

## Preface

Human-animal conflict, a phenomenon as old as the history of mankind and that the man had learnt to locally manage and live with, has over the time become an issue of concern. Whereas there is an increase in instances of the carnivores venturing into the habitations in the lookout for easy prey, reports of herbivores raiding agricultural crops are also on the rise. Both these situations cause negative impact on man's social, economic and cultural life as well as on the conservation of wildlife populations posing a big challenge to the wildlife managers and researchers.

The state of Himachal Pradesh is also facing the issue of increasing human-animal conflict, with the major animal species causing such conflict being common leopard, Asiatic black bear, rhesus macaque, nilgai, sambhar and wild pig. The State Forest Department (Wildlife Wing) undertakes various mitigating measures to reduce such conflicts. A monkey sterilization program has been under implementation over the past about ten years under which more than 1.25 lakh monkeys have already been sterilized putting an effective check on the potential buildup of the monkey population in the State. The forest plantation program has been modified to include planting of wild fruit bearing species. Similarly, the Department is in the process of developing comprehensive strategy for the management of nilgai, sambhar and wild boar in the lower areas of the State. Estimation of populations of these ungulate species is an obvious first step and the Department has entered into technical collaboration with the Wildlife Institute of India (WII), Dehradun for carrying out such estimation in the State.

The present report is the result of pilot survey for estimating ungulate populations in Una district of the State on 23-24 June 2017 and to test the sampling methodology. More than 200 personnel, including forest field staff of Una Forest Division, Forest Guards from different Wildlife Divisions, Trainee Forest Guards from Forestry Training Institute (FTI), Sundernagar and representatives of local Panchayats participated in the survey. This pilot survey afforded a very good hands-on experience to the forest field staff to use latest survey equipment, learn about survey techniques and share experience with their colleagues from other Divisions. The efforts by this team are commended. Sh. R. K. Dogra, Divisional Forest Officer, Una Forest Division and Sh. Rahul Sharma, the Assistant Conservator of Forests, Una Forest Division enthusiastically owned this exercise, made logistic arrangements and keenly participated in the survey. Their contribution is acknowledged with gratitude. The contribution of Sh. P. L. Chauhan, Chief Conservator of Forests, Wildlife (Hqrs.), Sh. N. P. S. Dhaulta, Divisional Forest Officer, Wildlife (Hqrs.) and Dr. Sandeep Rattan, Assistant Director Wildlife in planning and implementing the survey is acknowledged with gratitude. We would like to put on record sincere thanks to Dr. V. B. Mathur and Dr. G. S. Rawat, respectively the Director and the Dean, WII, Dehradun for agreeing to provide technical support to the Himachal Pradesh Forest Department for this important exercise. Our sincere thanks to Shri. Salvador Lyngdoh, Scientist, WII for training the field teams, efficiently coordinating the survey, analyzing data and drafting this report.

It is hoped that this report will lay the foundation for carrying out ungulate survey in the remaining parts of the State and in developing appropriate management strategies for addressing human-animal conflict, especially in respect of ungulates in the State.

**Dr. G.S. Goraya, IFS**



Forest staff at data collection on line transect

#### Contact

##### **Dr. GS Goraya, IFS**

Principal Chief Conservator of Forest  
(HoFF)

Forest Dept.  
Govt. of Himachal Pradesh  
Talland Road,  
Shimla 171001  
gurider09@hotmail.com



##### **Salvador Lyngdoh, Scientist**

Dept. of Animal Ecology &  
Conservation Biology  
Chandrabani 248001  
Wildlife Institute of India,  
Dehradun 248001  
salvador@wii.gov.in

Photo credits:  
Salvador Lyngdoh  
Santosh Thakur

**Suggested Citation :** Lyngdoh, S; Rawat, GS & Goraya GS (2017) Prey Population of Una, Himachal Pradesh. Survey Report. Himachal Pradesh Forest. Dept. & Wildlife Institute of India, 26 pp. *TR No. 2017/008*

## Executive Summary

A total of 587 sightings of three major prey species (n=207) and eight minor prey species (n=380) were observed in 378 km transect. Large prey species recorded were sambar, nilgai and wild pig. Barking deer, porcupine and hare included other prey. Primates included Hanuman langur and rhesus macaque. Galliformes included, Khalij Pheasant, Red Jungle fowl and Indian peafowl. Overall mean prey density (N = abundance in the study area) was 50.96 /km<sup>2</sup> (573) in which density/km<sup>2</sup> of sambar was estimated to be  $6.31 \pm 1$  (N = 32) ; nilgai was  $11.42 \pm 1.56$  (57); wild pig was  $1.49 \pm 0.40$  (7); barking deer was  $2.24 \pm 0.43$  (34) ; hare was  $1.24 \pm 0.43$  (19); porcupine was  $0.05 \pm 0.04$  (1); langur was  $3.94 \pm 1.37$  (59); rhesus macaque was  $5.26 \pm 1.66$  (79); Khalij pheasant was  $0.82 \pm 0.25$  (12); peafowl was  $12.32 \pm 1.59$  (185) and red jungle fowl was  $5.88 \pm 0.88$  (88).

Encounter rate along the trails for large ungulates was 0.55/km, primates was 0.07/km, pheasants was 0.74/km and other prey was 0.20/km. Overall encounter rate was 1.55 prey /km walked. Extrapolation of abundance at district level by considering ecologically potential habitats was done and the 'potential number of individuals' of animals that can occur was determined. Nilgai was between 1772.19 - 3030.79 individuals; sambar was between 1479.68 - 2757.31; wild pig was between 460.67 - 4506.48; barking deer was between 488.19 - 1052.73; Indian hare was between 408.97 - 1027.22; langur was between 1045.58 - 4063.71; rhesus macaque was between 1477.47 - 5112.53; Khalij pheasant was between 240.55 - 774.04; peafowl was between 4999.88 - 9300 and red jungle fowl was between 2316.89 - 4166.63 individuals respectively.

# Acknowledgements

---

This survey would not have been possible without the support of various persons and the dedication of the frontline staff. This was the first exercise of its kind in the state.

We wish to express our profound gratitude to

Dr. VB Mathur, Director, WII  
Sh. SK Sharma, PCCF, (Mgt.)  
Sh. A Srivastava, Registrar, WII  
Sh. PL Chauhan, CCF, HPFD  
Sh. RK Dogra, DFO, Una  
Sh. NPS Dhaulta, DFO, HQ  
Sh. R Sharma, ACF, Una  
Sh. R Thakur, RFO

Himachal Pradesh Forest Dept.  
Director, FTI & Rangers College

---

Range Officers of Una Forest Division  
Field staff of Una Forest Division  
Wildlife Wing Staff of HPFD

Adrian Lyngdoh, JRF  
Volunteers  
Guest House Staff



# contents

Introduction	1
Objectives & Scope	4
Methodology	5
Results	7
Individual Estimates	9

Density Maps	15
Photographs	21
References	22
Annex I	23
Annex II	24
List of Participants	



# Introduction

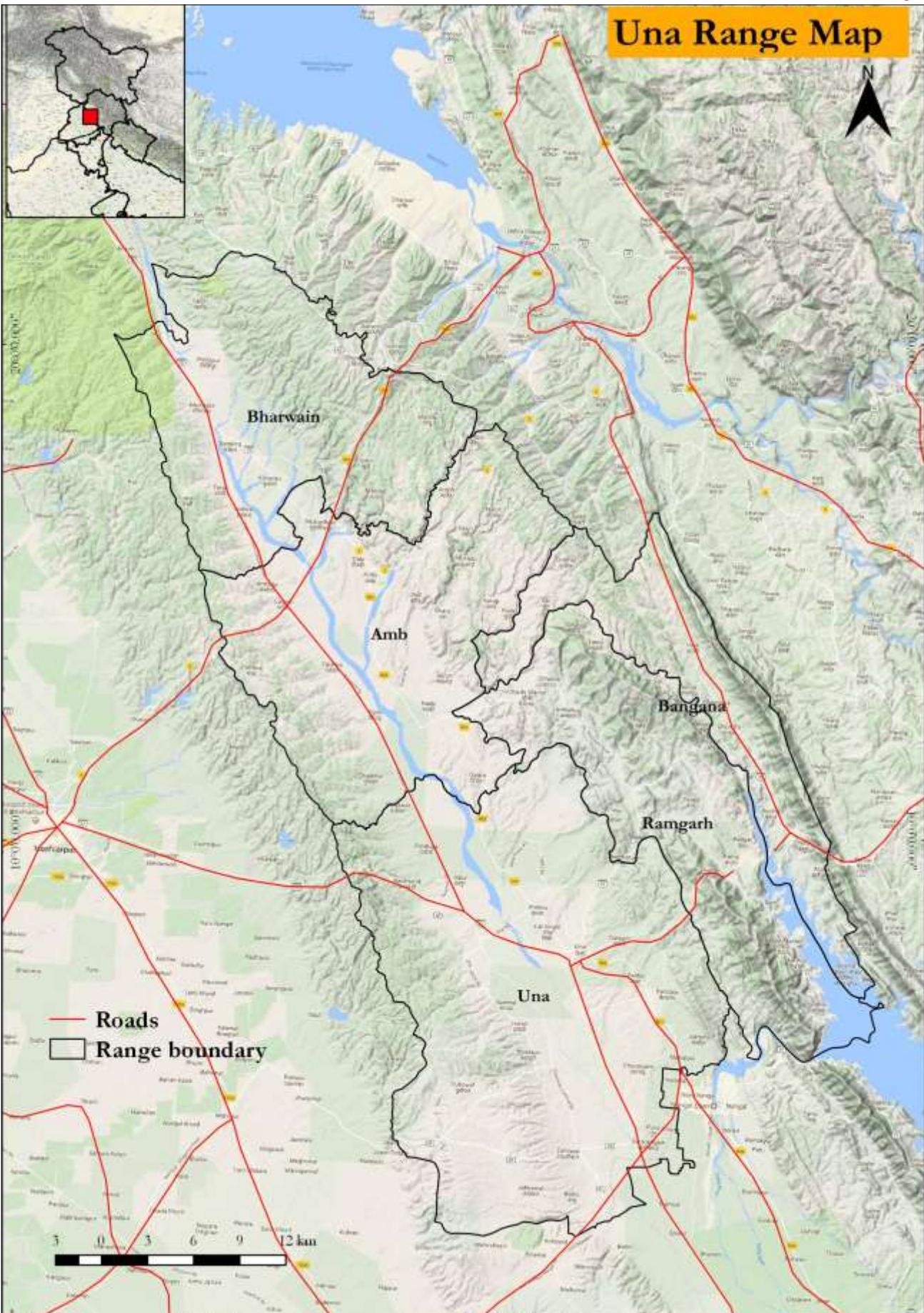


Wildlife management practices are incomplete without knowledge of relevant prey biomass. The strength of wildlife management lies in information and decision support systems for timely interventions in the framework of conservation. Various techniques have been developed for monitoring carnivore and ungulate populations (Burnham et al. 1980; Eberhardt 1978; Sulkawa & Liukko 2007; Laing et al. 2003). Estimating ungulate abundance in mountainous areas especially remains a challenge (Singh & Milner- Gulland 2011). A plethora of statistical advances in techniques, the logistical problem of surveying remote areas with constrained resources have to be considered while sampling for ungulate abundances.

It was proposed in consideration of various limitations in the Himalayan landscape of Himachal Pradesh a protocol that will employ optimal logistic effort, efficient utilization of time and resources, and lastly that will include a robust reliable data of population estimates for most ungulate species. The current technique which has been widely used across the country can be implemented in the state on an experimental basis so as to expand in future to the rest of the areas in the state. The protocol was designed to target species such as Sambar (*Rusa unicornis*), Nilgai (*Boselaphus tragocamelus*), Barking deer (*Muntiacus muntjak*), Wild Pig (*Sus scrofa*) and primate species viz. *Semnopithecus hector* and *Macaca mulatta*. The protocol also was able to capture taking into consideration logistic constraints galliformes such as Red jungle fowl (*Gallus gallus*), Indian peafowl (*Pavo cristatus*) & Khali pheasant (*Lophura leucomelanos*).

Una is the south-western most district of the state of Himachal Pradesh with a geographical area of 1540 km<sup>2</sup>. The district is covered with 523 km<sup>2</sup> of forests of various densities. The latitudinal and longitudinal extent of the district is from 31°-17'- 52" to 31°-52'- 0" north and 75°-58'- 02" to 76°-28'- 25" east respectively. About two thirds of the district has an elevation between 300-600 meters and the remaining about one third between 600-900 meters from the sea level. A few ridge tops and peaks also have elevation more than 900 meters. River Swan is the main river of the area fed only by rain-water situated in Shivalik foothills of northwest Himalayas. Its total length is 55 kms. The river overflows and erodes the banks during monsoon and causes damages to property and flora lying near the periphery of the river. Swan Catchment Area in Una district, Himachal Pradesh





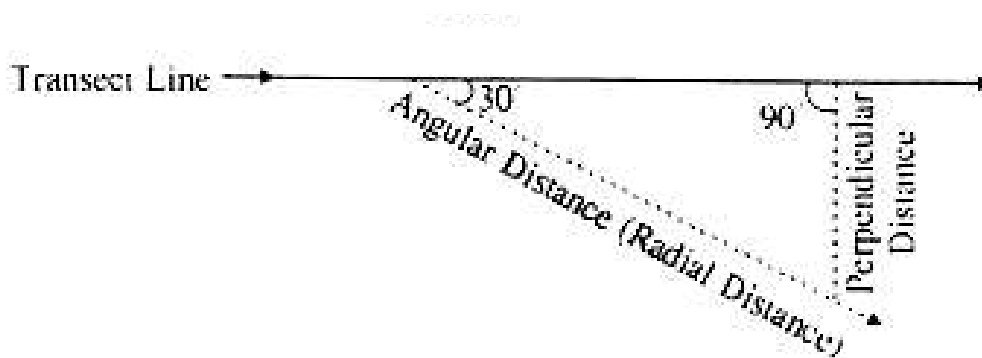


## Objectives & Scope

The current protocol has been systematically designed and to give insights into the presence absence or essential prey species in the state of Himachal species. It was an initial attempt and for the first time to obtain absolute and robust estimates of prey species in the state in a beat wise, range wise and district wise fashion to enable managers to effectively use this baseline information for adequate conservation strategies. With the adequate training of human resource, it was designed to also equip frontline staff in capacity and carrying our regular exercises in their respective field areas for future monitoring and hence Himachal Pradesh will be one the few progressive states that have employed such staff in a mass exercise. The generated information on carnivore presence as well that can be related of ungulate presence and suggest possible factors for conflict based on prey availability data.

The main objectives of the population estimation exercise were to Adequately lay straight line transects in the district

- ⇒ Build capacity of frontline staff in use of modern ungulate population estimate and survey techniques
- ⇒ Estimate presence of ungulate species in the district of Una
- ⇒ Estimate population of wild ungulate species namely sambar, nilgai, muntjac, wild pig, langur, rhesus macaque and galliformes in the district
- ⇒ Standardize a state wise protocol through this exercise for future population estimation exercise and capacity building



*Line Transect: Only objects seen are recorded*

The exercise was thus proposed in the following stages and days

Preparation Phase from 13 June to 20 June 2017

Execution Phase from 23 June to 25 June 2017

Analysis Phase from 1 July to 20 August 2017

# Methodology

Various phase wise execution of the exercise was carried out and is explained in detail below:

**Preparation Phase:** This is the first step prior to leading the survey. All ground personnel were adequately trained. Initial workshops were conducted in Chail and Sundernagar on the 24<sup>th</sup> Oct to 27<sup>th</sup> Oct, 2016. A second consecutive intensive workshop was conducted in Una on 13<sup>th</sup> June 2017 and finally a pre-field briefing and rehearsal was conducted on 23<sup>rd</sup> June 2017. The preparation of this stage involved training, mapping and on ground deployment of transects.

**Execution Phase:** The execution phase consisted of a range of information that was collected which include a) carnivore sign data b) ungulate encounter data and c) habitat quality data. Ungulate encounter data was collected from the transects that have been laid using a standard protocol as per distance sampling methodology and repeated thrice. The survey was completed using Distance based Line Transects (Buckland et al., 2005). Trails were also walked in the various beats with varying lengths to record carnivore sign data. Various ungulate pellet counts were also performed along regular intervals of transects i.e every 400 m for various prey species.



Data was entered in an MS Excel worksheet with details of observer, date, transect ID, Beat and other information for analysis and calculation of population estimates. All these were communicated and analyzed at the Wildlife Institute of India using Programme DISTANCE and GIS based soft wares. For **prey estimation**, Distance 6.0 (Thomas et al., 2010) software was used to estimate the line transect data for prey density estimation. Data was further extrapolated using available forest cover types as per FSI (2013).



## DISTANCE METHOD



### Forest cover types considered as potential habitats

Species	Forest Cover
Nilgai	OF +Scrub
Sambar	VDF + MDF
Wild Pig	All
Barking Deer	VDF + MDF
Hare	VDF + MDF + OF
Porcupine	All
Langur	All
Rhesus Macaque	All
Khalij pheasant	VDF + MDF
Peafowl	All
Red Jungle Fowl	VDF + MDF + OF

The most common method of estimating animal densities is line transect method (Eberhart, 1978; Anderson et al., 1979; Burnham et al., 1980; Buckland et al., 1993; 2001). This method has been successfully used in south east Asia to estimate the animals densities (Karanth & Sunquist 1992; Biswas & Sankar 2002; Harihar 2005; Andheria et al., 2007; Wang 2008; Ramesh 2009 & 2011). Line transect method is practically efficient and in expensive (Burnham 1980; Buckland et al., 1993, Karanth & Sunquist 1995; Varman & Sukumar 1995).

Sixty-six (66) line transects were chosen to enumerate the available prey species from June 24 to 25, 2017 covering a total effort of 368 km and 3,168 Human Hours were spent. Each transect was approximately 2 km in length and was walked repeatedly 3 times in the morning hours (4.30 am-7.00 am) and evening hours (5:30 pm to 8:00 pm) by three observers. Intensive study area was divided in to beats of 66 numbers and we ensured that beat had least a single transect. All the transects were marked with GPS coordinates and the bearing of the transects were obtained using a compass.

For each detection, the time, species, group size, group composition, animal bearing, angle (with a compass), sighting distance (Range finder), sex and age class of the individuals were recorded. Distance and angle were recorded from the center of the cluster. Density estimates obtained from transects were used to calculate the mean group and other relevant parameters. Density ranges at 95% CL was multiplied with available potential habitats i.e open forest, medium dense forest, very dense forest and scrub categories to determine 'potential number of individuals' of animals in the landscape.

*Note: Caution should be taken however in using these categories as they only denote 'potential no. of individuals' of a species. Potential abundance is assumed as number of individuals in an area that can ideally occur if we negate the effects of disturbance, hunting and other harvesting pressures or landscape heterogeneity. **These are not to be treated as actual abundances** of animals in the area.*



# Results

A total of 587 sightings of two major prey species ( $n=207$ ) and seven minor prey species ( $n=380$ ) were observed in 378 km transect. large prey species constituted sambar and nilgai. Wild pig, barking deer, porcupine and hare included other prey. Primate species such as Hanuman langur and rhesus macaque. Galliformes included, Khalij Pheasant, Red Jungle fowl, and Indian peafowl. Desirable precision level could not be achieved in some cases due to less than 40 sightings as suggested by Burnham et al., (1980), in such cases data was pooled for three years to get the density estimation of that species. Overall prey density was 50.96/ km<sup>2</sup> in which major prey was 21.46 /km<sup>2</sup> and minor prey was 29.50 /km<sup>2</sup>. Encounter rate along the trails was calculated for large ungulates was 0.55 /km, primates was 0.07/km, pheasants was 0.74/km and other prey was 0.20/km. Overall encounter rate was 1.55 prey /km walked.

**Table 1: Effort and Sampling Intensity of Una Ungulate Estimation Exercise**

Estimates	Large Ungulates	Other Prey	Primates	Pheasants	Total
Effort	378	378	378	378	378
Samples	66	66	66	66	66
Observations	207	74	28	278	587
Effective Strip Width (m)	700	245	80	241	NA
Encounter Rate	0.55	0.20	0.07	0.74	1.55

**Table 2: Characteristics of Model and Goodness of fit criteria used in every estimate**

Groups	Model Selection Criteria	Goodness of fit	Model Definition
Pheasants	AIC	Probability of a greater chi-square value, $P = 0.93$	Hazard Rate key, $k(y) = 1 - \text{Exp}(-(y/A(1))^{**}-A(2))$
Primates		Probability of a greater chi-square value, $P = 0.87$	Half-normal key, $k(y) = \text{Exp}(-y^{**2}/(2*A(1)^{**2}))$
Large Ungulate		Probability of a greater chi-square value, $P = 0.93$	Hazard Rate key, $k(y) = 1 - \text{Exp}(-(y/A(1))^{**}-A(2))$
Other Prey		Probability of a greater chi-square value, $P = 0.97$	Hazard Rate key, $k(y) = 1 - \text{Exp}(-(y/A(1))^{**}-A(2))$

The individual estimates of prey have been estimated as follows. Various abbreviations denote DS: Group Density; N: Observations; CV: Co-efficient of variation; LCL: 95% Lower Confidence Limit; UCL: 95% Upper Confidence limit. Various models were fitted for smoothening of estimates.

## Prey Abundance Estimates

Nilgai was the most abundant large prey in Una with a Density of 11.42 /km<sup>2</sup>. Among pheasants, peafowl was the most abundant prey with a density of 12.32 /km<sup>2</sup>. Similarly, Barking Deer or Muntjac was highest density among other prey with a density of 2.24 /km<sup>2</sup> while Rhesus macaque was the most densely distributed primate with a density of 5.26/ km<sup>2</sup>.

Group size indicates the cluster width in each of the species. Peafowl had a group density of 6.13 followed by Red Jungle fowl (2.93) and Nilgai (2.78). Sambar was known to be seen in solitary or with 2-3 individuals hence the group size was estimated to be 1.54. Porcupine was sighted only by one observer in one transect hence the group density as well the densities are low. Peafowl was the most sighted animal during the period of the survey while porcupine was the least sighted.

**Table 3: Individual Density Estimate of Prey species in Una District**

Individual Estimates	DS	Density (km <sup>-2</sup> )	N (Mean abundance in study area)	% CV D	LCL D	UCL D	Model
Nilgai	2.78	11.42	57.00	13.71	8.73	14.93	Hazard/Cosine
Sambar	1.54	6.31	32.00	15.93	4.62	8.62	
Wild Pig	0.36	1.49	7.00	27.05	0.88	8.62	
Barking Deer	1.69	2.24	34.00	19.58	1.53	3.29	
Hare	0.94	1.24	19.00	23.56	0.78	1.96	
Porcupine	0.04	0.05	1.00	100.85	0.01	0.25	
Langur	0.46	3.94	59.00	34.83	2.00	7.77	Half Normal/Cosine
Rhesus Macaque	0.62	5.26	79.00	31.69	2.83	9.78	Hazard/Cosine
Khalij Pheasant	0.41	0.82	12.00	30.75	0.46	1.48	
Peafowl	6.13	12.32	185.00	12.84	9.56	15.87	
Red Jungle Fowl	2.93	5.88	88.00	15.11	4.43	7.97	

**Table 4: Pooled estimates of Density among animal groups**

Pooled Estimates	Density (km <sup>-2</sup> )	Group Density	% CV Density	df	LCL Density	UCL Density
Pheasants	19.02	9.48	11.45	369.36	14.99	24.15
Primates	4.60	0.54	27.14	52.54	2.69	7.85
Large Ungulate	19.22	4.69	12.45	391.66	15.06	24.52
Other Prey	3.53	2.66	17.48	112.86	2.50	4.97

# Individual Estimates

## Sambar (*Rusa unicolor*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
SAMBAR	1.54	6.31	32.00	15.93	4.62	8.62

Sambar (*Rusa unicolor*) is distributed in much of southern Asia as far north as the south-facing slopes of the Himalayas, mainland Southeast Asia. Sambar are nocturnal or crepuscular. The males live alone for much of the year, and the females live in small herds of up to sixteen individuals. Indeed, in some areas, the average herd consists of only three or four individuals, typically consisting of an adult female, her most recent young, and perhaps a subordinate, immature female.



## Nilgai (*Boselaphus tragomelus*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
NILGAI	2.78	11.42	57.00	13.71	8.73	14.93

The **nilgai** or **blue bull** (*Boselaphus tragocamelus*) is the largest Asian antelope and is endemic to the Indian subcontinent. Nilgai are browsers as well as grazers and widely found in the foothills of the Himalayas. The nilgai is diurnal (active mainly during the day). The animals band together in three distinct kinds of groups: one or two females with young calves, three to six adult and yearling females with calves, and all-male groups with two to 18 members.



## Wild Pig (*Sus scrofa*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
WILD PIG	0.36	1.49	7	25.05	0.88	8.62

The wild boar, also known as the wild swine or Eurasian wild pig, is a suid native to much of Eurasia, North Africa, and the Greater Sunda islands. In India the wild pig is found all throughout the country except in the arid areas of Rajasthan and Gujarat and the high Himalayas. The species is mainly omnivorous often venturing into agricultural fields for forage. Wild pigs are active during the early morning and late afternoon and can become nocturnal in disturbed areas.



## Barking Deer (*Muntiacus muntjak*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
BARKING DEER	1.69	2.24	34	19.58	1.53	3.29

The Barking deer is known as such because of its loud dog-like bark when alarmed. It is a widely distributed species found in the peninsular, Terai as well as Northeastern states in India. It is a solitary animal but can be commonly sighted with one or more individuals. The Muntjac is a crepuscular animal that is active during the dawn and the dusk periods mostly. It is an important prey species of many large as well as medium-sized carnivores. The Muntjac is widely hunted for its meat however it is listed as a Least Concern species as well by the IUCN.



## Indian Hare (*Lepus nigricollis*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
HARE	0.94	1.24	19.00	23.56	0.78	1.96

The Indian hare (*Lepus nigricollis*), also known as the black-naped hare, is a common species of hare found in the Indian Subcontinent. The Indian hare is distributed throughout India, except the high reaches of the Himalayas and mangrove areas within the Sundarbans in the state of West Bengal. However, the population in India is subjected to severe fragmentation due to expanding agricultural fields and pressure on forest in terms of fuel wood collection and sometimes illegal hunting.



## Indian Porcupine (*Hystrix indica*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
PORCUPINE	0.04	0.05	1.00	100.85	0.01	0.25

This species has been recorded in Turkey and the eastern Mediterranean through southwest and central Asia (including Afghanistan and Turkmenistan) to Pakistan, India, Nepal, China and Sri Lanka. A very widespread species with no major threats, hence is assessed as Least Concern. It is a myth that quills are shot to the attacker but rather it rattles them which on contact are forced back into the attacker. Mostly a nocturnal animal





## Hanuman langur (*Semnopithecus hector*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
HANUMAN LANGUR	0.46	3.94	59.00	34.83	2.00	7.77

This species is found in a variety of habitats, such as moist deciduous forest of the Siwaliks, to oak forest in higher altitudes. This species occurs in Bhutan, northern India (Uttaranachal, Uttar Pradesh, and West Bengal), and Nepal. It is found in the Himalayan foothills from Rajaji National Park (Uttaranachal) in the west to near Pankhabari (southwestern Bhutan) in the east, and throughout in between (Brandon-Jones 2004).



## Rhesus macaque (*Macaca mullata*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
RHESUS MACAQUE	0.62	5.26	79.00	31.69	2.83	9.78

A diurnal and omnivorous macaque which is commensal with humans. It is capable of residing in various habitats from urban to desert and even forested habitats. This species is arboreal and terrestrial. It resides in a range of habitats, including temperate coniferous, moist and dry deciduous, bamboo, and mixed forests, mangroves, scrub, rainforest, and around human habitations and developments, including cultivated areas, temples, and roadsides. Capture and release of laboratory and “problem monkeys” from rural and urban areas into natural forests is a major threat to wild macaques.



## Khalij pheasant (*Lophura leucomelanos*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
KHALIJ PHEASANT	0.41	0.82	12.00	30.75	0.46	1.48

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion. Despite the fact that the population trend appears to be decreasing, the decline is not believed to be sufficiently rapid to approach the thresholds for Vulnerable under the population trend criterion. Males are rather variable depending on the sub-species involved, but all have an at least partially glossy bluish-black plumage, while females are overall brownish. Both sexes have a bare red face and greyish legs.



## Red Jungle Fowl (*Gallus gallus*)

SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
RED JUNGLE FOWL	2.93	5.88	88.00	15.11	4.43	7.97

The species is native to Bangladesh; Bhutan; Cambodia; China; India; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Pakistan; Philippines; Singapore; Thailand; Timor-Leste; Viet Nam. They are omnivorous and feed on insects, seeds and fruits, including those that are cultivated. Red jungle fowl regularly bathe in dust to keep just the right balance in their plumage

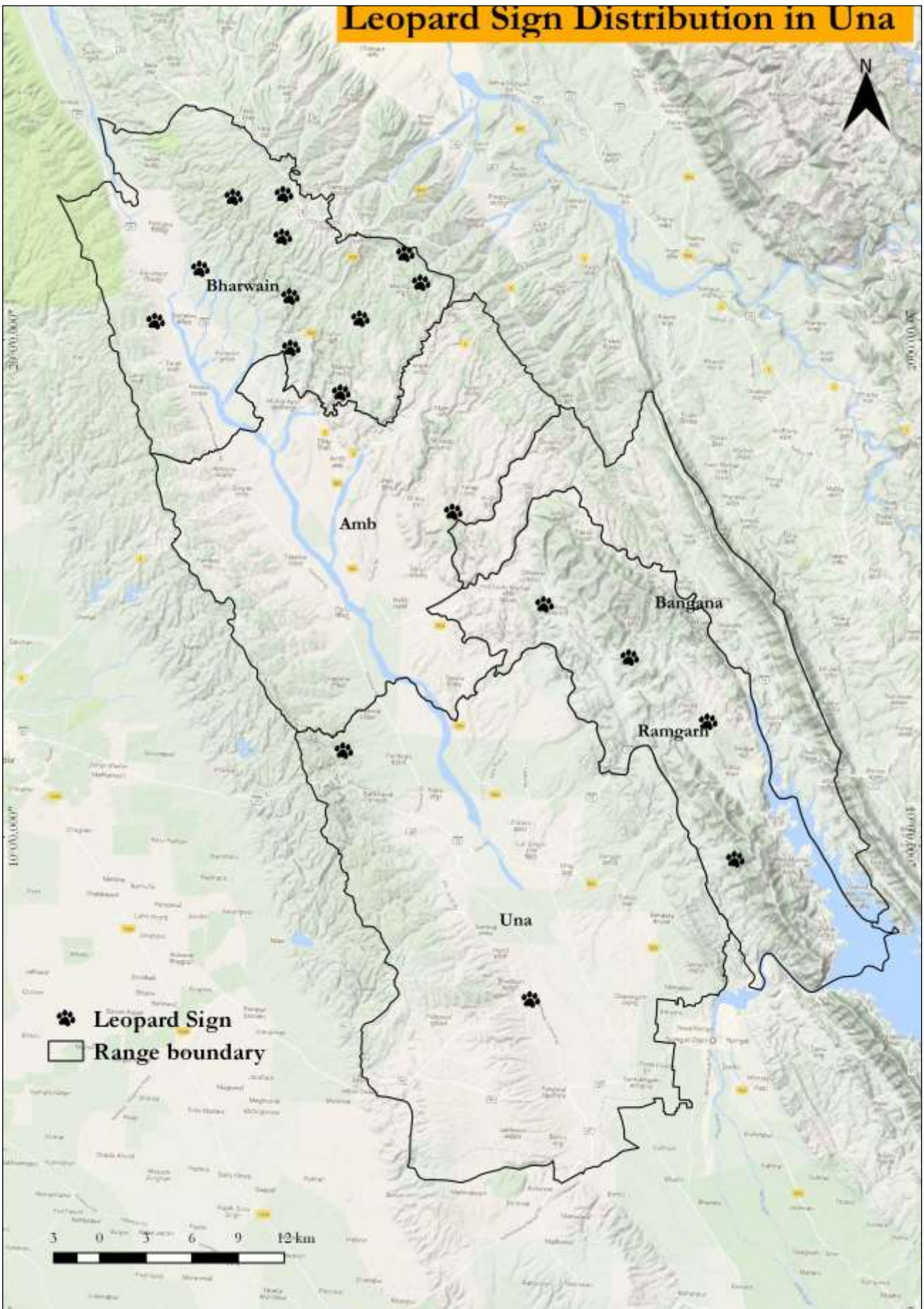


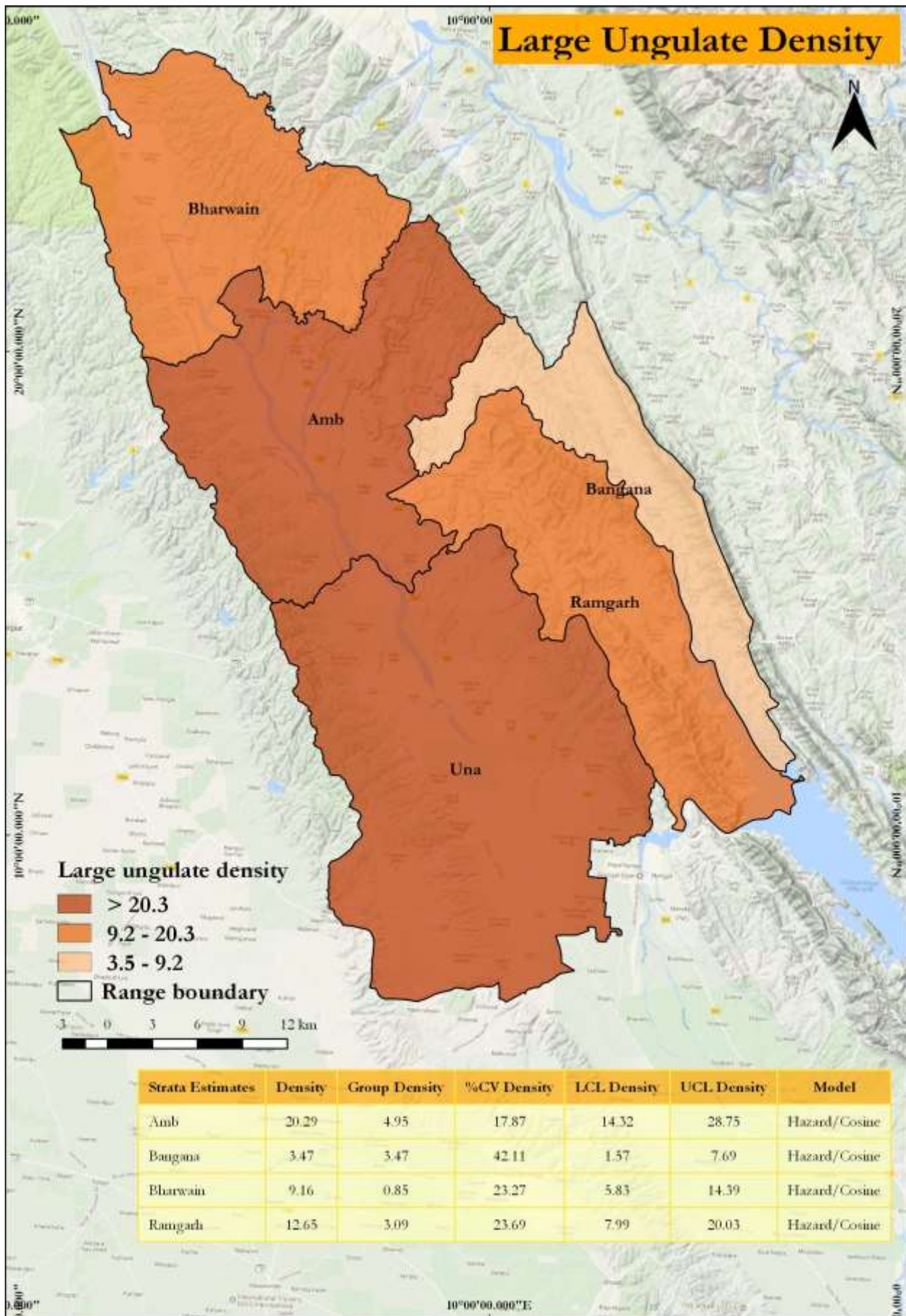
## Peafowl (*Pavo cristatus*)

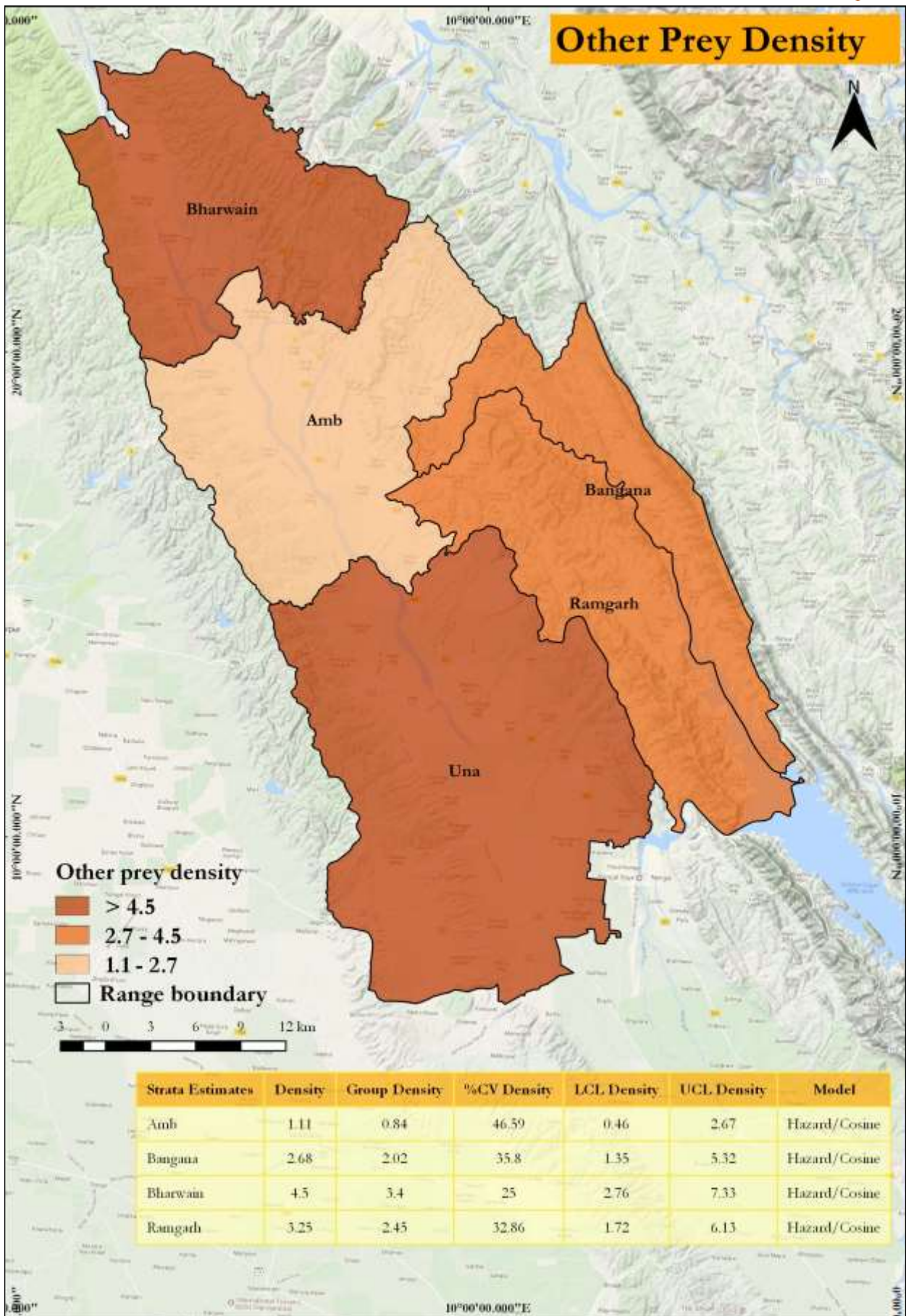
SPECIES	DS	DENSITY (KM <sup>-2</sup> )	N	% CV D	LCL D	UCL D
PEAFOWL	6.13	12.32	185.00	12.84	9.56	15.87

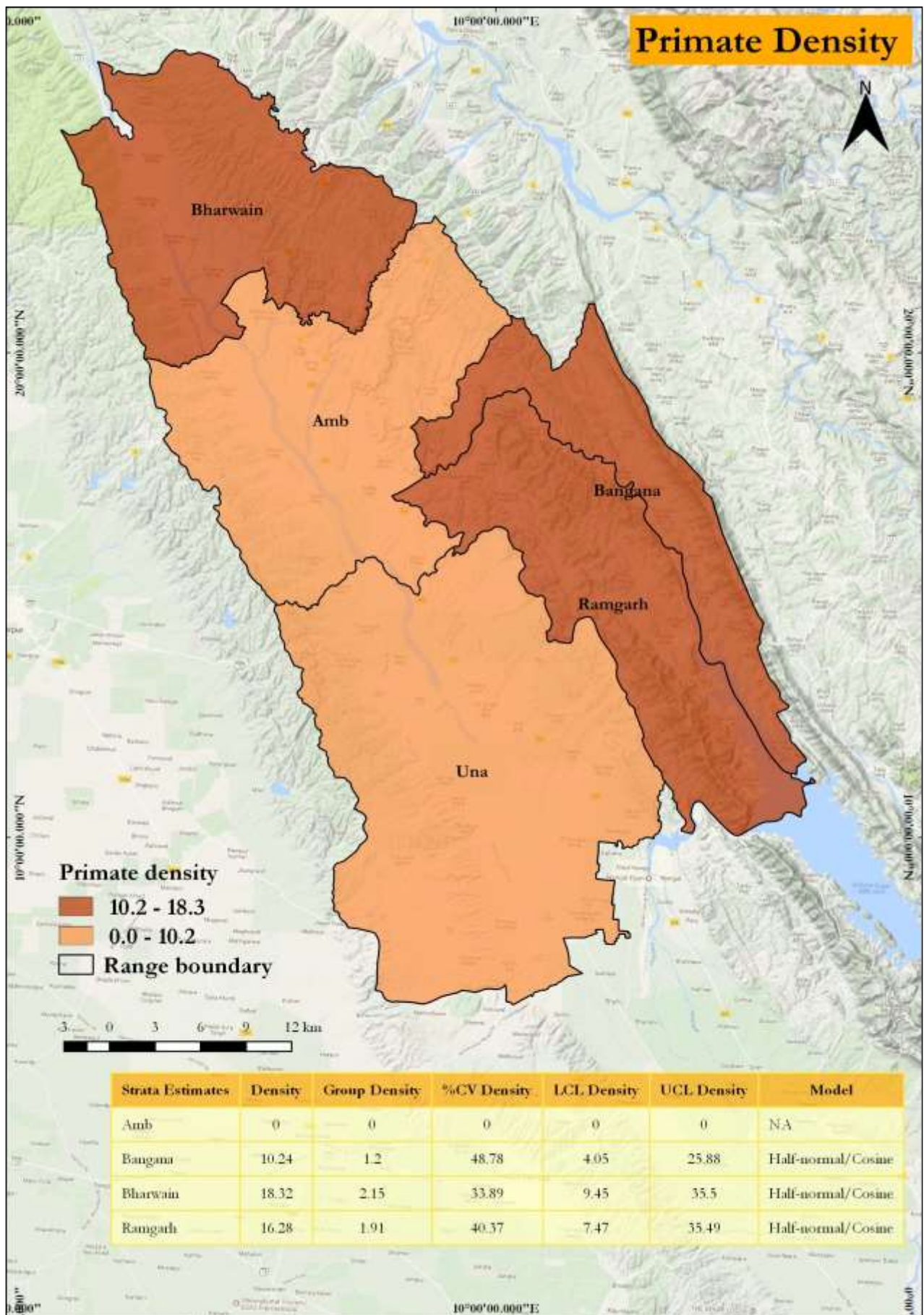
The Indian peacock has iridescent blue and green plumage. The peacock "tail," known as a "train," consists not of tail quill feathers, but highly elongated upper tail coverts. These feathers are marked with eyespots, best seen when a peacock fans his tail. Both sexes of all species have a crest atop the head. The Indian peahen has a mixture of dull grey, brown, and green in her plumage. The female also displays her plumage to ward off female competition or signal danger to her young. The global population size has not been quantified, but the species is reported to be common to locally very common.

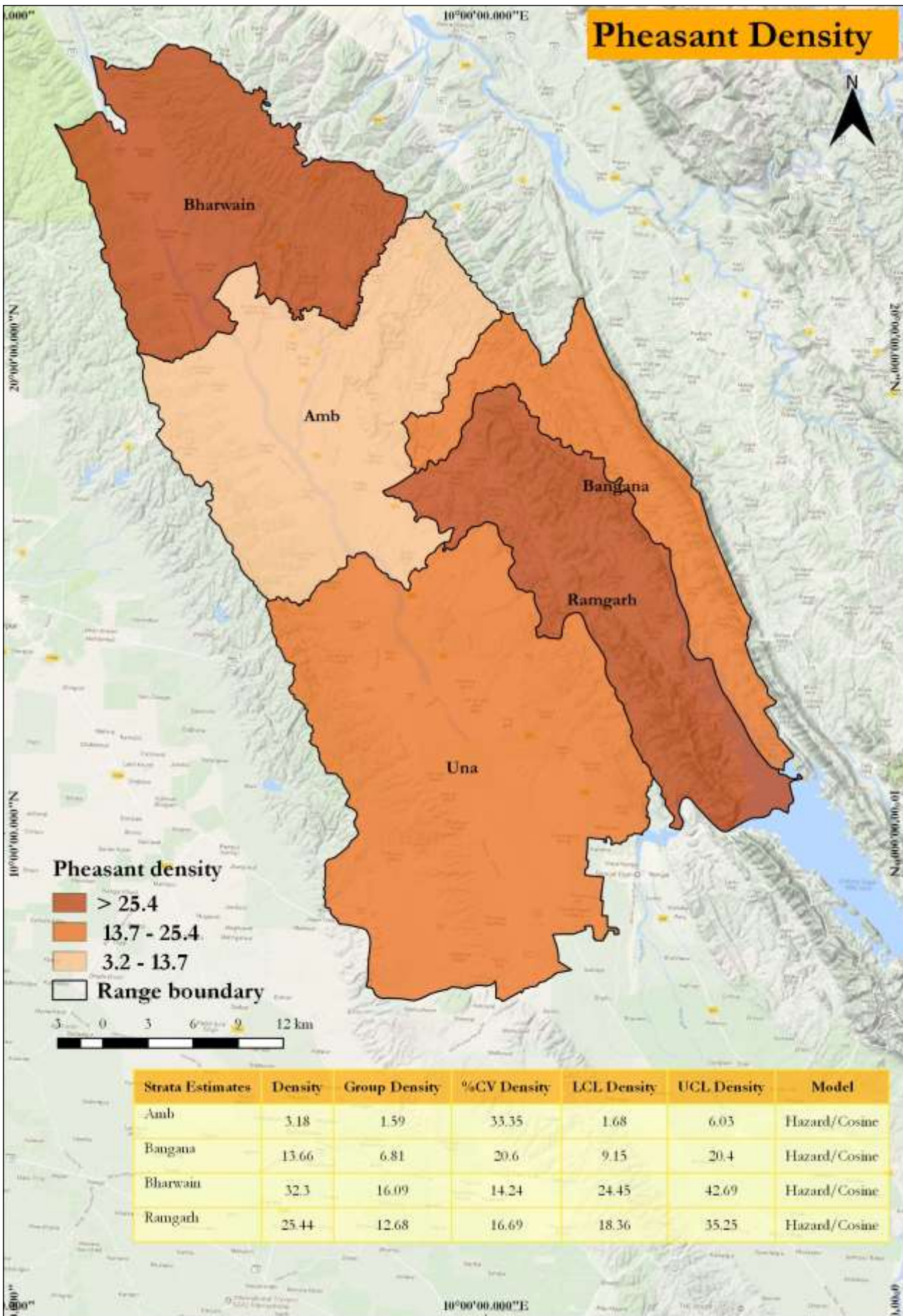














## Notes





## References

- Burnham, K. P., Anderson, D. R., & Laake, J. L. (1980). Estimation of density from line transect sampling of biological populations. *Wildlife monographs*, (72), 3-202.
- Eberhardt, L. L. (1978). Transect methods for population studies. *The Journal of Wildlife Management*, 1-31.
- Sulkava, R. T., & Liukko, U. M. (2007, January). Use of snow-tracking methods to estimate the abundance of otter (*Lutra lutra*) in Finland with evaluation of one-visit census for monitoring purposes. In *Annales Zoologici Fennici* (pp. 179-188). Finnish Zoological and Botanical Publishing Board.
- Laing, S. E., Buckland, S. T., Burn, R. W., Lambie, D., & Amphlett, A. (2003). Dung and nest surveys: estimating decay rates. *Journal of Applied Ecology*, 40(6), 1102-1111.
- Singh, N. J., & Milner-Gulland, E. J. (2011). Conserving a moving target: planning protection for a migratory species as its distribution changes. *Journal of Applied Ecology*, 48(1), 35-46.
- Buckland, S. T., Anderson, D. R., Burnham, K. P., & Laake, J. L. (2005). *Distance sampling*. John Wiley & Sons, Ltd.
- Karanth, K. U., & Sunquist, M. E. (1992). Population structure, density and biomass of large herbivores in the tropical forests of Nagarahole, India. *Journal of Tropical Ecology*, 8(1), 21-35.
- Biswas, S., & Sankar, K. (2002). Prey abundance and food habit of tigers (*Panthera tigris tigris*) in Pench National Park, Madhya Pradesh, India. *Journal of Zoology*, 256(3), 411-420.
- Harihar, K., & Kurkovsky, S. (2005, March). Using Jini to enable pervasive computing environments. In *Proceedings of the 43rd annual Southeast regional conference-Volume 1* (pp. 188-193). ACM.
- Andheria, A. P., Karanth, K. U., & Kumar, N. S. (2007). Diet and prey profiles of three sympatric large carnivores in Bandipur Tiger Reserve, India. *Journal of Zoology*, 273(2), 169-175.
- Wang, S. W., & Macdonald, D. W. (2009). Feeding habits and niche partitioning in a predator guild composed of tigers, leopards and dholes in a temperate ecosystem in central Bhutan. *Journal of Zoology*, 277(4), 275-283.
- Ramesh, T., Snehalatha, V., Sankar, K., & Qureshi, Q. (2009). Food habits and prey selection of tiger and leopard in Mudumalai Tiger Reserve, Tamil Nadu, India. *Journal of Scientific Transactions in Environment and Technovation*, 2, 170-181.
- Karanth, K. U., & Sunquist, M. E. (1995). Prey selection by tiger, leopard and dhole in tropical forests. *Journal of Animal Ecology*, 439-450.
- Varman, K. S., & Sukumar, R. (1995). The line transect method for estimating densities of large mammals in a tropical deciduous forest: An evaluation of models and field experiments. *Journal of Biosciences*, 20(2), 273-287.

## Annex I: Detail of Trail &amp; Leopard History in past 12 Months

S.no.	Beat Name	Trail Name	Leopard Activity in past 12 Months
1	Dhuiunsar	DPF Dhuiunsar to UPF Kharian	Yes
2	Mo-Miniar	Road side Tiyyari to UPF Tiyyar	No
3	Cowki	Chowki to Baduhi	No
4	Amroh	Baghmal to Kukhera	No
5	Ban Dhanet	Buhana to Matiana ( CAMP)	No
6	Saili	UPF Balkhalsa to UPF Chulehri	No
7	Makrer	UPF Makrer to Makrer	No
8	Mandli	UPF Dohak to UPF Ramgarh Awarala	No
9	Kariara	Harinagar to UPF Kothi	Yes
10	Bohru	UPF Lidkot to UPF Chulehri	No
11	Raipur	Pvt. Area Raipur to UPF Kolka	No
12	Paroian	DPF Thappal to UPF Paroain	Yes
13	Bhadarkali	R1 Pangel C-5 to Bharamshala Mahata	No
14	Joh	Pvt.land Joh to R1 Panjal C-19	No
15	Saloh-beri	R1 pangal c-32 to R1 Panjal C-30	No
16	Dauletpur	Kuha Devi to S.L Dauletpur	No
17	Nangal Jarialan	Chalet to Amboa	Yes
18	Sangnai	Jeetpur Behri to Deoli	No
19	Chowar	Mather to R-2 Lahra AC-4	No
20	Sidhchlahar	R-II Lohara AC-10 to AC-9	Yes
21	Rampur Kuthera	RII-Lohara AC-19	Yes
22	Bharwain	RII-Lohara BC-3 to BC-12	No
23	Kinoo	Kinoo to Kinoo Lohara	No
24	Guret	R-II Lohara BC-8,BC-II	No
25	Badhmana	Buri Sidh to Behma	No
26	Prithipur	Pirithipur (Pedhu ) To R-I Panjal C-9	No
27	Bangana	1UPF Masoth to UPF Mandu	Yes
28	Paniala	Naloot to pansai	No
29	Kanura	Tiyara to tureta	No
30	Solasingi	Jandana to Chamiani	No
31	Sarkeru	Jamun wali Khad to Kharohwali khad	No
32	Akor de Dhar	Akor de Dhar	yes
33	Chauli	DPF Sahari Baleha to putarea kulthu	Yes
34	Bharmout	Sir Bramana to Sir Rajpur	No
35	Arloo	Nahri to oel	No
36	Piploo	Chatehad to Samlara	No
37	Haroli	Haroli near civil hospital	No
38	Badhera	Damsuha Khad	yes
39	panjawar	Tanki balui khad from khad pool	No
40	Saloh	Law college to Khud Saloh	No
41	Behdala	Behdala near GHS	Yes
42	Bangarh	Bangarh	No
43	Polain	Tibbain to polain	No
44	Pandoga	M.S.C ispur to Panyal	Yes
45	Lamlehari	Lamlehari	No
46	Kungrath	Chhetran to Kungrath	No
47	Dulehal	heeran nagar to dulehar	No
48	Palkwah	Palkwah Bhaida to takkran	No
49	Singan	Beeton to Bat kalan	No
50	Una	Railway bridge raisery	No
51	Basal	Basal Damandni Road	No
52	Nehri	Choudhary ( Bhera ) to Charan ganga Khod	No
53	Thathal	Kistheri to iso therkalan	No
54	Amb	Kuther to khurd kuthera	No
55	Bhera	Charuruto to Haroli	No
56	Badoh	Danduwal to Lawaya bali Khuni	No
57	Jadla	Thodda dig to kakdala panga	No
58	Mawa Sindhian	Bara to pine Slope	No
59	Gagret	Bhuha bela to Aniherata bulding	No
60	Jowar	Nari Road acla to Parah	No
61	Lambar Sail	Patehar to Gangoti	No
62	Kotla	Jattabula to Sunethari beat	No
63	Suri	Kinnu tres	No
64	Dar Gujran	Burrji No.8 to Cheed tree	No

## Annex II : Detail of Transect Walked

Transect Name	km	Range	Beat
DPF Dhuinsar to UPF Kharian	2	Ramgarh	Dhuinsar
Roadside Tiyar to UPF Tiyar	2	Ramgarh	Mo-Maniar
Chowki to Baduhi	1.6	Ramgarh	Chowki
Baghmal to Kukhera	1.8	Ramgarh	Amroh
Buhana to Matiana ( CAMP)	1.6	Ramgarh	Ban Dhanet
UPF Balkhalsa to UPF Chulehri	2.1	Ramgarh	Saili
UPF Makrer to Makrer	1.8	Ramgarh	Makrair
UPF Dohak to UPF Ramgarh Awarala	1.8	Ramgarh	Mandli
Harinagar to UPF Kothi	2	Ramgarh	Kariara
UPF Lidkot to UPF Chulrhri	1.6	Ramgarh	Bohru
Pvt. Area Raipur to UPF Kolka	2.24	Ramgarh	Raipur
DPF Thappal to UPF Paroian	1.6	Ramgarh	Raipur
R1 Pangel C-5 to Bharamshala Mahata	2	Bharwain	Bhadarkali
Pvt.Land Joh to R1 Panjal C-19	2	Bharwain	Joh
R1 pangal c-32 to R1 Panjal C-30	1.5	Bharwain	Saloh -Beri
Kuha Devi to S.L Dauletpur	1.8	Bharwain	Dauletpur
Chalet to Amboa	1.9	Bharwain	Nangal Jarialan
Jeetpur Behri to Deoli	1.7	Bharwain	Sangnai
Mather to R-2 Lahra AC-4	1.5	Bharwain	Chowar
R-II Lohara AC-10 to AC-9	1.5	Bharwain	Sidhchlahar
RII-Lohara AC-19	1.5	Bharwain	Rampur Kuthera
RII-Lohara BC-3 to BC-12	1.5	Bharwain	Bharwain
Kinoo to Kinoo Lohara	1.5	Bharwain	Kinoo
R-II Lohara BC-8,BC-II	1.8	Bharwain	Guret
Buri Sidh to Behma	1.5	Bharwain	Badhmana
Pirthipur (Pedhu ) To R-I Panjal C-9	2	Bharwain	Prithipur
1UPF Masoth to UPF Mandu	2	Bangana	Bangana
Naloot to pansai	2.17	Bangana	Paniala
Tiyara to tureta	2.5	Bangana	Kanura
Jandna to Chamari	3	Bangana	Solasingi
Jamun wali Khad to Kharohwali khad	2	Bangana	Sarkeru
Akoi de Dhar	4	Bangana	Akoi de Dhar
DPF Sahari Baleha to putarea kulthu	1.6	Bangana	Chauli
Sir Bramana to Sir Rajpur	2	Bangana	Bharmout
Nahri to oel	2	Bangana	Arloo
Chatehad to Samlara	2	Bangana	Piploo
Harali near civil hospital	1.6	Una	Haroli
Damsuha Khad	1.6	Una	Badhera
Tanki balui khad from khad pool	1.6	Una	Panjawra
Law college to Khud Saloh	1.6	Una	Saloh
Behdala near GHS	2.2	Una	Behdala
Bangarh	2.1	Una	Bangarh
Tibbain to polain	1.6	Una	Polain
M.S.C ispur to Panyal	1.6	Una	Pandaga
Lamlehari	1.7	Una	Lamlehari
Chhetran to Kungrath	1.6	Una	Kungrath
heeran nagar to dulehar	1.8	Una	Dulehar
Palkwah Bhaida to takkran	1.6	Una	Palkwah
Beeton to Bat kalan	1.6	Una	Singa
Railway bridge raisery	2	Una	Una
Jambar Main Road Bridge	2	Una	Takka
Basal Damandni Road	1.8	Una	Basal
Choudhary ( Bhera ) to Charan ganga Khod	1.6	Amb	Nehri
Kistheri to iso therkalan	2	Amb	Thathal
Kuther to khurd kuthera	2	Amb	Amb
Charuruto to Haroli	2	Amb	Bhara
Danduwal to Lawaya bali Khuni	2	Amb	Badoh
Thodda dig to kakkdala panga	2	Amb	Jadla
Bara to pine Slope	2	Amb	Mawa Sindhian
Bhuha bela to Aniherata bulding	2	Amb	Gagret
Nari Road acla to tarah	2	Amb	Jowar
Nari Road acla to Parah	2	Amb	Jowar
Patehar to Gangoti	2	Amb	Lambar Sail
Jattabula to Sunethari beat	2	Amb	Kotla
S/L Palahar Bar	1.5	Amb	Repoh
Kinnu tres	1.6	Amb	Suri
Burji No.8 to Cheed tree	2	Amb	Dar gujran

P. L. Chauhan CCF PAN	Ritesh Kumar (WLG)	Ram Swaroop (PR)	Ranjit Singh Fgd
NPS Dhaulta DFO( Hqtr)	Rakesh Kumar (WLG)	Kehar Singh ( PR)	Thakur Dass Fgd
Dr. Sandeep Rattan Assistant Director O/o PCCF( WL) Talland Shimla	Harmesh Chand (Mali)	Devender Singh (I)	Ajay Kumar Fgd
R.K.Dogra ( DFO Una)	Neha (WLG)	Mohinder (MPW)	Ajay Kumar Fgd
Rahul Sharma ACF Una	Sh. Sadique Mhd. (FW)	Sh. Subhash Chand (I)	Anju Bala Fgd.
Rahul Sharma ACF Una	Raj Kumar (DR)	Sh.Ajay Kumar (Fgd)	Multan Singh Fgd
Rajesh Thakur RFO	Raj Kumar (I)	Nand Kishore (I)	Kavita Fgd
Hem Raj RFO	Rajni (WLG)	Japan Singh (PR)	Tilak Raj
Rajinder Singh DR	Parkash Chand (DR)	Puvinder Singh (WL)	Kishori Lal Fgd
Bishan Dass DR	Narayan Singh (I)	Rajeev Kumar (PR)	Bal Krishan Fgd
Ramesh Chand DR	Sanjeev Singh (WL)	Avtar Singh (PR)	Bahadur Singh FG
Pawan Kumar DR	Dhanwant Singh (I)	Som Nath	Ashok Kumar FG
Satnam Singh DR	Pooja Thakur (I)	Rakesh Kumar (PR)	Pawan Kumar FG
Santosh Kumar Thakur WL	Sunil Kumar (WL)	Deepak (PR)	Munish kumar FG
Sachin Fgd	Sunil Kumar (I)	Diksha (I)	Ajay Kumar FG
Kapil Dev Fgd	Bhupinder Sing (WL)	Chaman Lal (I)	Arjun Kumar FG
Sanjeev Kumar Fgd	Vishal Tandan	Pawn Kumar (PR )	Kishore FG
Pardeep Kumar Fgd	Dalip Singh (WL)	Iqwal Singh (PR)	Surjit singh FG
Shashi Bala Fgd	Vinod Kumar (I)	Jyoti (I)	Jasmer singh FG
Surjit Singh Fgd	Sapna Thakur (I)	Manmohan Sharma (I)	Jagdev FG
Narender Patial Fgd	Kanchan Sharma (I)	Anjali (WL)	Dinesh kumar Fg
Shakti Singh Fgd	Deep Ram (WL)	Kavita (I)	Pradeep singh FG
Usha Devi Fgd	Anita kumara (I)	Devi Singh (WL)	Vikrant FG
Rohit Kumar Fgd.	Arun Kumar (I)	Kapil Sharma (I)	Rattan Chand Fgd
Surjit Singh Fgd.	Aanchal Kumar (I)	Sachin (I)	Sanjeev Kumar FG
Manjeet Singh Fgd.	Manoj (I)	Jasmer Singh (PR)	Madhu Bala
Rampal Singh Fgd	Shashi kumar	Kritika Rana (I)	Ajit singh Rana
Anant Ram Fgd.	Atul Mahender (I)	Man Singh (I)	Abhishek jaswal
Sunil Kumar Fgd	Dharam pal FW	Raj Kumar (WL)	Arun Kumar
Jyoti Devi. Fgd	Bhim sen (I)	Surender Kumar (I)	Ranjeet Singh
Abhishek Fgd	Ranjit singh rana DR	Sarita (WL)	Sandeep
Karam Chand Fgd	Sandeep kumar	Gurmit (I)	Rajesh kumar
Ajay Kumar Fgd	Aanchal (I)	Jatinder Kumar (I)	Gurdev Singh FG
Jyoti Sharma Fgd	Gajjan Singh	Neeru Sharma (I)	Narender Kumar
Tersem Fgd	Reena (WL)	Sunny Kumar (I)	Rakesh kumar
Ankita Fgd	Jitender Kumar (I)	Surya bhagat Negi (WL)	Udham singh FG
Jaswant Singh	Tilak Raj FW	Subh Bala (DR)	Sanjeev Kumar
Ajay Kumar Fgd	Vinod Kumar PR	Gurdev singh	Sohan Singh (FW)
Jyoti Sharma Fgd	Mohd. Ali DR	Brahma Nand	Aarti Fgd.
Tersem Fgd	Mohd. Rafi PR	Baldev singh FW	Subhash (Mali)
Ankita Fgd	Bakhtaber Singh FW	Balwant singh P.R	Tarsem (FW)
Jaswant Singh	Hoshiar Singh PR	Sanjeev Kumar P.R	Kewal Singh (Fgd)
Ajay Kumar Fgd	Goldy PR	Raman Kumar P.R	Joginder Singh (FW)
Sanjeev Kuamr	Yashpal (I)	Gurdial chand	Neelma Fgd
Gopal Singh Fgd	Kamaljeet (I)	Liaquit Ali,Ashish WL	Guddu (I)
Akash Singh fgd	Pankaj Kumar PR	Kashmir singh P.R	Pawan Kumar (DR)
Janam Singh	Balbir FW	Kiran chandel (I)	Kuldeep Kumar (I)
Gaffur (MPW)	Shampal PR	Vijay Kumar (WL)	Amit Kumar (Fgd)
	Naresh (I)	Beena Devi (WL)	Kulbhushan (I)
	Sukhdev FW	Rattan Chand FW	Usha (WLG)
			Kuldeep sing (I)
			Rakesh Kumar FW
			Sashi Bhushan FG
			Mahender Singh



Khudabaksh FW  
Lucky Kumar PR  
Sher Singh FW  
Ved Ram (I)  
Ranjod singh PR  
Lucky (I)  
Seva Dass FW  
Rohit PR  
Rahul Negi (I)  
Darshan Lal FW  
Bhupinder Singh (WLG)  
Rakesh Kumar ( WLG)

DFO:- Divisional Forest Officer  
ACF: - Assistant Conservator of Forest  
RFO:- Range Forest Officer  
DR:- Deputy Ranger  
Fgd – Forest Guard  
WL/WLG: - Wildlife Guard  
T:- Trainee from FTI Sundarnagar  
PR:- Panchayat Representative  
FW:- Forest Worker  
MPW:- Multi-purpose Worker

