagaland, Burma, Java, Ceylon, Malaya, and the Congo. The Arakan hills prevented this species from moving naturally to the east, while the mountains of the Himalayas and Karakoram further prevented their travel north.

Indian blue peafowl do not migrate or travel widely. They are most common in deciduous, open forest habitats. Areas that had sufficient water sources and were

relatively distant from any human presence were also preferred if given the choice. Their basic requirements include a suitable roost tree, a small territory, and sufficient food. In their native range, peafowl are only found from 900 to 1200 m above sea level in areas with appropriate forest habitat to support them. Peafowl are able to adapt to much colder climates than their native range. In captivity, they can survive winters in southern Britain with only a simple shelter. However, in areas that are both damp and cold, peafowl do not fare as well. They are often kept in urban gardens and zoos.

Indian blue peafowl are known best for their exquisite train and plumage. If the length of the tail and wing span is included, the peafowl is considered one of the largest flying birds. They weigh in between 2.7-6 kg and have a wingspan of 1.4-1.6 m. They vary widely in length from 0.86-2.12 m. This species has long, strong, grayish-brown legs equipped for running away into brush for safety. Both sexes are equipped with spurs that are around 2.5 cm long; males will use them during the breeding season to ward off other competing males. Females are brown, grey, and cream-colored. Chicks are usually a light yellow to brown color. The males have a long train, about 1.2 m in length on average, from June to December. The train is discarded in January, but is grown again at a rapid pace when breeding season approaches. Their necks and breasts are a bright blue, golden feathers line their sides and backs, and their trains are an iridescent arrangement of multiple colors featuring ocelli (eye-spots). When displayed, the male's train spreads out in a wide fan, showing off gold, brown, green, and black feathers. Around 30 to 40 of the ocelli around the outer edges of the fan are not round but v-shaped. This complicated pattern is thought to be an advantage in mating, and even though it might seem like this bright pattern would make peafowl stand out, they can very easily disappear into foliage, making it extremely hard to spot.

There are three variations in the Indian blue peafowl. The white feathered peafowl has completely white feathers from the top of its head to the end of its train, with the ocelli barely visible. These are not albinos because they are true breeders (when bred with another white feathered peafowl, all their offspring will be white feathered peafowl as

well) and have brown eyes. In another version known as pied, random white feathers appear in the plumage. This results from an incomplete dominant gene. Due to a different mutation, another variation results in dark feathers with blue and green tips, called the black-winged peafowl. In addition, *Pavo cristatus* can hybridize with the green peafowl, *Pavo muticus*. For the past two decades, a new mutation in the plumage has been discovered almost every year. (Jackson, 2006; Somes and Burger, 1993).

This species becomes sexually mature at three years, though some males can breed at age of two years. Females will lay 3-5 brownish oval eggs, but in some cases have laid up to 12. The eggs are laid one at a time every other day. Their glossy shells have deep, small pores that let in water to keep it moist. The incubation period lasts up to 28 days.

The nest is made up of dry sticks and leaves, and is located on the ground, under shrubs. Naturally, a peahen will only lay one clutch per breeding season. Chicks are mobile and fully feathered at hatching, can fly in about one week, and rely on their mother for only an additional few weeks. Although the chicks are fairly resilient, they do need relatively warm temperatures to survive and can die in colder climates. Males and females look alike until the males develop their train and bright feathers. It takes up to three years for males to develop a full train. It is almost impossible to tell the difference until a couple of months after hatching in which the males have longer legs. Also, the males will have light gray outer primary feathers and their female counterparts will be brown.

9.9 Habit and habitat of Bengal monitor lizard

The Bengal monitor is a large monitor lizard widely distributed over the Indian Subcontinent, as well as parts of Southeast Asia and West Asia. Males are generally larger than females. Young monitor lizards are more colorful than adults. Young have a series of dark crossbars on the neck, throat, and back. On the dorsal surface of young monitors, there are a series of yellow spots with dark transverse bars connecting them. As they mature, the ground color becomes light brown or grey, and dark spots give them a speckled appearance.

Bengal monitors are found both in dry semiarid desert habitats to floodplains, scrubland, and moist forest. They are also often found in agricultural areas.

Bengal monitors are solitary and usually found on the ground but can climb well. The young are often seen on trees and may also climb trees to escape from predators. The larger ones prefer to escape on the ground. They can also swim well and can stay submerged for at least 17 minutes. Bengal monitors usually shelter in burrows they dig or crevices in rocks and buildings or in tree hollows. They can also use trees and bushes or abandoned termite mounds for shelter. Bengal monitors, like other varanids, sleep at night and are diurnal, becoming active around 6 AM and bask in the morning sun. During winter, in the colder parts of their distribution range, they may take shelter and go through a period of reduced metabolic activity. They are not territorial and may change their range seasonally in response to food availability. Bengal monitors are usually shy and avoid humans.

Bengal monitors are carnivores and scavengers. Their typical diet consists of beetles, grubs, orthopterans, scorpions, snails, ants, and other invertebrates. They may also feed on frogs, fish, lizards, snakes, rodents and ground birds. Bengal monitors are also scavengers. They sometimes feed on dead animals. In areas where livestock is common, they often visit dung, where they forage for beetles and other insects.

Bengal monitors are polygynandrous (promiscuous) meaning that both males and females have multiple partners. The main breeding season takes place from June to September. Females dig a nest hole in the level ground or a vertical bank and lay the eggs inside, filling it up and using their snouts to compact the soil. The females often dig false nests nearby and shovel soil around the area. They sometimes make use of a termite mound to nest.

The main threat to Bengal monitors is hunting. They are hunted for skin, meat, and sometimes because of fear. The fat of Bengal monitors is also used in traditional medicine.

9.10 Habit and habitat of Indian rock python

Indian pythons are large nonvenomous snakes native to tropical regions of the Indian subcontinent and Southeast Asia. They are usually whitish or yellowish in color with the blotched patterns varying from tan to dark brown shades. This varies with terrain and habitat.

Indian pythons are found in almost parts of India. They live in a wide range of habitats, including grasslands and savannahs, swamps, marshes, rocky foothills, woodlands, open forest, and river valleys.

Indian pythons lead a solitary life and may be seen in pairs only during the mating season. They are nocturnal and mainly terrestrial creatures. However, they are also very good climbers and can often be seen hanging on branches of trees. Indian pythons are excellent swimmers and can spend lot of time in water. They can be wholly submerged in water for many minutes if necessary. They like to shelter in abandoned mammal burrows, hollow trees, dense water reeds, and mangrove thickets. During colder autumn and winter months, these snakes hibernate. Lethargic and slow-moving even in their native habitat, Indian pythons exhibit timidity and rarely try to attack even when attacked. They usually move in a straight line, by "walking on its ribs".

Indian pythons are strict carnivores and feed on mammals, birds, amphibians, and reptiles.

Indian pythons are oviparous as they lay eggs. Females lay up to 100 eggs, which they protect and incubate within 2 or 3 months. The hatchlings are 45-60 cm in length and grow very fast. The hatchlings become independent soon after hatching and reproductive maturity is attained at the age of 2 to 3 years.

Main threats to Indian pythons include habitat loss, collection for the pet trade and hunting for their skin, which is highly valued in the leather trade. These snakes are also often killed out of fear and many times when they enter habitation to catch got or poultry.

Chapter 10 Conservation plan for Wildlife

10.0 Habitat management for wildlife

Wildlife management largely involved evaluation of habitat and assessment, monitoring of vegetation and population status monitoring periodically, identification of habitat conditions that favor the growth of wildlife in the area. Effort has to be made to promote the welfare factors and arrest the decimating factors. Participation and support of local public is an important buy in to make the conservation plan work and outcome becomes successful.

10.1 Water management

Water sources are an important asset in any dry deciduous ecosystem. Animals move large distances in search of water in lean season and are forced to move to the regions with open water areas. It is therefore important to have a clear picture of water availability in the buffer zone of the proposed area so that animals can be prevented from moving outside the reserve forest boundary, where they become prone to poaching and other threats. Water resource management is therefore a priority work in dry seasons in the buffer zone. In extremely dry years even the permanent water-holes and streams dry up resulting in large number of animal mortality. The water sources are also frequented by predators, as apart from meeting their water requirement they also need to cool their bodies and the chances of successful predation also increases as large number of herbivores tend to congregate in such areas.

The area is well provided with natural and artificial water sources of various types. There are a few pockets where waterholes are absent. It is proposed to construct water holes at these points. Waterholes should be created by constructing check dams across perennial water sources for storing water in the summer. Such water sources don’t need to be filled artificially and store water throughout the year. Currently the area suffers from shortage of water during lean season in peak summers. In the areas devoid of natural

stream/nallah/rivulets or river it is proposed to have at least 5 water holes in each range where water becomes scarce in summers. The site selection is be done by the forest department. These water holes should be maintained throughout the year for ensuring year round availability of water to avoid foraying of wildlife to the outside areas of the forest.

A map showing the presence of such waterholes in the area is shown in the Figure 6.1. The areas with seasonal water presence must be monitored regularly and water holes needs to be crated and maintained on year round basis for the availability of water in them so as to contain the movement of wildlife outside of forest patches.

Water management and its availability is being viewed as a significant conservation activity as it will be of immense help for tigers, leopards, bears and other schedule I animals to remain restricted to the forested patches and not stray in habitation and agricultural areas in search of water in the village ponds.

10.2 Weed Management

Weeds like *Mesosphaerum, Acanthospermum, Aeschynomene, Lantana camara* and *Ageratum*are seen in the area. In fact although at some places weed act as good soil binders reducing erosion and surface runoff hut because they are not desired at that place, they are called weeds. Chind (Phoenix) comes up in areas where fire breaks repeatedly. But once it has colonised the area, even if the frequency of fire hazard reduces to negligible, it doesn't go away and starts interfering with regeneration of principal species.

Such areas that are suitable for weed eradication will be selected annually for weed removal. Although a variety of biological and chemical control measures are available, still the forest staff largely depends on uprooting of weeds for eradications. Care should be taken to completely uproot the weed and bum it before the seed fall. The area should be worked up in two successive years for complete eradication, as the seeds fallen before the uprooting may germinate in the area.

These worked up areas need close monitoring to prevent emergence of same or new weeds there.

If the weed infested area is having good canopy density, efforts should be made to see that regeneration of principal species that may come up profusely in the area in rainy season after weed eradication work is protected. If the weed infested area is open one it can be converted into grassland by suitable management intervention, after the eradication of weeds.

10.3 Grassland Management & development of meadows

Natural grasslands are those open areas in the forests that support palatable grasses. Grasslands are absolutely essential for maintaining good population of herbivore.

Plantation activity should generally not be taken up in these grasslands. Forest departments working plans have a general prescription for planting 'blanks' or grassy banks. Unless these grasslands are managed as fodder reserves, these are the prime target for plantation activities. The open scrub areas should be targeted for pasture and meadow development. These should be planted with the native species of grasses. The locals can be involved to collect the seed grasses and can be sprayed after mixing them dung and soil. Growth of grasses will not only provide food but also cover to many species.

In the study area, many blanks or degraded forest areas have good growth of grass. In such areas the development of grasses should be encouraged by suitable interventions. The details of such compartments are given in table 6.2. To maintain existing grassland/ grass bearing good areas in perpetuity it is necessary to keep them free from the invasion of weed and woody species. Also the weeds like lantana and *Cassia tora* are showing presence in areas and woody species have also started invading the areas. To keep these areas in good health following measures are to be taken.

1. Cutting and uprooting of unpalatable grasses, before their seeding starts.
2. Uprooting of weeds from these areas at the end of rainy season before seeding.
3. Uprooting of woody species in rainy season.

4. Fire protection around the meadows.
5. Maintenance of water resources near/inside these areas.

Regular monitoring about the grassland use pattern by different species should be done. Seasonal use of grasslands by wild animals should be noted though monitoring. Presence and absence of palatable and not-palatable grasses and invasion of weeds and woody species should be monitored for amending management interventions suitably. Such grassland will render habitats to Blackbuck in the area although their population right now is very low.

A list of grass species to be planted is recommended below (Table 10.1) to be planted in the areas completely devoid of vegetation. Grasses will immediately provide food and cover for many species and also provide stability to soil and help prevent erosion from such areas. The grass seeds must be collected in winters as the grasses mature and should be stored safely at a designated place. Just before monsoon sets in the grass seed mixed in cow dung can be sprayed in the blank areas for germination. The Compartments identified for grassland development and plantation of fruiting species are given in table 10.2.

Table 10. 1 Species of grasses recommended for plantation

S.No	Scientific name	Family
1	Dichanthium annulatum	Poaceae
2	Saccharum spontaneun	Poaceae
3	Heterpogon contortus	Poaceae
4	Vetiveria zizanoides	Poaceae
5	Imperata cylindrica	Poaceae
6	Apluda mutica	Poaceae
7	Arundinella setosa	Poaceae
8	Dendrocalamus strictus	Poaceae

9	Sorghum halepense	Poaceae

Table 10. 2 List of compartment for plantations/grassland development

Radius (Km)	Range	Beat	Comp No	Plantation	Grassland
5- 10	Bargawan	Parihasi	115	Yes	Yes
5-10	Bargawan	Parihasi	116	Yes	Yes
5-10	Bargawan	Bagdari	118	Yes	Yes
5-10	Bargawan	Bagdari	119	Yes	No
5-10	Bargawan	Pokhara	120	No	No
5-10	Bargawan	Pokhara	121	No	No
5-10	Bargawan	Pokhara	122	No	Yes
5-10	Gorbi	Parsohar	123	No	No
5-10	Gorbi	Parsohar	124	No	No
5-10	Gorbi	Parsohar	125	Yes	No
5-10	Gorbi	Silphoria	162	Yes	Yes
5-10	Gorbi	Silphoria	163	No	Yes
5-10	Gorbi	Bagaiya	165	Yes	Yes
5-10	Gorbi	Ajgurh	171	Yes	No
5-10	Gorbi	Ajgurh	172	Yes	No
5-10	Gorbi	Ajgurh	175	Yes	Yes
5-10	Gorbi	Ajgurh	176	Yes	Yes
5-10	Gorbi	Peperkhad	177	Yes	Yes
5-10	Gorbi	Peperkhad	178	Yes	Yes
5-10	Gorbi	Peperkhad	179	Yes	No
5-10	Gorbi	Peperkhad	180	Yes	Yes
5-10	Gorbi	Peperkhad	181	Yes	Yes
5-10	Gorbi	Peperkhad	182	Yes	Yes
5-10	Gorbi	Churki	183	No	Yes

5-10	Gorbi	Churki	184	Yes	No
0-5	Gorbi	Churki	185	Yes	No
0-5	Gorbi	Churki	186	Yes	No
0-5	Gorbi	Churki	187	No	No
0-5	Gorbi	Churki	189	Yes	No
0-5	Gorbi	Gobi	190	Yes	No
0-5	Gorbi	Gobi	191	Yes	No
0-5	Gorbi	Ramgarh	194	No	No
0-5	Gorbi	Ramgarh	195	No	Yes
5-10	Bargawan	Badokhar	197	Yes	Yes
5-10	Gorbi	Ramgarh	198	No	No
5-10	Bargawan	Badokhar	199	Yes	Yes
0-5	Waidhan	Morba	255	Yes	Yes
0-5	Waidhan	Morba	256	Yes	No
0-5	Waidhan	Morba	257	No	No
0-5	Waidhan	Morba	258	No	No
0-5	Waidhan	Morba	259	No	No
0-5	Waidhan	Morba	260	No	No
0-5	Waidhan	Dudhichua	261	No	No
0-5	Waidhan	Dudhichua	262	No	No
0-5	Waidhan	Dudhichua	263	No	No
0-5	Waidhan	Dudhichua	264	No	No
0-5	Waidhan	Waidhan	265	No	No
0-5	Waidhan	Navanager	266	No	No
0-5	Waidhan	Navanager	267	No	No
0-5	Waidhan	Navanager	268	No	No
0-5	Waidhan	Navanager	269	No	No
0-5	Waidhan	Amlori	270	No	No

0-5	Waidhan	Navanager	271	No	No
0-5	Waidhan	Medhuli	272	No	Yes
0-5	Waidhan	Medhuli	273	No	No
0-5	Waidhan	Medhuli	274	No	Yes
0-5	Waidhan	Medhuli	275	No	Yes
0-5	Waidhan	Amlori	276	No	No
0-5	Waidhan	Padari	277	No	No
0-5	Waidhan	Padari	278	No	No
0-5	Waidhan	Padari	279	Yes	Yes
0-5	Waidhan	Padari	280	No	Yes
0-5	Waidhan	Padari	281	Yes	Yes
0-5	Waidhan	Amlori	282	Yes	Yes
0-5	Waidhan	Amlori	283	Yes	Yes
0-5	Waidhan	Amlori	284	No	No
0-5	Waidhan	Amlori	285	No	No
0-5	Waidhan	Gadaria	286	Yes	Yes
0-5	Waidhan	Gadaria	287	Yes	No
0-5	East Sarai	Pidarwah	288	Yes	Yes
5-10	East Sarai	Pidarwah	289	No	No
5-10	East Sarai	Bandenwada	290	No	No
0-5	Waidhan	Gadaria	298	Yes	Yes
0-5	Waidhan	Gadaria	299	No	Yes
0-5	Waidhan	Gadaria	300	No	Yes
0-5	Waidhan	Gadaria	301	No	Yes
5-10	Waidhan	Pipra	302	No	Yes
0-5	East Sarai	Pidarwah	303	No	Yes
5-10	East Sarai	Pidarwah	304	No	Yes
5-10	East Sarai	Bandanwada	305	No	Yes

5-10	Waidhan	Pipra	306	Yes	Yes
5-10	Waidhan	Pipra	307	No	No
5-10	Waidhan	Khutar	308	No	No
5-10	Waidhan	Khutar	309	Yes	No
5-10	Waidhan	Khutar	310	Yes	No
5-10	Waidhan	Khutar	311	Yes	Yes
5-10	Waidhan	Chaura	312	Yes	Yes
5-10	Waidhan	Chaura	313	Yes	Yes
5-10	East Sarai	Bandanmada	318	No	No
5-10	Waidhan	South Amilia	388	No	Yes
0-5	Anpara	Aundhi	1	Yes	Yes
5-10	Anpara	Randahor	2	No	Yes
5-10	Anpara	Lojhera	3	Yes	Yes
5-10	Anpara	BairpanN	4	Yes	Yes
5-10	Anpara	BairpanS	5	Yes	Yes

10.4 Fire Management

10.4.1 Additional Firewatchers

There are a instances of fire outbreak in the study area during the summer season and it becomes very difficult to control these fires due to lack of staff and resources. Local people do not help in putting out fires, though they are supposed to do so. At present firewatchers are employed in the fire season for four months from March to June for helping in fire protection. It is proposed that additional firewatchers should be employed from the local community during the fire season for helping in fire control.

10.4.2 Creation of watchtowers

Creation of Fire watch tower can be crucial in early detection of forest fires and its timely communication to the firefighting staff to prevent large scale damage to the forests. A fire watcher is deployed throughout the day on these watchtowers and gives information on

fires as soon as they occur. The watcher can only give direction and approximate distance of the location of the fire. Watchtowers will increase the accuracy of the location of the fires. Five watch towers (One in each range) should be built at a suitable vantage location from where the large area can be seen and monitored.

10.4.3 Maintenance of Fire lines

Maintenance of fire lines can significantly prevent the risk and spread of fire from one patch to the other patch. It is recommended that the fire lines/breaks should be maintained properly before the fire season. Labor must be employed from the local community for cutting and clearing of fire lines. Cool season fire should be used for burning the residual material on the fire line. Due care needs to be taken while burning fire lines to avoid any case of accidental fires. People for local community should be hired as fire watchers for at least four months (March to June) to help detect and fight fires. This will also generate some local employment and in turn goodwill amongst local people for forest and wildlife.

10.5 Staff Training

The Forest Department staff will benefit from training courses on wildlife conservation since many of them are not oriented towards wildlife. Regular training courses on various topics of wildlife conservation should be conducted for the field staff. Some topics that are relevant in this respect are:

- Importance of wildlife and biodiversity
- Wildlife biology of various species
- Wildlife law, procedures for handling wildlife legal cases
- Intelligence gathering with respect to wildlife poaching cases
- Wildlife monitoring, census techniques
- Wildlife issues in timber harvesting
- Tranquillizing and trapping problem animals

10.6 Signages & Speed Breakers

There is considerable traffic of vehicles along various roads in the area and with upcoming of the proposed project the traffic intensity is further going to increase. In this light educative signage should be put up along these roads to inculcate importance of wildlife among the travelers on this road. Fire protection, importance of wildlife, anti-poaching messages and wildlife species found in the area are some of the topics that can be taken in the signage.

Speed Breakers must be constructed on NH 39 and Singrauli- Bargawan road and on any other road where the possibility of wildlife mortality is felt by the forest department. Speed breakers must be constructed at every one KM segment along with appropriate sinages for speed limits and wildlife conservation messages.

10.7 Prevention of Littering in the Forest areas

Dumping of municipal solid waste has been observed in many forested areas (Compartment Number 261 & 274) especially on the fringe of the mines (Plate 7.5 in Chapter 7). The Municipal Corporation of Singrauli must be informed of this and should be asked to immediately clean these areas by collecting all the dumped garbage in the forested area. Check post must be created at all such locations where the roads are leading in the forested areas to stop such a practice. An awareness program must be conducted for the Municipal corporation staff to sensitize them on significance of forests and their conservation.

10.8 Protection huts

Temporary protection huts should be put up at suitable places in the forest for the field staff and helpers. Helpers can stay in the huts at night to increase the effectiveness of patrolling. Two protection huts at suitable locations as decided by the forest department are proposed for each range. Presence of protection huts shall also ensure that there is a fixed schedule of patrolling and monitoring of the wildlife in the region.

10.9 Secret Funds for Intelligence Gathering

Intelligence gathering is an important aspect of controlling illicit activities such as poaching or timber smuggling and there is necessity of developing a network of informers. There should be provision for giving rewards to informers to ensure regular supply of information. Hence, a secret fund should be provided to each division that does not need to be accounted for.

10.10 Management of dead and decaying trees

Large or medium standing dead trees are called as snags. These snags provide birds, reptiles, insects, amphibian and mammals with habitat to breed, rest, take refuge and unobstructed vantage points to raptors to help them in hunting the prey. Large downed trees also provide important habitat for wildlife. The trees that have started to die are also extremely important, as they will contribute to the number of snags in the area. Dead trees must be left undisturbed so that they can be used as habitat by dependent species. In this case the snag conservation is important as species like Bengal monitor use them in search of insects. Pythons are also known to use snags for hunting the arboreal animals.

The areas in the close vicinity of snags must also be protected as snags also undergo succession. The use of snags is largely influenced by the internal and external characteristics of the snags and the successional stages of the plant community that surrounds the snags.

If there are groups of dead trees found in the area, they must also be protected from felling. Large trees with hollows and holes must not be cut. The trees that are fallen over the nallah or stream should also not be removed from its place.

10.11 Management or Non-vegetative Unique habitats

Wildlife habitats are very often identified only with the vegetation communities, but there are some habitats where vegetation association is not obvious. These are called as unique habitats. Geomorphic features represent these habitats with special functions not provided in plant communities or their successional stages (Thomas 1979). These habitats do not occur as frequently as the vegetative habitats but nonetheless add to the diversity of the

environment, which otherwise is largely dominated by plant communities. Little or no attention has generally been paid on these lesser known and lesser occurring habitats, their usefulness in management and their role in enriching the wildlife diversity of the area. These features show a very clumped distribution and are restricted only to certain areas as their formation depends solely on geomorphology of the area.

The study area has a hilly terrain and hence there are structures like caves, dens, cliffs, talus, burrows etc. All of these are extremely important to wildlife species like sloth bear, leopards, python, Pangolins etc. Special attention needs to be given to such areas. All kinds of human related disturbance activities must be avoided in such areas.

10.12 Protection against spread of disease in wild animals

Grazing by domestic animals in the forested areas can become an important source of disease spread to the wildlife. The reason for this is presence of domestic animals almost in all parts of the forest and, using the same water sources that are used by wild animal. The only way by which this can be avoided is inoculating the domesticated animals regularly for some of the most prevalent and common diseases in the area. Foot & Mouth (FMD), Rinderpest and Anthrax are some of the most common diseases in the livestock as informed through interaction with villagers in the area. It is proposed that a grant must be provided by NCL for the inoculation of animals especially against FMD. Forest Department shall ensure that all livestock in 10 Km radius zone of Moher Sub-basin area are vaccinated.

10.13 Minimizing Man Animal Conflict

The Project authorities as a part of their overall corporate social responsibility can also explore the possibility of using some subsidy based financial instrument to evolve some insurance mechanism to compensate for losses to property and crop due to wild animals in the villages that are located in the forest patches that are part of 10 km radius of Moher sub-basin. A program like **"Compensation for Coexistence"** can be initiated for which a onetime seed grant can be given by NCL as seed money to substantiate the compensation paid by the forest department. This will also ease of some amount of pressure on the forest department and from this seed grant, an interim relief can be immediately offered

to the sufferers. The grant shall be judiciously used to take care of their medical/hospitalization charges or immediate relief for crop depredation. The Procedure for release of such grants can be decided by the DFOs of Singrauli and Renukoot Forest Divisions. This will significantly help to garner more support for wildlife conservation and will contribute to the overall conservation success for elephants and other schedule I animals in the area.

In the High Crop depredation areas (Fig 7.2 in Chapter 7) there might be need to set up appropriate mitigation measures like fence, Cattle or elephant proof trenches. The Crop depredation by Elephants in the study area has been significantly lessened as the elephant movement is not so frequent but Nilgai and wild pigs continue to damage crops in the area. Increase in cases of man animal conflict is also attributed to the large scale mining and associated disturbance cased to the wild aninmals. This has forced animals to move in the neighboruign forested patches and hence increase in number of cases. Minimizing man animal conflict is seen as a major instrument in achieving conservation of wildlife in long run in the area.

There is also a need to create a health care system of timely treatment and preparedness in the nearby hospitals to take care of wildlife induced injuries caused to the people. Most of the injuries in the area are reported to be caused by jackals. The hospitals must have sufficient stock of anti-rabies vaccines as the disease might be transmitted to human from jackals in case of bites. It is also proposed that NCL should provide ambulance for the purpose so that as and when they are needed they can be pressed into action to bring such patients to the hospital. Nehru Shatabdi Chitiksalaya a well established hospital of NCL could be used for this purpose and a doctor should be readily available to deal with such cases which may require dealing with minor injuries to surgery in case of mauling by sloth bear or attack by leopard. Since these kind of services can only be provided by the hospital hence no separate budgetary provision is made in the conservation plan. This can also be taken as part of CSR responsibility by NCL. This will definitely help wildlife

conservation in long way as timely treatment will help reduce animosity by locals towards animals.

10.14 Control of Grazing & Firewood collection

Due to large number of villages in the study area, the problem of livestock grazing and fuel wood collection has been observed in most parts of the forests within 10 km radius of Moher Sub-basin. There is an urgent need to earmark certain areas as free from grazing to minimize the grazing induced disturbance to the wildlife. Some of the degraded areas can be developed as pastures where regulated grazing can be permitted. There must be strict monitoring of the grazing practice to ensure minimal disturbance to the forest.

Similarly, the areas need to be demarcated from where the villagers can collect fuel wood. The norms for fuel wood collection must also be developed. Fuel wood plantations must be carried out in the village outskirts so that the need to go to the forested areas can be minimized. The use of briquettes must also be explored with the villagers. NCL can set up a center where they can manufacture briquettes from coal dust and provide it to the villagers at a reduced cost. It is advisable to get all villages connected with Ujjawala Yojna of the Government of India, so that they have access to the clean and non-polluting fuel. All the above proposed actions will have to be implemented in combination of each other, as it will take time before people will learn not to go to forest for fuelwood.

10.15 Conservation of Butterfly fauna

It is recommended that the project authorities start long term butterfly conservation programme by using appropriate in-situ and ex-situ conservation measures. Establishment of butterfly rearing parks may be seen as long term conservation and awareness programme.

Butterflies are of primary importance in recycling of nutrients and play significant role in the maintenance of soil structure and fertility. Butterflies are one of the important food chain components of the birds, reptiles and spiders. Butterflies are also extremely good indicators of environmental changes and respond immediately to the disturbances caused

due to change or alteration of their habitat. The Project area has butterfly diversity so it is important to develop mitigatory measures for this group of insects.

10.15.1 Butterfly rearing parks

The various species of butterflies can be reared artificially. The basic requirement for this will be establishment of large airy aviary, with various egg laying platns, larval food plants, adult attractants like nectar, salt patches and rotting fruits. The males and females are naturally attracted to these cages.Post matign females would lay the eggs on the egg layign plants inside the enclosure. Once the larvae hatches they will be able to feed on larval food plants already present in the enclosure.

It is, therefore, proposed to create two butterfly-rearing parks. A total of two enclosures should be constructed one in the waidhan range and one in Anpara range to ensure conservation of butterfly species in the area. These can also be used as interpretive tools for spreading awareness in local people, mining community, school and college going students in the area. The sites shall be decided by the respective DFO's of the concerned divisions

10.16 Sloth bear Conservation programme

The Sloth bears are relatively in abundance only in the East Serai forest range area and not so common in other areas around the Moher Sub-basin mining area. Interviews with local people revealed that earlier bears were quite common in the area but over a period of time their sighting frequency has reduced significantly. Very few cases of man animal conflict involving bears are reported from the area. It is recommended to initiate bears conservation activities in the proposed project area. The State Forest Department of MP will act as the nodal agency to carry out and implement the Bear conservation programme in collaboration with Uttar Pradesh Forest Department and the financial provisioning for the same will be done by Project authorities. The bear habitats and denning sites in the buffer zone should be identified and earmarked so that the populations are not disturbed by any of the project related activities. The denning sites in the 10 km radius area of

MSB should be preserved with utmost care in their natural habitat so that, these are available for bears to use.

The termite mounds in the 10 km should be protected especially as they act a food source for sloth bears all year round.

Bear normally litter in early summer hence disturbance created during this time can seriously affect the litter rearing. These details should be incorporated in the work schedule and operation plans whenever some activity during the operation phase is planned.

Bear substantially use non vegetative areas such a caves and other such structure for breeding and resting. Such habitats should be protected. Such structure if lost will be destroyed forever and it will be impossible to reconstruct such habitats by way of restoration.

A proper Sloth bear census should be carried out regularly in the project area jointly by the MPFD and UPFD to assess the status of the sloth bears in the project area and its surrounds. A complete survey should also be carried out as a part of larger research programme to assess and monitor the bear populations and its habitat in the 10 km radius zone of the MSB mining area.

10.17 Developing conservation Framework for Elephants

Wild elephants have been known to be moving in the region in the past. With the increased mining and the subsequent fragmentation, the movement of elephants has been severely impacted in the region. The MSB mining area currently is sandwiched between three elephant corridors as identified by the working plan of the Singrauli Forest division. These are namely.

A. Baikuthpur (South) –Rihand Sagar- Sonbhadra.

B. Baikunthpur & Sanjay National park (South) – Sonbhadra- Rihand Sagar (East)

C. Baikunthpur & Sanjay National park (South) - Kachan reservoir- Serai- Gopad- Baikunthpur

However, the elephant population has gone down in the region and it is only occasionally that movement of elephants is recorded in these areas. However, what is important is that the elephants use still some of the patches. Figure 5.8 shows that the areas of East Serai Forest division within 0-5 & 5-10 km radius of the MSB mining area has been used by the elephants between 2016-2020. There have been though incidence though stray of elephants coming on 0-5 km radius zone also during the year 2008-10 and 2011-15. This movement has been temporary in nature and occasionally straying in the peripheral areas MSB.

The most important elephant corridor right now is Baikunthpur-Kachan-Sarai-Gopad-Baikunthpur. Certain parts of east Sarai forest range are part of this corridor. Figure 10.1 shows the areas in 10 km radius which are also part of the elephant corridor. East Sarai is the most important area for protection and conservation from the perspective of conserving it for elephants in the area. Elephants normally enter these areas in the month of October to February. From Figure 10.1 and 10.2 it is evident that there are few proposed coal mine sites also in the East Sarai range area. If these mining sites become functional in near future this part of the corridor will be completely blocked. East Sarai holds high significance as not just elephant corridor but also as potential wildlife habitat.

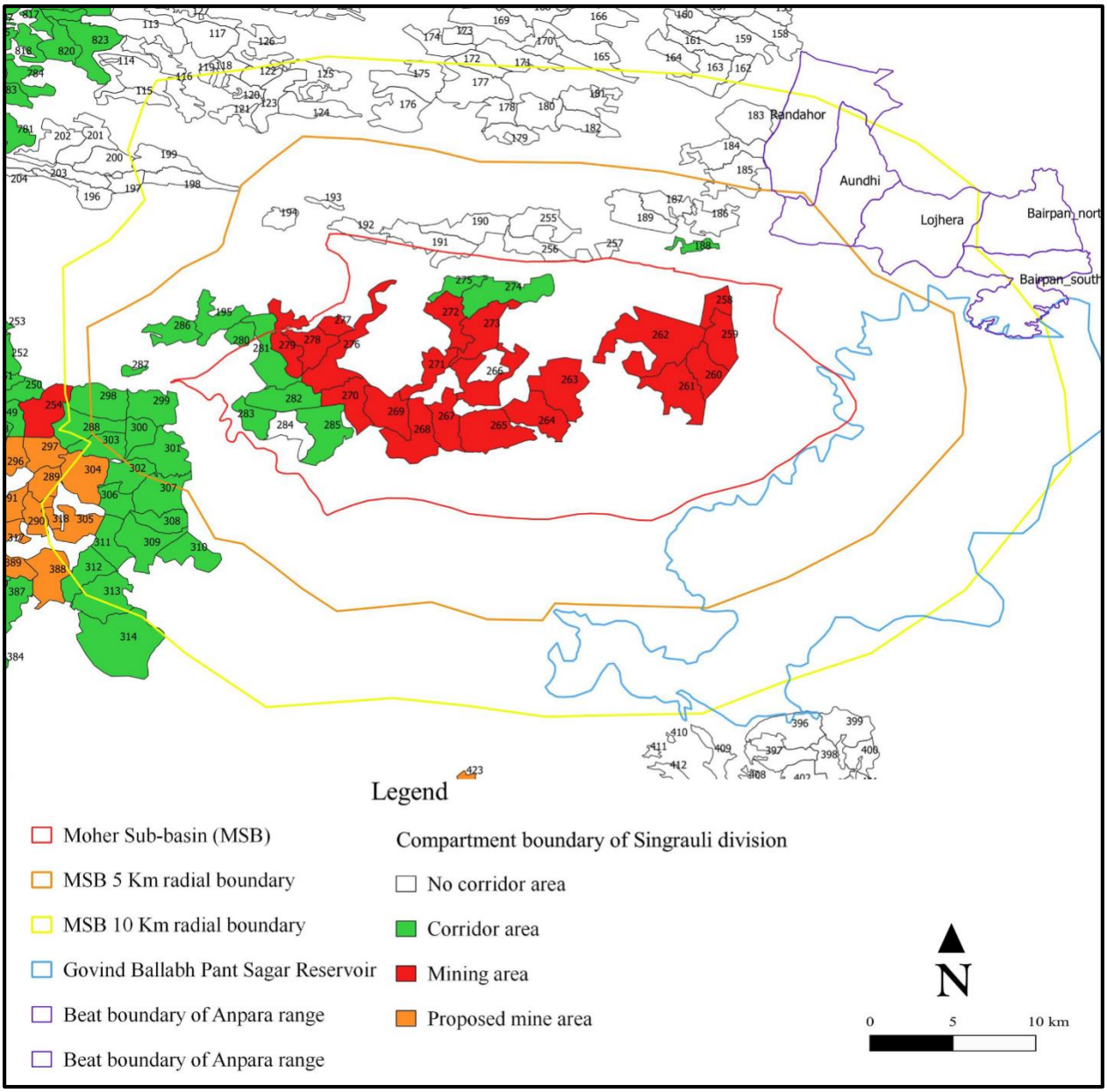

Figure 10. 1 Elephant corridor in forest areas in 0-5 & 5-10 km radius of MSB

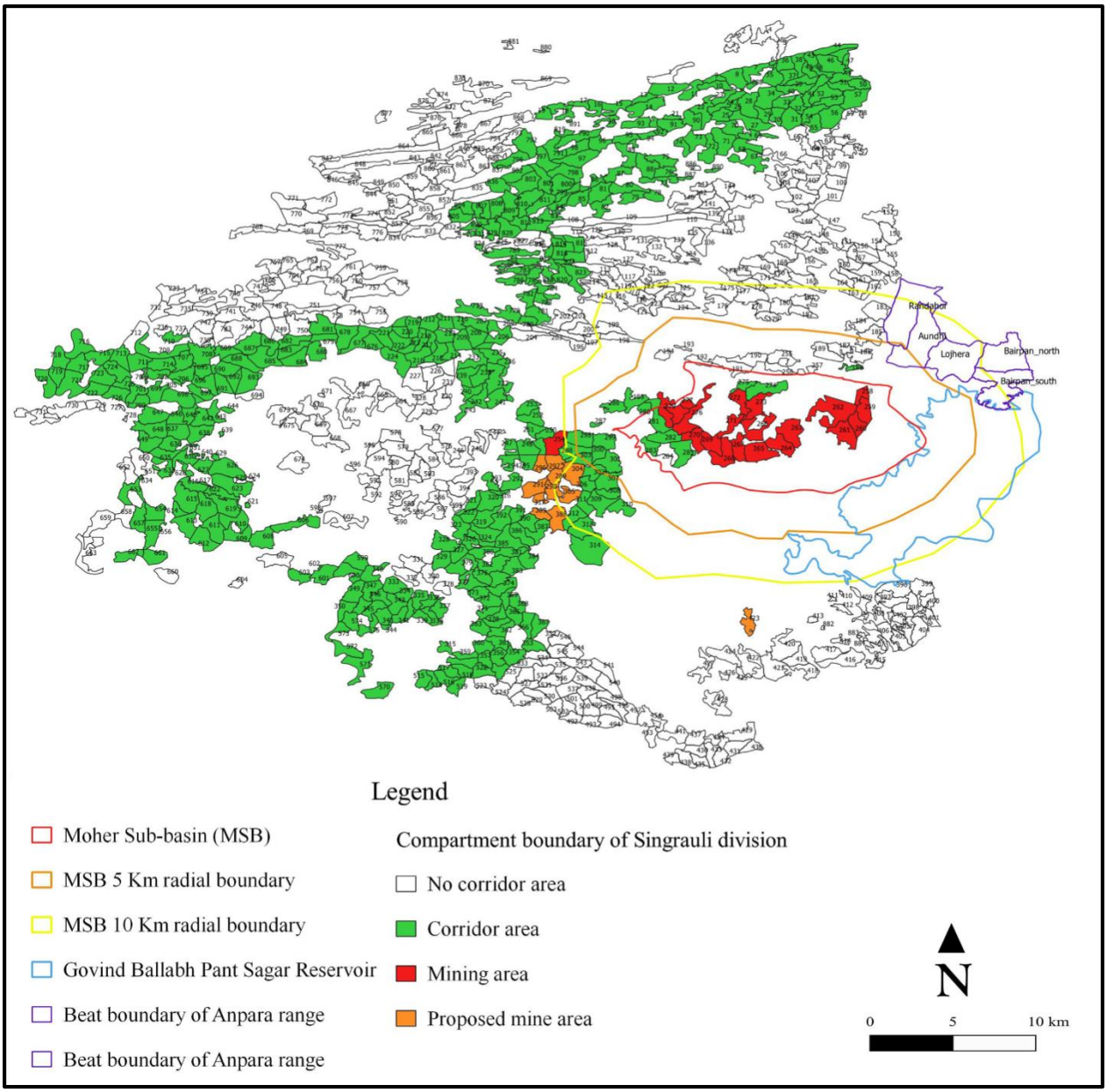

Figure 10. 2 Map of Elephant corridor at landscape level and study area

The total duration of the movement period is not so well known. The data obtained and the observation made do not however suggest extensive use of the areas upto 10 km by elephants but every year there are some instances of few incidences of elephants coming into these areas. A large number of measures will have to be taken to ensure the mining and elephant conservation on sustained basis.

10.17.1 Elephant monitoring squad

There is a need to initiate long term elephant conservation in the area. The State Forest Department of Madhya Pradesh should create a special elephant monitoring squad. This is proposed as a major activity to support the elephant conservation in the study area. The proposed squad will focus on the elephant movement across the larger landscape surrounding the proposed project area and must examine habitat used by the elephants whenever they pass through the forested areas adjacent to the Moher sub-basin mining area. The proposed elephant squad must be equipped with appropriate vehicle with monitoring equipment like binoculars, digital cameras, communication system (wireless or mobile), GPS. This will be a dedicated squad for elephant conservation in the project area.

The proposed elephant conservation squad will act as an early warning system & pre-warn/ advice the NCL/villages/local administration about the movement pattern of elephants as and when they are passing through the nearby forest areas. The proposed elephant conservation squad will also provide information of elephant movement to State forest department of UP if themovement is likely to happen in the Anpara range of renukoot division also.

The following activities have to be carried out by the State Forest Department in addition to the above for updating information on elephants in the area:

a. Population monitoring either by direct counts or by way of dung count.

b. Assessment of food plant availability in the forested area adjacent to the proposed mining block as the elephants in search of food invade nearby villages, crop fields and destroy these crops and sometimes even there is conflict between human beigns and elephants.

10.17.2 Awareness camps on elephants

Awareness camps must be regularly organized regarding elephants for the locals and all the work force engaged on with the NCL. These awareness camps must focus on the

knowledge on elephant behavior and how to deal with the elephant menace. The people need to be educated about the ecological significance of conserving the elephants. Elephant experts should be engaged to carry out this work. These awareness camps must be organized at fixed intervals and should be organized more intensively during the period that elephants are passing through the forested areas adjacent to the proposed mining block. All the staff of mine should have some basic minimum understanding of the elephant behavior as well as behavior of other wild animals of the area.

10.17.3 Measures against use of Explosive

The mining activity requires operations like blasting and drilling for OB removal and large scale earthwork, which may cause noise pollution in the neighboring wildlife communities and somewhat damages the wildlife habitats. Ground vibrations occur due to blasting operations and species living in the vicinity areas may be indirectly impacted by such an action if proper prophylactic measures are not taken effectively.

With reference to the wild elephants, it is proposed that great care should be taken when blasting operations are planned. Blasting should be avoided when elephants are passing through the forested areas adjacent to the proposed mining block as the sound could irritate and disturb elephants and may in turn prompt them to cause more damage in the area.

10.17.4 Right to pass for Elephants

Since the project area is historically the habitat for wild elephants and elephants have known to move in these areas frequently in past, it is proposed that during the mining operations right to pass should be granted to elephants. It is proposed that whenever elephants come close to the proposed mining block, the proposed elephant conservation squad should inform the project authorities of such a movement. The Project authorities should take strategic decision on brining the activities on low profile for the period that elephants peacefully pass through the area without being provoked or disturbed and the activities should not be resumed to full scale unless the squad gives go ahead signal. All the staff and workers must be aware of the fact that the operations have been slowed

down for the want of providing safe and disturbance free passage to the wild elephants during the specified period.

10.17.5 Habitat conservation for Elephants

As an important habitat conservation strategy for elephants in the 10 km radius zone, it is recommended that all good areas of Sal forest should not be disturbed.

It may be of paramount significance to preserve the riparian habitats in the 10 km radius area. Elephants are known to stay close to water sources and keeping the riverine areas free from disturbance would be of immense help in providing safe habitat to the animals. It has to be ensured that the run off from mines should at no cost enter in any river or nallah in the forested areas.

Plantation of Bamboo and other species like Ziziphus spp., *Bridelia retusa*, *Grevia tilieaefolia*, must be taken up in appropriate areas in the corridor patches within 10 km radius to enhance the habitat quality for elephants.

10.18 Conservation of Big cats

The big cats like tiger and leopards are not abundantly present in the study area though there are evidences of their presence in the area. Tiger has been rarely seen in the study area except for one or two evidences suggesting the presence of tiger in the area. That however does not qualify to make a clear statement on absence of the species in the study area. The study area enjoys connectivity with Sanjay Dubri tiger reserve in MP and Guru Ghasidas National Park in Chhattisgarh. So the possibilities of tiger either straying or moving into these areas will always exist. Hence it is proposed that a proper tiger census should be carried out and regularly to ascertain the presence or absence of tigers in the study area. Every presence information must be dealt with utmost care to ensure the complete safety of tigers whenever they enter the study area.

With regards to the leopards, it is recommended that their movement and presence absence must also be monitored meticulously as the chances of man animal conflict are higher in case of leopards. This is because of the adaptive nature of the species and its

ability to survive in sub-optimal conditions as well. The Singrauli Forest Division must collapsible cages and team of rescue expert to rescue leopards if they either fall in village wells or enter the houses in the middle of night. Every reported kill must be monitored so that the incidence of carcass poisoning can be avoided.

10.19 Conservation Strategy for Indian Peafowl

The natural range of Indian peafowl is essentially the Indian subcontinent, with India covering a vast majority of its range from the outer Himalaya through the large part of peninsular India. It is a bird of scrub jungle and forest fringes. It is also found in agricultural fields and close to human habitation. The Indian peafowl is listed as Least Concern species in the red list of IUCN owing to its widespread distribution. Under WPA 1972, it has been accorded Schedule I status. The species is seen almost in all parts of the study aera. As of now there appears to be no direct or indirect threat to Peafowl from the proposed project. There might be though some hunting that may be taking place. Some indirect evidence pf peafowl feathers in abundance were seen once. it is recommended that census of peafowl be carried out annually in this area to monitor the population. More awareness on the overall status of the bird be spread amongst the local people as well as the mining community.

10.20 Conservation Strategy for Python

In the study area the population status of python could not be ascertained due to lack of data. However, people have reported sighting python in the area which is not unusual as these reptiles are commonly found close to villages in search of poultry and goats. There are twofold approaches recommended for conservation of this species in the area.

10.20.1 In- situ conservation

It is of paramount significance to protect the python population. Public conservation awareness programme should be launched for conservation and management of the species.

Whenever Pythons are sighted in the mining areas, they must be captured by a trained snake catcher and be released in a suitable habitat in the 10 km zone.

10.20.2 Ex – Situ conservation

Ex-situ conservation means literally, "off-site conservation". It is the process of protecting an endangered species of plant or animal by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans. Captive breeding programme can be used as an important ex-situ conservation tool to maintain viable populations. A snake rescue center should be created at Waidhan for this purpose. The funds to set up the rescue center will be provided by the Project proponent. The rescue center shall be managed by the MP Forest department.

10.21 Conservation of Indian Pangolin

Indian pangolin has been mostly reported from the east Sarai forest range of Singrauli forest division. There is need to initiate the population monitoring of this extremely shy species as it is mostly nocturnal in nature. Not much is known about the population status of this species from the area. Given the threat that this species faces all through it distributional range, there is an urgent need to conserve the species in all its habitats. The Camera trap should be used along with the surveys and discussions with the locals to get more information on the presence of this species. Local people must be made aware about the conservation of Indian pangolins and their active participation must be sought in seeking information on any illegal trade, if at all happening in the area.

10.22 Monitoring

Since the forested patches in 10 km radius of Moher sub-basin are home to elephants, Tiger, Leopard, Sloth bears, Indian pangolin it is important that population status and movement pattern of all schedule I species in 10 Km area of the project area is monitored routinely . It is proposed that 40 pair of camera traps, one vehicle for research staff, camera, binoculars, laptops, GPS etc be procured by the for which money shall be provisioned by the NCL to regular monitoring of the movement pattern of tigers, leopards and sloth bears and other schedule I species in the 0-5 and 5-10 Km radius area. The Forest Department shall hire One researcher to help and assist the Forest Department

with monitoring related work. The researcher so apppinted shall monitor the areas both in MP and UP which are part of 10 KM radius from the Moher Sub basin.

10.23 Overall Education and awareness

The conservation of wildlife without understanding and knowing the values of wildlife in terms of economy, tangible and intangible benefits is difficult. Imparting wildlife education is difficult among the local inhabitants due to lack of education and awareness. The population of the project area falls under this group. The area experiences some hunting pressures, therefore, awareness and proper education regarding the values of wildlife welfare, protection and environmental preservation should be promulgated in the area. Wildlife education programme and awareness should be organized through audio visual assistance, pamphlet distribution, and talks on the site, screening movies and holding various wildlife awareness camps. Hoarding and signboards must be encouraged and erected at critical wildlife points.

Events like wildlife week, Van Mahotsav, world forestry day, world wetland day and world environment should be used as an opportunity to spread the message of wildlife conservation in villages, schoolsand colleges in the area.

Chapter 11 Cost of Conservation Plan

11.1 Cost of executing the conservation plan

The Conservation plan is applicable to the 0-10 Km radius of Moher Sub basin mining area of NCL. Of the total terrestrial area present in 0-10 km radius almost 81% area falls in Singrauli region of Madhya Pradesh and 19% falls in the Renukoot region of Uttar Pradesh. Parts of four Forest ranges of Singrauli Forest Division fall in 0-10 km in Madhya Pradesh and parts of one forest range of Renukoot froest division falls in Uttar Pradesh.

The total capital cost of executing the wildlife conservation plan is Rs. 2633.50 lacs for a period of ten years (Table 12.1). Of the total amount of Rs. 2633.50 lacs 2134.00 lacs are for singrauli Forest Division, Madhya Pradesh and 499.5 lacs is Renukoot Forest Division, Uttar Pradesh.

11.2 Conclusion

It is hoped that with the successful implementation of the proposed conservation plan the lager objective and the overarching aim of ecologically sustainable development will be achieved. It is expected that with this wildlife plan the forests of Singrauli Forest Division and Renukoot Forest Division that fall in the 0-5 and 5-10 km radius zone of Moher sub-basin mining area will support wildlife over the period of time.

Table 11. 1 Cost of wildlife conservation plan for Singrauli Region.

		Madhya Pradesh		Uttar Pradesh	
SL.NO	**ITEM OF WORK**	**Fixed Capital cost (in Rs. laks)**	**Recurring cost (in Rs. laks) per year**	**Fixed Capital cost (in Rs. laks)**	**Recurring cost (in Rs. laks) per year**
1	Water hole creation (25 Nos- 20 in MP and 5 in UP) @ Rs 2.5 lac per water hole and maintenance and management of existing water holes.	50.00	4.0	12.5	1.00
2	Weed eradication & management	-	20.00		5.00
3	Grassland management & meadow Development	120.00	8.00	30.00	2.00
4	Fire control, additional fire watchers, five fire watch towers (4 in MP & 1 in UP) and fire line maintenance	150.00	15.00	50.00	5.00
5	Signage & Speed Breakers	18.00	-	2.00	-
6	Creation of 3 Forest Naka to prevent littering of waste in forest area in MP	30.00	-	-	-
7	Construction of 10 protection huts	120.00	-	30.00	-
8	Secret funds for intelligence gathering(LS)	20.00	-	5.00	
9	Inoculation of domestic livestock for disease prevention in Wild animals	-	4.00	-	1.00

10	Minimizing Man Animal conflict				
10.1	Crop depredation & Wildlife induced Human injury Compensation fund (LS)	150.00	-	50.00	-
10.3	Construction & maintenances of Fences, cattle proof trenches in sensitive areas	150.00	08.00	50.00	2.00
11	Creation of two butterfly park	10.00	1.00	10.00	1.00
12	Creation of elephant conservation squad				
12.1	2 Patrolling vehicle for conservation squad Wages for driver, fuel cost and maintenance	20.00	4.0	-	-
12.2	Equipment (wireless, digital cameras, binoculars, night vision devices, scaring devices,)	50.00	-	-	-
12.3	Additional forest helpers (6) for 10 years @10,000 PM for the conservation squad	-	7.2	-	-
13	Python Conservation				
13.1	Creation of Python breeding/rescue center and its maintenance at Waidhan	20.00	2.00	-	-
13.2	Trained snake handler (1) for 10 years @ 10000 PM	-	1.2	-	-
14	Survey, Census, monitoring of wildlife in 0-5 km and 5-10 km zone Purchase of 40 pairs (35 pairs for MP and 5 pairs for UP) of camera traps, vehicle for research team and other monitoring equipment	40.00	4.00	10.00	1.00
14.1	Research staff (1 No) @ 35000 PM for 10	42.00	1.00	-	-

	years plus their logistic cost.				
15	Habitat management and Improvement for elephants and other wildlife, plantation of fruiting species	-	25.00	-	05.00
16	Wildlife education & Awareness in villages, townshps in 0-5 and 5-10 Km radius area	-	10.00	-	02.00
	Total	**990.00**	**114.4**	**249.50**	**25.00**
	Total Recurring cost for 10 years	-	**1144.00**	-	**250**
	Total cost of wildlife Plan for MP (990.00+1144.00) and UP (249.50+250)	**2134.00**	-	**499.50**	-
	Total cost of wildlife Plan (2134+499.50)	**2633.50**			

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Annexure I Government Notification

F. No. 8-57/2017-FC
Government of India
Ministry of Environment, Forest and Climate Change
(Forest Conservation Division)
****

Indira Paryavaran Bhawan
Aliganj, Jorbagh Road
New Delhi – 110 003
Dated: 19th April, 2018

To,

The Principal Secretary (Forests),
Department of Forests & Environment,
Government of Madhya Pradesh,
Bhopal.

Sub: Diversion of 467.809 hectares of forest land/revenue forest land (443.000 ha. forest land + 24.809 ha. Revenue forest land=467.809 ha. forest land) for Opencast Coal Mining in favour of M/s. Northern Coal Fields Limited, Rewa in Singrauli District State of Madhya Pradesh.-regarding.

Sir,

I am directed to refer to the Addl. Principal Chief conservator of Forests (Land Management) and Nodal Officer, Forest (Conservation) Act, 1980, State Government of Madhya Pradesh's letter No. F-1/783/2017/10-11/3262 Bhopal dated 30.10.2017 on the above mentioned subject, seeking prior approval of Central Government under Section-2 of the Forest (Conservation) Act, 1980, and to say that the said proposal has been examined by the Forest Advisory Committee constituted by the Central Government under Section-3 of the aforesaid Act.

2. After careful consideration of the proposal of the State Government of Madhya Pradesh and on the basis of the recommendations of the Forest Advisory Committee, the Central Government hereby agrees ***to accord stage-I / In-principle*** approval under the Forest (Conservation) Act, 1980 for the diversion of 467.809 hectares of forest land/revenue forest land (443.000 ha. forest land + 24.809 ha. Revenue forest land=467.809 ha. forest land) for Opencast Coal Mining in favour of M/s. Northern Coal Fields Limited, Rewa in Singrauli District State of Madhya Pradesh, subject to the following conditions:-

(i) Legal status of the diverted forest land shall remain unchanged;
(ii) Compensatory afforestation over the degraded forest land of 467.809 ha. (twice in extent to the area of forest land proposed to be diverted (2 x 467.809 = 935.618 ha.) of degraded forest land shall be raised within a period of three years with effect from the date of issue of Stage-II clearance and maintained thereafter as per approved plan by the State Forest Department at the cost of the user agency;
(iii) **Compensatory afforestation shall be raised over double the diverted forest land on orange forest and at least 1000 plants per hectare (467.809 ha x 2 x 1000 =935780 plants) shall be planted over identified degraded forest land under administrative management control of forest department as per the working plan prescription with provision for ten years on subsequent maintenance;**
(iv) **25% of CA cost will be deposited extra by the user agency for soil and moisture conservation (SMC) activities on the CA land;**
(v) **Complete compliance of FRA will be done and certificate on prescribed form will be submitted along with the compliance report;**
(vi) **The representatives of the UA have informed that not all the trees enumerated in the lease area will be felled. Trees falling in the safety zone area, around internal roads, magazine area, etc. will be maintained as intact as far as possible. Felling of trees will be undertaken under the supervision of the State Forest Department;**
(vii) **Labour working in the mine should be provided with the LPG to avoid pressure on surrounding forests;**

(viii) **Residential accommodation for the labourers working in the mine should be ensured to avoid pressure on forest land for temporary residential accommodation;**

(ix) **A committee, including DFO as member, should be constituted for the monitoring of conditions to be stipulated by the Government of India and implementation of reclamation plan;**

(x) **Safety zone should be protected by appropriate measures to ensure protection of the surrounding forest so as not cause hindrance to the movement of wild animals;**

(xi) **The State Government / user agency shall arrange to furnish an Integrated Wildlife Plan for the region;**

(xii) **Area to be diverted required to be demarcated on ground and measured, mapped the said information would be submitted to the Regional office who will forward its comments to this Ministry for further action;**

(xiii) **The State Government will ensure the rehabilitation of the oustees in accordance with the National Rehabilitation Policy;**

(xiv) The land identified for the purpose of CA shall be clearly depicted on a Survey of India topo-sheet of 1:50,000 scale;

(xv) The User Agency shall transfer the cost of raising and maintaining the compensatory afforestation at the current wage rate in consultation with State Forest Department in the account of Ad-hoc CAMPA of the concerned State through online portal. The scheme may include appropriate provision for anticipated cost increase for works scheduled for subsequent years;

(xvi) The User Agency shall transfer the funds for the Net Present Value (NPV) of the forest land being diverted under this proposal from the User Agency as per the orders of the Hon'ble Supreme Court of India dated 28.03.2008, 24.04.2008 and 09.05.2008 in Writ Petition (Civil) No. 202/1995 and the guidelines issued by this Ministry vide its letter No. 5-3/2007-FC dated 05.02.2009 through online portal of Ad-hoc CAMPA account of the State Concerned;

(xvii) At the time of payment of the Net Present Value (NPV) at the present rate, the user agency shall furnish an undertaking to pay the additional amount of NPV, if so determined, as per the final decision of the Hon'ble Supreme Court of India;

(xviii) Any fund received from the user agency under the project, except the funds realized for regeneration/ demarcation of safety zone, shall be transferred to Ad-hoc CAMPA through online portal of Ad-hoc CAMPA account of the State Concerned;

(xix) The user agency shall obtain the Environment Clearance as per the provisions of the Environment (Protection) Act, 1986, if required;

(xx) Following activities shall be undertaken by the user agency under the supervision of the State Forest Department at the project cost and appropriate cost of the plan / scheme shall be **deposited in Ad-hoc CAMPA account through online E-portal;**

a. A plan containing appropriate mitigative measures to minimize soil erosion and choking of streams shall be prepared and implemented;
b. Planting of adequate drought hardy plant species and sowing of seeds in the appropriate area within the mining lease to arrest soil erosion;
c. Construction of check dams, retention /toe walls to arrest sliding down of the excavated material along the contour;
d. Stabilize the overburden dumps by appropriate grading/benching so as to ensure that angles of repose at any given place is less than 28°; and
e. Strict adherence to the prescribed top soil management;

(xxi) All the funds received from the User Agency under the project shall be transferred to Ad-hoc CAMPA through online e-portal in the concerned Saving Bank Account in Corporation Bank, Lodi Road, New Delhi-110003;

(xxii) The user agency shall prepare a land surrender schedule for surrender of the mined out and biologically reclaimed forest land in accordance with the existing mine plan and progressive mine closure plan and submit an undertaking that mined out and biologically reclaimed forest land will be surrendered to the State Forest Department as per this schedule;

(xxiii) User agency in consultation with the State Forest Department shall create and maintain alternate habitat/ home for the avifauna, whose nesting trees are to be cleared in this project. Bird nests artificially made out of eco-friendly materials shall be used in the area, including forest area and human settlements, adjoining the forest area being diverted for the project;

(xxiv) User agency either himself or through the State Forest Department shall undertake fencing, protection and afforestation of the safety zone area (as per the Ministry's guidelines dated 27.05.2015), at the project cost.

(xxv) User agency either himself or through the State Forest Department shall undertake afforestation on degraded forest land, one and half time in extent to the area used for safety zone;

(xxvi) Period of diversion of the said forest land under this approval shall be for a period co-terminus with the period of the mining lease proposed to be granted under the Mines and Minerals (Development and Regulation) Act, 1957, and the Rules framed there-under as amended;

(xxvii) User agency either itself or through the State Forest Department shall undertake gap planting and soil & moisture conservation activities to restock and rejuvenate the degraded open forests (having crown density less than 0.4), if any, located in the area within 100 meters from outer perimeter of the mining lease;

(xxviii) The User Agency shall prepare a list of existing village tanks and other water bodies with GPS co-ordinates located within five km. from the mine lease boundary. This list is to be duly verified by the concerned Divisional Forest Officer. The User Agency shall regularly undertake desilting of these village tanks and other water bodies so as to mitigate the impact of siltation of such tanks/water bodies. A detailed plan for desilting of identified ponds and water bodies to be prepared in consultation with forest department and shall be submitted to MoEF & CC before Stage-II approval;

(xxix) The User Agency shall implement the R&R Plan as per the R&R Policy of State Government in consonance with National R&R Policy, Government of India before the commencement of the project work and implementation. The said R&R Plan will be monitored by the State Government/Regional Office of MoEF &CC along with indicators for monitoring and expected observable milestones;

(xxx) User agency shall undertake mining in a phased manner and take due care for reclamation of the mined over area. The concurrent reclamation plan shall be executed by the User Agency as per the approved mining plan/scheme and an annual report on implementation thereof shall be submitted to the Nodal Officer, Forest (Conservation) Act, 1980, Government of Madhya Pradesh and the Addl. Principal Chief Conservator of Forests (Central), Ministry of Environment & Forests, Regional Office, Bhopal. If it is found from the annual report that the activities indicated in the concurrent reclamation plan are not being executed by the user agency, the Nodal Officer or the Addl. Principal Chief Conservator of Forests (Central) may direct that the mining activities to be suspended till such time, such reclamation activities are satisfactorily executed;

(xxxi) No labour camp shall be established on the forest land;

(xxxii) User agency shall provide firewood **preferably alternate fuel** to the labourers and the staff working at the site so as to avoid any damage and pressure on the adjacent forest areas;

(xxxiii) Boundary of the mining lease and safety zone shall be demarcated on ground at the project cost, by erecting four feet high reinforced cement concrete pillars, each inscribed with its serial number, forward and back bearing, distance from pillar to pillar and GPS co-ordinates;

(xxxiv) Forest land shall not be used for any purpose **other than that specified** in the proposal;

(xxxv) State Government shall complete settlement of rights, in term of the Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, if any, on the forest land to be diverted and submit the documentary evidence as prescribed by this Ministry in it's letter No. 11-9/1998-FC (pt.) dated 3rd August 2009 read with 05.07.2013, in support thereof;

(xxxvi) The user agency shall submit the annual self -compliance report in respect of the above conditions to the State Government, concerned Regional Office and this Ministry by the end of March every year regularly.

(xxxvii) Any other condition that the Regional Office (Western Zone), Bhopal of this Ministry, may stipulate, from time to time, in the interest of conservation, protection and development of forests & wildlife;

(xxxviii) The State Government and user agency shall comply the provisions of the all Acts, Rules, Regulations, Guidelines, Hon'ble Court & NGT Order (s) pertaining to this project, if any, for the time being in force, as applicable to the project;

(xxxix) In compliance of the Rule 41 of the Mineral Conservation and Development Rules, 1988 the restoration of flora in the entire lease area will be done in such a manner so as:

(a) To cause least damage to the flora of the area held under prospecting license / mining lease and the nearby areas.

(b) Take immediate measures for planting in the same area or any other area selected by the Controller General or the authorized officer not less than twice the number of trees destroyed by reason of any prospecting or mining operations.

(c) Look after them during the subsistence of the licence/lease after which these trees shall be handed over to the State Forest Department or any other authority as may be nominated by the Controller General or the authorized officer; and

(d) Restore, to the extent possible, other flora destroyed by prospecting or mining operations.

(xl) The details of such number of trees to be felled on forest as well as non-forest area in the lease and plantation of double the number of trees in the lease area or outside will be provided to the concerned Divisional Forest Office, and the Concerned Regional Office of the Ministry who will monitor such plantation efforts by the company;

(xli) **The user agency should ensure that the compensatory levies (CA cost, NPV, etc.) are deposited through challan generated online on web portal and deposited in appropriate bank online only. Amount deposited through other mode will not be accepted as compliance of the Stage- I clearance; and**

(xlii) **The period of lease and lease documents shall be submitted to MoEF & CC prior to Stage-II approval;**

3. After receipt of the report on compliance to the conditions stipulated in the paragraph-2 above, from the State Government of Madhya Pradesh, final / stage-II approval for diversion of the said forest under Section-2 of the Forest (Conservation) Act, 1980 will be issued by this Ministry. Transfer of the said forest land to the user agency shall not be effected by the State Government of Madhya Pradesh till final/stage-II approval for its diversion is issued by this Ministry.

Yours faithfully,

(Nisheeth Saxena)
Sr. Assistant Inspector General of Forests (FC)

Copy to:-

1. The Principal Chief Conservator of Forests, Government of Madhya Pradesh, Bhopal.
2. The Addl. Principal Chief Conservator of Forests (Central), Regional Office (Western Zone), Bhopal.
3. The Nodal Officer, under the forest (Conservation) Act, 1980, Forest Department, Government of Madhya Pradesh, Bhopal.
4. User Agency.
5. Monitoring Cell, FC Division, MoEF & CC, New Delhi, for uploading.
6. Guard File.

(Nisheeth Saxena)
Sr. Assistant Inspector General of Forests (FC)

Email

SPEED POST

भारतीय वन प्रबंध संस्थान
INDIAN INSTITUTE OF FOREST MANAGEMENT

(An Autonomous Institute of the Ministry of Environment & Forests, Government of India)

Forest-369
03/12/2020

IIFM/NCL/IWLMP/2020-04 /505
20.11.2020

To

Shri. C.S. Tiwari
General Manager (Forest), NCL
Post Singrauli Colliery
Northern Coalfields Ltd.
Distt. Singrauli, MP- 486889

Sub: Regarding Release of reaming 50% payment for Integrated Wildlife Plan for Singrauli Region.

Dear Sir,

Greetings from IIFM Bhopal!

As per your email dated 26th October 2020, 12 copies of the integrated wildlife plan for the singrauli region have been submitted to your office.

IIFM is in receipt of Rs.26,55,943 (50% advance) informed vide letter No. DCH/GM/Env/Forest/2020/788 dated 07.02.2020.

You are kindly requested to release the remaining balance 50% amount of Rs. **26,55,400/-** (Twenty Six lacs fifty five thousand four hundred only). The Invoice dated 19.11.2020 vide no IIFM-12 and mandate form for Electronic fund transfer/internet banking payment is enclosed for your kind perusal.

Kind Regards

Dr. Yogesh K Dubey

Encl: Invoice & mandate form

may kindly be sent to Dudhichua Project for release of Payment
04/12/20
GM (Forest)

Shri Rahul Singh
Sr. Mgr. (Wildlife) Forest

for n.a. pl
04.12.20

For further necessary pl
04.12.20

GM (DCH)

नेहरू नगर, पोस्ट बाक्स नं. 357, भोपाल म.प्र. – 462003, भारत
NEHRU NAGAR, POST BOX No. 357, BHOPAL, M.P., 462003, INDIA-PBX : 2775716, 2773799, 2767851
Fax : 91-755-2772878, Website : www.iifm.ac.in
इस कार्यालय में हिन्दी पत्रों का स्वागत है

Union Bank of India

A/C Payee

दुधिचुआ शाखा मध्य प्रदेश, पिन – 486 890.
Dudhichua Branch, Madhya Pradesh, Pin - 486 890.
IFS CODE : UBIN0542610

VALID FOR 3 MONTHS FROM THE DATE OF ISSUE

दिनांक DATE 2 1 1 2 2 0 2 0
D D M M Y Y Y Y

1NQ11

PAY Yourself (As Per List Enclosed) ********** या धारकाको OR BEARER

रुपये RUPEES Twenty One Crore Thirty Four Lac Only /- **********

********** अदा करें ₹ 21,34,00,000.00/-

खाता सं. A/c No.	426101010024005	चेक क्र. Cheque No.	33288191

For NORTHERN COALFIELDS LIMITED DUDHICHUA PROJECT

2. Auth. Signatory 1. Auth. Signatory
AuthorisedSignatory

भारत की हमारी सभी शाखाओं में सममूल्य पर देय
PAYABLE AT PAR AT ALL OUR BRANCHES IN INDIA

PLEASE SIGN ABOVE THIS LINE

⑈ 288191⑈ 486026106⑆ 426133⑈ 29

AGENCY COPY

NEFT / RTGS CHALLAN for Ad-HOC CAMPA

Date : 21-12-2020

Agency Name	NORTHERN COALFIELDS LTD
Application No	5813685139
MoEF/SG File No.	8-57/2017-FC
Location	MADHYA PRADESH
Address	Panjreh - bhawan CMD OFFICE Singrouli
Amount(in Rs)	213400000/-

Amount in Words : Twenty One Crore Thirty Four Lakh Rupees Only

NEFT/RTGS to be made as per following details;

Beneficiary Name	MADHYA PRADESH CAMPA
IFSC Code.	CORP0000371
Pay to Account No.	150765813685139 Valid only for this challan amount.
Bank Name & Address:	Corporation Bank Lodhi Complex Branch, Block 11,CGO Complex, Phase I, Lodhi Road, New Delhi -110003

- This Challan is strictly to be used for making payment to CAMPA by NEFT/RTGS only

BANK COPY

NEFT / RTGS CHALLAN for Ad-HOC CAMPA

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- This Challan is strictly to be used for making payment to CAMPA by NEFT/RTGS only

After making successful payment, User Agencies may send a line of confirmation through Email: helpdeskcampa@corpbank.co.in

SBINR52020122303364518

20/12/2020