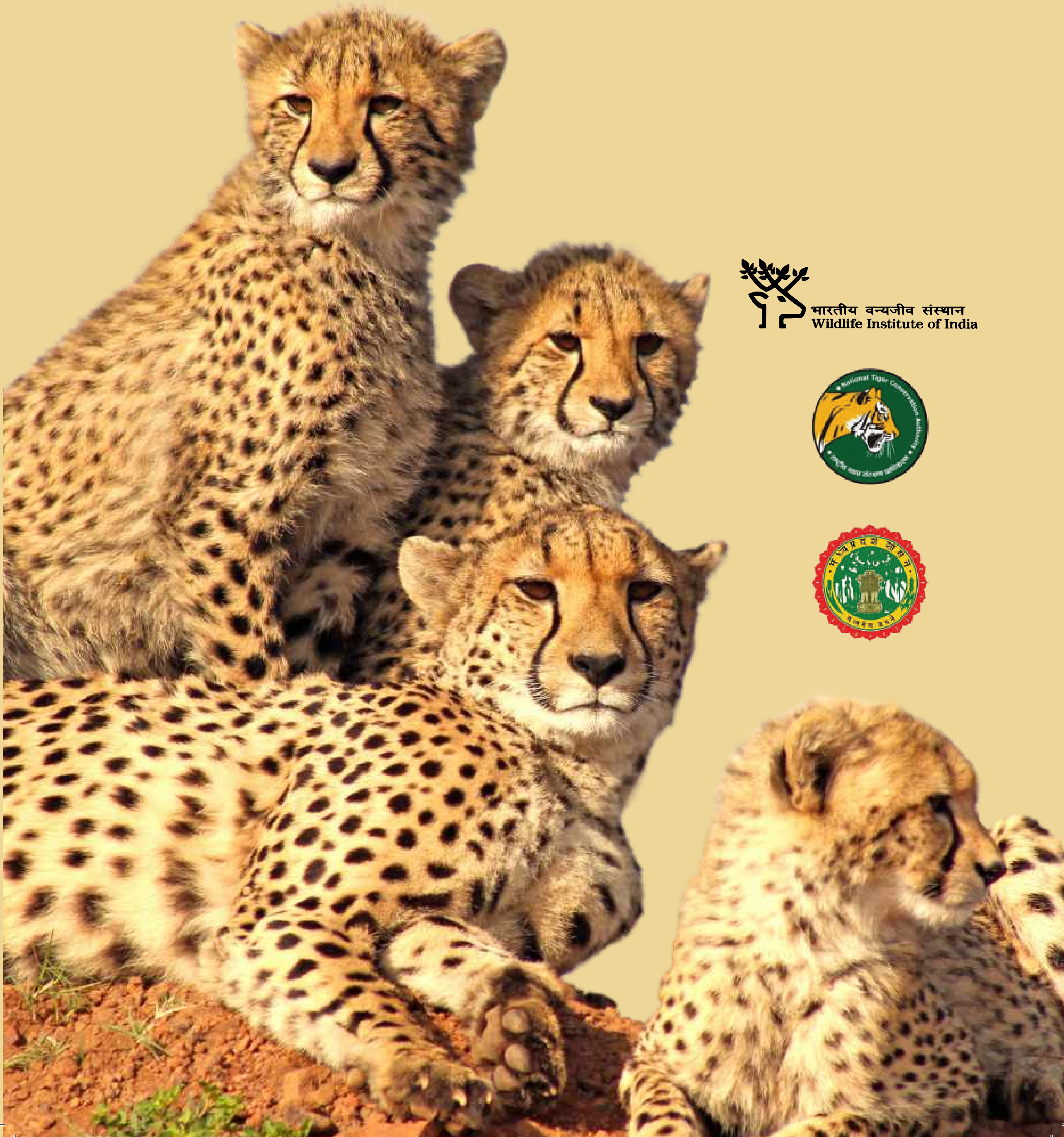
Action Plan for Introduction of Cheetah in India

(With Emphasis on the First Release Site- Kuno National Park)



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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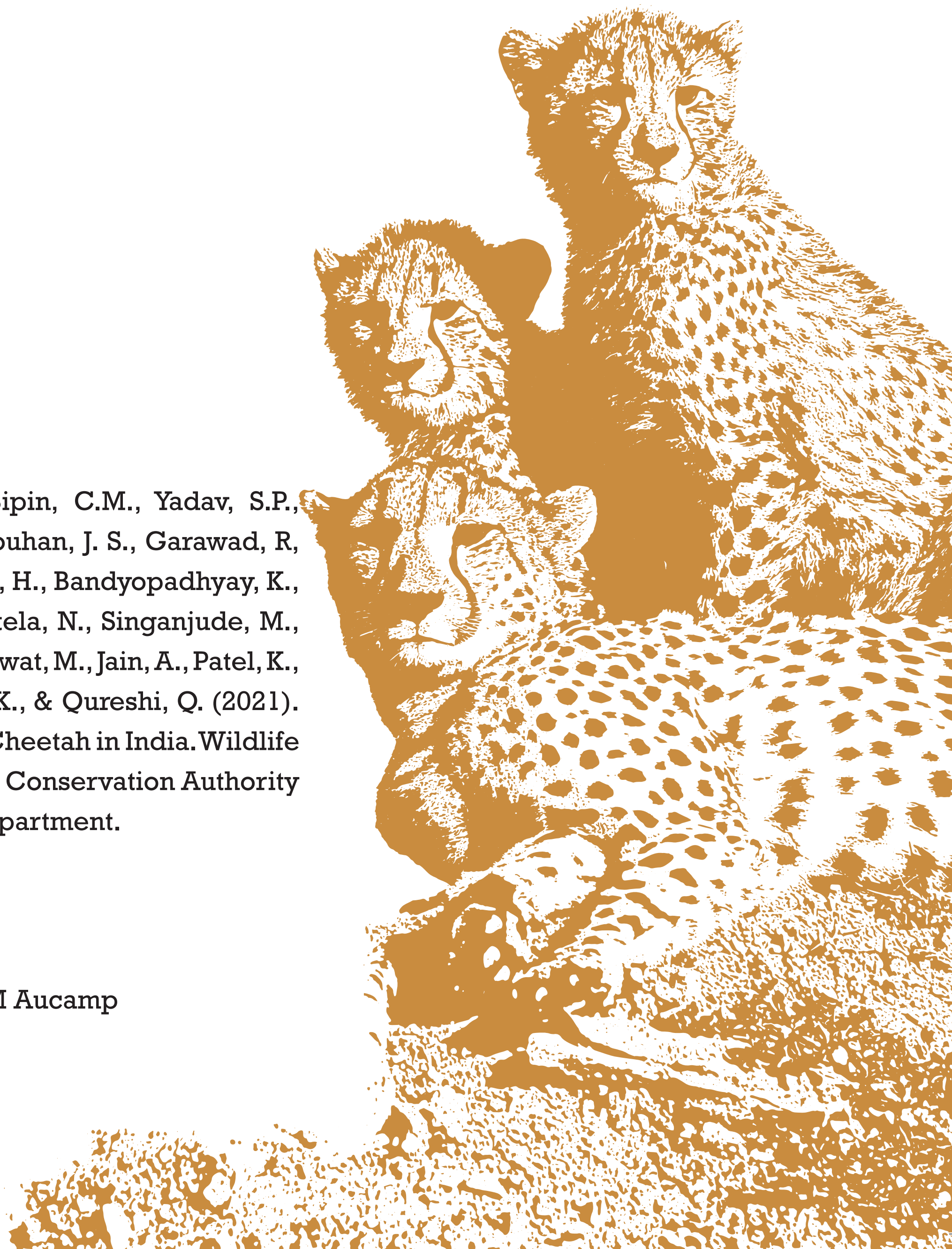

मंत्री
पर्यावरण, वन एवं जलवायु परिवर्तन
और
श्रम एवं रोज़गार
भारत सरकार

सत्यमेव जयते

MINISTER
ENVIRONMENT, FOREST AND CLIMATE CHANGE
AND
LABOUR AND EMPLOYMENT
GOVERNMENT OF INDIA

भूपेन्द्र यादव
BHUPENDER YADAV

MESSAGE

India has embarked on a path of development, yet it has not lost focus on the environment. Project Cheetah aims to bring back the only extinct large mammal in independent India – the cheetah. The project is not only about the charismatic cheetah in itself, but more for its role to restore the balance within ecosystems it inhabited.

The tiger has served as a flagship and umbrella species of forest systems, the cheetah will fill this void for open forests, savanna and grassland habitats. The project cheetah will bring in resources to restore these neglected habitats that in turn will conserve their biodiversity, harness their ecosystem services and their ability to sequester carbon to their maximum potential. The opportunities for ecotourism will enhance local community livelihood options. The action plan based on sound science will steer this globally important conservation project to success.

With best wishes.

Date: 27.11.2021

(Bhupender Yadav)

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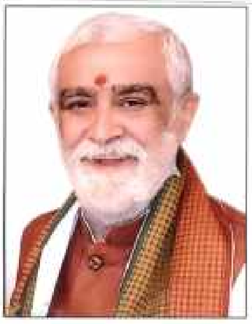
सत्यमेव जयते

आहारशुद्धौ सत्त्वशुद्धिः

स्वच्छ भारत
एक कदम स्वच्छता की ओर



संदेश

अहिंसा परमो धर्मः को आत्मसात करने वाली भारत भूमि न केवल वन्यजीवों की आश्रय-स्थली रही है, अपितु पवित्र वेदों में उनका वर्णन करके जनमानस को प्रेरित करने तथा उनके संरक्षण की प्रेरणा भी देती रही है। ऋग्वेद में चीता को पिसा कहा गया है। इसके शौर्य एवं सौंदर्य का वर्णन करती ऋचा इस प्रकार है-

सिंहाइव नानदति प्रचेतसः पिशाइव सुपिशो विश्ववेदसः।
क्षपोजिन्वन्तः पृषतीभिर्ऋष्टिभिः समित्सबाधः शवसाहिमन्यवः॥

(जिस प्रकार प्रबुद्ध व्यक्तियों की उपस्थिति से समूह की शोभा, कीर्ति एवं महिमा बढ़ जाती है, उसी प्रकार चीता, सिंह जैसे जीवों से वन की शोभा बढ़ जाती है।)

इसी प्रकार अर्थर्वेद में चीता प्रजाति के पराक्रम का वर्णन इस प्रकार है-

सिंहस्य रात्री उसत्ति पिसास्य व्याघ्रास्य द्विपिनो वर्काएददे"
अश्वस्य ब्रधान्नामपुरुसाया मायुम पुरु रुपानीकर्नुसू विभति"॥

(जो मनुष्य अंधकार में, कठिनाई में, सिंह, चीता, तेंदुआ आदि के समान पराक्रमी होते हैं, वे ही यशस्वी और तेजस्वी होते हैं)

परंतु भारत के इतिहास का कुछ कालखंड पराधीनता का रहा, उस कालावधि में चीता का आखेट इतना अधिक हुआ कि प्रजाति विलुप्त हो गई। परंतु वर्तमान सरकार जिस तरह भारत के अतीत के गौरव को प्राप्त करने के लिए कृत संकल्प है, उसी प्रकार वन्यजीवों के संरक्षण के लिए भी प्रतिबद्ध है। इसी कड़ी मे भारत सरकार ने विलुप्त चीता प्रजाति को दक्षिण अफ्रीका तथा नामीबिया से लाकर, उन्हें एक संरक्षित वातावरण देकर पुनः भारतीय संस्कृति और हमारी जैव-विविधता का अंग बनाने के लिए एक महत्वाकांक्षी कार्य-योजना बनाई है।

बाघों के संरक्षण की तरह चीता संरक्षण में भी हमें सफलता मिलेगी, ऐसा मेरा विश्वास है। भारत की जैव-विविधता को अधिक समृद्ध करने वाली इस कार्य-योजना की सफलता की मैं मंगल कामना करता हूँ।

(अश्विनी कुमार चौबे)

।। प्लास्टिक नहीं, कपड़ा सही ।।

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Foreword

Conservation translocations have become a common practice to conserve species and restore ecosystems. India has embarked on an ambitious globally important conservation initiative, that is to restore it's lost living heritage in the form of the Cheetah. In today's era the science of conservation translocations has reached great heights and the time of *chuck it and chance it* are over. The IUCN Reintroduction Group has painstakingly developed guidelines for conservation practitioners in a manner that covers all aspects of a conservation translocation project. Rarely can all the aspects of these guidelines be met in real life situations, yet the action plan for the introduction of the cheetah in India addresses each of these in a pragmatic and scientific manner. This document highlights the preparedness of India in bringing back the cheetah. Conservation practitioners across India who will be involved with this project will find the action plan as an appropriate guide for implementing this project. I wish all success for the project and hope to see vibrant wild cheetah populations in India within this lifetime.

(Dr. S. P. Yadav)

Content

1 Executive Summary

Reintroductions/ conservation translocations of large carnivores have increasingly been recognised as a strategy to conserve threatened species and restore ecosystem functions. The cheetah is the only large carnivore that has been extirpated, mainly by over-hunting and loss of habitat in India in historical times. India now has the economic ability to consider restoring its lost natural heritage for ethical as well as ecological reasons. With this context, a consultative meeting of global experts was held at Gajner in September, 2009. A consensus was reached at this meeting for conducting a detailed survey of selected sites to explore the potential of introducing the cheetah in India. The Ministry of Environment & Forests, Government of India mandated the Wildlife Institute of India and the Wildlife Trust of India with this task.

Amongst the ten surveyed sites in five central Indian States, Kuno Palpur National Park (KNP) in the State of Madhya Pradesh was rated high on the priority list for considering the introduction of the cheetah because of its suitable habitat and adequate prey base. Additionally, a lot of restorative investment had already been made at this site for introducing the Asiatic lions. Kuno National Park today is 748 km^2, that is devoid of any human settlements and forms part of the larger Sheopur-Shivpuri dry deciduous open forest landscape spanning an area of 6,800 km^2. The other

recommended sites for reintroduction of cheetah in India based on the 2010 surveys as well as recent assessments are Nauradehi Wildlife Sanctuary (1197 km^2, habitat 5500 km^2), Gandhi Sagar Wildlife Sanctuary – Bhainsrorgarh Wildlife Sanctuary complex (~2500 km^2), Shahgarh bulge in Jaisalmer, Rajasthan (4220 km^2), and Mukundara Tiger Reserve as fenced enclosure (~80 km^2) for holding and conservation breeding of cheetah in controlled wild conditions. (permissions from the Government of Rajasthan and NTCA are yet to be obtained for Mukundara TR use of predator enclosure for cheetah).

Hunting is prohibited in India and safe sufficient habitats are currently available for the cheetah. With the mitigation of the threats that caused extinction of the cheetah in India the Supreme Court of India has permitted the introduction first on an experimental basis. Population Viability Analysis has shown high probability of long-term cheetah persistence within populations that exceed >50 individuals or when smaller populations are managed as a metapopulation. Long-term commitment of resources and personnel has been achieved from the Central and State Governments with endorsement from the Union Minister, Government of India and Madhya Pradesh Chief Minister to implement this project successfully. Since it is not possible to source the critically endangered Asiatic cheetah *(Acinonyx jubatus venaticus)* from Iran without detrimental impacts on the survival of this sub-species, India aims to establish a founding population of cheetah based on availability of sufficient numbers and continued supply of behaviorally suitable, genetically diverse, healthy cheetah, without mixing of sub-species within any landscape.

India would also like to assist the Government of Iran and the world conservation community with conservation efforts of the Iranian cheetah. Cheetah as a species are constrained by space across their range, protected landscapes of India offer to extend the range of the cheetah and contribute to global efforts in conserving them.

Locally cheetah as a flagship would evoke a greater focus on the predicament of the much abused dry-open forest/savanna ecosystems and the need to restore and manage them. Additionally, cheetah introduction would greatly enhance local community livelihoods through eco-tourism prospects. The restoration of cheetah in India must be viewed not simply as an introduction of a species, however charismatic it may be, but as an endeavour to better manage and restore some of our most valuable yet most neglected ecosystems and the species dependent upon them.

KNP has been chosen as the first site for the cheetah introduction since it is ready with the required level of protection, prey, and habitat to house the cheetahs. KNP was estimated to have a current capacity to sustain 21 cheetahs. Once a cheetah population establishes itself within KNP, dispersers would colonize the landscape and potentially hold 36 individuals. Once a cheetah population is established in KNP, reintroduction of the lion or colonization by tigers would not be detrimental for cheetah persistence. Kuno offers the prospect of housing four large felids of India - tiger, lion, leopard and cheetah to coexist as they did in the past. Simultaneously, restorative investments in other selected areas (Nauradehi and Gandhisagar Protected Areas) have commenced in the form of incentivized voluntary relocation of human settlements, prey supplementation, and habitat management through weed removal and livestock grazing control.

2 Introduction & Background

The world today is witnessing the highest concern society has ever shown towards conservation of large carnivores and their ecosystems (Mech 1996, Schaller 1996, Weber & Rabinowitz 1996). Yet, the numbers and range of most of the large carnivores continue to decline (Dinerstein *et al.* 2007, Karanth & Chellam 2009). A major effort to stall and indeed try to reverse this declining trend has been through reintroduction/ conservation translocation efforts across the range of extirpated large carnivores (Breitenmoser *et al.* 2001). Successful establishment of carnivore populations as well as failures have marked such efforts (Smith & Bangs 2009, Johnsingh & Madhusudan 2009). The successful recovery of the wolf in Greater Yellowstone Ecosystem, Idaho, and Banff National Park are perhaps the best examples of human induced re-establishment of the functional role of a large carnivore in an ecosystem (Bangs *et al.* 2001, Hebblewhite & Smith 2010). However, increasingly, such vast areas are no longer available for carnivore reintroductions across the globe and establishment of carnivore populations on fenced-off game reserves and private ranches is becoming an important component for the survival of several species in many landscapes (Smith 2006). Scientific planning and management using the established principles of conservation biology is the key to enhancing the value of these small populations in conserving top carnivores (Hayward & Somers 2009).

Despite the immense and ever mounting demographic pressure, India has lost only one large wild mammalian species since the country's independence in 1947. And if the Javan *(Rhinoceros sondaicus inermis)* and the Sumatran *(Dicerorhinus sumatrensis lasiotis)* rhinoceroses, which in any case had peripheral existence in the eastern extremity of the country, be excluded, India has not lost a large mammalian species in historical times, barring one – the cheetah *(Acinonyx jubatus venaticus)*. The animal, charismatic in its own right, therefore, also has a very special significance for the national conservation ethic and ethos. The very name of the animal *"Cheetah"* originates from Sanskrit meaning "the spotted one" and Neolithic cave paintings in central India as ancient as 10-20 kBP depict the cheetah (Divyabhanusinh 2006).

Bringing the cheetah back to India, important in itself, would have equally important conservation ramifications. In saving it one would have to save not only its prey-base comprising certain threatened species, but also other endangered species of the grasslands/ open forest ecosystems, some of which are on the brink of extinction. Amongst these are the caracal *(Caracal caracal)*, the Indian wolf *(Canis lupus pallipes)* and three endangered species of the bustard family- the Houbara *(Chlamydotis undulata macqueenii)*, the lesser florican *(Sypheotides indica)* and the most endangered of all, the great Indian bustard (GIB) *(Ardeotis nigriceps)*. The grassland/ open forest dependent species, both avifaunal and faunal, have suffered a more drastic decline than any other species adapted to other biomes, simply because these habitats have undergone the most qualitative and quantitative decimation of all ecotypes in the sub-continent.

The country has been able to preserve several critical ecosystems in the name of iconic flagship species such as the tiger *(Panthera tigris)*, Asian elephant *(Elephas maximus)*, gharial *(Gavialis gangeticus)*, the great one-horned rhinoceros *(Rhinoceros unicornis)*, amongst others that inhabit such habitats. However, the grassland and scrub-thorn forest ecosystems have been declining as they are generally considered a wasteland and a blank by India's state forest departments. As nearly all the productive grasslands have been converted into croplands, historically the principal prey of the cheetah in these habitats, the blackbuck *(Antilope cervicapra)*, is also living a very precarious life due to its conflict with the agrarian communities.

Cheetah restoration will be part of a prototype or model for restoration of original cheetah habitats and their biodiversity, helping to stem the degradation and rapid loss of biodiversity now underway. Lessons learnt from this process will benefit the management of these ecotypes, the most overused, least managed and yet the most productive biomes in the country.

Dry grasslands and open forests are under-represented in the national network of Protected Areas. The National Wildlife Action Plan of India calls for appropriate bio-diversity representation in the country's Protected Area Network (India's National Wildlife Action Plan 2017). The National Forest Commission of Government of India also strongly recommends further protection of grasslands and associated flagship species (National Forest Commission Report 2006). This is particularly relevant to India, which has the largest livestock population in the world (DBT 2021, Livestock census of India 2012 & 2019), majority of which is free-ranging.

Among large carnivores, conflict with human interests are lowest for cheetahs, as they are not a threat to humans and usually do not attack large livestock. Bringing back a top predator restores historic evolutionary balance resulting in cascading effects on various levels of the ecosystem (Fritts et al. 1997, Bangs *et al.* 2001), which leads to: (A) Better management and restoration of wildlife habitat (grasslands, scrublands and open forest ecosystems), (B) Conservation of cheetah's prey and sympatric endangered species and (C) A top-down effect of a large predator

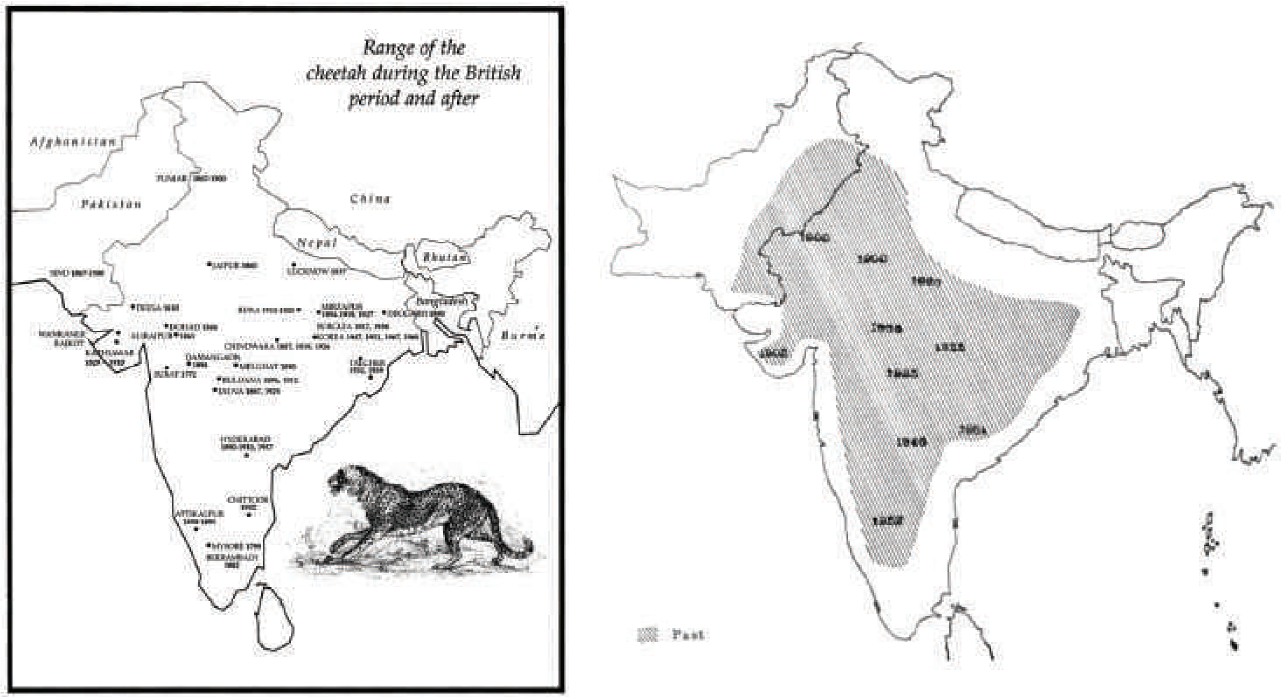
that enhances and maintains the diversity in lower trophic levels of the ecosystems.

In the Anthropocene, most of the large carnivores' populations are limited by safe spaces for their survival and subsequent expansion. Space becomes one of the most limiting resources in countries like India with high human density. Many Protected Areas and most forests are inhabited by humans and their livestock (Wani & Kothari 2007). Continuous attrition of forest quality caused by extraction of resources by an ever increasing human and livestock population is a cause for concern (Wani & Kothari 2007) for biodiversity conservation as well as sustainability of human livelihoods. Unfortunately, in the early 1970's and 80's forest dwellers were evicted often without appropriate compensation and handholding for livelihoods resulting in bitterness towards PAs (Jhala *et al.* 2021). Now, human settlements cannot be evicted from forests by law in India (Forest Rights Act 2006), however, if forest dwelling communities want to resettle outside voluntarily there is no law prohibiting it. Incentive driven voluntary relocation is a mechanism wherein an amount of INR 1,500,000 (USD 20,000) is given to an adult for relocating outside of the core of Protected Areas by the Central or State Government (NTCA 2010 & 2021). Often this package is combined with various rural development schemes of the Government to offer an incentive which constitutes a small fortune by Indian standards and is difficult to turn down. The community benefits by moving out of the remote forests where their crops are raided by wildlife, there is limited facility for education, medication, and access to markets, to join mainstream society having better livelihood options for themselves and their progeny. Simultaneously, biodiversity benefits by having more human impact free space within the protected area.

Cheetah populations have very little space for expansion in Africa and the protected landscapes of India offer this space within the cheetahs' historical range. In our effort to bring the cheetah back to India, we aim to achieve both the biological objectives i.e. a) re-establish the ecosystem function role of the cheetah in representative areas of its former range and b) contribute to the global effort towards the conservation of the cheetah as a species. Simultaneously, we are hopeful that the project will boost and enhance the livelihood options and living conditions of the local communities in and around the landscapes where the cheetah is likely to be introduced through increased revenues from ecotourism and associated activities.

2.1. Historical Background

The historical range of the cheetah in India (Figure 1) encompassed the entire country except the high mountains, coasts and the northeast region; from west of Bengal in the east to west of Pakistan into Afghanistan and Iran in the west and from Punjab in the north to north western Tamil Nadu in the South (Seshadri 1969, Divyabhanusinh 2006).



(a) (b)

Figure 1. Historical range of the cheetah in India- (a) Divyabhanusinh 2006, (b) Seshadri 1969.

The main reasons for the decline of cheetah in India were large scale capture of animals from the wild for coursing, bounty and sport hunting, extensive habitat conversion along with consequent decline in prey base (Divyabhanusinh 2006, Rangarajan 1998). The last cheetahs in the wild were recorded in 1948 where three cheetahs were shot in the Sal *(Shorea robusta)* forests of Koriya District, Chhattisgarh State with a few sporadic reports from central and Deccan regions till mid 1970's (Divyabhanusinh 2006, Divyabhanusinh & Kazmi 2019- Please refer Appendix 1).

The plight of the cheetah in India was acknowledged by the Government of India way back in 1952 during the first wildlife board meeting of Independent India *"called for assigning special priority for the protection of the cheetah in central India"* (Chaturvedi 1965, Divyabhanusinh 2006) and a "bold experimentation to preserve the cheetah" was suggested (Seshadri 1969). Subsequently, negotiations had commenced with the of Iran in 1970's with the Shah of Iran for bringing the Asiatic cheetah to India in exchange for the Asiatic lions (Ranjitsinh 2017). Around the same time, the Wildlife (Protection) Act was enacted in 1972 which outlawed all forms of hunting and capturing wild animals in India, except for scientific reasons or when they pose a threat to human life. Subsequently, with the establishment of a network of Protected areas, implementation of effective wildlife legislation and a dramatic change in the conservation ethos and awareness in the country inter alia, the original cause for the extinction of the cheetah in India has been adequately addressed. The discussions to bring the cheetah back to India were revived in 2009 by the Wildlife Trust of India who organized a two-day international workshop at Gajner, Rajasthan, India, on September 9th and 10th to deliberate the possible introduction of cheetah into India. This meeting was attended by experts from across the world and officials of the Government of India from the Ministry of Environment and Forests, and representatives of the state governments of the prioritised former cheetah range states- Gujarat, Rajasthan, Chhattisgarh and Madhya Pradesh (list of participants in Appendix 2). The experts were of a considered opinion that establishing cheetah populations in India was feasible, taking into account the presentation made by the Wildlife Institute of India and others. It was opined that further detailed surveys and analyses be carried out in the areas short-listed to confirm this and, to determine the modalities and the inter-se priority of possible release sites.

Keeping in view the small Asiatic cheetah population of Iran from which sourcing was not advisable and the genetic similarity between the Iranian and the African cheetah, the assembly was of the opinion that the African cheetah should be used for introduction into India. It was also opined that there should be collaboration and synergy between India and Iran in the conservation of the cheetah in Asia and India should learn from the experience of Iran. The assembly also gave, inter-alia, valuable recommendations with regard to sourcing and translocation, for the pre-release, release and post-release considerations and for health screening and quarantine, which will all be taken into account at the appropriate time. Participating experts and organizations involved with bringing the cheetah back to India pledged support in sourcing, translocation, rehabilitation and monitoring, including training of their Indian counterparts.

On receipt of the report of the consultative meeting at Gajner, Shri. Jairam Ramesh- Minister of Environment and Forests (2009-11), Government of India (GoI) gave directions to Dr. M. K. Ranjitsinh, Wildlife Trust of India & Dr. Y. V. Jhala, Wildlife Institute of India to prepare a detailed road map for the reintroduction of the cheetah, which had to include a detailed analysis of different potential sites. In pursuance of the decisions taken at Gajner and the directions of Ministry of Forest & Environment (GoI), ten sites within seven landscapes situated in the states of Chhattisgarh, Gujarat, Madhya Pradesh (MP), Rajasthan and Uttar Pradesh (Figure 2) were surveyed between 2010 and 2012.
1. Chhattisgarh: Guru Ghasidas National Park (NP), 2. Gujarat: Banni Grasslands, 3. Madhya Pradesh: Dubri Wildlife Sanctuary (WLS), Sanjay NP, Bagdara WLS, Nauradehi WLS and Kuno National Park, 4. Rajasthan: Desert NP WLS and Shahgarh Grasslands, 5. Uttar Pradesh: Kaimur WLS.

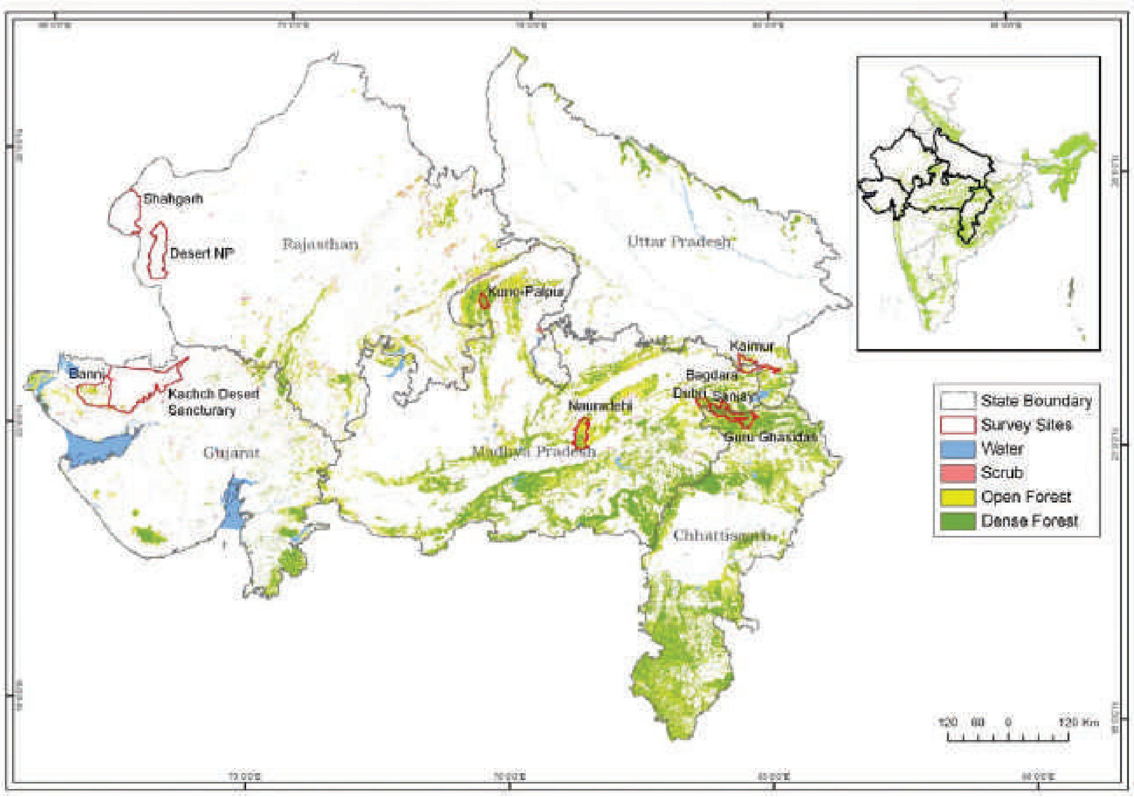


Figure 2. The location of potential cheetah re-introduction sites surveyed in the states of Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh and Chhattisgarh in India.

The important factors that govern the occupancy and abundance of large carnivores are a) availability of safe habitat, b) availability of prey and c) attitudes of local communities towards conservation and their livelihood dependencies on natural resources (Sanderson *et al.* 2006, Hayward *et al.* 2007). Ranjitsinh and Jhala (2010) addressed each of these factors by collecting field data at potential sites, analysed the information to provide recommendations for the management of the site with details of resources required for establishing a population of cheetah in the long-term.

Criteria of long-term success for the conservation of a species has often been the establishment of a "minimum viable population" which is extremely stringent, especially in the case of a newly introduced endangered carnivore, as it translates to large numbers (Gilpin & Soule 1986, Shaffer 1981). A more pragmatic approach to assess success of reintroductions is proposed by Hayward *et al.* (2007a, b) and Gusset (2009) wherein three objectives need to be met: a) acceptable survival of the released generation, b) breeding by the released generation and their offspring and c) persistence of the re-established population which could be assessed through population viability models. Ranjitsinh and Jhala (2010) conducted traditional Population Viability Analysis (PVA) (Lacy 2005) to determine population sizes that need to be achieved for long-term persistence of introduced cheetah in a landscape. The PVA analysis also explores alternative management strategies of managing geographically isolated populations as "managed meta-populations" (Gusset 2009).

From the 10 potential sites evaluated for the feasibility of establishing cheetah populations in India based on IUCN guidelines for reintroductions that consider species viability based on demography, genetics and socio-economics of conflict and livelihoods (Ranjitsinh & Jhala 2010), Kuno NP in the state of Madhya Pradesh was considered ready for receiving cheetah with the least management interventions since a lot of investments had been done in this Protected Area for reintroducing Asiatic lions. As per the directions of the Supreme Court of India in 2020, the cheetah introduction in India is being overseen by the National Tiger Conservation Authority (NTCA), Ministry of Environment Forest and Climate Change (MoEF&CC), Government of India (GoI) guided and directed by the committee of experts designated by the Supreme Court of India comprising of Dr. M.K. Ranjitsinh, Dr. Dhananjai Mohan and Additional Director General (Wildlife), MOEF&CC. The WII was given the task of providing technical assistance and coordinating the project of introducing the cheetah headed by Dr. Y.V. Jhala, with team members- Prof. Qamar Qureshi, Dr. Sutirtha Dutta and Mr. Bipin C.M., by the NTCA and the expert committee on cheetah introduction for a period (phase 1) of five (05) years with a budget of INR Thirty-nine (39) Crores (USD 5 million).

Subsequently, additional five (05) sites- Mukundara Hills Tiger Reserve (TR), Shergarh WLS, Bhainsrorgarh WLS in Rajasthan and Gandhi Sagar WLS and Madhav NP in MP were assessed based on IUCN guidelines for reintroductions as mentioned above, by the WII on the request of the State Governments along with the reassessment of Kuno NP and Nauradehi WLS during 2020-21 (Jhala et al. 2021a).

The assessment reports and conservation action plans prepared for Shahgarh, Nauradehi, and Kuno (Jhala et al. 2011 & 2012) are provided as Appendices 3-5. The action plan for establishing a cheetah population in Kuno NP in accordance with the IUCN guidelines (IUCN 2013) for reintroductions and conservation translocations is detailed below.

Image 1. Open thorn forest habitat dominated by *Acacia catechu* in Kuno National Park.

2.2. Eco-Climatic Niche Model for Cheetah in India

Cheetah presence locations from Southern Africa (South Africa, Namibia, Botswana and Zimbabwe) were used along with relevant eco-climatic covariates to model equivalent niche space in India using Maximum Entropy Models (MaxEnt; Phillips et al. 2004). For this analysis we limited our extent to southern Africa since this was the likely source from which the Indian population of cheetahs are to be procured. We obtained presence locations (16,495) of cheetah (Weise et al. 2017, van der Merwe unpublished data) along with data on land use and land cover (LULC) (2013, 250m, Moderate Resolution Imaging Spectroradiometer (MODIS), National Aeronautics and Space Administration-NASA), precipitation & temperature (1970-2000, 1000m, WorldClim Ver2- Fick and Hijmans 2017), elevation (2014, 30m, Shuttle Radar Topography Mission (SRTM), NASA and the National Geospatial-Intelligence Agency (NGA), Rodriguez et al. 2005, Farr et al. 2007), aridity (1950-2000, 1000m, WorldClim Global Climate Data, Zomer et al. 2007 & 2008), human impacts (1000m, Kennedy et al. 2019) from both southern Africa and India. We divided the presence data into two random parts of, 70% to build models and 30% to test the models. MaxEnt models using linear, quadratic, and threshold features were run in MaxEnt software version 3.4.4 (Phillips et al. 2017). We first ran univariate models and based on variable contribution and ecological importance we included them in multivariate models. One hundred bootstrap runs were performed on relevant models and resultant models were evaluated in terms of model fit and predictive ability of the training and test data (ROC and AUC criteria and omission/ commission analysis of test data). Species response curves to each covariate were examined and ecologically interpreted.

The MaxEnt model had a good predictive ability and model fit and the covariates had relevant ecological interpretations. Cheetah habitat suitability was best explained by grassland, scrub and open forest systems, semi-arid environments, low human impacts, and temperatures that tended to be hotter compared to cooler regimes (Figure 3). The response curves for cheetah showed that species' most suitable habitats are in arid and semi-arid regions of India (savanna, woody-savanna and open shrublands). Response curve of human pressure showed the highest percentage contribution (32.1%) to the model, with high suitability in areas with low human pressures and rapidly declines as human pressure increases. Response curve for elevation (DEM) shows species' suitability in areas with elevation between 200- 2000 meters. Response curve for minimum temperature of the coldest month shows that areas having low temperature (not below 2° Celsius) are not suitable. Cheetah habitat suitability was limited to areas with maximum temperature between 23° to 40° Celsius in the warmest months and mostly in semi-arid regions (Model inputs and results are appended in Annexure1).

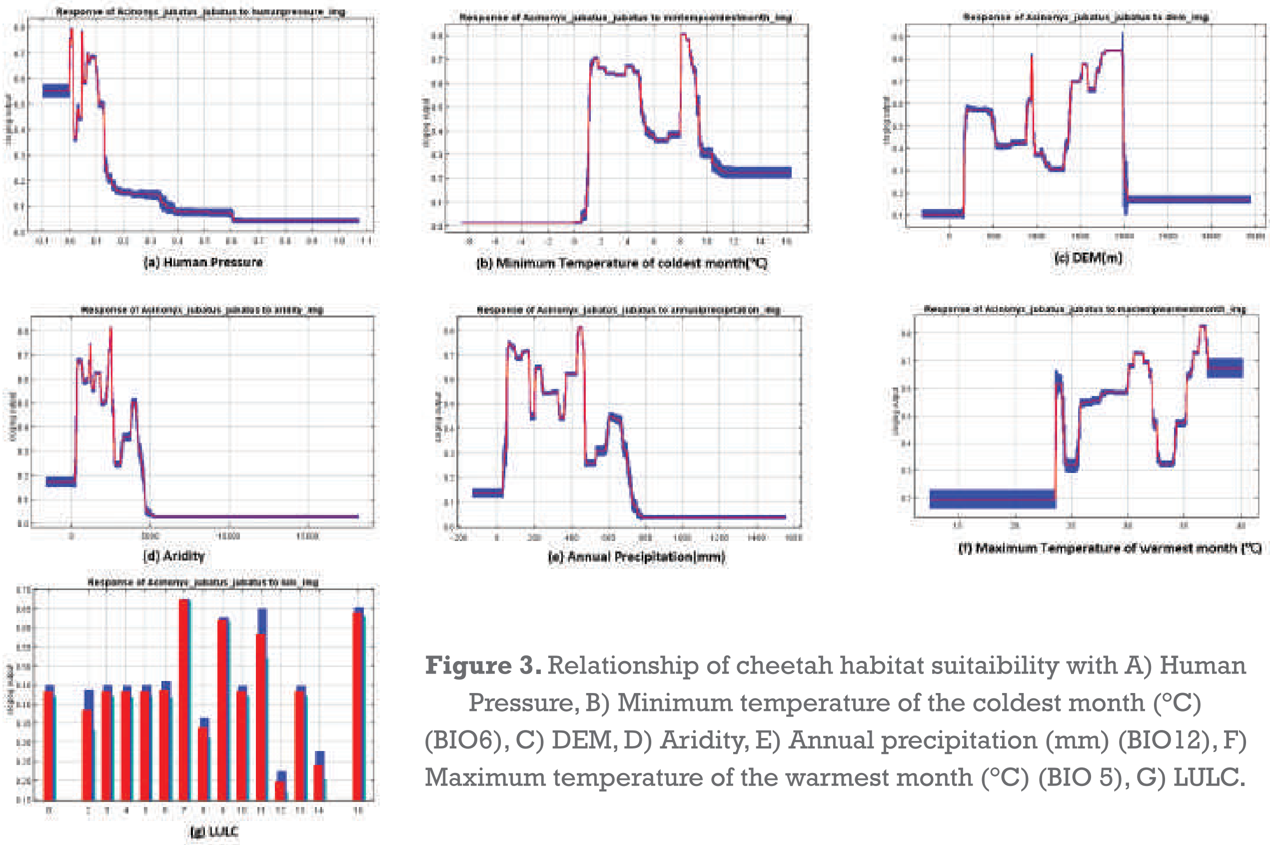


Figure 3. Relationship of cheetah habitat suitaibility with A) Human Pressure, B) Minimum temperature of the coldest month (°C) (BIO6), C) DEM, D) Aridity, E) Annual precipitation (mm) (BIO12), F) Maximum temperature of the warmest month (°C) (BIO 5), G) LULC.

The niche prediction in India coincided with the historical strongholds of the cheetah in India (Figure 4). The analysis shows that the climatic niche of the cheetah from southern Africa exists in India with Kuno NP having a high probability of cheetah habitat suitability. If cheetah locations from across their range were used for this analysis, a larger extent in India was likely to be depicted as cheetah habitat niche.

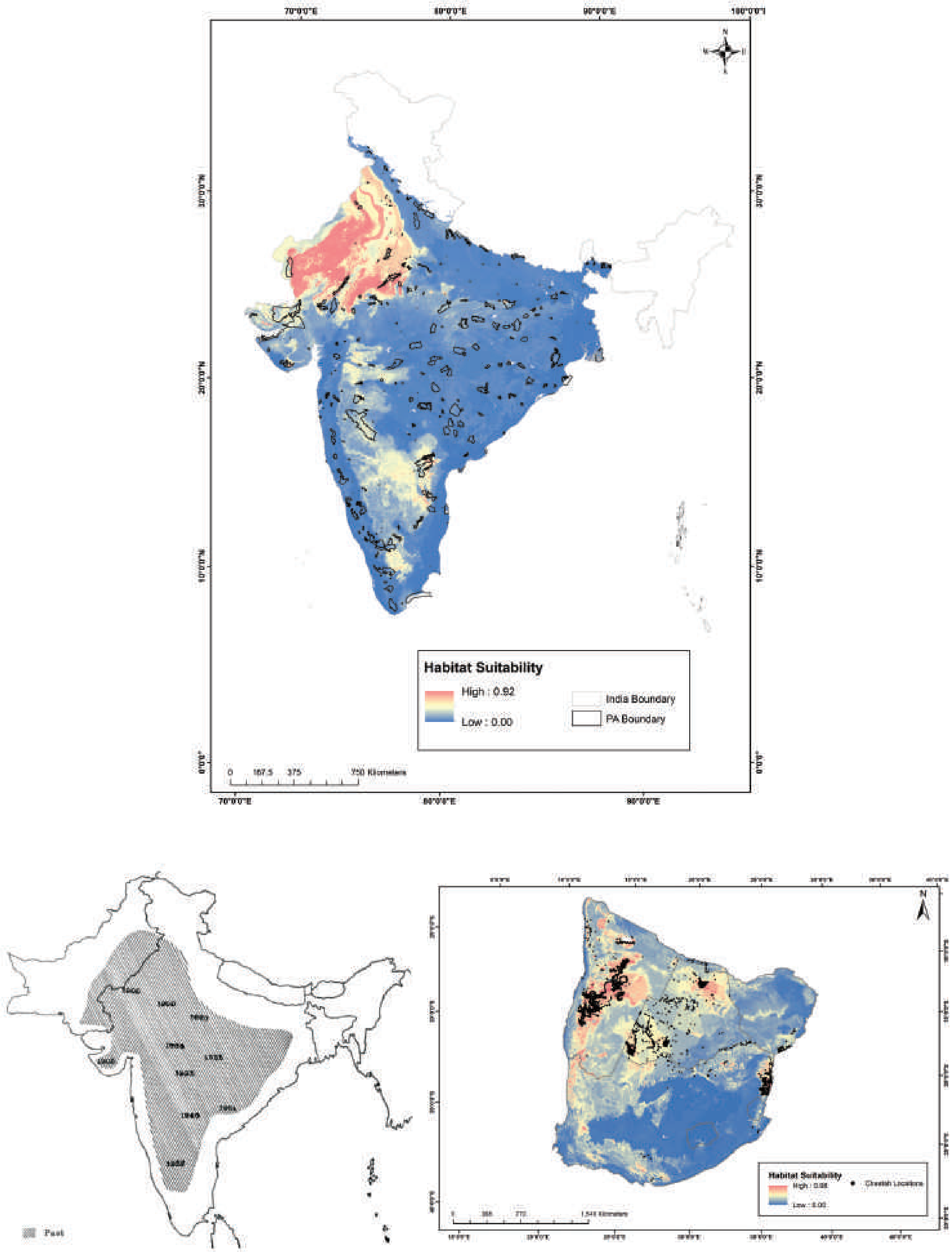


Figure 4. MaxEnt output probability map of cheetah habitat suitability in India (top), Historical range of the cheetah in India- Seshadri 1969 (bottom left) and MaxEnt output probability map of cheetah habitat suitability in southern Africa (bottom right).

Project Goal and Objectives

3

3.1. Goal

Establish viable cheetah metapopulation in India that allows the cheetah to perform its functional role as a top predator and provides space for the expansion of the cheetah within its historical range thereby contributing to its global conservation efforts.

3.2. Objectives

1. To establish breeding cheetah populations in safe habitats across its historical range and manage them as a metapopulation.
2. To use the cheetah as a charismatic flagship and umbrella species to garner resources for restoring open forest and savanna systems that will benefit biodiversity and ecosystem services from these ecosystems.
3. To enhance India's capacity to sequester carbon through ecosystem restoration activities in cheetah conservation areas and thereby contribute towards the global climate change mitigation goals.
4. To use the ensuing opportunity for eco-development and eco-tourism to enhance local community livelihoods.
5. To manage any conflict by cheetah or other wildlife with local communities within cheetah conservation areas expediently through compensation, awareness, and management actions to win community support.

3.3. Aims of Cheetah Translocation in Kuno National Park

The primary aim is to establish a free-ranging population of cheetahs in and around the Kuno NP of Madhya Pradesh (MP). Further, this population in KNP will be managed as a metapopulation with other two to three established populations of cheetah in India with occasional "immigrants" brought in from Africa, as and when needed.

Within this larger goal, the project will strive to achieve the following objectives:

a. Provide adequate security and conserve local flora and fauna.
b. Revive and maintain the grassland and open forest systems existing in the PA and adjacent areas in an optimum productive state and thereby evolve management techniques and practices for better conservation of these habitats.
c. Build the capacity of the state forest department in the field of habitat and prey management, in view of the emerging needs.
d. Use the expertise of MP state forest department in mass translocation of herbivores, particularly blackbuck, nilgai and chital, in view of the emerging need for protection of crops and scientific management of wildlife populations while simultaneously augmenting prey base in Kuno NP and other cheetah introduction sites.
e. Conserve and enhance the faunal diversity, especially the threatened species, such as the gharial and the chousingha and provide a future safe haven for even more endangered species such as the caracal, great Indian bustard and the lesser florican in the larger landscape.
f. Generate benefits for the local people through the development of wildlife tourism and ancillary activities.
g. Develop the capacities of the local communities to co-exist with wild animals, particularly large carnivores.

4 Suitability of the Introduction Area

4.1. Site Information

Kuno NP covers an area of 748 km² made free of all human habitation through incentivized voluntary relocation of forest settlements and is located in the Sheopur district of Madhya Pradesh (Figure 5). The NP and adjoining buffer area is part of Kuno Wildlife Division which covers an area of 1235 km² (Kuno Management Plan 2020). The perennial Kuno river flows through the Park. The western side of the river is dominated by hills with medium to steep slopes while the eastern bank falls towards the valley and therefore has flatter terrain with gentle medium slopes and flat river valley (Chaudhary 2001). On its south-eastern side of the boundary, Kuno NP forms a contiguous forest landscape with patchy connectivity to Panna TR through the Shivpuri forest area. Ranthambhore NP and Kailadevi WLS (both part of the Ranthambhore TR) are connected with Kuno NP through good forest patches towards the north- western boundary from across the river Chambal (Jhala *et al.* 2008). The contiguous habitat patch is about 6800 km² with a high potential for cheetah occupancy in over 3200 km² (Figure 6). Kuno NP is classified under the Semi-arid – Gujarat Rajputana (zone 4B) bio-geographic zone (Rodgers *et al.* 2002). The average maximum summer temperature has been reported as 42.3° C, while the lowest winter temperatures are between 6 and 7° C (Chaudhary 2001). The average annual rainfall in the area is about 760 mm (Banerjee 2005).

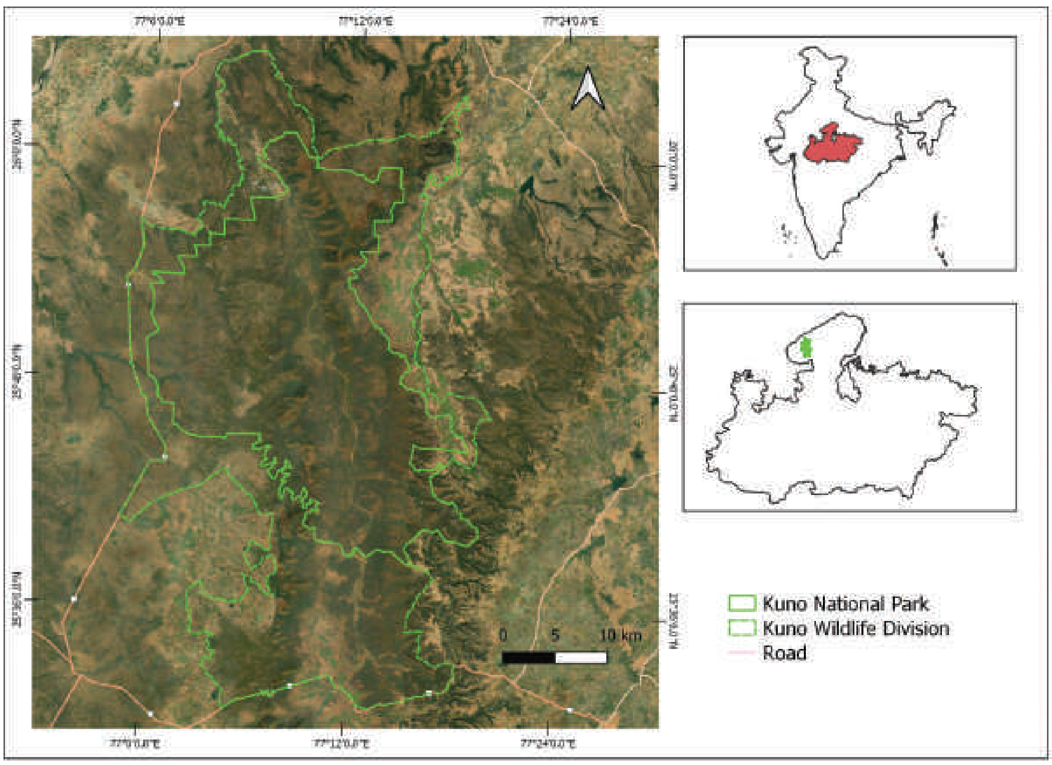


Figure 5. Location of Kuno National Park within the state of Madhya Pradesh, India.

Image 2. Savanna habitat in Kuno National Park.

Kuno NP falls under the northern tropical dry deciduous forest as per the revised classification of forest types of India (Champion & Seth 1968). The dominant trees in this landscape are *Anogeissus pendula* and *Boswellia serrata*, while the middle story is dominated by *Acacia catechu, Acacia leucopholea* and *Diospyros melanoxylon. Zizyphus sp.* makes the lowest part of the canopy cover. Shrub species comprises of *Grewia flavescens, Helicteres isora, Vitex negundo.* Grass species include *Heteropogon contortus, Apluda mutica, Aristida hystrix, Themeda quadrivalvis, Cenchrus ciliaris, Dicanthium annulatum and Desmostachya bipinnata.* Kuno is probably one of the only wildlife sites in the country where there has been a complete relocation of villages from inside the park (one village relocation is underway, in a part of the recently added area of the National Park). These village sites and their agricultural fields that were inside the NP have now been taken over by grasses and are managed as savannah habitat (Image 2).

The wild ungulates and herbivorous mammals found in the area are chital *(Axis axis)*, sambar *(Rusa unicolor)*, nilgai *(Boselaphus tragocamelus)*, wild pig *(Sus scrofa)*, chinkara *(Gazella bennettii)*, chousingha *(Tetracerus quadricornis)*, blackbuck *(Antilope cervicapra)* now only on the periphery of the NP, northern plains gray langur *(Semnopithecus entellus)*, rhesus macaque *(Macaca mulatta)*, Indian porcupine *(Hystrix indica)* and black-naped hare *(Lepus nigricollis)*. Mammalian carnivores include leopard *(Panthera pardus)*, sloth bear *(Melursus ursinus)*, striped hyaena *(Hyaena hyaena)*, gray wolf *(Canis lupus pallipes)*, golden jackal *(Canis aureus)*, Indian fox *(Vulpes bengalensis)*, ratel *(Mellivora capensis)*, jungle cat *(Felis chaus)*, Asiatic wild cat *(Felis lybica ornata)*, rusty spotted cat *(Prionailurus rubiginosus)*, Indian gray mongoose *(Herpestes edwardsii)*, ruddy mongoose *(Herpestes smithii)*, Asian palm civet *(Paradoxurus hermaphroditus)* and small Indian civet *(Viverricula indica)*.

Human density is low in this area, due to a long history of dacoits. However, now with the control of dacoits, farmers from outside the locality are settling and practice irrigated intensive agriculture outside of the forest areas. Tribal communities like the Mogiyas who are known for their hunting skills reside very close to the northern and eastern boundaries of the park. Sahariya, a sub-caste within the Gonds, are the most dominant of the tribes and their populations are settled in villages all around the Sanctuary. The Bhils, have settled on the south-western parts of the park, and often get into problems with Forest Department personnel, since they continue poaching activities and encroaching on forest land and resources (Chaudhary 2001). People from the Kachchh region of Gujarat have also settled in the area nearly 30-35 years back, and have been given the right to cultivate (*'patta'* land) by the forest department. Almost every village has 'baniya' (trader) families who own provision shops and operate small-scale money-lending business within the village, while land lords 'thakurs' in these villages continue to own some of the largest agricultural land holdings in the area. The other predominant communities in the area are Gujjar and Yadav who are landowners and pastoralists. The other communities are Dhakad and Jatav, who own some of the largest agricultural holdings. The main livelihoods of people are agriculture, pastoralism, casual labor and collection of non-timber forest products.

The protected area of 748 km^2 within the NP is almost free of human settlements (incentivized voluntary relocation of one village- Bagcha is underway) and domesticated livestock. The 24 villages that were located within the NP were relocated outside the boundaries of the Protected Area in 1998 (Kabra 2009). Also, the NP has an approximate population of 500 feral cattle (Banerjee 2005) left behind by people when they moved out. This population of feral animals' forms part of the prey base for any large carnivore inside the park. The potential cheetah habitat of 3200 km^2 outside of the National Park has 169 villages within it.

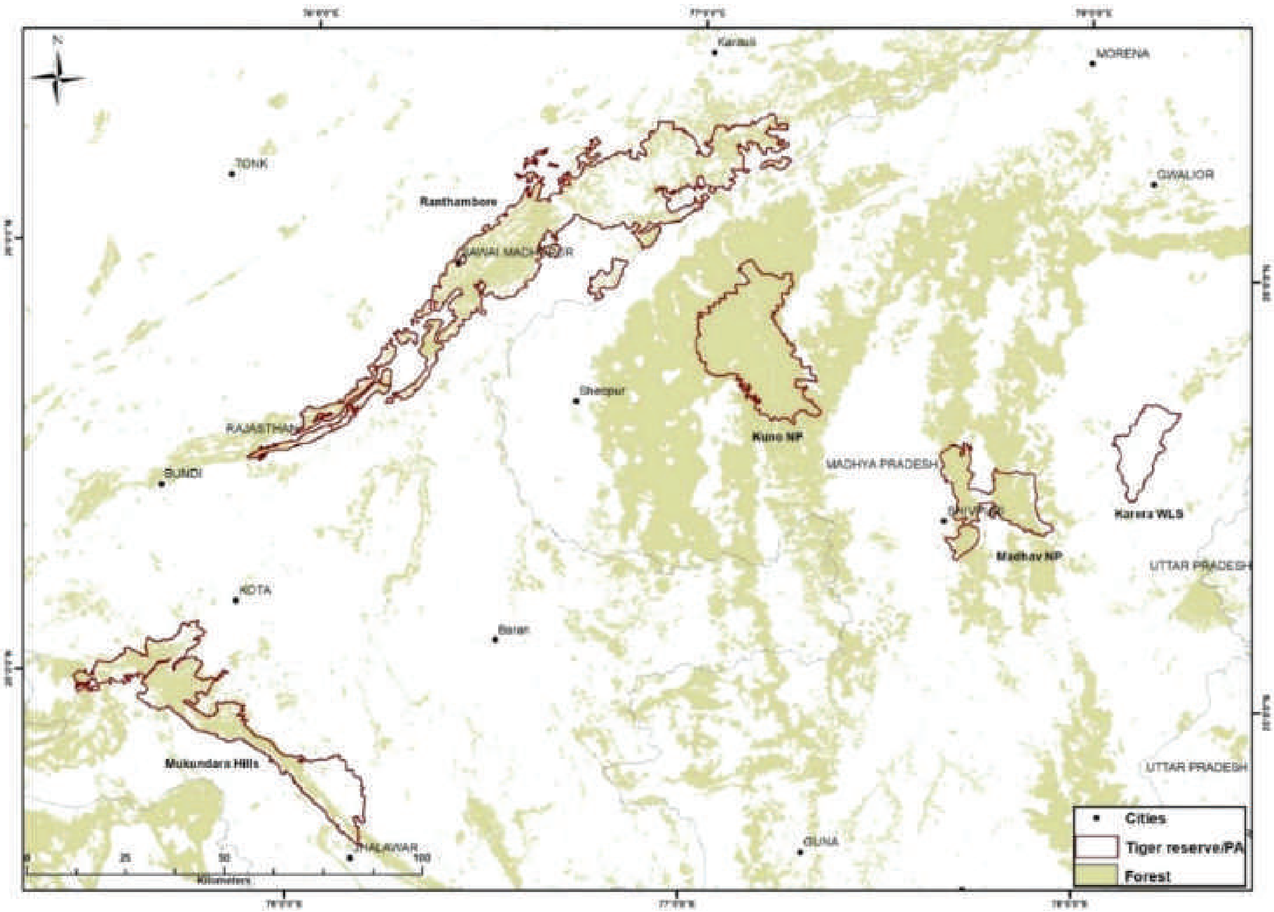


Figure 6. The location of Kuno National Park is shown within the contiguous landscape of Sheopur-Shivpuri forest of 6800 km^2.

Action Plan 5

Considerations for formulating objectives & actions to achieve the goals of cheetah translocation in Kuno NP. The Action Plan has been developed in compliance with IUCN guidelines (Annexure 2).

IUCN (2013) guidelines for reintroduction and conservation translocations mention that any conservation translocation should have clearly defined goals and should follow a logical process from initial concept to design, feasibility and risk assessment, decision-making, implementation, monitoring, adjustment and evaluation. Hayward & Somers (2009) have documented various biological and social considerations for designing conservation reintroductions of top-order predators. The points those need to be considered for formulating objectives and actions to achieve the cheetah reintroduction goals in Kuno NP include:

5.1. Site Assessment and Prey Density of Kuno National Park

Kuno NP (748 km^2) forms part of a large landscape (6800 km^2) that has ample habitat suitable for cheetah (3200 km^2). The latest prey assessment was carried out by the WII during 2021 used line transect based (Buckland *et al.* 2001) and random camera trap based (Howe *et al.* 2017) DISTANCE sampling (Annexure 3). Chital is the most abundant wild prey in Kuno NP with a population density of 38.48 individuals per km2 and 51.58 animals per km^2 for all potential cheetah prey species.

Image 3. Chital female and fawn in Kuno National Park.

5.2. Current Cheetah Carrying Capacity of Kuno National Park

The carrying capacity for cheetah (Hayward *et al.* 2007) at Kuno was computed using the latest population densities of potential cheetah prey obtained from distance sampling. We used ¾ female weight to surrogate the weight of an average prey individual in the population. All prey species below weight of 60 kg were considered potential cheetah prey (Hayward *et al.* 2007, Laurenson *et al.* 1995) for calculating prey biomass. Amongst primates only 10% of langurs were considered as potentially available and amongst large ungulates like nilgai and sambar only their young (30% of the population) were considered as potential cheetah prey.

Relationship between predator density (log10; x-axis) and prey biomass (log10; y-axis)
Preferred prey weight range; $y = -2.641 + 0.411x$ (Hayward *et al.* 2007)

Kuno NP with its reduced human pressures after the relocation of villages from within the park holds potential to sustain up to 21 cheetahs based on its existing prey base. Based on carrying capacity estimates, the potential cheetah habitat covering over 3200 km^2 in Kuno landscape with restorative measures and scientific management could provide prey base for up to 36 cheetahs, making this one of the most suitable landscapes for cheetah in terms of prey availability.

5.3. Population Habitat Viability Analysis (PHVA)

A PVA model was parameterized based on demographic parameters of cheetah obtained from literature (Caro 1994, Eaton 1974, Laurenson *et al.* 1995, Cristescu *et al.* 2018) for analysis in VORTEX 9.93 (Lacy *et al.* 2005). Single populations varying in carrying capacity from 20 to 100 cheetah were modeled as well as a managed metapopulation with occasional "immigrants" from Africa for the first 15 years after reintroduction were modeled.

Probability of extinction of cheetahs was most sensitive to number and frequency of supplementation of cheetahs subsequently after the initial reintroduction of 8-12 individuals and carrying capacity (K) for cheetahs. Based on the population habitat viability model analysis, individual cheetah population that has carrying capacity over 25 individuals has a higher chance of persistence over the long-term with appropriate augmentation and management. Managing different site populations as a metapopulation enhanced their chances for long term survival, as well as to maintain genetic diversity (Gusset 2009). The model inputs and results are appended in Annexure 4.

5.4. Habitat Management

5.4.1. While the current carrying capacity for Kuno NP is a maximum of 21 cheetahs, once restored the larger landscape can hold about 36 cheetahs that as per the results of PHVA would be viable for long-term by itself without immigrants as well. Thus it emphasizes the need of further enhancing the current carrying capacity and prey base of Kuno for long-term viability of the cheetah population. This can be achieved by gradually including the remaining part of the Kuno Wildlife Division (1,280 km^2) and parts (potential cheetah habitat) of the larger Kuno-Sheopur-Shivpuri landscape (3,300 km^2) for restorative investments and prey restoration. Leopards are already there in Kuno in significant numbers with a density of about 9 leopards per 100 km^2 (Jhala *et al.* 2018). Cheetah and leopards can coexist if adequate prey base and other resources are available. With prey restoration, reintroduction of lions as well as colonization by tigers in future are both viable possibilities in Kuno landscape.

Image 4. Leopard in Kuno National Park.

5.4.2. Currently most of Kuno NP has good water management with all the water holes (natural and artificial) spaced uniformly. Further, water management on plateau habitats with a density of one perennial water hole within a radius of 4 km from each other would enhance the use of these habitats by ungulates and enhance the carrying capacity of Kuno NP further. Village relocated areas will be managed as grasslands to promote natural prey base for cheetahs and leopards and other endangered wildlife species of the region. Sustained efforts would be made to eradicate weed species like *Prosopis juliflora, Cassia tora, Lantana camara, Ageratum conyzoides,* and *Eupatorium* spp. from the grasslands. Another threat is the encroachment of grasslands by unpalatable species such as Acacia leucopholea, Vitex negundo and Butea monosperma, which can reduce the area of the grasslands (Rawat 2003). Woody tree growth need to be regularly thinned so as to enable the existence of savanna-grasslands as an arrested successional stage, to sustain high density of wild ungulates. Fortunately, the forest of Kuno NP is mostly of open canopy type with abundance of browse and supports ungulate densities similar to that of grasslands.

5.4.3. Incidence of fire in Kuno NP has reduced substantially due to the resettlement of villages outside the PA. However, it is common on the periphery of the NP and would be further controlled. The forests are abundant with khair *(A. catechu)*, prized for its 'katha' contents, salai *(Boswellia serrata)* and dhak *(Butea monosperma)* rich with resin content used in chemical industries. High tapping pressures by the local people therefore affect these species. Non-timber Forest Produce (NTFP) collection and incidence of fire would be managed through increased surveillance and regulation. Poaching of wildlife is often associated with the collection of NTFP.

5.4.4. MP forest department would attempt incentivized voluntary resettlement of two more villages (Jaangarh and Maratha) as proposed earlier from Kuno Wildlife Division to integrate about additional 300 km^2 area to the current inviolate zone. The incentivized voluntary resettlement would be planned and executed as per the NTCA norms. MoEF&CC would also assist with financial aid to MP forest department for this purpose as it did previously. The subsequent restoration activity would involve managing agriculture fields as grasslands, perennial water management, plantation of miscellaneous forage species like *Ziziphus, Acacia, Carissa, Dichrostachys, Aegle, Terminalia, Diospyros,* etc. to enhance the carrying capacity of the landscape.

5.4.5. The size of the Kuno NP is 748 km^2, but the size of the forested habitat is over 6,800 km^2 extending from Kailadevi part of Ranthambhore TR, through the forests of Sheopur to Madhav in Shivpuri. Of this landscape 3,200 km^2 area (potential cheetah habitat) can be initially managed as the potential buffer zone for Kuno NP before upgrading it to PA in the long run. A buffer zone management strategy for this Shivpuri-Sheopur-Kuno landscape will be developed in line with the NTCA's landscape management plan guidelines (Gopal *et al.* 2007). These guidelines emphasize incentives and enhancement of livelihood of resident communities, compensation for livestock kills, mitigation of human-wildlife negative interactions (discussed in the later sections of the action plan), and curtailment of high impact developmental activities.

5.5. Organizational Commitments

NTCA would provide financial and administrative support to the cheetah introduction program in India. A stand-alone budget for project Cheetah has been earmarked as a part of the ongoing Centrally Sponsored Scheme of Project Tiger (CSS-PT), GoI. The State Forest Department of Madhya Pradesh (and other State Forest Departments) would provide financial supplementation, logistical, infrastructural and administrative support. Participation of Government and Corporate Agencies through Corporate Social Responsibility (CSR) would be encouraged for additional funding at the State and Central level. The WII, National and International carnivore/cheetah experts/agencies would provide technical and knowledge support to the cheetah introduction in India.

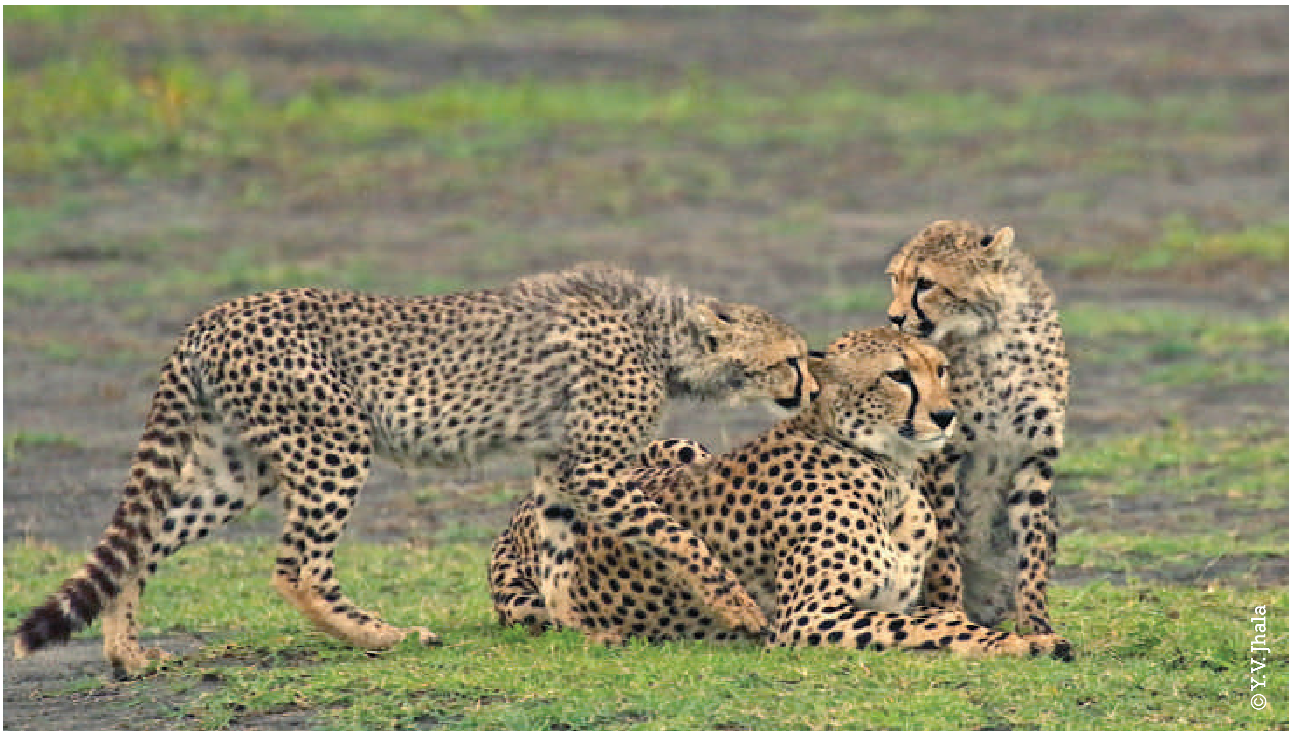
A long-term (at least 25 years) Cheetah Program involving financial, technical and administrative commitments needs to be guaranteed by the Central and the State Governments to adhere to the Action Plan. Cheetah conservation should become a part of the mandate of the NTCA and under the Project Tiger Scheme of funding by the MoEF&CC. Financial commitments should be flexible to accommodate rational changes to a translocation and population establishment plan during implementation and subsequent monitoring.

5.6. Training of Personnel

Officials of the MoEF&CC, NTCA, WII, State Forest Departments would be sensitized through study tours to cheetah conservation reserves in Africa. Cheetah managers and biologists from Africa would be invited to impart training of Indian counterparts. Indian cheetah project managers, veterinarians, biologists would be trained at specific sites in South Africa and Namibia in techniques of capture, anesthesia, and management of cheetah. The potential venues for training Indian managers, veterinarians and biologists are through the Endangered Wildlife Trust (EWT), South Africa and the Center for Veterinary Wildlife Studies, University of Pretoria, South Africa and the Cheetah Conservation Fund (CCF), Namibia. The resource persons identified for this training (but not limited to) are Dr. Laurie Marker & Others from CCF Namibia, Mr. Vincent van der Merwe & others from EWT, Dr. Leith Myers & Dr. Adrian Tordiffe from the University of Pretoria and Mr. Les Carlisle from &Beyond. This action plan would be modified (if required) on the basis of these learnings. Trained staff would be posted at cheetah conservation sites for minimum period of five years and possibly longer.

5.7. Founder Cheetah Population

The IUCN reintroduction guidelines (IUCN 2013) define *reintroduction* "as the intentional movement and release of an organism inside its indigenous range from which it has disappeared" while in the case where the original indigenous organism is not available then the guidelines suggest to use the *most suitable* existing sub-species, or a close relative of the extinct species within the same genus that is similar in appearance, ecology and behavior to the extinct form; this is referred to as *Conservation introduction*. The locally extinct cheetah-subspecies of India (*Acinonyx jubatus venaticus;* Charruau *et al.* 2009, O'Brien *et al.* 2017, Rai *et al.* 2020) survive as a small relict population in Iran currently numbering ~30 individuals (Kalatbari *et al.* 2017) and are considered as critically endangered with a declining trend (Durant *et al.* 2015). An important consideration for conservation translocations is that the sourcing of animals should not be detrimental for the survival of the source population (IUCN 2013). The founding population should also be genetically diverse, behaviorally appropriate, of ideal age and sex composition, able to adapt to the climatic, habitat conditions, and prey types of the introduction site, and be available in reasonable numbers for supplementation of the introduced population over a sustained period of time (IUCN 2013). Since cheetah from Iran are clearly unavailable and inappropriate as a source for reintroduction to India, the best alternative needs to be determined that meet the above criteria.



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The next ideal choice for the founder population would be from populations that were genetically, ecologically and behaviorally closest to the extinct cheetah in India. Amongst mammals', cheetahs are recorded to have one of the least genetic diversity and are more similar to each other across their entire extant range when compared to other species (Dobrynin *et al.* 2015). Therefore, the considered opinion of cheetah geneticists from across the world after careful evaluation of all published scientific studies on cheetah genetics is that all sub-species of the cheetah are equally close to A. *jubatus venaticus* (Annexure 5) and therefore genetic considerations do not play an important role in selecting a founding population in comparison to other criteria mentioned above.

The criteria for the source would be the availability of a continuous supply of legally obtained healthy cheetah that are genetically diverse, can hunt wild prey, are wary of humans but not overly skittish so that managing them is difficult, and sourcing for introduction in India would not imperil source populations. Since India currently does not have any native cheetah, the ecologically and behaviourally most suited population that meets the source population criteria (IUCN 2013) would suffice the need since there would be no genetic mixing of subspecies. The only population that currently meets the above stringent requirements of a source for India's efforts to introduce the cheetah are from southern Africa (*A. j. jubatus;* South Africa, Namibia, Botswana). This region holds the largest cheetah populations ~ 4000 (about 66% of the global cheetah population) (Durant *et al.* 2015) and meets the required criteria for a source for translocation and for future supplementations without detrimental impacts on the source populations.

All efforts would be made so that the cheetah introduction program in India can assist in the global conservation efforts for the cheetah as a species and help assist conserve vulnerable genetic lineages. However, these efforts should not be at the cost of jeopardizing the cheetah introduction program in India. In future, if cheetah range countries, are in need of safe sites to house their endangered cheetah genetic lineages, India would strive to provide alternatives without mixing the sub-species, in distinct landscapes or in large fenced areas.

About 12-14 wild cheetahs (8-10 males and 4-6 females) from various parks/reserves/areas that are ideal (reproductive age group that is genetically diverse, disease free, behaviorally sound-e.g. not overly imprinted to humans but tolerant, predator wary, capable of hunting wild prey, and socially tolerant of each other) for establishing a new cheetah population would be imported as required from South Africa/Namibia/Other African Countries, as a founder stock for five years initially and then as may be required by the program. The animals' lineage and condition would be checked in the host country, to ensure that they are not from an excessively inbred stock and in the ideal age group, so as to conform to the needs of a founding population while securing a wide gene pool for the founding Indian cheetah population. The founders will be individuals with known life histories and lineages, being monitored by the supplying agencies/experts/donors (identified as part of the cheetah metapopulation management program, research and conservation project) and selected keeping in mind ecological aspects such as relatedness, behavior, sociality, etc.

Lead scientist from WII has liaised with potential scientists, individuals rehabilitating cheetah, game reserve owners, and Park authorities to explore potential source populations. Dr. Laurie Marker, Cheetah Conservation Fund, Mr. Vincent van der Merwe, Cheetah Metapopulation Coordinator-Endangered Wildlife Trust, Mr. Les Carlisle from &Beyond, Dr. Adrian Tordiffe and Dr. Leith Meyer Center for Wildlife Management- University of Pretoria, have offered assistance in securing appropriate cheetah for India from southern African populations. Some of these experts (L. Marker, Les Carlise and V. van der Merwe) have visited and evaluated Kuno NP and other potential sites for their appropriateness to house a cheetah population. Indian team would visit cheetah source sites and managed population sites for selecting founding individuals and understanding management issues. The selection of animals suitable for release would be the responsibilities of the chosen supplying agencies/experts/donors in South Africa/Namibia/ Other African Countries and would be verified by Indian carnivore experts. Multiple populations of cheetah are envisaged to be established in India and are proposed to be managed as a metapopulation with occasional "immigrants" brought in from Africa, as and when needed.

5.8. Disease and Health Management of the Founders

5.8.1. Prevalence of diseases in carnivores and their conservation implications are well documented (Gilbert *et al.* 2015). In a transcontinental conservation translocation program such as the current one, proper precautions and mechanisms need to be in place to ensure that a) no novel pathogens from country of origin (southern Africa) are inadvertently introduced into India (Kuno NP and other introduction areas) and b) prevalent pathogens at the Indian release site(s) that may be novel to the Southern African cheetah against which they may have no natural immunity are appropriately addressed so that they do not cause undue morbidity and mortality.

Among the initial steps to avoid unwanted disease/health complications is the selection of disease resistant founder stock. The greatest risk is however likely in animals born and bred *ex-situ* or in unnatural conditions such as zoological parks, farms, ranches, captive breeding centers (Walker *et al.* 2008, Kock *et al.* 2010). In the populations which have bred naturally (*in-situ*), epidemiological processes and natural selection pressures would have greatly reduced the likelihood of pathogen persistence and healthy individuals are unlikely to be a high disease risk, while simultaneously having developed resistance to certain diseases (Kock *et al.* 2010). As elaborated earlier, the founder stock for current cheetah introduction project are all free ranging, naturally bred individuals, thus likely not to be at high risk of harboring major diseases. However, even the small risks can be identified and effectively avoided by carrying out adequate preliminary investigations, prophylaxis and other veterinary preventive medicine measures in founder animals (Kock *et al.* 2010).

5.8.2. Steps to prevent novel wildlife disease introduction to India

Diseases reported for wild cheetahs in Africa include Anthrax, Mycobacterium Sp., Sarcoptic Mange, Feline herpesvirus (FeHV), Feline immunodeficiency virus (FIV), Helicobacter-Associated Gastritis, etc. (Terio *et al.,* 2018). Other uncommon diseases include Canine distemper (CDV), Feline parvovirus (FPV), Feline calicivirus (FCV), Rabies, Feline coronavirus (FCoV) and Feline Infectious Peritonitis (FIP) (Terio *et al.,* 2018). Though some of these diseases are also prevalent in non-domestic felids of India (Nigam *et al.,* 2016), all the cheetah being translocated (founder stock) to India would be appropriately sampled and screened in the country of origin using appropriate molecular diagnostics/seroprevalence methods as per international norms. All founder cheetah would be kept under observation in a quarantine facility in the host country for manifestation of any illness after capture. Any cheetah found to be a carrier of a pathogen novel to India would not be considered for translocation. Vaccinations and health checks/ treatments as per the domestic norms (DAHD, 2021) would be implemented in the country of origin before cheetah are transported to India.

Domestic requirement for the import of felids (tiger, lion, snow leopard, leopard, cheetah, puma, jaguar, other large & lesser cats) into India – Department of Animal Husbandry & Dairying (DAHD), 2021- Ministry of Fisheries, Animal Husbandry & Dairying, Government of India

a. **Requirement:** Show /shows no clinical sign of diseases including Rabies, Feline enteritis, Feline pan leukopenia, Leptospirosis, Distemper, Scabies, Pseudorabies (Aujeszky's disease), Blood parasites (protozoan diseases) including Babesiosis, Anaplasmosis, Trypanosomiasis and Toxoplasmosis prior/during the transport.

   Protocol to be followed: Cheetahs would be quarantined to observe clinical signs for above in the country of origin and appropriate diagnostic tests whenever necessary would be carried out to ensure absence of above diseases.

b. **Requirement:** The animal(s) should be vaccinated against rabies (for the animal(s) above three months of age) with a vaccine licensed and approved by the exporting country.

   Protocol to be followed: Prophylactic Rabies vaccine, followed by a booster at 3 weeks post first dosage before being imported to India.

A Veterinary Health Certificate for the above would be obtained from a certified/ designated veterinarian in the country of origin.

In addition to the above, the cheetahs to be translocated to India would also be subjected to be prophylaxis against Canine distemper, Feline rhinotracheitis, Feline calicivirus, Feline panleukopenia viruses, Feline herpes virus type 1 and Chlamydophila felis (as per the international protocol/protocol at country of origin). External parasites would be controlled using Fipronil spray and internal parasites would be treated with Milbemycin oxime and praziquantel in the form of tablets/ or doramectin injectables. Sometimes, capture and transportation stress result in the manifestation of latent infections as clinical diseases. On arrival to India, cheetahs would be quarantined for the required period in a predator proof enclosure at the site of release and monitored for manifestation of any sickness as per the regulation of import of live animals under the Livestock - importation Act, 1898 (DAHD, 2021).

5.8.3. Assessing disease risks to founder cheetahs at release sites

Carnivores in general are susceptible to a wide array of debilitating pathogens (Appel *et al.* 1994, McCarthy *et al.* 2007), many of which are either native to or easily transmissible from domestic species. Over the past decade Canine distemper has been confirmed as cause of mortality in at least four wild tigers in India, two of which are from central Indian landscape (Nigam *et al.* 2016), while a recent outbreak of canine distemper in Gir landscape had led to death of significant number of Asiatic lions in the landscape (Mourya *et al.* 2019). Confirmed cases of Rabies have also been reported in wild felids from India, including tigers and leopards (Burton 1950). Apart from these, diseases like tuberculosis (Arora 2003), Leptospirosis (Arora 1984), Feline panleukopenia (Sharma 1997), etc. and protozoans such as babesia and toxoplasma have also been recorded among various non-domestic felids (both free ranging and captive) in India (Nigam *et al.* 2016).

While carnivores like cheetahs from a distant continent in a very different epidemiological environment would have also encountered diseases endemic in their area of origin, these animals may lack acquired immunity or resistance to the infections at the release site. With the world witnessing radical changes in climate, landscape, and ecosystems the epidemiology of diseases caused by a number of infectious agents is also undergoing profound readjustments. This necessitates a rigorous scientific assessment to establish prevalence of potential carnivore pathogens/diseases at the release sites (Kuno NP and other release sites), so as to ensure implementation of appropriate preventive medicine procedures on founder stock on their arrival at release sites. For the above, sufficient samples need to be collected from several carnivore/ omnivore species and feral dogs/cats from different locations in/ around the Kuno and other release sites. If novel pathogens that can potentially be of serious risk to the introduced cheetah are detected, appropriate prophylactic steps like vaccination would be undertaken to minimize the risk of infections to the introduced cheetah.

5.8.4. Veterinarians- Dr. Leith Myers and Dr. Adrian Tordiffe from the Centre for Veterinary Wildlife Studies- University of Pretoria, Dr. Sanath Krishna Muliya and Dr. Tushna Karkaria, Wildlife Institute of India, and Veterinary officers from Madhya Pradesh would oversee the disease and prophylaxis aspects. Dr. Richard Kock, from the Royal Veterinary College, UK, would be consulted when required.

Image 5. Chital male in Kuno National Park.

5.9. Individual Cheetah Welfare, Capture, Holding and Transportation to Kuno from South Africa

Though the aim of the program is to establish a population in India from source(s) in Africa, each individual cheetah is considered valuable and shall be cared for with its best welfare at the core of the program. Mechanisms for capture and translocations would attempt to make them least stressful and program implementers will remain ever mindful of animal ethics and care.

5.9.1. Immobilization and Capture of Cheetahs - Drug Dosages

Cheetahs would be captured from free ranging conditions either by darting or in a trap-cage by experienced veterinarians and trappers. Cheetah would be anesthetized using a combination of Ketamine (2.37–3.25mg/kg body weight) and Medetomidine (0.048–0.073 mg/kg body weight) (Kreeger & Arnemo 2018) injected intramuscularly using a gas-powered projectile (Dan-Inject Aps., Sellerup Skovvej, Børkop - Denmark) dart delivery system. Actual dosage can be decided on the spot, taking into consideration the animal's health and condition, level of excitement, physiological status, gender, age, time of the day, and ambient temperature. Reversal agents (Atipemazole), lifesaving drugs and a well-equipped wildlife rescue vehicle would be kept handy in case of any emergency. For cheetah management in India these drugs (or alternatives suggested by cheetah veterinarians) would be procured after necessary drug clearances from the Drug Controller General of India and the Narcotic Commissioner (Ministry of Finance, Central Bureau of Narcotics) if needed. Safety and minimal stress to each individual cheetah would be ensured by a professional team in South Africa (South African National Biodiversity Institute, Endangered Wildlife Trust, ASHIA Cheetah Conservation, University of Pretoria), Namibia (Cheetah Conservation Fund), and in India (NTCA, WII, MP Forest Department and other agencies/ experts).

Each sedated cheetah would be aged, weighed, measured and ectoparasites and blood samples collected using the standardized capture protocols. Each cheetah would be equipped with a satellite-GPS-VHF radio-collar facilitating their future monitoring and individual identification. Photo profiles of all the individual cheetahs would be maintained by the NTCA, WII, MP forest department, cheetah management and research teams in India.

5.9.2. Transportation of Cheetahs

Cheetah transportation would be conducted in a manner that adheres to all International, source and recipient country laws, is safe, and minimizes risk to the animals, employees, and general public. Transportation would be carefully planned to ensure that the fastest route is taken, with the fewest number of stops and transfers. The cheetah metapopulation program of EWT in South Africa regularly translocate cheetah by road and air between in-country populations and for International reintroduction programs and therefore has good proven experience in crate design and transportation protocols. These protocols would be adopted or modified in consultation with EWT experts for transporting cheetah to India. For international transportation from Africa by flight, standard crates according to specifications of *Live Animals Regulations* of the International Air Transport Association (IATA) would be used. Transport crates of dimensions- Length 1.2m * Height 0.9m * Width 0.5m are recommended for the transport of Cheetah (Image 6).

©Vincent van der Merwe

Image 2. Wooden International Air Transport Association (IATA) specification crates made by A.W. Gilson and used by EWT for safe transportation of cheetah in South Africa.

Crates made from bounded plywood or shatter board bound with wood and have sufficient air holes that allow for good ventilation would be used. Air holes on the sides and top of the crate also allow for the Cheetah to be viewed whilst in transit. There would be adequate cushioning at the base of the crate, usually in the form of a rubber mat. Additionally, handles would be positioned around the crate in case manual unloading is necessary.

International transportation would be done by either a commercial airline or by a chartered flight. Qatar Airways has offered to transport cheetah from Johannesburg to Delhi. This airline regularly transports live animals for conservation programs across the world and has good experience to provide safe transport with minimal stress. If sufficient number of cheetah are translocated in one consignment, then it is better to use a chartered flight since then veterinarians have access to the cheetah throughout the flight duration.

Transportation from Delhi to Kuno would be done by road or by flight to Gwalior from where the animals would be transported to Kuno by road. Copies of health certificates, transaction permits and all other relevant documents would be shipped along with the cheetahs. A trained veterinarian and two to three trained personnel along with all the necessary supply and equipment would accompany the shipment.

5.10. Monitoring of Cheetahs by Radio-Telemetry

All the founder cheetahs would be fitted with satellite/GPS/VHF collars enabled with a ground data download facility. The formal procedure of procuring radio-telemetry equipment (radio-collars, receivers, antenna and data management software) would be started well in advance as their shipment may require 4-6 months. WII/ MPFD/NTCA would obtain the radio-telemetry and subsequent monitoring equipment since they have technical knowhow about the procurement system from the international firms. Cheetah cubs born in Kuno for at least two generations would be collared prior to their dispersal at the age of 16-17 months. Radio-telemetry would assist in daily monitoring of movement, behavior, predation, conflict and mortality. These are important aspects that need to be monitored to safeguard the introduced cheetah, assess their wellbeing and evaluate the progress of the introduction project. Radio-telemetry based monitoring would allow for active management interventions in case cheetah venture into unfavorable habitats, allow for quick compensation dispensation in case of livestock depredation, and determine causes of cheetah mortality.

5.11. Soft Release of Cheetahs in Kuno

5.11.1. Cheetahs would be 'soft released'. This would reduce their tendency to disperse long distances from their site of release (homing instinct). Short (2010) reports that a soft release strategy proved more successful in comparison with a hard release (67% versus 27%). The short-soft-release method generally has a significantly lower mortality hazard in comparison with hard-release and captive-born methods & also ameliorates stresses associated with the sudden release of the individuals into unfamiliar environments as in hard-release methods (Hayward & Somers 2014).

5.11.2. Soft-releases have been used successfully in reintroductions of northern Rocky Mountain gray wolf (*Canis lupus occidentalis,* Fritts *et al.* 2001), red wolf *(Canis rufus,* Phillips *et al.* 2003), Mexican wolves (*Canis lupus baileyi,* Parsons 1998), swift fox (*Vulpes velox*, Sasmal *et al.* 2015), cheetahs (*Acinonyx jubatus jubatus*, Marnewick *et al.* 2004) and African lions (Hunter *et al.* 2007, Miller *et al.* 2013, Slotow & Hunter 2009).

5.11.3. In India, such method has also been successfully used for tiger reintroductions in Sariska and Panna Tiger Reserves (Sankar et al. 2010, Harsh *et al.* 2015, Ramesh 2015).

5.11.4. The cheetahs would be housed, in the predator proof fenced enclosures (Area- 6 km^2, seven compartments- 0.7 to 1.1 km^2) in Kuno NP (Figure 7 & Image 7). Male coalitions and females would be kept in separate but adjoining compartments so that they are able to know each other before release. The location of the enclosure is such that the cheetahs can see for some distance to understand the environment and the presence of prey and predators before release. Adequate water and shade is available in the enclosure and would be suitably augmented if needed. Natural prey within the enclosure would ensure that cheetah become accustomed to hunting Indian prey species before their release.

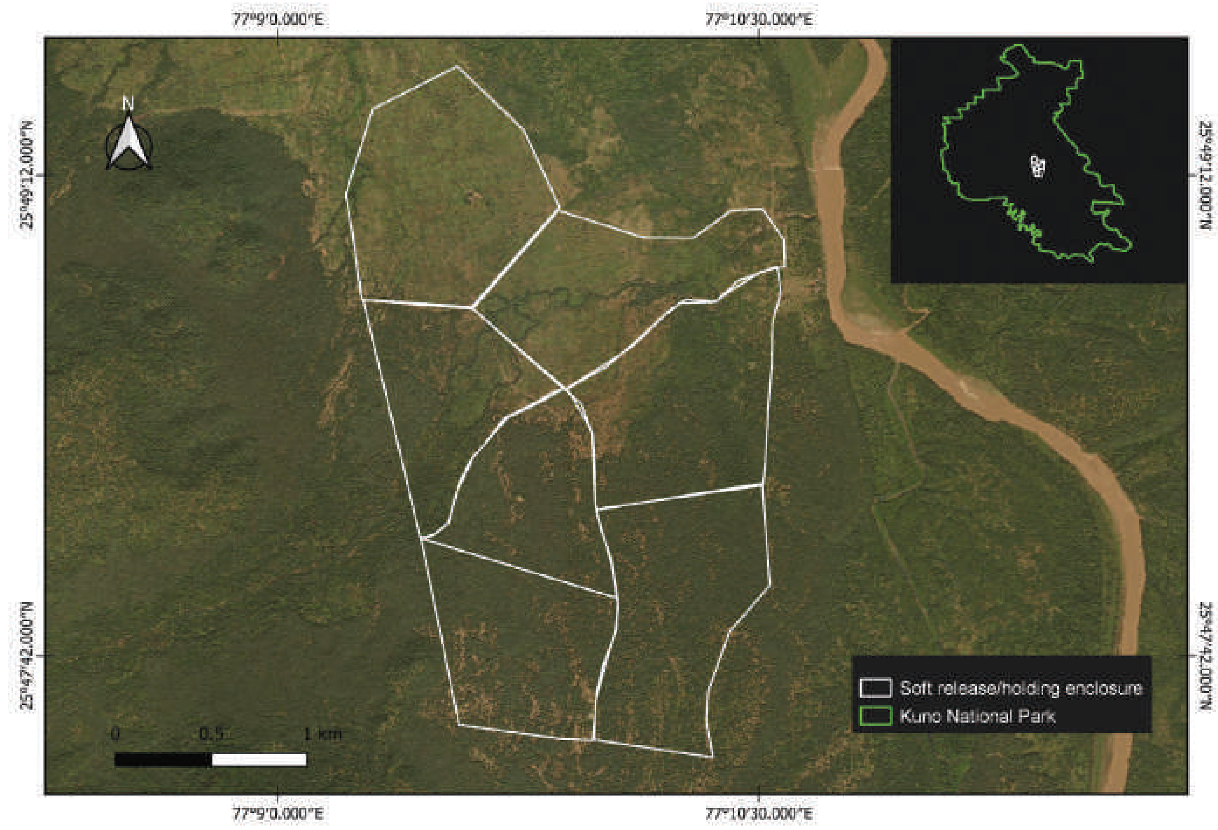

Figure 7. Predator proof fenced enclosure with compartments for soft release of cheetahs in Kuno National Park.

Image 7. Predator proof fenced enclosure under construction for soft release of cheetahs in Kuno National Park.

5.11.5. Radio collared male (coalitions) would be released from the holding enclosure first after an appropriate period (1-2 months). They are expected to establish a coalition territory after exploring and investigating the available habitat, but would tend to return to the enclosure to meet the females. The presence of females in the main enclosure would ensure that the males do not wander too far away, after their exploration instinct is satiated. Their movements would be monitored 24 hours a day by the local State Forest Department staff, assisted by the cheetah research team. If any animal tends to get into undesirable environment, it would be brought back. Darting would only be done if essential, by qualified trained personnel.

5.11.6. The radio collared females would be released, 1-4 weeks after the males, depending upon the state of the males' comfort in the new environment. The females would be monitored and kept under observation through radio telemetry, as in the case of males described above. Once all the cheetahs settle down and establish home ranges/territories (one to three months), the homing-in monitoring frequency can be reduced to two-three (02-03) locations per day and one good visual observation on alternate days for verifying health, condition, and any injury signs. Remote location data from telemetry would be set for 10-12 GPS locations per day communicated daily through satellite/GSM communication.

5.11.7. Experienced cheetah expert(s) from the source agency/country would stay/visit the project site, from before the arrival of the cheetah up to about two months after the release of the females from the enclosure, to advise and assist in coping with any unwarranted situations, to care for the cheetah in captivity, opine on their readiness and that of the habitat for the release and to help monitor the animals after their release. The expert(s) would also train the local staff. The expert(s) would work in close association with the veterinary team in Kuno. A permanent veterinary unit and cheetah tracking and monitoring teams would be established at Kuno NP.

5.12. Post-Release Monitoring and Research

Monitoring is important for protection, day-to-day management and for research, all leading to adaptive management (Williams *et al.* 2002). The Kuno NP management will be responsible for monitoring essential for protection and management while a cheetah research team will monitor for research. The research and management monitoring teams will work in close coordination and share information between themselves. The research team will have biologists, veterinarian(s), and sociologist(s) and field assistants equipped with research equipment, vehicles (two 4WD, and two motorcycles) funded by the cheetah project (NTCA or MP Forest Department or both).

5.12.1. The cheetah population in Kuno needs to be intensively monitored and managed at least for 10 years with all the adult cheetahs fitted with GPS/satellite collars. Radio-collars on cheetahs would be replaced immediately in case the battery life ends or there is a technical snag.

5.12.2. Research in all aspects of system recovery and interactions including ecology, physiology, and behaviour of the cheetahs and their population trends, as well as of their prey species, would be addressed by the cheetah research team in collaboration with the NTCA. The research team would be facilitated by the MP Forest Department with four-wheel drive vehicles, field assistants and all other necessary logistic support. The team would work in close association with the local forest officials (Range and Sub-division levels). A half-yearly monitoring/research review meeting would be organized at New Delhi/Bhopal/Gwalior/Kuno where the Cheetah Expert committee, NTCA officials, WII representatives, MPFD officials and external expert(s)/agencies (as and when required) to assess the progress of cheetah project.

5.12.3. The following research/monitoring programs would be undertaken by the cheetah project team under the supervision of the NTCA

5.12.3.1. The establishment of the cheetah populations offers unique opportunity to understand the role of top predators in ecosystems. All introduced cheetah and their F1 progeny (and if required for research some subsequent generation offspring) would be radio-collared (Satellite /GPRS /GPS /VHF). The experiment would be utilized to study the cheetah as a species a) its ecology with respect to ranging, habitat use, predation (Williams *et al.* 2014), interactions with co-predators; b) its behaviour with respect to intra- and inter-specific interactions, sociality, reproduction and predation strategies with respect to different prey; c) possibility of studying cheetah physiology with respect to field energetics with the use of isotopes (Pagano & Williams 2019) and physiological bio-monitors (Laske *et al.* 2017) would also be explored. Study of prey species with respect to their behaviour especially anti-predatory strategies and demography. Appropriate collaborations with international experts would be established for addressing novel modern approaches. Monitoring through telemetry would be done by both the cheetah research team and the Forest Department team for informed management. Data between the two teams would be shared for the mutual objective of better conservation of the cheetah population.

5.12.3.2. Radio-telemetry

All adult cheetahs would be equipped with GPS/satellite collars for the first 10 years. After that selectively animals would be equipped with radio-collars to monitor a few individuals. Young animals would be radio-collared before they reach their dispersal ages (about 17 months) to identify new areas in the larger Kuno landscape explored by the cheetahs. Information on survivorship, ranging, movement, dispersal, resource selection, predation and aspects of livestock depredation and interactions with humans would be recorded from radio-telemetered cheetahs.

5.12.3.3. Monitoring cheetahs' diet

Systematic collection of cheetah scats would be undertaken on a regular basis to monitor the cheetah diet through scat analysis. Such samples could also be used for parasitological assay, which may prove important in assessing the prevalence of parasitic infections. Attempts would be made to locate all predation events (kills) by cheetahs for the first few years to understand feeding ecology and impact of cheetah predation on prey demography.

5.12.3.4. Monitoring prey populations

Annual abundances of wild ungulates in Kuno would be estimated based on Distance sampling (both foot transects and camera trap based) to measure food availability for the cheetahs and other carnivores. Efforts would be made to estimate the prey abundance in the larger Kuno landscape (3,200 km^2) at least once in two years to monitor the impacts of protection and eco-restoration on prey population. Currently, Kuno NP has sufficient prey base to support about 21 cheetahs and other carnivores in the area. However, increase in the predator population in the area might lead to certain effects on certain prey species and even to habitat (trophic cascade effects- Ripple &

Beschta 2012, Ripple *et al.* 2014). The response of the prey species to a new predator would be monitored by the research team to understand the dynamics and, supplementation of prey (such as chital and nilgai) if needed would be decided on the basis of annual assessments.

Image 8. Chital and peafowl on the banks of Kuno river with Palpur fort in the background in Kuno National Park.

5.12.3.5. Monitoring other carnivores

Abundances and population parameters of other carnivores (such as leopards, hyenas, jackals, wolves, foxes, jungle cat etc.) would be regularly monitored using methods such as mark-recapture (Jhala *et al.* 2020), random encounter models and distance sampling based on camera traps. About 200 infra-red flash camera traps may suffice for this purpose. Scat samples of other carnivores need to be collected to assess their diets and prey preferences. This would enable the management to understand the probable niche partitioning mechanism operating in Kuno. These exercises can, however, be started even before the cheetahs are released. This would be helpful in evaluating changes in population dynamics and dietary shift (if any) of predators before and after cheetah introduction.

5.12.3.6. Molecular genetics

Genetic analysis of all founders (micro-satellite based, and genomic analysis) would be carried out. Subsequent monitoring of the cheetah population genetics based on microsatellite and/or SNP analysis would allow for monitoring loss of genetic variability and inbreeding (if any) and help decide on active management of the metapopulation through immigrants from other cheetah populations in India or from Africa.

5.12.3.7. Monitoring vegetation and anthropogenic disturbances

Sample plots in the major vegetation types would be established and monitored for seed germination, recruitment and succession. This can be achieved by marking adequate sample area and collecting data repeatedly at an interval of three to five years for a period of 25 to 30 years. High resolution habitat mapping of the landscape on a GIS domain at an interval of every five years would be done so as to monitor the changes in the habitat and landscape connectivity. Data on various anthropogenic activities (such as cutting, lopping, grazing, human trails etc.) would be collected following the protocol (field guide) developed by Jhala *et al.* (2013). The vegetation and anthropogenic data would be collected from localities under varying intensities of anthropogenic activities and under different management practices. The propensity of Kuno to support a large prey base is related to its grasslands, savanna, miscellaneous open forests especially "Kardhai" *(Anogeissus pendula)* forests. These would be particularly studied, including the composition of and changes therein, of perennial grass species that are the preferred food of the herbivores. Invasive exotics would be controlled annually by appropriate managerial interventions.

5.12.3.8. Monitoring and studying human-cheetah interactions in Kuno landscape

The success of the cheetah introduction program in the long run would depend on human-cheetah relationships. Public awareness campaigns are underway for the local communities with a local mascot named *"Chintu Cheetah"* (Image 9). The Chief Minister of Madhya Pradesh has asked all state officials and elected members of the state assembly from the constituencies around Kuno NP to disseminate correct information regarding the cheetah-human interface. Further, ensure that local communities are aware that there is no threat to humans from cheetahs and that any livestock depredation would be immediately and effectively compensated. Actual instances of cheetah presence near human habitations would be quantified through data from radio-telemetered cheetahs. Human perceptions would be assessed through structured questionnaire surveys for adaptive management of community attitudes. Such information would become crucial in active management of cheetahs in the landscape and for future policy making.

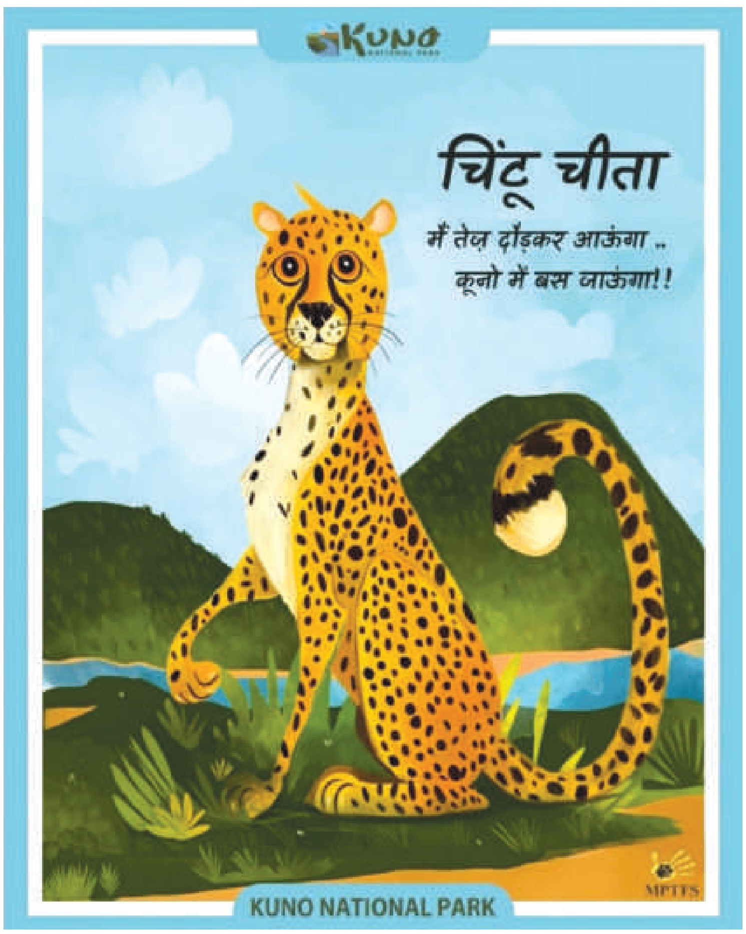

Image 9. Poster of public awareness campaigns conducted by Madhya Pradesh State Forest Department for the local communities with a mascot named *"Chintu Cheetah"*.

5.12.3.9. Monitoring cheetah population through individual identification
A computer database wherein profiles of individually identified cheetahs would be maintained by the research team and NTCA and analyzed to study cheetah demography and population dynamics. Individual profiles of all the cheetahs of Kuno would be maintained by the research team as well as by the park management so as to monitor cheetah survival and other vital rates. This becomes an important tool to monitor cheetah population in Kuno when the collaring of individuals is reduced or eventually stopped (i.e. after the third generation of cheetah population).

5.12.4. If approximately 5% growth rate in the released population is achieved, after incorporating natural mortality, births and annual supplementation, the released population should reach carrying capacity level in about 15 years. To reach the landscape carrying capacity, population size of 36 cheetahs the time required would be close to 30-40 years depending on survival, recruitment and supplementation. During the initial years of cheetah introduction (5 – 6 years) or population below 18-20 adult cheetahs, it may be prudent not to allow cheetahs to disperse into sink habitats of the landscape. If there are such instances, cheetah(s) would be captured and brought back to Kuno NP or translocated to other release sites. This would be done as per NTCA's Standard Operating Procedure available for managing straying tigers in human dominated landscapes- available at http://projecttiger.nic.in/WriteReadData/CMS/Final_SOP_11_01_2013.pdf. The larger landscape would be allowed to be populated by cheetahs only after the landscape is secured, the prey base adequately enhanced and risks to their survival are minimized. However, such landscape level efforts are not quick fix since their enactments demand time and they must not impede the immediate goal of establishing cheetah population inside the National Park. Rather they would be concomitant with cheetah introduction exercises inside Kuno NP.

5.12.5. Hard boundaries of the potential cheetah habitats in Kuno NP, abutting human habitation would be secured through proper fencing if needed, in consultation with the local community, to minimize livestock depredation, poaching and straying of cheetahs into human habitats and of livestock into the cheetah habitat, thereby precipitating negative interactions with humans.

5.13. Genetic Management: Supplementation

5.13.1. Genetic management of the reintroduced population would be done in a similar manner as is being done for game reserves in South Africa through a managed metapopulation program by EWT (Buk *et al.* 2018) and South African experts would be consulted. Cheetah that disperse into sink habitats would be prime animals to move between populations in India, supplemented occasionally by cheetah brought in from Southern Africa. Genetic profile of individuals and populations will be maintained and monitored through microsatellite/SNP markers.

5.13.2. Capture, handling, transport and release of the cheetahs during the subsequent years would be as per the norms discussed before (or by any improved facility available in future and deemed technically feasible for translocations) and would aim at minimizing injury/stress and mortality.

5.14. Management of Cheetahs and Leopards in Kuno

Currently, the density of leopards is 9 individuals per 100 km2 in Kuno NP (Jhala et al. 2018). Cheetahs and leopards would sometimes get involved in inter-specific strife resulting into injuries and even deaths. But that would be a natural process and management by appropriate supplementation and recruitment from the introduced population would compensate for these. The leopard population in the landscape needs to be managed during initial years of cheetah introduction (4-5 years) so as to avoid/minimize interspecific strife and allow the cheetah population to stabilize. The best strategy would be to radio-collar (GPS/satellite) eight (8-10) leopards at least, so as to study the interaction between these two carnivores as part of the research program in Kuno. The research would aim at radio-collaring of leopards and other predators (such as leopards, hyenas, jackals, foxes, jungle cat etc.) in Kuno prior to the release of cheetah and then monitor them at the same temporal scale. This would generate valuable information on resource separation amongst carnivore communities in Kuno and would be of immense help in formulating future management plans. Based on this research, management strategies to permit and promote coexistence or to manage these carnivore populations need to be decided for the future.

5.15. Capacity Building

5.15.1. Veterinary teams (each with one officer and minimum three assistants) would be recruited and posted at Palpur and Sesaipura to manage the released cheetahs and other carnivores, in cases of straying, injury and conflict. The teams would have separate jurisdictions overseeing the eastern and western parts of Kuno NP and would have round the clock responsibilities. Extra incentives and overtimes would be paid to them and all forest staff of Kuno NP as per the MP Government's rules. Each team would be equipped with a wildlife rescue van (preferably a 4WD mini truck), wireless systems, adequate drugs, darting equipment and other necessary paraphernalia. A well-equipped veterinary and rescue care center would be constructed with long-term housing facilities for at least 3-5 cheetahs and leopards for medical interventions and treatments. This is essential so as to provide treatment for mild ailments, injuries, or to temporarily hold animals that may be unfit for wild release. Each Range office would be provided with two transport cages, one each for cheetahs and leopards to expedite rescue operations outside the park.

5.15.2. Two-three separate cheetah tracking teams would be constituted. Each team would be comprised of two to three young, motivated staff having interest in wildlife and two to three labors recruited on a daily wage basis. The primary duty of this team would be to continuously monitor radio-collared cheetahs and assist the cheetah management and research teams. This has been practiced in Sariska and Panna Tiger Reserves where the State forest department's tiger tracking teams are continuously monitoring the reintroduced tigers in close association with WII research team. The team would also learn to track non-collared cheetahs and other carnivores over time. Each team would be equipped with two-three motorcycles and a wireless system so that they can report any case of conflict, injury and/or disease instantly to the veterinary teams. The tracking team would also be trained over the years to capture and handle cheetahs and other carnivores so as to augment the capabilities of the veterinary team.

5.15.3. Importance of protection for successful conservation cannot be overemphasized. A protection regime against poaching by firearm, snaring, trapping, poisoning and electrocution and accidental deaths due to road accidents would be initiated urgently around Kuno. This would be achieved by patrolling (both in vehicle and on foot) different areas of Kuno NP and the larger landscape. Modern smart patrol monitoring system like MSTrIPES would be implemented in Kuno NP. A patrolling squad led by a Sub- Division Officer/ Assistant Conservator of Forest/ Range Forest Officer (SDO/ACF/RF)) ranking officer and comprising of 2-3 armed frontline staff (including one lady guard) and 1-2 police constables (as and when required including a lady constable) would be constituted. The squad would be provided with a well-equipped vehicle to patrol areas of Kuno and outer landscape anytime of the day. Maintenance, creation and upgradation of road networks within the park and in the buffer areas would be kept in mind. A vigil would be kept on illegal mining, illegal fishing and hazardous electric connections in the villages and farmlands. The patrolling squad is not a replacement of the regular patrolling done by the Rangers and other frontline staff; it is an addition to that.

5.15.4. Intelligence gathering would be done at bus stands, road side *dhabas* (restaurants), liquor shops, hotels, railway stations through a network of local contacts amongst the communities. Check posts with CCTV surveillance would be erected at strategic points on Pohari-Gwalior, Pohari-Shivpuri and Pohari-Sheopur highways to monitor vehicles passing through there.

5.15.5. Local people of Mogiya and Sahariya tribes would be employed on daily wages, one in every village to develop a landscape level informal informant system. Identity of such informants would be kept secret as far as possible and they would be awarded with monetary incentives for useful and timely information. The informant team would directly report to the local Range Officers about any movement of suspicious vehicles/people, use of electric fences/snares in the farmlands, incidence of any poaching, rescue/relief needs of wildlife, any livestock predation by predators etc. This information network would play an important role in prevention of poaching and other conflict incidents in and around Kuno.

5.15.6. A project implementation team consisting of NTCA, WII, Veterinarians, experts & personnel (as required), MP State Forest Department personnel- Chief Conservator of Forests (CCF) in charge of the project, Division Forest Officer/ Deputy Conservator of Forest (DFO/ DCF), ACF(s), RFO(s), deputy rangers, foresters and to the extent possible the forest guards would be selected on the basis of their interest, commitment and capabilities and posted for a minimum period of at least 3 years and if possible up to 5 years in consultation with NTCA and Cheetah Expert Committee. The senior members of the team, including lead scientist, project biologist (s) and veterinarian(s), would be sent on a training tour to selected tiger reintroduction sites in India and cheetah reintroduction sites in Africa. The composition of the team for training would be decided by the Cheetah Expert Committee in consultation with NTCA, WII and National/ International cheetah experts. The senior members, who would be trained abroad, would train the junior staff of Kuno NP. The entire staff working for Kuno NP would be paid a 'Project Allowance' at par with the allowance paid to the staff working for Project Tiger.

5.15.7. To provide adequate amenities and ensure welfare of the staff, a staff welfare fund would be developed based on revenue generated through tourism (canteen, sale of merchandise, etc. as is being done in Kanha Tiger Reserve). The fund would provide the frontline staff with financial assistance and incentives as and when required. Each staff (permanent and temporary) working under the cheetah introduction project would be provided with a life cum accident insurance and a full medical reimbursement policy during his/her service period. Uninterrupted supply of field kits, medicines, mosquito nets, torches etc. to the frontline staff of Kuno NP would be ensured. Remote area allowances as per the government rules would be paid to staff deputed in the park.

5.15.8. Increased mobility of staff, arms and equipment

Kuno NP would be provided with at least two additional patrolling vehicles (four-wheel drives for regular patrolling) and two mini truck (with four wheel drives) for carrying cages and other necessary materials during rescue operations. Additional four wheel vehicles would also be provided to the forest ranges which are sensitive to wildlife crimes. Frontline staff would be provided with motorcycles for daily beat patrolling. Running costs of the vehicles/motorcycles (fuel and maintenance) would be borne by the MP forest department. Arms and ammunitions would be purchased in sufficient amount with a minimum of three rifles, three shot guns and two pistols per range and be distributed to the frontline staff after appropriate training in their safe use. Each forest beat would have a GPS unit, a laser range finder, one compass (Sunnto), one binocular and one digital camera for patrolling and monitoring wildlife. Photo documentation of wildlife crimes, rescue/treatment operations and human-wildlife conflict cases would be made mandatory. Night patrolling (on foot or motorcycles) is helpful for catching offenders and acts as a major deterrent to crime. A photo-copier-fax-printer and a computer would be provided to each Range office for facilitating their office work and managing data on patrolling through MSTrIPES. Distribution of adequate mobile phones, wireless walkie-talkie sets (minimum one hand set per beat) to all frontline staff would be ensured. Staff without any access to electric connections would be provided with extra batteries and solar chargers.

5.15.9. Training

Regular in-house training of the forest officials, veterinary team, frontline staff and cheetah tracking teams would be organized periodically. The field staff would be trained by international cheetah experts and the possibility of having an expert at the field site for longer durations during the initial phase of the reintroduction would be explored. Training on jurisprudence, wildlife forensics, and aspects of illegal trade would be organized for local forest department staff with the help of institutions/organizations like WII, WWF-India, Wildlife Trust of India (WTI), Wildlife Crime Control Bureau (WCCB) and others. Cheetah management and research teams in coordination with the NTCA would organize regular training programs for the officers and staff on issues like smart patrolling, ecological monitoring of cheetah, prey, other carnivores and habitat (such as handling of GPS and other equipment, line transects, camera traps, radio-telemetry, MSTrIPES, digital photography, etc.) in Kuno.

5.15.10. Additional computers and peripheries would be purchased at various administrative -Circle, Division and Range levels to cope up with maintenance of increasing amounts of records. Additional clerical posts (data manager, computer operator, hardware engineer, accountant, wireless operators etc.) would be created and recruited as per need in the future.

5.15.11. Inter-sectorial collaborations

Inter-departmental coordination would be explored. Much of the success of the Kuno cheetah introduction program would depend on this. Collaboration with police and revenue department is essential to design conservation friendly land policy and strengthening protection in and around Kuno. Northern fringes of Kuno landscape form part of Chambal valley, earlier infamous for its notorious dacoits and therefore ensuring protection to every part of Kuno sometime becomes difficult for the forest staff. Assistance of armed police force would be sought in cases of confrontations. Similar alliances with other state governmental departments like agriculture, rural development, tribal development, transport, tourism, power, law etc. would be maintained. Officers from other departments would be oriented towards various aspects of wildlife conservation and legislations on a regular basis. A tehsil level monitoring committee under the chairmanship of DFO/DCF, Kuno NP and a district level coordination committee under the chairmanship of CCF-Gwalior would meet at least once in two months to supervise various facets of management and collaborations. MP forest department would also be prepared to work in close cooperation with the Rajasthan forest department especially with the adjoining Ranthambhore Management Unit to monitor interstate movements of cheetahs and in future, tigers.

Image 10. Chousingha in Kuno National Park.

5.16. Community Participation: Awareness & Outreach, Conflict Mitigation and Livelihood Enhancement

5.16.1. People's support and eco-development

In programs of carnivore introduction, one has to be aware of the human dimensions of such undertakings. The pre-eminent importance of considering people's reactions to receiving previously absent wild carnivores in their environment shines through in many of the contributions. The need to involve people whose livelihoods may be affected is absolutely essential, but when ignored may have disastrous consequences. The situation is easy to manage in the Kuno landscape as the communities are used to living in close proximity of large carnivores.

5.16.1.1. No landscape level conservation program can be sustained without the help of local communities. Confidence of local villagers would be won through various outreach & awareness programs. Sarpanches (village head men), local leaders, teachers, social workers, religious figures and NGOs would be provided with a better stake in the conservation. Awareness programs would be run at schools, colleges and villages sensitizing people about the conservation problems and various schemes available with the forest department. Dissemination of public opinion (pro cheetah/ conservation) developed by elected representatives as well as civil servants. Various pro-active rural development and eco-development projects such as construction and repair of village roads, financial and logistic aids for education and self-employment, construction of bridges, check dams, anicuts and cause ways, facilities to schools, clean drinking water facilities, sanitation (mobile toilets), medical facilities, solar street lights, solar cookers, improvement and repair of houses and protection from open irrigation well etc. would be introduced. Range officers would hold regular meetings with the village Panchayats (Councils)/ Gram Sabha (elected representatives) and other stakeholders about their problems and attempts would be made whole-heartedly to solve them by inter-departmental deliberations.

5.16.1.2. A Cheetah Conservation Foundation (like Tiger Conservation Foundation) would be established where gate receipts, donations get deposited and 40% of the revenue generated goes to communities in the buffer zone and percolate to the marginalized local communities of the society while the rest are used for park management. This would substantially prevent them from anti-social activities. Continuous deliberations would be made to dissuade the former gang members of local dacoits and poachers so as to rehabilitate them in mainstream society.

5.16.1.3. Kuno has people who eat meat once a week or once a month on average. There is also a significant percentage that eats meat every day. Bush meat consumption was prevalent in the region (Ranjitsinh & Jhala 2010). People in the area were found to own country-made guns, bows and arrows and catapults. To enhance the natural prey population in the area, these poaching proclivities would have to be controlled. Collaborations with state animal husbandry department would be made to introduce poultry farms in the area for providing easy access to meat for local people.

5.16.2. Veterinary programs

All free-ranging dogs in the surrounding villages would be vaccinated against rabies, canine distemper and parvovirus periodically, to prevent the contagion from reaching cheetahs and other wildlife and to prevent infection of the local human population. Free-ranging dogs seen inside the cheetah habitat within the sanctuary harassing wild ungulates would be controlled.

Persons bitten by dogs or jackals would be inoculated against rabies free of cost by the forest department. To prevent spread of livestock borne diseases (such as anthrax), a veterinary monitoring system would be introduced wherein all the livestock of the surrounding villages would be vaccinated for foot and mouth disease (FMD), rinderpest at free of costs by the forest department. Water points would be cleared with lime annually. Continuous disease monitoring of the populations of wild ungulate and feral cattle within the NP would be undertaken.

5.16.3. There are no known or historically recorded attacks by cheetah on humans. Cheetah may predate small livestock like sheep and goats. Understanding people-carnivore relationship, becomes crucial especially for the conservation of large carnivores and contribute to success of the cheetah introduction program in Kuno. Cheetah research team would carry out a continuous study to understand livestock predation pattern by large carnivores and aim to understand local people's perception towards conservation. Site specific mitigation measures would be implemented based on the inferences of such studies. Livelihood securities for the local communities need to be ensured at any cost. Reparative measures such as compensation schemes have no substitute in shaping successful conservation programs worldwide. Activities like paying compensation would be considered as ecosystem maintenance costs that need to be paid to the local communities.

5.16.4. Since all cheetah will be radio-collared, predation events on livestock would be very easy to validate and compensation would be paid within 24 hrs. of the event to prevent retaliation. Compensation cannot buy one's tolerances but majority of the people see it as an instant financial relief. Therefore, the compensation rates for livestock predation for various livestock productivity classes would be decided after a thorough market survey. Cheetah rarely scavenge or return to a kill, therefore chances of losing animals to retaliation using poison will be rare. The compensation scheme would be revised regularly (preferably every 3 years) to truly reflect the changing local market prices. The cheetah project has built in a budgetary head for livestock compensation based on an overt assumption that 30% of cheetah diet would be small livestock.

5.16.5. A majority of people have problems with crop raiding by ungulates in the area. Wild pigs and nilgai have been reported to be the highest damage-causing species (Ranjitsinh & Jhala 2010). Crop damage compensation in reflectance with market price would therefore be initiated urgently. A forest officer not below the rank of a Ranger would investigate the site within 48 hours of the occurrence and decide upon the extent of damage and compensation. Quantifying crop damage is not always an easy task because of a number of ambiguities. National NGOs having experience in working on similar front would be involved in this. A better alternative is to subsidize crop insurance against damage by wild ungulates from the Cheetah Conservation Foundation. Crop damage compensation is likely to diminish negative interactions in two ways. On one hand it would allow farmers to stay away from fields thereby exposing them less to the carnivore attacks. On the other hand, the farmers neither need to possess guns nor fix snares and electric fences around their farmlands thereby decreasing the likelihood of accidental deaths to cheetahs and other wildlife. Other crop damage mitigation measures such as pulsating electric fences (Chauhan 2006), chain-link fencing of farms, erecting makeshift machans (guard huts) etc. would be subsidized. Collectively it would ensure greater tolerance of the local people towards wildlife.

5.16.6. A study on the patterns of crop damage would be undertaken as a part of the research and monitoring plan of Kuno NP so as to identify the areas prone to such damage and quantify the extent of economic loss faced by the communities. Based on the finding, fencing off boundaries of Kuno NP at certain strategic points to reduce crop damage and livestock grazing inside the park would be considered in consultation with the local community.

5.16.7. Farmers' choice of cropping patterns shape human wildlife conflict considerably (Jhala 1993, Vijayan & Pati 2002). An awareness program involving officials and experts from agriculture and wildlife departments and agriculture universities would be initiated educating local communities about this important aspect as well as guiding them about the high yielding yet eco-friendly varieties of crops available.

5.17. Wildlife Tourism, Eco-Clubs, Nature Education Camps and Revenue Generation

5.17.1. There would be a clear cut policy about wildlife tourism in Kuno. The park authorities and the civil administration of the region would prepare a five to ten-year site specific tourism policy in accordance with the Comprehensive Guidelines of the NTCA (memo no 15-31/2012-NTCA dated 15.10.2012) which would address the land-use and development of the surrounding areas as well. The plan prepared by the park management and civil authorities would be endorsed by the Cheetah Expert committee and NTCA in consultation with cheetah management and research team. The plan would explicitly demarcate the park roads and the tourism zones in the larger Kuno landscape. A tourism carrying capacity for the park would be estimated. This figure would be included in the Management Plan and be followed stringently without any violation.

5.17.2. Sustainable and conservative tourism subservient to the conservation needs of the NP and of the project would be encouraged so that jobs and business opportunities for the local people can be created, and the project and the Kuno NP get adequate public support. An attempt to generate revenues through brand building, marketing, sponsorships, merchandising etc. would be undertaken, through private partnerships, but in complete consonance with the conservation activities and prerequisites.

5.17.3. Wildlife tourism strategy of Kuno would serve as a model for the rest of the country as here there is scope and the opportunity to plan. However, many site-specific strategies need to be implemented well in advance. The control of tourism and the entry of vehicles in the PA, would be as directed by the Director of Kuno NP.

5.17.4. Business enterprises such hotels, resorts, other commercial structures in the landscape and vehicles entering inside the park would be kept under strict vigil. No commercial establishment/ activity would be allowed within 1 km from the NP boundary. Ideally there should be a committee to ensure that any permanent buildings being constructed in a radius of 2 km of forest edge should be approved by an aesthetics committee constituted by the DFO/ DCF, representative(s) of the District Magistrate Office, local Panchayat Office and a member of the local NGO, to ensure that gaudy concrete block buildings are not constructed that mar the beauty of Kuno landscape.

5.17.5. A Cheetah Conservation Foundation on the lines of Tiger Conservation Foundations would be set-up as mentioned above, where all gate and permit fees would remain with the park as being done in other Tiger Reserves of Madhya Pradesh. Hotels and resorts that use Kuno NP for their guest visits would be charged a small (~5%) but significant tax on their profits that would be deposited in the Cheetah Conservation Foundation. Forty percent of the tourist revenue would be ploughed back in to local community welfare in the buffer zone. Preference would be given to those communities that have been resettled from within Kuno NP. Mechanisms would be put in place so that all community members are aware of the financial benefits they are receiving are due to cheetah introduction. Awareness campaigns, school nature camps, illustrated talks, video shows, special films made on this topic would be screened on regular intervals in all buffer zone villages.

5.17.6. There is potential for earning significant revenues from the project from filming, photo documentation, merchandising, sponsorship and tourism on a competitive basis. This income would be credited to the Cheetah Conservation Foundation and would be spent on its management as well as for assisting the local communities, as per the system already prevailing in the State of MP. A proactive approach to market the project as a brand would be adopted to promote conservation as an economic activity, after fully ensuring that it in no way hampers the conservation interest and priorities of the project and of the NP.

5.17.7. In order to spread awareness among local people and sensitize the youth, eco-clubs, nature education camps, teacher training camps, street plays etc. would be organized regularly. A directory of local wildlife enthusiasts and nature lovers would be maintained for assisting the department in such awareness programs.

5.18. Publicity and Media Management

Pro-active media management with scientific facts and not based on speculations or educated guesses would be adopted by the project implementing agencies. A media spokesperson (preferably the Cheetah Expert Committee, CCFs, NTCA representative, Cheetah management and research teams' representative(s)) would only officially liaise with the media and statement from any other person from the departments should not be considered as 'official'. A media-note briefing the latest updates about the project would also be issued/uploaded at a regular interval by the NTCA and forest department of Madhya Pradesh in consultation with the Cheetah Expert Committee and the cheetah management and research teams. Media would be sensitized to acknowledge that they have an immense role in making local/global audience aware of the scientific facts and figures about the project/ conservation issues, shaping public opinion and they should act responsibly while promoting conservation efforts.

5.19. Annual Review and Monitoring

NTCA in coordination with Cheetah Expert committee, MPFD and the cheetah management and research teams would invite wildlife managers and conservation biologists and agencies of the country/abroad with subject knowledge/working experiences to seek their expertise during several phases of the project implementation. This is also likely to broaden institutional representation in the committee and enhance its credence and credibility. After the cheetahs are released in Kuno, the progress of the project would be reviewed every six months in the first five years and subsequently once a year by NTCA, MPFD and cheetah management and research teams along with the International/National experts (as and when required), and wildlife biologists of the country. Such monitoring would be a long-term (20-25 years) process and be coordinated by NTCA in association with MPFD and cheetah management and research teams. It is recommended that the results and findings of cheetah introduction be published and peer-reviewed at frequent intervals to allow other conservation attempts to benefit from the experiences. This would be part of a continuous feedback loop with the results of the documented evaluation leading to alterations to the existing reintroduction program via an adaptive management strategy. Although the guidelines promulgated in the current Action Plan are likely to be relevant for long term (15-20 years); they would, however, be revised by NTCA in consultation with MPFD and national/ international cheetah experts/agencies as per emerging situations during various implementation phases of cheetah introduction.

5.20. Criteria for Assessing Success and Exit strategy

The cheetah introduction program requires long-term (at least 25 years) financial, technical and administrative commitments from MoEF&CC, NTCA, MPFD (State forest departments of other introduction sites) and WII.

5.20.1. Criteria for project success for the short-term

- 50% survival of the introduced cheetah for the first year.
- Cheetah establish home ranges in Kuno NP.
- Cheetah successfully reproduce in the wild.
- Some wild born cheetah cubs survive to > 1year.
- F1 generation breeds successfully.
- Cheetah based revenues contribute to community livelihoods.

5.20.2. Criteria for assessing long-term success of the project

- Cheetah are established as an integral part of the ecosystem with natural rates of survival (~70% adults, 25-40% cubs/juveniles) and reproduction.
- Long-term viable metapopulation is established in India (either in Kuno itself or in combination of 3-5 cheetah reserves).
- Genetic diversity of established cheetah population(s) in India are representative of their founder population(s).
- Major increase in quality habitat, prey, and mammalian diversity seen in Cheetah Conservation Reserves.
- Local communities make significant improvements in their economies through eco-development from cheetah conservation foundations and direct remunerations through employment generation.

5.20.3. Failure

Introduced Cheetah do not survive or fail to reproduce in five years. Failure of securing cheetah habitats in the larger landscape and commence investments in their restoration through protection, habitat management and prey augmentation. In such a case, the Program needs to be reviewed for alternative strategies or discontinuation.

Conclusion 6

Carnivore reintroduction/conservation translocation is an appropriate conservation strategy to restore the integrity of ecosystems. It is a rapidly growing science which, if carried out appropriately, has the potential to be a valuable component of the conservationist's toolkit. However, many pitfalls exist that can result in the total or partial failure of a reintroduction/conservation translocation program and can potentially waste valuable and limited resources. This Action Plan developed in accordance with the IUCN guidelines aims to implement the cheetah introduction program in Kuno and other cheetah introduction sites based on science and pro-active management.

Flow chart showing the chronological structure of the action plan in compliance with IUCN Reintroduction Guidelines

Pre-translocation Phase
(design, feasibility, risk assessment & decision making)

Planning & Management

- Site Assessment, prey & carrying capacity of Kuno (Section 5.1.1 & Annex 5.3 & 8.1)
- PHVA models (Section 6 & Annex 5.1, 5.2 & 6.1)
- Protection regime (Section 2)
- Organizational commitments, budgets (Sections 5.2 & 5.4)
- Capacity building (Section 5.4)

Social Considerations

- Social carrying capacity, eliciting larger public support, mitigation of conflicts, maintaining livelihood securities, benefit sharing etc. (Section 5.2)

Biological Considerations

- Founder population (Sections 5.1.4, 5.1.5 & Annex 5.5 & 6.2)
- Disease & health monitoring (Sections 5.1.6, 5.3, 6.4 & Annex 5.6, 6.4 & 7)
- Habitat management (Section 5.1.2 & Annex 5.3)
- Management of leopards (Annex 6.3)

Translocation Phase
(implementation)

Capture & transportation of cheetahs

- Capture, immobilization & veterinary considerations (Section 5.1.5)
- Transportation to Kuno & soft release in the enclosure (Sections 5.1.5 & 7.2 & Annex 5.6)

Soft release of cheetahs

- Design of enclosure, animal welfare considerations, pre-release monitoring of stress & other factors (Section 5.1.5 & Annex 7 (sub headings 8, 14, 15, 16, 18 & 19)

Post-translocation Phase
(monitoring, evaluation & adjustment)

Supplementation, Review & Monitoring

- Intensive immediate post-release monitoring through telemetry (Sections 4.2, 6 & Annex 6.3, 6.7, 7, 8.2 & 8.3)
- Supplementation & genetic considerations (Section 5.1.4 & Annex 5.5)
- Annual review & monitoring (Section 8 & Annex 9), Criteria for assessing success & Exit strategy (Section 4.3 & Annex 8.3)

References

1. Anderson, R.M. and May, R.M. 1979. Population biology of infectious disease. Part I. Nature, 280: 361 - 367.
2. Appel, M.J. and Summers, B.A., 1995. Pathogenicity of morbilliviruses for terrestrial carnivores. *Veterinary microbiology, 44*(2-4), pp.187-191.
3. Arora, B.M. 2003. Bacterial Diseases. In. Arora BM (ed.). Indian Wildlife Diseases and Disorders. Association of Indian Zoo and Wildlife Veterinarians, Bareily 243005, India. Pp 7.
4. Arora, B.M. 1984. Disease Pattern in Wildlife. Project report, Center for Wildlife Conservation, management, and disease surveillance, IVRI. Izatnagar, India.
5. Banerjee, K. 2005. Estimating the ungulate abundance and developing the habitat specific effective strip width models in Kuno Wildlife Sanctuary, Madhya Pradesh. Dissertation submitted in partial fulfillment of the degree of M.Sc. Forestry, Forest Research Institute University, Dehradun, 170 pp.
6. Bangs, E. and Shivik, J.A., 2001. Managing wolf conflict with livestock in the northwestern United States. Carnivore Damage Prevention News 3:2-5.
7. Brealey, J.C., Fernandes, C., Vercammen, P. and Hunter, L.T., 2020. Conservation genomic analyses of African and Asiatic Cheetahs *(Acinonyx jubatus)* across their current and historical species range. *BioRxiv*.
8. Breitenmoser, U., Breitenmoser-Wursten, C. and Carbyn, L.N., 2001. Assessment of carnivore reintroductions. In (Eds.) Gittleman, J.L., Funk, S.M., Macdonald, D.W., and Wayne, R.K. 2001. Carnivore Conservation. pp. 241–280.
9. Buchanan, J.M. 2003. Cost and choice, 454-456: In The encyclopedia of public choice, Rowley, C.K. and Schneider, F. (eds.), Kluwer Academic Publishers, London, UK.
10. Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. & Thomas, L. 2001. Introduction to Distance Sampling: Estimating abundance of biological populations. Oxford University Press, Oxford, UK.
11. Buk, K.G., van der Merwe, V.C., Marnewick, K. and Funston, P.J. 2018. Conservation of severely fragmented populations: lessons from the transformation of uncoordinated reintroductions of cheetahs *(Acinonyx jubatus)* into a managed metapopulation with self-sustained growth. Biodiversity and Conservation 27, pages 3393–3423.
12. Burton, H.W., 1950. Rabies in a tiger-two proved instances. *Journal of the Bombay Natural History Society, 49*, pp.538-541.
13. Caro, T.M. 1994. Cheetahs of Serengeti Plains: Group living in an asocial species. University of Chicago Press. Chicago.
14. Champion H.G., and Seth, S.K. 1968. A revised classification of Forest types in India.
15. Charruau, P., Fernandes, C., OROZCO-terWENGEL, P., Peters, J., Hunter, L., Ziaie, H., Jourabchian, A., Jowkar, H., Schaller, G., Ostrowski, S. and Vercammen, P., 2011. Phylogeography, genetic structure and population divergence time of cheetahs in Africa and Asia: evidence for long-term geographic isolates. *Molecular Ecology, 20*(4), pp.706-724.
16. Chaudhary, L.K. 2001. Management plan of Kuno Palpur Sanctuary. Part I (pp 153) and Part II (pp 226). Madhya Pradesh Forest Department, India.
17. Chaturvedi, M.D. 1965. Wildlife Management in India in Conservation in India- Proceedings of the special meeting of the Standing Committee of the Indian Board for Wildlife. IUCN Publication New Series Supplementary Paper No 17.
18. Chauhan, N.P.S. 2006. Manual on power fencing for wild animals. http://www2.wii.gov.in/publications/researchreports/2006/manual_power_fencing_content.pdf. Wildlife Institute of India, Dehra Dun.
19. Cristescu, B., Schmidt-Küntzel, A., Schwartz, K.R., Traeholt, C., Marker, L., Fabiano, E., Leus, K., Traylor-Holzer, K. (2018). A review of population viability analysis and its use in cheetah conservation, In Eds. Philip J. Nyhus, Laurie Marker, Lorraine K. Boast, Anne Schmidt-Küntzel 2018. Biodiversity of world: Conservation from genes to landscapes. Cheetahs: biology and conservation, Academic Press.
20. Department of Biotechnology-DBT. 2021.- https://dbtindia.gov.in/schemes-programmes/research-development/agriculture-animal-allied-sciences/animal-and-livestock
21. Dinerstein, E., Loucks, C., Wikramanayake, E., Ginsberg, J., Sanderson, E., Seidensticker, J., Forrest, J., Bryja, G., Heydlauff, A., Klenzendorf, S. and Leimgruber, P., 2007. The fate of wild tigers. *BioScience, 57*(6), pp.508-514.
22. Divyabhanusinh. 2006. The End of a trail- The cheetah in India. 3rd ed., Oxford Publishing House.
23. Divyabhanusinh and Kazmi, R., 2019. Asiatic Cheetah *Acinonyx jubatus venaticus* in India: A Chronology of Extinction. Reactions and a Correction. *Journal of the Bombay Natural History Society (JBNHS), 116*, pp.153-154.
24. Dobrynin, P., Liu, S., Tamazian, G., Xiong, Z., Yurchenko, A.A., Krasheninnikova, K., Kliver, S., Schmidt Küntzel, A., Koepfli, K.P., Johnson, W. and Kuderna, L.F., 2015. Genomic legacy of the African cheetah, Acinonyx jubatus. *Genome biology, 16*(1), pp.1-20.
25. Durant, S., Mitchell, N., Ipavec, A., Groom, R. 2015 *Acinonyx jubatus*. The IUCN Red List of Threatened Species 2015 (e.T219A50649567). https://dx.doi.org/10.2305/IUCN.UK.2015-4.RLTS.T219A50649567.en.
26. Eaton, R. L. 1974. The cheetah: the biology, ecology, and behavior of an endangered species. New York, London: Van Nostrand Reinhold Company.
27. Farr, T.G., Rosen, P.A., Caro, E., Crippen, R., Duren, R., Hensley, S., Kobrick, M., Paller, M., Rodriguez, E., Roth, L., Seal, D., Shaffer, S., Shimada, J., Umland, J., Werner, M., Oskin, M., Burbank, M. and Alsdorf, D. 2007. The Shuttle Radar Topography Mission. Review of Geophysics, 45, RG2004.
28. Fick, S.E. and Hijmans, R.J. 2017. WorldClim 2: new 1km spatial resolution climate surfaces for global land areas. International Journal of Climatology, 37 (12), 4302-4315.

29. Forest Rights Act. 2006. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Government of India.
30. Fritts, S.H., Mack, C.M., Smith, D.W., Murphy, K.M., Phillips, M.K., Jimenez, M.D., Bangs, E.E., Fontaine, J.A., Niemeyer, C.C., Brewster, W.G. and Kaminski, T.J. 2001. Outcomes of hard and soft-releases of reintroduced wolves in central Idaho and the Greater Yellowstone Area, 125–148: In Large mammal restoration: ecological and sociological challenges in the twenty-first century, David, M., Reed, F.N. and Jeffery, L.L. (eds). Island Press, Washington DC.
31. Gilbert, M., Soutyrina, S.V., Seryodkin, I.V., Sulikhan, N., Upyrkina, O.V., Gonchuruk, M., Matthews, L., Cleaveland, S., and Miquelle, D.G. 2015. Canine distemper virus as a threat to wild tigers in Russia and across their range. Integrative Zoology, 10: 329-343.
32. Gilpin, M.E. and Soulé, M.E. 1986. Minimum viable populations: processes of species extinction, 19-34: in Conservation Biology: the science of scarcity and diversity, Soulé, M.E. (ed.), Sinauer, Sunderland, MA.
33. Gopal, R., Sinha, P.R., Mathur, V.B., Jhala, Y.V. and Qureshi, Q. 2007. Guidelines for preparation of tiger conservation plan. A technical document of the National Tiger Conservation Authority, Ministry of Environment and Forests, Government of India, NTCA/01/07, iii + 93 pp.
34. Gusset, M. 2009. A Framework for Evaluating Reintroduction Success in Carnivores: Lessons from African Wild Dogs. Pages 307-320 in M.W. Hayward and M.J. Somers (Eds.) Reintroduction of Top-Order Predators. ZSL & Wiley Blackwell West Sussex, UK.
35. Harsh, S., Jena, J. and Dave, C. 2015. Connecting habitat corridors for tigers in Panna Landscape - A rapid assessment of forests around Panna Tiger Reserve, WWF-India, New Delhi, India.
36. Hayward, M. W., O' Brien, J., Kerley, G.I.H. 2007. Carrying capacity of large African predators: Predictions and tests. Biological Conservation 139(2007) 219-229.
37. Hayward, M.W., Adendorff, J., O'Brien, J. Sholto-Douglas, A., Bissett, C., Moolman, L.C., Bean, P., Fogarty, A., Howarth, D., Slater, R., Kerley, G.I.H. 2007a. Practical considerations for the reintroduction of large, terrestrial, mammalian predators based on reintroductions to South Africa's Eastern Cape Province. The Open Conservation Biology Journal 1-1-11.
38. Hayward, M.W., Adendorff, J., O'Brien, J. Sholto-Douglas, A., Bissett, C., Moolman, L.C., Bean, P., Fogarty, A., Howarth, D., Slater, R., Kerley, G.I.H. 2007b. The reintroduction of large carnivores to the Eastern Cape South Africa: An assessment. Oryx 41, 205-214.
39. Hayward, M.W. and Somers, M.J. (eds.). 2009. Reintroduction of Top-Order Predators. Zoological Society of London and Wiley-Blackwell West Sussex, UK, xvi + 459 pp.
40. Hayward, M.W. and Somers, M.J. 2014. Translocations in South Africa: lion reintroductions in perspective. Current Conservation, 8: 12 – 19.
41. Hebblewhite, M. and Smith, D.W. 2010. Wolf community ecology: Ecosystem effects of recovering wolves in Banff and Yellowstone national parks. The world of wolves: new perspectives on ecology, behavior and management, eds Musiani M, Boitani L, Paquet P (Univ of Calgary Press, Calgary, AB, Canada), pp 69–120.
42. Howe, E.J., Buckland, S.T., Després-Einspenner, M.L. & Kühl, H.S. 2017. Distance sampling with camera traps. Methods in Ecology and Evolution, 8, 1558–1565.
43. Hunter, L.T.B., Pretorius, K., Carlisle, L.C., Rickelton, M., Walker, C., Slotow, R. and Skinner, J.D. 2007. Restoring lions Panthera leo to northern KwaZulu-Natal, South Africa: short-term biological and technical success but equivocal long-term conservation. Oryx, 41: 196-204.
44. India's National Wildlife Action Plan 2017-2031 (2017). Ministry of Environment Forest and Climate Change, Government of India
45. IUCN/SSC. 2013. Guidelines for reintroductions and other conservation translocations. Version 1.0. Gland, Switzerland: IUCN Species Survival Commission, viiii + 57 pp.
46. Jhala Y.V., Gopal R., Qureshi Q.(eds). 2008. Status of Tigers, Co-predators and Prey in India by National Tiger Conservation Authority and Wildlife Institute of India. TR08/001 pp 164.
47. Jhala, Y.V., Qureshi, Q., and Yadav, S.P. 2021. Status of leopards, co-predators, and mega herbivores in India, 2018. National Tiger Conservation Authority, Government of India, New Delhi, and Wildlife Institute of India, Dehradun. ISBN - 81-85496-56-0
48. Jhala, Y.V., Qureshi, Q., Gopal, R. and Sinha, P. (eds.). 2010. Status of the tigers, co-predators and prey in India, 2010. National Tiger Conservation Authority, Government of India, New Delhi, and Wildlife Institute of India, Dehradun. TR2011/003, 302 pp.
49. Jhala, Y.V., Qureshi, Q. and Nayak, A.K. (eds). 2020. Status of tigers, co-predators and prey in India, 2018. National Tiger Conservation Authority, Government of India, New Delhi, and Wildlife Institute of India, Dehradun.
50. Jhala, Y.V., Qureshi, Q., Gopal, R. and Amin, R. 2013. Field guide: monitoring tigers, co-predators, prey and their habitats. Fourth edition. Technical Publication of National Tiger Conservation Authority, New Delhi and the Wildlife Institute of India, Dehradun.
51. Jhala, Y.V. 1993. Damage to Sorghum crop by blackbuck. Tropical Pest Management, 39: 23 – 27.
52. Jhala et al. 2011. Action Plan for the Reintroduction of the Cheetah (Acinonyx jubatus) in Kuno Wildlife Sanctuary, Madhya Pradesh. Cheetah Task Force, Madhya Pradesh Forest Department and Wildlife Institute of India.
53. Jhala et al. (2011). Action Plan for the Reintroduction of the Cheetah (Acinonyx jubatus) in Shahgarh Landscape. Cheetah Task Force, Rajasthan Forest Department and Wildlife Institute of India.
54. Jhala et al. 2012. Action Plan for the Reintroduction of the Cheetah (Acinonyx jubatus) in Nauradehi Wildlife Sanctuary, Madhya Pradesh. Cheetah Task Force, Madhya Pradesh Forest Department and Wildlife Institute of India.
55. Jhala, Y.V., Gopal, R., Mathur, V., Ghosh, P., Negi, H.S., Narain, S., Yadav, S.P., Malik, A., Garawad, R., and Qureshi, Q. 2021. Recovery of tigers in India: Critical introspection and potential lessons. People and Nature, 3, 281-293.
56. Jhala, Y. V., Bipin, C. M., Jhala, H. Y., Yadav, S. R. and Chouhan, J. S. 2021. Assessment of cheetah introduction sites and proposed actions. Wildlife Institute of India, Forest Department of Rajasthan and Forest Department of Madhya Pradesh. Technical Note.
57. Johnsingh, A.J.T. and Madhusudan, M.D., 2009. Tiger reintroduction in India: conservation tool or costly dream. Reintroduction of Top-order

Predators. Wiley-Blackwell, Oxford, UK, pp.146-163.
58. Kabra, A. 2009. Conservation-induced displacement: A comparative study of two Indian protected areas. Conservation and Society 7(4): 249-267.
59. Karanth, K.U. and Chellam, R., 2009. Carnivore conservation at the crossroads. Oryx, 43(1), pp.1-2.
60. Kennedy, C.M., Oakleaf, J.R., Theobald, D.M., Baurch-Murdo, S. and Kiesecker, J. 2019. Managing the middle: A shift in conservation priorities based on the global human modification gradient. Global Change Biology, 25(3), 811-826.
61. Khalatbari L., Jowkar H., Yusefi G.H., Brito J.C., and Ostrowski S. 2017. The current status of Asiatic cheetah in Iran. Cat News 66: 10–13.
62. Khalatbari, L., Brito, J.C., Ghoddousi, A., Abolghasemi, H., Breitenmoser, U., Breitenmoser-Würsten, C., Yusefi, G.H., Ostrowski, S. and Durant, S.M., 2018. Sanctioning to extinction in Iran. Science, 362(6420), pp.1255-1255.
63. Kock, R.A., Woodford, M.H. and Rossiter, P.B., 2010. Disease risks associated with the translocation of wildlife. Revue scientifique et technique, 29(2), p.329.
64. Kreeger, T.J. 1996. Handbook of wildlife chemical immobilization. International Wildlife Veterinary Services Inc. Post Box 37, Larammie, WY, USA, 356 pp.
65. Kreeger, T.J., and Arnemo, J.M. 2018. Handbook of wildlife chemical immobilization- 5th edition. Published by authors. 472pp.
66. Kuno Management Plan (2020). Madhya Pradesh Forest Department.
67. Lacy, R.C., M. Borbat, and J. P. Pollak. 2005. VORTEX: A Stochastic simulation of the extinction process. Version 9.50. Brookfield, IL: Chicago Zoological Society.
68. Laske, T., Iaizzo, P. and Garshelis, D. 2017. Six Years in the Life of a Mother Bear - The Longest Continuous Heart Rate Recordings from a Free-Ranging Mammal. Sci Rep 7, 40732.
69. Laurenson, M.K., Wielebnowski, N. and Caro, T.M., 1995. Extrinsic factors and juvenile mortality in cheetahs. Conservation Biology 9, 1329-1331.
70. Livestock Census of India (2012). 19th Livestock Census-2012, All India report. Ministry of Agriculture, Department of Animal Husbandry, Dairying & Fisheries Animal Husbandry, Krishi Bhawan, New Delhi.
71. Livestock Census of India. 2019. 20th Livestock Census-2019, All India report. Ministry of Fisheries, Animal Husbandry & Dairying, Department of Animal Husbandry & Dairying, Animal Husbandry Statistics Division, Krishi Bhawan, New Delhi.
72. Marnewick, K., Beckhelling, A., Cilliers, D., Lane, E., Mills, G., Herring, K., Caldwell, P., Hall, R. and Meintjes, S. 2007. The status of the cheetah in South Africa. Cat News, 3, pp.27-31.
73. McCallum, H. and Dobson, A.P. 1995. Detecting disease and parasite threats to endangered species and ecosystems. Trends in Ecology and Evolution, 10: 190 - 194.
74. McCarthy, A.J., Shaw, M.A. and Goodman, S.J., 2007. Pathogen evolution and disease emergence in carnivores. Proceedings of the Royal Society B: Biological Sciences, 274(1629), pp.3165-3174.
75. Mech, D.L. 1996. A new era for carnivore conservation. Wildlife Society Bulletin 24: 397–401.
76. Miller, S.M., Bissett, C., Burger, A., Courtenay, B., Dickerson, T., Druce, D.J., Ferreira, S., Funston, P.J., Hofmeyr, D., Kilian, P.J., Matthews, W., Naylor, S., Parker, D.M., Slotow, R., Toft, M. and Zimmermann, D. 2013. Management of reintroduced lions in small, fenced reserves in South Africa: an assessment and guidelines. South African Journal of Wildlife Research, 43: 138–154.
77. Mourya, D.T., Yadav, P.D., Mohandas, S., Kadiwar, R.F., Vala, M.K., Saxena, A.K., Shete-Aich, A., Gupta, N., Purushothama, P., Sahay, R.R. and Gangakhedkar, R.R., 2019. Canine distemper virus in Asiatic lions of Gujarat State, India. Emerging infectious diseases, 25(11), p.2128.
78. National Tiger Conservation Authority (NTCA). 2010. Protocols/ Guidelines for voluntary village relocation in notified core /critical tiger habitats of Tiger Reserves. https://ntca.gov.in/assets/uploads/guidelines/Village_relocation_guidelines.pdf
79. National Tiger Conservation Authority (NTCA). 2021. Order- F.No. 15-3/2008-NTCA(Vol.III) Pt. dated April 8th 2021. https://ntca.gov.in/assets/uploads/guidelines/Village_Relocation_Order.pdf
80. Nigam, P., Muliya, S.K., Srivastav, A., Malik, P.K., Shrivastava, A.B. and Mathur, V.B. 2016. Patterns of Mortality in Free Ranging Tigers. Technical Report. Wildlife Institute of India – National Tiger Conservation Authority.
81. O'Brien, S.J., Johnson, W.E., Driscoll, C.A., Dobrynin, P. and Marker, L. 2017. Conservation genetics of the cheetah: lessons learned and new opportunities. Journal of Heredity. 1;108(6):671-677.
82. Pagano, A.M. and Williams, T.M. 2019. Estimating the energy expenditure of free-ranging polar bears using tri-axial accelerometers: A validation with doubly labeled water. Ecology and evolution, 9(7), pp.4210 4219.
83. Parsons, D.R. 1998. "Green fire" returns to the Southwest: reintroduction of the Mexican wolf. Wildlife Society Bulletin, 26: 799–807.
84. Phillips, M.K., Henry, V.G. and Kelly, B.T. 2003. Restoration of the red wolf. In (eds). Mech, D. L. and Boitani, L. (2003). Wolves: behavior, ecology, and conservation. University of Chicago Press.
85. Phillips, S.J., Dudík, M. and Schapire, R.E. 2004. A maximum entropy approach to species distribution modeling. Proceedings of the twenty-first international conference on machine learning, 655-662.
86. Phillips, S.J., Anderson, R.P., Dudík, M., Schapire, R.E., Blair,M. 2017. Opening the black box: an open-source release of Maxent. Ecography 40: 000–000 (ver. 0).
87. Prost, S., Machado, A.P., Zumbroich, J., Preier, L., Mahtani-Williams, S., Meissner, R., Guschanski, K., Phillips, M.K., Henry, V.G. and Kelly, B.T. 2003. Restoration of the red wolf. USDA National Wildlife Research Center-Staff Publications. Paper 234, Fort Collins.
88. Ranjitsinh, M.K. and Jhala, Y.V. 2010. Assessing the potential for reintroducing the cheetah in India. Wildlife Trust of India, Noida and Wildlife Institute of India, Dehra Dun. TR2010/001, 161 pp.

89. Ranjitsinh, M.K. 2017. A Life with Wildlife: From Princely India to the Present. HarperCollins.
90. Rawat, G.S. 2003. A visit to Kuno Palpur Sanctuary, Madhya Pradesh. WII Newsletter (Winter 2003), 10: 11 - 14.
91. Rai, N., Verma, S.K., Gaur, A., Iliescu, F.M., Thakur, M., Golla, T.R., Chandra, K., Prakash, S., Tabasum, W., Ara, S. and Singh, L. 2020. Ancient mtDNA from the extinct Indian cheetah supports unexpectedly a deep divergence from African cheetahs. Scientific reports, 10(1), pp.1-11.
92. Ramesh, K. 2015. Reintroduction-based recovery of tiger in India: an overview. Paper presented in IUCN Asia Regional Conservation Forum, August 11. 2015. Global Tiger Forum. http://globaltigerforum.com/resources_files/179_Tiger%20Reintroduction%20in%20India_11August2015.pdf.
93. Rangarajan M. 1998. The role of administration in extermination. Fresh evidence on the cheetah (Acinonyx jubatus) in India. Journal of the Bombay Natural History Society, Vol. 95: 1998.
94. Report of the National Forest Commission. 2006. Government of India.
95. Ripple, W.J. and Beschta, R.L. 2012. Trophic cascades in Yellowstone: the first 15 years after wolf reintroduction. Biological Conservation, 145: 205 – 213.
96. Ripple, W.J., Beschta, R.L., Fortin, J.K. and Robbins, C.T. 2014. Trophic cascades from wolves to grizzly bears in Yellowstone. Journal of Animal Ecology, 83: 223-233.
97. Rodgers, W.A., Panwar, H.S. and Mathur, V.B. 2002. Wildlife Protected Area Network in India: A Review (Executive Summary). Wildlife Institute of India, Dehradun.
98. Rodriguez, E., Morris, C.S., Belz, J., Chapin, E., Martin, J., Daffer, W. and Hensley, S. 2005. An assessment of the SRTM topographic products. Technical Report JPL D-31639, Jet Propulsion Laboratory, Pasadena, California, USA.
99. Sanderson, E., Forrest, J., Loucks, C., Ginsberg, J., Dinerstein, E., Seidensticker, J., Leimgruber, P., Songer, M., Heydlauff, A., O'Brien, T., Bryja, G., Klenzendorf, S., Wikramanayake, E. 2006. Setting priorities for the conservation and recovery of wild tigers: 2005–2015. The technical assessment. WCS, WWF, Smithsonian, NFWF–STF, Washington DC.
100. Sankar, K., Qureshi, Q., Nigam, P., Malik, P.K., Sinha, P.R., Mehrotra, R.N., Gopal, R., Bhattacharjee, S., Mondal, K. and Gupta, S. 2010. Monitoring of reintroduced tigers in Sariska Tiger Reserve, Western India: preliminary findings on home range, prey selection and food habits. Tropical Conservation Science, 3: 301 – 318.
101. Sasmal, I., Honness, K., Bly, K., McCaffery, M., Kunkel, K., Jenks, J.A. and Phillips, M. 2015. Release method evaluation for swift fox reintroduction at Bad River Ranches in South Dakota. Restoration Ecology, 23: 491 - 498.
102. Schaller, G.B. 1996. Introduction: carnivores and conservation biology. Carnivore behavior, ecology, and evolution (ed J.L Gittleman) pp. 1-10. Cornell University Press. Ithaca, NY.
103. Shaffer, M.L., 1981. Minimum population sizes for species conservation. BioScience, 31(2), pp.131-134.
104. Sharma, A. 1997. Morbidity and mortality in Large Felids. Wildlife Information Bulletin. 3(1). 1- 2.
105. Seshadri Balakrishna. 1969. The twilight of India's wildlife. John Bakers Publishers. London.
106. Short, J. 2010. Australian animal welfare strategy: the characteristics and success of vertebrate translocations within Australia. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT, viii + 97 pp.
107. Slotow, R. and Hunter, L.T.B. 2009. Reintroduction decisions taken at the incorrect social scale devalue the conservation contribution: African lion in South Africa. 43 -71: In The Reintroduction of Top-order Predators, Hayward, M.W. and Somers, M.J. (eds). Wiley- Blackwell, Oxford.
108. Smith, D.W. 2006. Re-introduction of gray wolves to Yellowstone National Park, USA. Re-introduction NEWS 25,29-31.
109. Smith, D.W. and Bangs, E.E., 2009. Reintroduction of wolves to Yellowstone National Park: history, values, and ecosystem restoration. Reintroduction of top-order predators. Oxford: Wiley-Blackwell, pp.92-125.
110. Terio K.A., Mitchell E., Walzer C., Schmidt-Küntzel A., Marker L. & Citino S. 2018. Diseases Impacting Captive and Free-Ranging Cheetahs- In book: Cheetahs: Biology and Conservation. Biodiversity of the World: Conservation from Genes to Landscapes (pp.349-364) Editors: Nyhus, P.J., Marker, L., Boast, L.K. & Schmidt-Küntzel, A. Academic Press.
111. Vijayan, S. and Pati, B.P. 2002. Impact of changing cropping patterns on man-animal conflicts around Gir Protected Area with specific reference to Talala sub-district, Gujarat, India. Population and Environment, 23: 541 – 559.
112. Walker, S.F., Bosch, J., James, T.Y., Litvintseva, A.P., Valls, J.A.O., Piña, S., García, G., Rosa, G.A., Cunningham, A.A., Hole, S. and Griffiths, R. 2008. Invasive pathogens threaten species recovery programs. Current Biology, 18(18), pp. R853-R854.
113. Wani, M. & Kothari, A. 2007. Protected Areas and human rights in India. The impact of the official conservation model on local communities. Policy matters, IUCN, 15, 100-115.
114. Weber, W. and Rabinowitz, A., 1996. A global perspective on large carnivore conservation. Conservation Biology, 10(4), pp.1046-1054.
115. Weise, F.J., Vijay, V., Jacobson, A.P., Schoonover, R.F., Groom, R.J., Horgan, J., Keeping, D., Klein, R., Marnewick, K., Maude, G., Melzheimer, J., Mills, G., van der Merwe, V., van der Meer, E., van Vuuren, R.J., Wachter, B., Pimm, S.L. 2017. The distribution and numbers of cheetah (Acinonyx jubatus) in southern Africa.PeerJ 5:e4096
116. Williams, B.K., Nichols, J.D. and Conroy, M.J. 2002. Analysis and management of animal populations. Academic Press, London, UK, 817 pp.
117. Williams, T.M., Wolfe, L., Davis, T., Kendall, T., Richter, B., Wang, Y., Bryce, C., Elkaim, G.H. and Wilmers, C.C. 2014. Instantaneous energetics of puma kills reveal advantage of felid sneak attacks. Science, 346(6205), pp.81-85.
118. Zomer, R.J., Bossio, D.A., Trabucco, A., Yuanjie, L., Gupta, D.C. and Singh, V.P. 2007. Trees and water: smallholder agroforestry on irrigated lands in northern India. International Water Management Institute, Colombo, Sri Lanka, Research Report 122, 45 p.
119. Zomer, R.J., Trabucco, A., Bossio, D.A., van Straaten, O. and Verchot, L.V. 2008. Climate change mitigation: a spatial analysis of global land suitability for clean development mechanism afforestation and reforestation. Agriculture Ecosystems and Environment, 126, 67-80.

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Annexures

1 Annexure

Eco-Climatic Niche Model for Cheetah in India

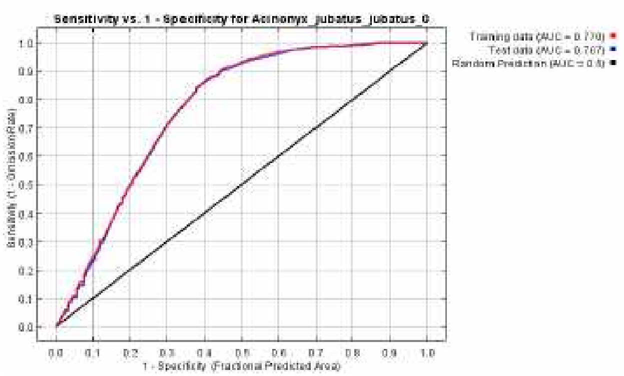


Figure 1A-1.- The AUC and specificity/sensitivity graphs of habitat suitability models of cheetah

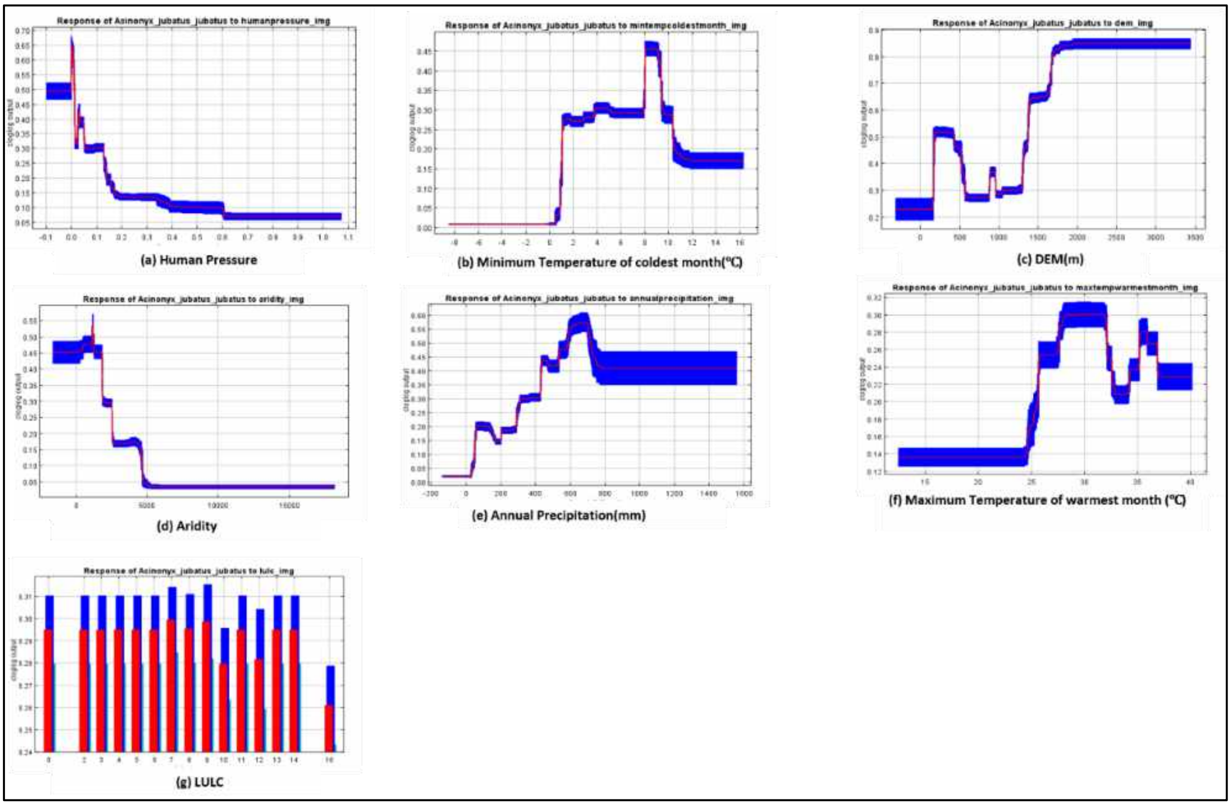


Figure 1A-2. Response curves of individual variables with respect to habitat suitability of cheetah- A) Human pressure, B) Minimum temperature of the coldest month (°C) (BIO6), C) DEM, D) Aridity, E) Annual precipitation (mm) (BIO12), F) Maximum temperature of the warmest month (°C) (BIO 5), G) LULC (Classes: 0-Water, 1-Evergreen needleleaf forest, 2-Evergreen broadleaf forest, 3-Deciduous needleleaf forest, 4-Deciduous broadleaf forest, 5-Mixed forest, 6-Closed shrublands, 7-Open shrublands, 8-Woody savannas, 9-Savannas, 10-Grasslands, 11-Seasonal grasslands, 12-Croplands, 13-Urban and built-up, 14-Cropland/Natural vegetation mosaic, 15-Snow and ice, 16-Barren or sparsely vegetated).

Table 1A-1-Contribution percentage of covariates with standard deviation (sd) to the best model explaining habitat suitability of cheetah

Covariates	Percent contribution (SD)	Permutation contribution (SD)
Human Pressure	32.1 (1.44)	19.1 (1.24)
Minimum temperature of the coldest month	27.5 (0.68)	19.9 (0.74)
DEM	23.1 (0.83)	23 (1.17)
Aridity	8.6 (1.01)	20.5 (1.37)
Annual Precipitation	5.6 (0.49)	16.1 (0.83)
Maximum temperature of the warmest month	4.1 (0.64)	1.9 (0.21)
LULC	0.1 (0.6)	0.2 (0.9)

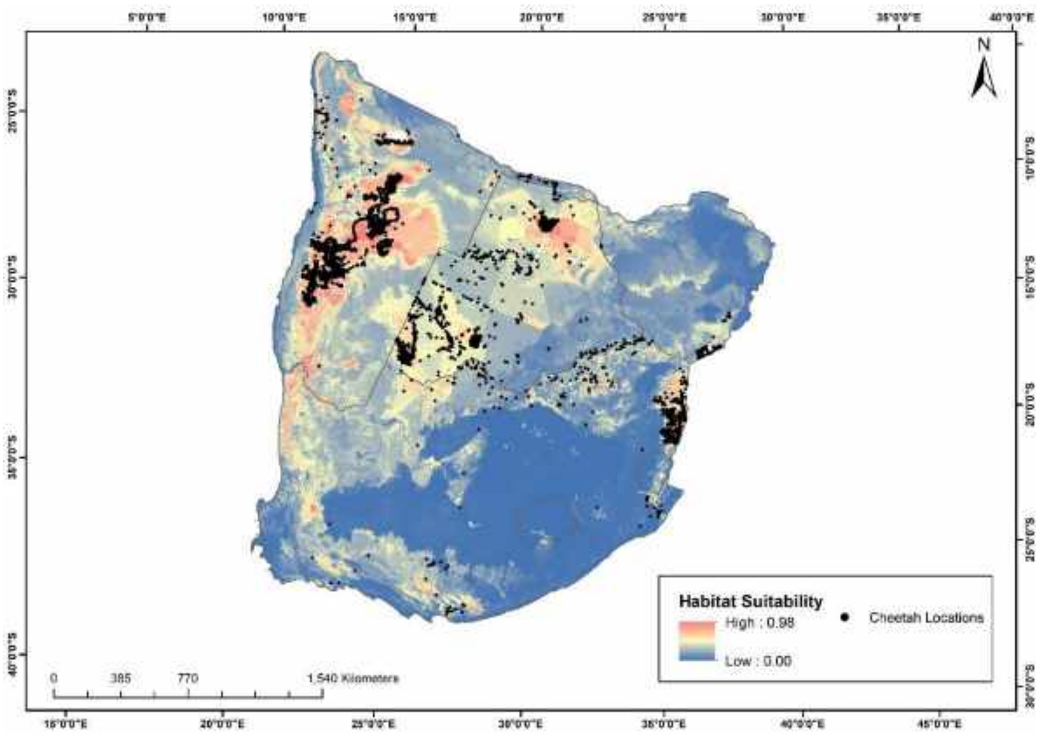


Figure 1A-3. MaxEnt output probability map of cheetah habitat suitability in southern Africa

2 Annexure

Compliance of Action Plan for Introduction of Cheetah in India with IUCN Guidelines 2013

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
1.	Section 3.2. Deciding when translocation is an acceptable option states that there should generally be strong evidence that the threat(s) that caused any previous extinction have been correctly identified and removed or sufficiently reduced.	*2.1. Historical Background - After the enactment of Wildlife (Protection) Act of India in 1972, and in the last five decades establishment of a network of Protected areas, implementation of effective wildlife legislation and a dramatic change in the conservation ethos and awareness in the country inter alia, the original cause for the extinction of the cheetah in India has been adequately addressed.*	
2.	Section 4. Planning a translocation subsection 4.1. Goals, objectives and actions states that every conservation translocation should have clearly defined goals.	*3. Project Goal and Objectives 3.1. Goal - Establish viable cheetah metapopulation in India that allows the cheetah to perform its functional role as a top predator and provides space for the expansion of the cheetah within its historical range thereby contributing to its global conservation efforts. 3.3. Aims of Cheetah Translocation in Kuno National Park. - The primary aim is to establish a free-ranging population of cheetahs in and around the Kuno NP of Madhya Pradesh (MP). Further, this population in KNP will be managed as a metapopulation with other two to three established populations of cheetah in India with occasional "immigrants" brought in from Africa, as and when needed.*	*3.2. Objectives 1. To establish breeding cheetah populations in safe habitats across its historical range and manage them as a metapopulation. 2. To use the cheetah as a charismatic flagship and umbrella species to garner resources for restoring open forest and savanna systems that will benefit biodiversity and ecosystem services from these ecosystems. 3. To enhance India's capacity to sequester carbon through ecosystem restoration activities in cheetah conservation areas and thereby contribute towards the global climate change mitigation goals. 4. To use the ensuing opportunity for eco-development and eco-tourism to enhance local community livelihoods. 5. To manage any conflict by cheetah and/or other wildlife with local communities within cheetah conservation areas expediently through compensation, awareness, and management action.*
3	Section 5.1.1. Basic biological knowledge & Annexure 8.1- Survey/monitoring before release states that "it is desirable to collect baseline information on any area before releases into it."	*5.1. Site assessment and prey density of Kuno National Park (NP).*	*- All introduction sites have been assessed for habitat size and quality (Section 5.1, Appendices -3-5), prey (Appendix 6), and human impacts (Appendices 3-5)*

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
4	Section 6. Ecological risk and sub-heading 13 of Annexure 5.3- Habitat states that "possible ecological roles of the focal species in any new environment should be carefully evaluated, with the particular concern that the conservation interests of other species and habitats will not be jeopardised by the translocation."	*5.1. Site assessment and prey density of Kuno NP.* *5.2. Current cheetah carrying capacity of Kuno NP.* *- Kuno NP holds potential to sustain up to 21 cheetahs based on its existing prey base.* *-Kuno can house lions and tigers once cheetah population is established.*	*Studies by the WII on prey, co-predators and habitat in Kuno (Appendices 3-5) generated ecological information that address the concerns raised in the IUCN Guidelines' section and annexure.*
5	Section 5.1.1. Basic biological knowledge, Feasibility & design category Annexure 5.1- Background biological and ecological knowledge & Annexure 5.2- Models, precedents for same/similar species. The section and annexures state that "some type of modelling should be used to predict the outcome of a translocation under various scenarios, as a valuable insight for selecting the optimal strategy" and should be based on "data from previous species management activities".	*2.2. Eco-Climatic Niche Model for Cheetah in India.* *- MaxEnt Species distribution model based on eco-climatic variables suggest good cheetah habitat in India and in Kuno NP* *5.1. Site assessment and prey density of Kuno NP.* *5.2. Current cheetah carrying capacity of Kuno NP.* *5.3. PHVA models of cheetah in Kuno* *- Kuno population and managed metapopulation in India.*	*The biomass models developed for carrying capacity estimation were based on information on cheetah diet and preferred prey species (similar sized prey in Kuno).* *PVA models were parameterized based on long-term ecological studies on cheetah available from literature.*
6	Section 6. Risk assessment & Feasibility and design category Annexure 6.1- Assessing the risk landscape states that "a risk assessment should carefully consider all information on the species' biology", "known pathogens or parasites, probability of potential impacts", "take into account of all sources of uncertainty and apply them at an appropriate spatial scale."	*5.3. PHVA models of cheetah in Kuno.* *- Probability of extinction of cheetahs was most sensitive to number and frequency of supplementation of cheetahs subsequently after the initial reintroduction of 8-12 individuals and carrying capacity (K) for cheetahs.* *5.8. Disease and health management of founders.* *- Details in S. No.11 of this table.*	*- PHVA models based on long-term ecological studies on cheetah incorporates uncertainty along with metapopulation management.* *- Protocols/measures to prevent introduction of novel wildlife diseases/ pathogens/ parasites/ and assessment of prevalence of potential carnivore pathogens/ parasites/ diseases at the release sites.*

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
7	Section 5.1.2. & Feasibility and design category Annexure 5.3- Habitat emphasized creating suitable habitat through extension/ creation of PAs (habitats), eco-restoration and removal of unwanted species.	*5.4. Habitat management.* *- Measures for enhancement of the Protected Area (inviolate area of 700 km^2 devoid of human disturbances) by eradication of weed species, management of grassland, water and fire in addition to promotion of palatable species to increase prey base and regulation of non-timber forest produce in the buffer area for future expansion of the PA along with landscape management.*	*A buffer zone management strategy for this Shivpuri-Sheopur-Kuno landscape (potential cheetah habitat- 3200 km^2) will be developed in line with the National Tiger Conservation Authority (NTCA)'s landscape management plan guidelines*
8	Sub-heading numbers 8 and 9 of Section 5.2. Social feasibility emphasizes the need of having mechanisms ensuring inter-organizational commitments. Sub section 5.4. Resource availability states that the "funding agencies should be aware that rational changes to a translocation plan during implementation are normal, and budgets should be flexible enough to accommodate such changes."	*5.5. Organizational commitments.* *- The roles and responsibilities of the implementing agencies- National Tiger Conservation Authority, Madhya Pradesh Forest Department (MPFD), other State Forest Departments and the Wildlife Institute of India (WII) is delineated along with the flexibility of allocating funds to accommodate rational changes to a translocation plan during implementation and subsequent monitoring. Project cheetah will become an integral scheme of the Government like Project Tiger under the auspices of the NTCA.*	*Staff welfare fund, Cheetah Conservation Foundation for receiving funds from gate receipts, donations, tourism revenue and other revenues; 40% to be used for eco-development works in buffer zone communities*
9	Sub section 5.4. Resource availability states that "effective translocation management" should "emphasis on incorporating social skill sets as well as biological/technical expertise."	*5.6. Training of personnel.* *- Officials/Scientists/Managers/ Researchers/ Staff of the implementing agencies will be trained by Cheetah Experts/ Scientists/ Managers/ Researchers/ Staff of the Agencies/Universities/Departments in/from the source country on relevant fields of management/ veterinary/ ecology/ conservation of the cheetah.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
10	Feasibility and design category sub section 5.1.4. Founders states that "founders can be either from a captive or wild source." Feasibility and design category sub section 5.1.5. Animal welfare states that "every effort to be made to minimize social disruption and resultant stresses on the source population." Annexure 5.5- Founders-genetic considerations states that "the removal of individual(s) from a source should not jeopardize the social dynamics or any critical ecological function therein." Annexure 6.2- Risk to source population states that "the removal of individual(s) from a source should not cause a reduction in its viability." Sub section 7.2. Release strategy and Annexure 7- Release and implementation sub-headings 1 (identification of the most appropriate life stage for translocation), 2 (deciding optimum number of founders), 4 (maintaining social dynamics) and 8 (identifying the time of the reintroduction considering the species' ecology, biology and behavior).	*Section 5.7. Founder cheetah population.* *- India currently does not have any native cheetah. It is not feasible to source cheetah from Iran since that would jeopardize the survival of the last <25 Iranian cheetah. The ecologically and behaviourally most suited population that meets the source population criteria as per IUCN Guidelines would suffice the need since there would be no genetic mixing of subspecies and the only population that currently meets the above requirements of a source are from southern Africa (A. j. jubatus; South Africa, Namibia, Botswana). This region holds the largest cheetah populations ~ 4000 (about 66% of the global cheetah population) and meets the criteria for a source of continuous supply of legally obtained healthy cheetah for translocation and for future supplementations without detrimental impacts on the source populations.* *- About 12-14 free-ranging wild cheetahs (8-10 males and 4-6 females) from various parks/reserves/areas that are ideal (naturally bred, reproductive age group that is genetically diverse, disease free, behaviorally sound- eg. not overly imprinted to humans but tolerant, predator wary, capable of hunting wild prey, and socially tolerant of each other) after checking their lineage and condition for establishing a new cheetah population would be imported as required from South Africa/ Namibia/ Other African Countries, as a founder stock for five years initially and then as may be required by the program. The founders will be individuals with known life histories and lineages, being monitored by the supplying agencies/experts/donors (identified as part of the cheetah metapopulation management program, research and conservation project) and selected keeping in mind ecological aspects such as relatedness, behavior, sociality etc.* *The release strategy is detailed in S. No.14 of this table- Section 5.11. Soft Release of Cheetahs in Kuno.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
11	Sub-section 5.1.6. and Annexure 5.6- Disease and parasite considerations state that "the management of disease and known pathogen transfer is important, both to maximise the health of translocated organisms and to minimise the risk of introducing a new pathogen to the destination area" which can be achieved through a surveillance. Section 5.3. Regulatory compliance states that "national requirements for animal health before release should be met." Annexure 6.4- Disease risk states that "risk assessment should focus on known pathogens in the translocation stock that are likely to have undesirable impacts on other organisms at the destination. Generalist pathogens with no known history at the destination are a particularly high risk." Sub heading 15. Pre-release treatment of founders of Annexure 7- Release and implementation states that "pre-release treatment or medication can help to protect animals from pathogens encountered after release."	*5.8. Disease & health management of founders.* *-The founder-stock for current cheetah introduction project are all free ranging, naturally bred individuals, thus likely not to be at high risk of harboring major diseases.* *- To prevent novel wildlife disease introduction to India all founder cheetah would be kept under observation in a quarantine facility in the host country for manifestation of any illness after capture and appropriately sampled, screened in the country of origin before transportation using appropriate molecular diagnostics/ seroprevalence methods and administered vaccinations and health checks/treatments as per international norms/ protocols /protocol at country of origin as well as administered vaccinations and health checks/treatments as per the domestic norms/ protocols prescribed by Department of Animal Husbandry and Dairying, Government of India (GoI).* *- On arrival to India, Cheetahs would be quarantined for the required period in a predator proof enclosure at the site of release and monitored for manifestation of any sickness as per the regulation of import of live animals under the Livestock - importation Act, GoI.* *- Scientific assessment to establish prevalence of potential carnivore pathogens/diseases at the release sites by collecting sufficient samples from several carnivore/omnivore species and feral dogs/cats from different locations in/ around the release sites would be undertaken to ensure implementation of appropriate preventive medicine procedures and prophylactic steps like vaccinations on founder stock.* *- Veterinarians from South Africa, United Kingdom (Consultant), WII and Madhya Pradesh Forest Department would oversee the disease and prophylaxis aspects.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
12	Sub section 5.1.5. Animal welfare and 7.2. Release strategy state that "Minimising stress during capture, handling, transport and pre-release management will enhance post release performance." Annexure 5.6. Disease and parasite considerations state that "poorly designed transport containers and methods of transport, extended time in transport, and lack of adaptation prior to transport can contribute to the occurrence of disease and mortality during the translocation process."	*5.9. Individual Cheetah Welfare, Capture, Holding and Transportation to Kuno from South Africa.* *5.9.1. Immobilization and Capture of Cheetahs-Drug Dosages.* *- The protocol developed for the capture and immobilization of cheetahs aims at minimizing stress on the captured individuals in the IUCN Guidelines' sub section.* *- Safety and minimal stress to each individual cheetah would be ensured by a professional team in South Africa (South African National Biodiversity Institute, Endangered Wildlife Trust, ASHIA Cheetah Conservation), Namibia (Cheetah Conservation Fund), and in India (NTCA, WII, MP Forest Department).* *5.9.2. Transportation of Cheetahs* *-Cheetah transportation would be conducted in a manner that adheres to all International, host and recipient country laws, is safe, and minimizes risk to the animals, employees, and general public.* *- For international transportation from Africa by flight, standard crates according to specifications of Live Animals Regulations of the International Air Transport Association (IATA) would be used. A trained veterinarian and two to three trained personnel along with all the necessary supply and equipment would accompany the shipment.* *5.8. Disease & health management of founders.* *- Details in S. No.11 of this table.*	
13	Section 8. Monitoring and continuing management and Annexure 8.2- Monitoring after release state that "post-release monitoring is an essential part of a responsible conservation translocation and the intensity and duration of monitoring should be proportional to the scale of the translocation and the levels of uncertainty and of risk around the translocation results."	*5.10. Monitoring of Cheetahs by Radio-Telemetry.* *- All the founder cheetahs would be fitted with satellite/GPS/VHF collars enabled with a ground data download facility. Cheetah cubs born in Kuno for at least two generations would be collared prior to their dispersal at the age of 16-17 months.* *- The cheetah population in Kuno would be intensively monitored and managed at least for 10 years with all the adult cheetahs fitted with GPS/satellite collars.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
14	Sub section 5.1.5. Animal welfare states that "Stress in translocated animals may occur during capture, handling, transport and holding, including through confining unfamiliar individuals in close proximity, both up to and after release." Sub-heading 8 of Annexure 7- Release and implementation states that "the life history, ecology and behaviour of the focal species, together with any seasonality in essential resource availability, should guide scheduling of releases." Sub-heading 14 of Annexure 7- Release and implementation states that "animals can be behaviourally conditioned before release; this may be particularly valuable for socially complex species." Sub-heading 15 of Annexure 7- Release and implementation states that "pre-release treatment or medication can help to protect animals from pathogens encountered after release." Sub-heading 16 of Annexure 7- Release and implementation states that "animals may be held for some period at the release site to allow them to accustom to local conditions." Sub-headings 18 and 19 of Annexure 7- Release and implementation states that "during or following release, the provision of artificial caging, shelters or residences, or supplementary food and water can increase survival of animals" and that can be achieved by managing and "modifying conditions such as irrigation, light levels and available nutrients."	*5.11. Soft Release of Cheetahs in Kuno.* *- Cheetahs would be soft released into predator proof fenced enclosures with partitions in Kuno NP. Male coalitions and females would be kept in separate but adjoining compartments so that they are able to know each other before release. The location of the enclosure is such that the cheetahs can see for some distance to understand the environment and the presence of prey and predators before release. Adequate water and shade is available in the enclosure and would be suitably augmented if needed. Natural prey within the enclosure would ensure that cheetah become accustomed to hunting Indian prey species before their release.* *- Experienced cheetah expert(s) from the source agency/country would stay/visit the project site, from before the arrival of the cheetah up to about two months after the release of the females from the enclosure, to advise and assist.* *5.8. Disease & health management of founders.* *- Details in S. No.11 of this table.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
15	Sub section 4.2. Monitoring program design states that "monitoring the course of a translocation is an essential activity and should be considered as an integral part of translocation design." It also provides guidelines on methods and protocols of data collection and agencies/personnel responsible for conducting research and dissemination of finding. Sub-heading 6 of Section 6. Risk assessment and Annexure sub-sections 6.3. Ecological consequences of translocation and 6.7. Socio-economic risks state that "the ecological consequences of a translocation affecting both the translocated species and other species or ecological processes in the destination community" and potential direct (livelihood) and indirect negative impacts on human interests should be monitored to develop and revise post-monitoring management strategies. Annexure 7- Release and implementation- Discouraging post-release dispersals. Annexure sub section 8.2. Monitoring after release states that "Post release monitoring should focus on demographic monitoring, behavioral monitoring, ecological monitoring, genetic monitoring, health monitoring and socio-economic monitoring." Annexure sub section 8.3. Continuing management emphasizes on "Adaptive management" and "active adaptive management" based on monitoring.	*5.12. Post-Release Monitoring and Research.* *- The cheetah population in Kuno would be intensively monitored and managed at least for 10 years with all the adult cheetahs fitted with GPS/satellite collars. Information on survivorship, ranging, movement, dispersal, resource selection, predation and aspects of livestock depredation and interactions with human would be recorded from radio-telemetered cheetahs.* *-Protection/management monitoring and research monitoring teams will be separate and provided will all required resources for their tasks.* *- During the initial years, cheetah dispersals into sink habitats would be actively deterred and if required captured and brought back inside the boundaries of Kuno NP as per NTCA's Standard Operating Procedure available for managing dispersing tigers in human dominated landscapes.* *- Research and monitoring programs include (a) Cheetah ecology with respect to ranging, habitat use, predation, interactions with copredators; (b) its behaviour with respect to intra- and inter-specific interactions, sociality, reproduction and predation strategies with respect to different prey; c) possibility of studying cheetah physiology with respect to field energetics with the use of isotopes and physiological bio-monitors d) Monitoring cheetahs' diet, prey and other carnivores (niche partitioning mechanism) (e) Genetic analysis of all cheetah founders (f) Monitoring vegetation and anthropogenic disturbances (g) Monitoring and studying human-cheetah interactions and (h) Monitoring cheetah population through individual identification,* *- A half-yearly monitoring/research review meeting would be organized where the Cheetah Expert committee, NTCA officials, WII representatives, MPFD officials and external expert(s) (as and when required) to assess the progress of cheetah project.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
16	Sub section 5.1.4. and Annexure 5.5- Founder emphasizes enhancement of genetic diversity in the reintroduced populations to ensure long term persistence of the populations.	*5.13. Genetic Management: Supplementation.* *- Genetic management of the reintroduced cheetah population would be done in a similar manner as is being done for game reserves in South Africa through a managed metapopulation program by Endangered Wildlife Trust and South African experts would be consulted.* *- Cheetahs that disperse into sink habitats would be prime animals to move between populations in India, supplemented occasionally by cheetah brought in from Southern Africa.* *- Capture, handling, transport and release of the cheetahs during the subsequent years would be as per the procedures detailed in Section 5.9. Individual Cheetah Welfare, Capture, Holding and Transportation to Kuno from South Africa.*	
17	Annexure 6.3- Ecological consequences of translocation states that "inter-specific competition is a major risk for any reintroduction and that should be studied and managed."	*5.14. Management of Cheetahs and Leopards in Kuno.* *- Eight (8-10) leopards at least, would be to radio-collared (GPS/satellite) to study the interaction between these two carnivores as part of the research program in Kuno.* *- The research would aim at radio-collaring of leopards and other predators (such as leopards, hyenas, jackals, foxes, jungle cat etc.) in Kuno prior to the release of cheetah and then monitor them at the same temporal scale which would generate valuable information on resource separation amongst carnivore communities in and would be of immense help in formulating future management plans to permit and promote coexistence.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
18	Sub-heading 2 of sub section 5.2. Social feasibility states that "translocation planning should accommodate the socioeconomic circumstances, community attitudes and values, motivations and expectations, behaviours and behavioural change, and the anticipated costs and benefits of the translocation. Understanding these is the basis for developing public relations activities to orient the public in favour of a translocation." Sub-heading 3 of sub section 5.2. Social feasibility says that "mechanisms for communication, engagement and problem-solving between the public (especially key individuals most likely to be affected by or concerned about the translocation) and translocation managers should be established." Sub-heading 6 of sub section 5.2. Social feasibility states that "the design and implementation stages of a translocation program should acknowledge the potential for negative impacts on affected parties or for community opposition" and should address that appropriately. Sub-headings 8 and 9 of sub section 5.2 (social feasibility) highlights inter-organizational collaborations and requirement of establishing "of special teams working outside formal, bureaucratic hierarchies that can guide, oversee and respond swiftly and effectively as management issues arise."	*5.15. Capacity Building.* *- Staff reinforcement in Kuno NP and providing opportunities for local people for these jobs.* *- Establishment of well-equipped veterinary teams with round the clock responsibilities remunerated with extra incentives and benefits.* *- Constitution of well-equipped tracking teams trained over the years to capture and handle cheetahs and other carnivores so as to augment the capabilities of the veterinary team.* *- A patrolling squad constituting of multi-departmental enforcement agencies in addition to the regular patrolling regime empowered with modern smart patrol monitoring system like MSTrIPES and information network constituting of local people would be established in Kuno NP.* *- The senior members of the implementation team, including lead scientist, project biologist (s) and veterinarian(s), would be sent on a training tour to selected tiger reintroduction sites in India and cheetah reintroduction sites in Africa as early as possible.* *- A staff welfare fund would be developed based on revenue generated through tourism to provide insurance, amenities, allowances and the entire staff working for Kuno NP would be paid a 'Project Allowance' at par with the allowance paid to the staff working for Project Tiger in India. Resources would be provided for increased mobility of staff, arms, equipment, data management and administration.* *- Regular in-house training of the forest officials, veterinary team, frontline staff and cheetah tracking team would be organized periodically.* *- Inter-sectorial collaborations with other state governmental departments and neighboring states would be established.*	

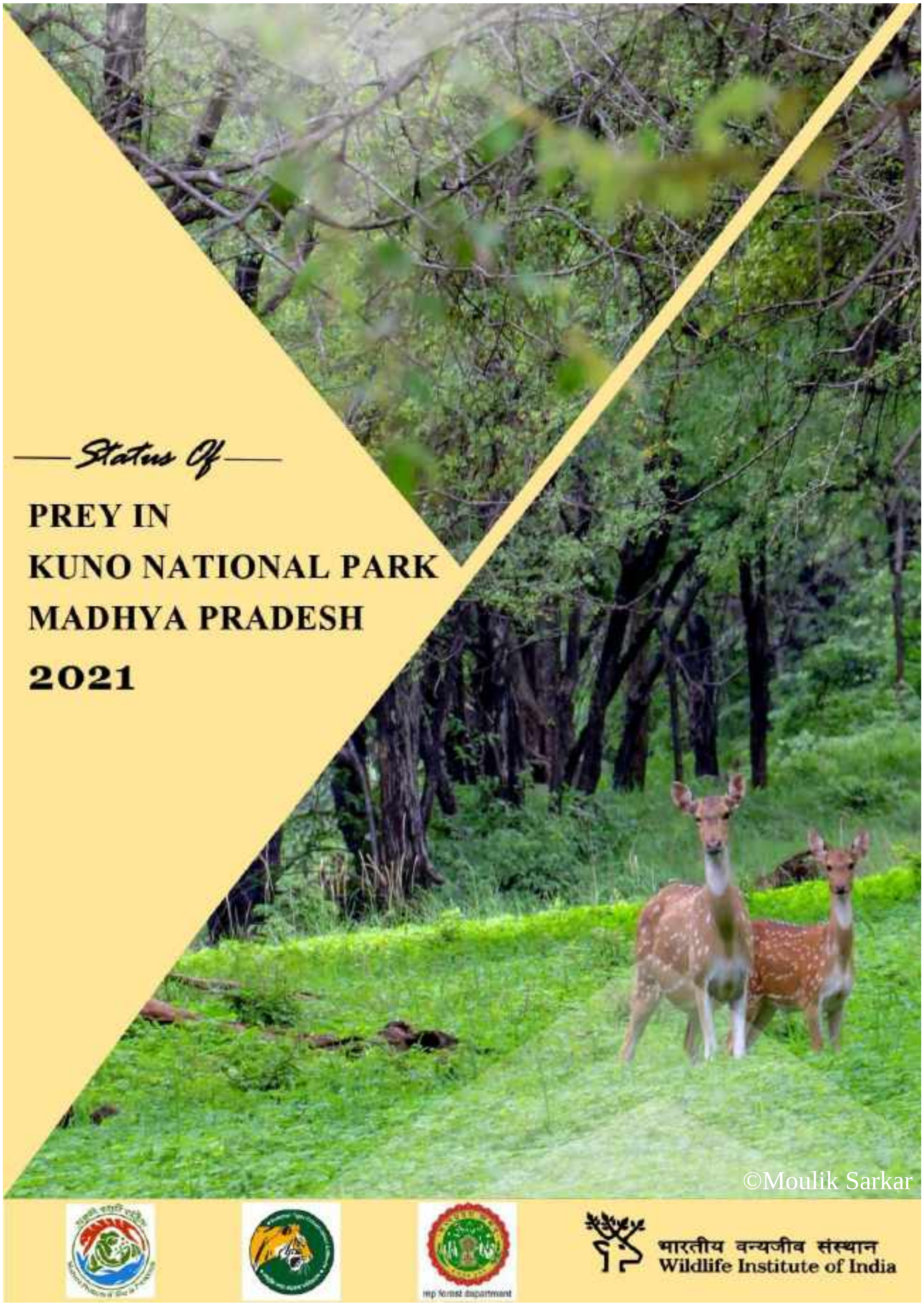
S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
19	Sub-heading 2 of sub section 5.2. Social feasibility states that "translocation planning should accommodate the socioeconomic circumstances, community attitudes and values, motivations and expectations, behaviours and behavioural change, and the anticipated costs and benefits of the translocation. Understanding these is the basis for developing public relations activities to orient the public in favour of a translocation." Sub-heading 3 of sub section 5.2. Social feasibility says that "mechanisms for communication, engagement and problem-solving between the public (especially key individuals most likely to be affected by or concerned about the translocation) and translocation managers should be established." Sub-heading 6 of sub section 5.2. Social feasibility states that "the design and implementation stages of a translocation program should acknowledge the potential for negative impacts on affected parties or for community opposition" and should address that appropriately. Sub-headings 8 and 9 of sub section 5.2 (social feasibility) highlights inter-organizational collaborations and requirement of establishing "of special teams working outside formal, bureaucratic hierarchies that can guide, oversee and respond swiftly and effectively as management issues arise."	*5.16. Community Participation: Awareness & Outreach, Conflict Mitigation and Livelihood Enhancement.* *- People's support would be garnered through various outreach, sensitization & awareness programs along with eco-development and pro-active rural development activities with the help of local and National NGOs would be implemented.* *- A Cheetah Conservation Foundation (like Tiger Conservation Foundation) would be established where gate receipts, donations etc. get deposited and 40% of the revenue generated goes to communities in the buffer zone and percolate to the marginalized local communities of the society while the rest are used for park management.* *- Veterinary programs such as free vaccination of dogs (against rabies, canine distemper and parvovirus) livestock against foot and mouth disease periodically as well as animal disease monitoring in the surrounding villages would be undertaken.* *- Collaborations with state animal husbandry department would be made to introduce poultry farms in the area for providing easy access to meat for local people.* *- A continuous study would be carried out to understand livestock predation pattern by large carnivores and aim to understand local people's perception towards conservation for site specific mitigation measures to be implemented.* *- The cheetah project has built in a budgetary head for livestock depredation compensation based on an overt assumption that 30% of cheetah diet would be small livestock.* *- Livestock depredation compensation/ monitoring collared cheetah and resolving conflict immediately/ dissemination of public opinion (pro cheetah/conservation) developed by elected representatives as well as civil servants.* *- Study on the patterns of crop damage would be undertaken as a part of the research and monitoring plan of Kuno NP so as to identify the areas prone to such damage to target awareness programs and mitigation measures. Crop damage compensation in the surrounding villages in reflectance with market price would be initiated.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
20	Sub-heading 6 of sub section 5.2. Social feasibility states that "the recognized objective of any translocation program is to contribute to the economic benefits of the locals/nation for long-term with special emphasis on the communities who bear the direct cost (if any) of such program."	*5.17. Wildlife Tourism, Eco-Clubs, Nature Education Camps and Revenue Generation.* *- Kuno NP authorities and the civil administration of the region would prepare a five to ten-year site-specific tourism policy in accordance with the Comprehensive Guidelines of the NTCA which would address the land-use and development of the surrounding areas as well and would be endorsed by the Cheetah Expert committee and NTCA in consultation with WII.* *- An attempt to generate revenues through brand building, marketing, sponsorships, merchandising etc. would be undertaken, through private partnerships, by sustainable and conservative tourism with opportunities of jobs and businesses for locals but in complete consonance with the conservation activities and prerequisites.* *- The control of tourism and the entry of vehicles in the PA, would be as directed by the Director of Kuno NP.* *- In addition to the revenues from gate and permit fees retained with the park as being done in other Tiger Reserves of Madhya Pradesh, hotels and resorts that use Kuno NP for their guest visits would be charged a small (~5%) but significant tax on their profits that would be deposited in the Cheetah Conservation Foundation being set up wherein 40% of the tourist revenue would be ploughed back in to local community welfare in the buffer zone.* *- A proactive approach to market the project as a brand would be adopted to promote conservation as an economic activity for earning significant revenues from filming, photo documentation, merchandising, sponsorship and tourism on a competitive basis contributing to the Cheetah Conservation Foundation within the conservation interest and priorities of the project and of the NP and would be spent on its management as well as for assisting the local communities.* *- To spread awareness among local people, sensitize the youth and promote the foundation, eco-clubs, nature education camps, teacher training camps, street plays etc. would be organized regularly.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
21	Section 9 and Annexure 9- Dissemination of information states that "dissemination should aim to ensure that maximum information around a conservation translocation is available in timely and suitable fashion to target audiences. Hence, communication should start at the planning stage, followed by reporting on progress at key stages of the project, and with this information disseminated to all parties involved. It prevents conflict with interested parties in both source and destination areas, and generates trust that any translocation is undertaken with integrity and without hidden motives and allows the evaluation of success whilst a translocation is in progress." Annexure sub section 8.3. Continuing management emphasizes on "Adaptive management" and "active adaptive management" based on monitoring.	*5.18. Publicity and Media Management.* *- A media spokesperson (preferably the Cheetah Expert Committee, CCFs, NTCA representative, Cheetah management and research teams' representatives) would only officially liaise with the media* *- A media-note briefing the latest updates about the project would also be issued/uploaded at a regular interval by the NTCA and forest department of Madhya Pradesh in consultation with the Cheetah Expert Committee, cheetah management and research teams.* *- Media would be sensitized regularly about the immense role they play in making local/global audience aware of the scientific facts and figures about the project and they should act responsibly while promoting conservation efforts.* *5.19. Annual Review and Monitoring* *- NTCA in coordination with Cheetah Expert committee, MPFD cheetah management and research teams would invite wildlife managers and conservation biologists and agencies of the country/abroad with subject knowledge/working experiences to seek their expertise during several phases of the project implementation.* *- After the cheetahs are released in Kuno, the progress of the project would be reviewed every six months in the first five years and subsequently once a year for a period of 20-25 years by the NTCA, MPFD, cheetah management and research teams along with the international experts (as and when required), and wildlife biologists of the country.* *- Results and findings of cheetah introduction would be published and peer-reviewed at frequent intervals to allow other conservation attempts to benefit from the experiences as a part of a continuous feedback loop with the results of the documented evaluation leading to alterations to the existing reintroduction program via an adaptive management strategy as per emerging situations.*	

S. No.	IUCN Guidelines' Section/Annexure Number	*Action Plan Section Number - Compliance*	*Remarks*
22	Section 4.3. and Annexure 8.3- Exit strategy states that "The decision to discontinue is defensible if translocation design includes indicators of lack of success and the tolerable limits of their duration, or if undesired and unacceptable consequences have occurred. An exit strategy should be an integral part of any translocation plan. Having a strategy in place allows an orderly and justifiable exit."	*5.20. Criteria for Assessing Success and Exit strategy.* *5.20.1. Criteria for project success for the short-term.* *- 50% survival of the introduced Cheetah for the first year.* *- Cheetah establish home ranges in Kuno NP.* *- Cheetah successfully reproduce in the wild.* *- Some wild born cheetah cubs survive to > 1 year.* *- F1 generation breeds successfully.* *- Poaching incidences reduce.* *- Cheetah based revenues contribute to community livelihoods.* *5.20.2. Criteria for assessing long-term success of the project.* *- Cheetah are established as an integral part of the ecosystem with natural rates of survival (~70% adults, 30-50% cubs/juveniles) and reproduction.* *- Long-term viable metapopulation is established in India (either in Kuno itself or in combination of 3-5 cheetah reserves).* *- Genetic diversity of established cheetah population(s) in India are representative of their founder population(s).* *- Major increase in quality habitat, prey, and mammalian diversity seen in Cheetah Conservation Reserves.* *- Local communities make significant improvements in their economies through eco-development from cheetah conservation foundations and direct remunerations through employment generation.* *5.20.3. Failure* *- If introduced cheetah do not survive or fail to reproduce in five years, the program needs to be reviewed for alternative strategies or discontinuation.* *- Fail to secure cheetah habitats in the larger landscape and unable to commence investments in their restoration through protection, habitat management and prey augmentation.*	*The cheetah introduction program requires long-term (at least 25 years) financial, technical and administrative commitments from Ministry of Environment Forest & Climate Change (MoEF&CC)-GoI, NTCA, MPFD (State Forest departments of other introduction sites) and WII.*

3 Annexure


Status Of
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STATUS OF PREY IN KUNO NATIONAL PARK MADHYA PRADESH

2021

Wildlife Institute of India **Madhya Pradesh Forest Department**

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STATUS OF PREY IN KUNO NATIONAL PARK MADHYA PRADESH 2021

1. INTRODUCTION

1.1. Kuno National Park

The Kuno National Park (748 km^2) is classified under the Semi-arid – Gujarat Rajputana (zone 4B) biogeographic zone (Rodgers et al. 2002). It is a dry deciduous forest, consisting mainly of *Anogeissus pendula*, *Acacia catechu* and *Boswellia serrata* communities and their associated flora (Figure 3A-1)**.** The average maximum summer temperature has been reported as 42.3° C, while the lowest winter temperatures are between 6 and 7° C (Chaudhary 2001). The average annual rainfall in the area is about 760mm (Banerjee 2005).

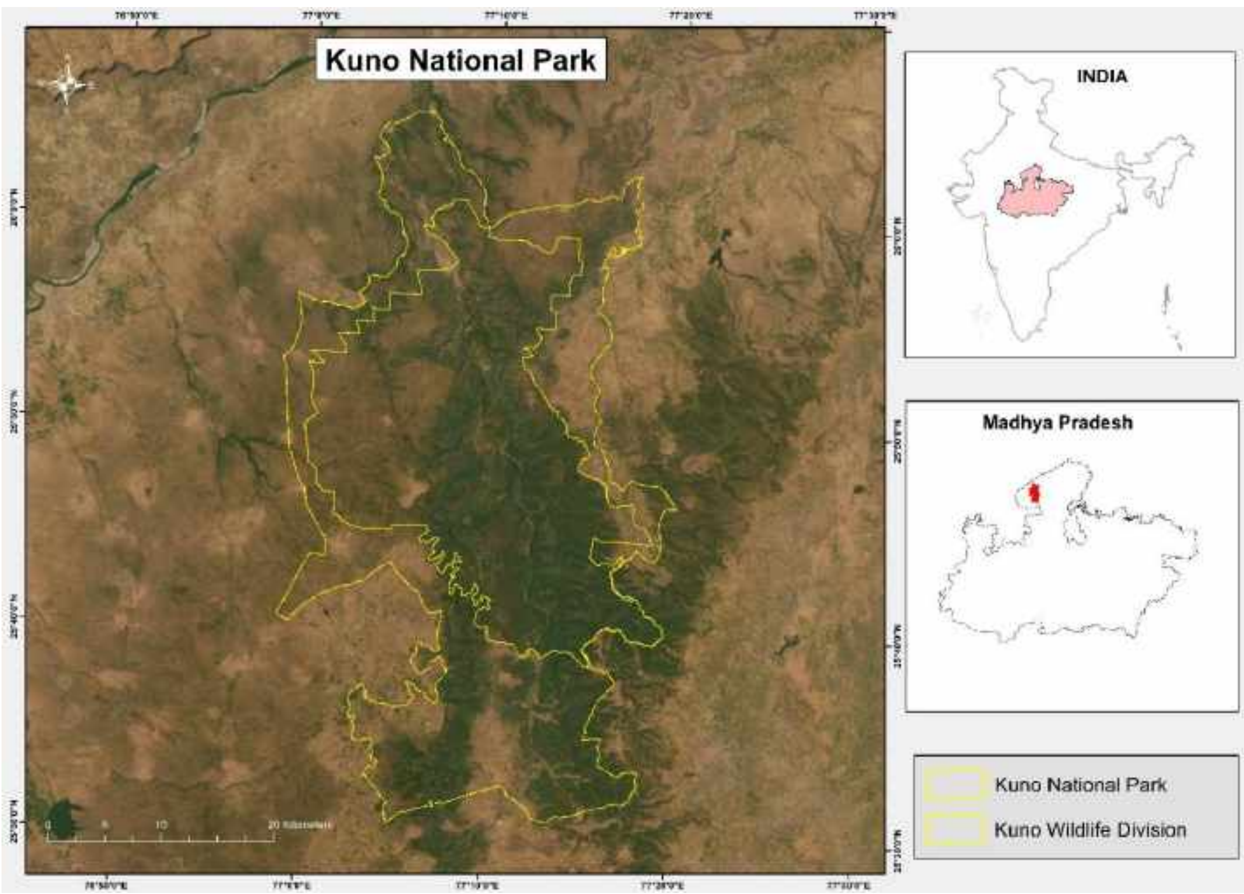

Figure 3A-1. Map of Kuno National Park, Madhya Pradesh

Image 3A-1. Savanna habitat in Kuno National Park. ©Shantanu Sharma

Image 3A-2. *Boswellia serrata* forest in Kuno National Park. ©Moulik Sarkar

The terrain of the Sanctuary is flat and undulating with some hillocks dotting the landscape. The density of the forests varies, as expected, but, significantly, the forest floor in most forest types supports rather luxuriant growth of grasses and other fodder plants (Images 3A-1 & 3A-2). The dominant tree species, *Anogeissus pendula*, itself is a very important fodder species of the region. The Sanctuary is inhabited by all the usual animals of the region, such as leopard (*Panthera pardus*), wolf (*Canis lupus*), jackal (*Canis aureus*), Indian fox (*Vulpes bengalensis*), striped hyena (*Hyaena hyaena*), jungle cat (*Felis chaus*), Asiatic wild cat (*Felis lybica ornata*), rusty-spotted cat (*Prionailurus rubiginosus*), ratel (*Mellivora capensis*) among carnivores and spotted deer (*Axis axis*), sambar deer (*Rusa unicolor*), nilgai (*Boselaphus tragocamelus*), chinkara (*Gazella bennetti*), wild pig (*Sus scrofa*) and chowsingha (*Tetracerus quadricornis*) amongst herbivores. Other species like sloth bear (*Melursus ursinus*), small indian civet (*Viverricula indica*), Asian palm civet (*Paradoxurus hermaphroditus*) are also present in the National Park.

Image 3A-3. Spotted deer. ©Parul Sen

Image 3A-4. Chousingha ©Nupur Rautela

Image 3A-5. Nilgai. ©Shanatanu Sharma

Image 3A-6. Sambar deer. ©Shanatanu Sharma

The perennial Kuno river (Image 3A-7) flows through the middle of the Protected Area (PA), providing assured water supply to the denizens throughout the year. The potential of the PA to support high densities of wild animals can be adjudged from the fact that a former Maharaja of Kolhapur is believed to have shot 28 tigers in a hunt lasting just 32 days, in 1950's (Ranjitsinh *pers. comm.*). The PA had a small tiger population until 2004-2005, but now it reports only occasional presence of tigers dispersing from the Ranthambhore Tiger Reserve of Rajasthan, which is only about 60km away. Currently there are no tigers in the PA. One male tiger (T38) after spending a decade in the park returned back to Ranthambhore Tiger Reserve in January 2020.

Image 3A-7. Kuno river surrounded by *Anogeisis pendula* forest in the National Park. ©Moulik Sarkar

The predominant communities in the area are Sahariyas, Gujjars and Yadavs. The main livelihoods of people are agriculture, pastoralism, casual labor and collection of non-timber forest products. People of Moghiya and Bhil tribes, well-known for their hunting abilities, reside in low numbers amongst the fringe villages. The other communities are Dhakad, Jatav and Thakur, who own some of the largest agricultural holdings.

2. METHODS

2.1. FIELD SURVEY DESIGN

Field sampling to assess prey populations was conducted in Kuno National Park from February to April, 2021. Sampling protocols designed to assess tigers, co-predators, prey and habitats across tiger landscapes in India (Jhala et al. 2013) were followed in this study.

2.1.1. Estimation of prey densities using line transect: Line transect method was used to estimate population density of prey (Buckland et al. 2001). A forest beat (area demarcated for patrolling) was considered as the sampling unit and a fixed line transect with length varying from 2 to 3 kilometers was walked. Since beats are spread out across the entire Protected Area, this transect layout design allows for sampling across all habitat types within the Protected Area (Jhala et al. 2013). A total of foot survey effort of 152 km was carried out in ~350 km^2 of the National Park which constituted the old wildlife sanctuary to estimate prey densities (Figure 3A-2).

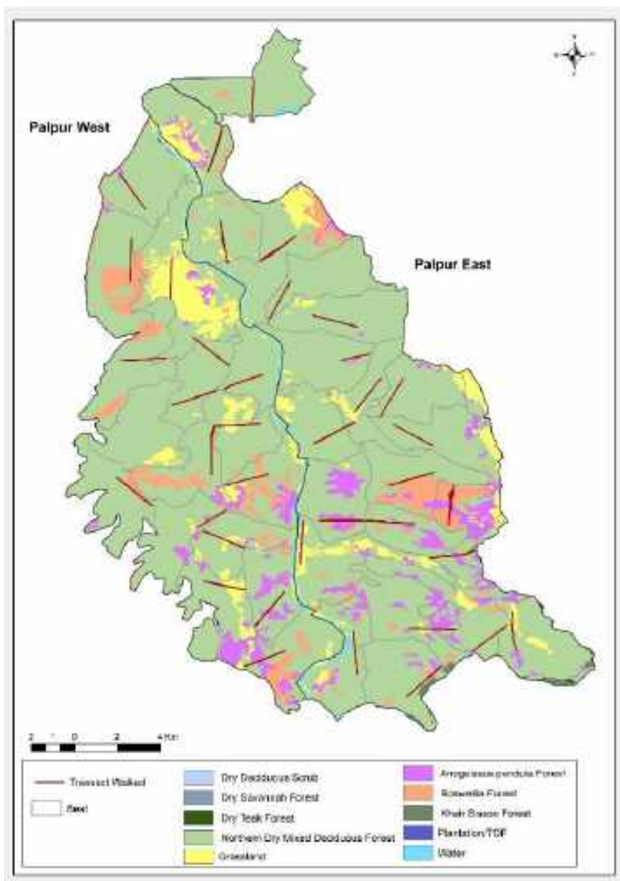

Figure 3A-2. Map showing line transects sampled in Kuno National Park during March- April 2021 for prey density estimation.

Start and end locations (GPS coordinates) of each transect were recorded using an e-Trex 30 GARMIN© GPS unit. For accurate distance measurement of prey sighted on the line transect was recorded with the aid of a laser range finder (Bushnell 800 pro). A compass (Suunto) was used to record walk bearing and animal bearing. All prey species detected along with their cluster sizes were recorded.

To quantify the habitat parameters and determine levels of human disturbance, vegetation plots were sampled at every 400 meters along the line transect. A total of 234 vegetation plots were sampled for number of trees per species in 15-meter radius, shrub percentage per species in 5-meter radius and grass species in 1-meter radius. For human disturbance, number of wood cutting and lopping signs, bamboo cutting signs and presence of fire and domestic cattle (direct or indirect evidence) were noted. For ungulate pellets count an area of 2m×20m was sampled on the opposite side of the vegetation plot along the transect line.

2.1.2. Estimation of prey densities using camera trap data: Prey densities were estimated using distance sampling based camera trap survey (Howe et al. 2017). Camera traps were deployed on random locations irrespective of animal distribution. The whole area of the park was divided into grids of 2 km^2. A total of 29 locations were sampled using camera traps for a period of approximately 20 days (Figure 3A-3). The camera traps were deployed habitat wise and for every location vegetation plot data along with ungulate pellets count were recorded. Camera traps were calibrated for distance measurement of the animals captured in the field of view of the camera. Calibration was done up to 15-20 meters depending on the vegetation coverage in front of the camera. Each camera in the survey was used as a point transect. Reconyx camera traps were used for this purpose which have both thermal and motion sensors. Camera traps were programmed to record 10 consecutive pictures in 10 seconds without any delay between pictures.

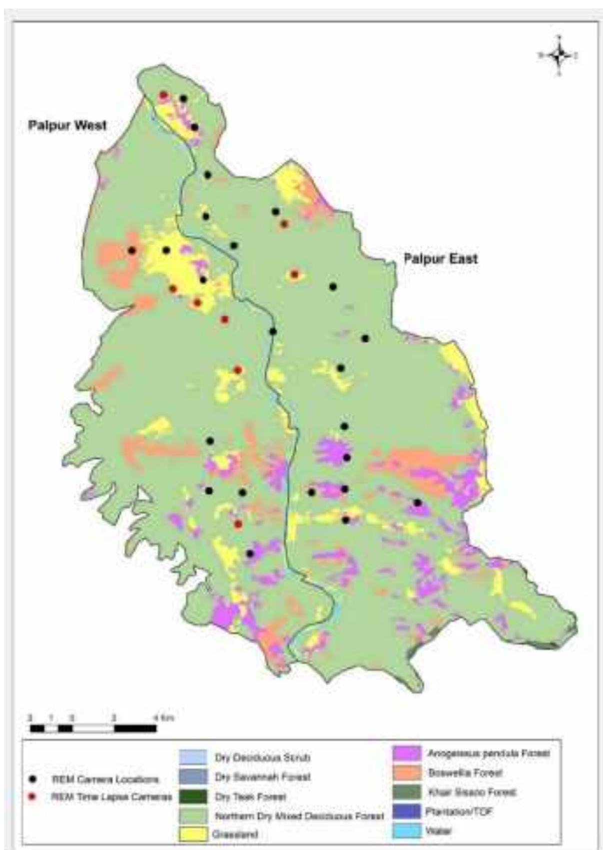

Figure 3A-3. Habitat proportional random camera trap placement for estimation of prey density in Kuno National Park during March- April 2021.

2.2. ANALYTICAL METHODS

2.2.1. Estimation of prey densities using line transect data: Animal sightings from the line transect data were analyzed using DISTANCE 7.3 software (Thomas et al. 2009). Distance enables the computation of detection probability for the sightings obtained during transects (Buckland 1985; Buckland et al. 1993; Karanth & Nichols 2017). This detection probability provides estimation of animal abundances without the influence of biases in detection of animals that may arise due to varying habitat types, animal sizes or group sizes. For species with less observations, data recorded from previous surveys conducted during the same season were pooled together to obtain a global detection function and stratified by the year to obtain density estimates.

2.2.1.1. Model selection: For DISTANCE analysis several models were used with varying group intervals and truncations to select a model that best fit the data. Detection function was usually fitted using half normal, hazard rate or uniform models as key functions with cosine series expansion. Outliers from the data were truncated. AIC values, goodness of fit tests, visual inspection of the detection function and variances associated with the estimates obtained were used to select the most appropriate model for each prey species (Buckland et al. 2001).

2.2.2. Estimation of prey densities using camera trap data: Camera trap was deployed at a point 'k' which is independent of animal movement for a period of time 'Tk'. Each camera trap was set to record images as long as a targeted animal is available to trigger it. Temporal effort is calculated by multiplying by the total number of trap occasion (24×60×60×sampling session) and transformed into seconds (Howe et al. 2017). Distances and angle of the initial triggers were extracted from ANIMETRE 3.18 tool (Jhala et al. unpublished data) Distances and angle were then used to fit the detection function to get the effective detection radius (EDR) and effective detection angle (EDA). Spatial coverage was calculated using the fraction of the circle i.e. ϴ which is the field of view of the camera trap. The density estimation follows standard point transect methods (Buckland et al. 2001) using the EDR.

3. RESULTS

3.1. Prey densities obtained from line transect sampling: Distance sampling survey was conducted from 15th February 2021 to 29th April 2021. Prey estimates of eight prey species were obtained from distance sampling using line transect. Chital was the most abundant prey species with density of 23.43 (4.67SE) per km^2, followed by langur 7.97 (2.94SE) per km^2 and sambar 1.95 (0.65SE) per km^2.

Table 3A-1. Summary of prey densities in Kuno National Park 2021 (line transect survey)

Species	Number of observations	Effective Strip Width(SE) in m	Density (SE) individuals per km^2	CV of Density	Mean Cluster size (SE)	Estimated population in ~350 km^2
Chital	104	65.95 (4.92)	23.43 (4.67)	19.94	4.45 (0.42)	8200
Sambar	14	61.49 (3.61)	1.95 (0.65)	33.49	2.61 (0.53)	682
Chowsingha	8	55.29 (4.23)	0.55 (0.23)	41.56	1.17 (0.21)	192
Nilgai	4	69.10 (6.28)	0.18 (0.11)	62.77	0.95 (0.15)	63
Wild Pig	3	45.17 (2.00)	0.40 (0.22)	56.56	0.92 (0.05)	140
Langur	20	52.27 (3.18)	7.97 (2.94)	36.92	6.33 (1.57)	2790
Peafowl	8	52.85 (2.00)	0.85 (0.40)	47.39	1.72 (0.27)	297
Feral Cattle	17	68.03 (5.75)	1.24 (0.44)	35.55	1.51 (0.25)	434
Total prey population						12798

3.2. Prey densities obtained from camera trap sampling: Camera trap based distance sampling survey was conducted from 19th February 2021 to 23rd April 2021. Prey estimates of eight prey species were obtained from distance sampling using camera trap method. Chital was the most abundant prey species with mean density of 38.48 per km^2, followed by peafowl (8.92 per km^2) and hare (4.50 per km^2).

Table 3A-2. Summary of prey densities in Kuno National Park 2021 (camera trap method)

Category	Chital	Sambar	Nilgai	Wild Pig	Chowsingha	Langur	Peafowl	Hare	Feral Cattle
No. of camera traps	29	29	29	29	29	29	29	29	29
Temporal Effort (seconds)	62750691	62750691	62750691	62750691	62750691	62750691	62750691	62750691	62750691
Number of individuals photo captured	18609	1667	399	792	182	638	2371	1686	462
Mean angle in Degree(SE)	48.12 (0.0)	39.72 (4.59)	47.24 (0.0)	21.55 (1.39)	48.12 (0.0)	40.94 (7.43)	43.29 (4.25)	31.06 (3.95)	37.21 (5.45)
Mean distance in m (SE)	4.28 (0.09)	5.42 (0.29)	5.43 (0.48)	6.6526 (0.42)	3.14 (0.35)	3.79 (0.71)	3.35 (0.20)	4.68 (0.21)	2.52 (0.59)
Mean Area (95%CI)	7.70E-06 (7.0E-06 -8.0E-06)	1.02E-05 (6.50E-06 -1.59E-05)	1.22E-05 (8.50E-06 -1.75E-05)	8.30E-06 (5.70E-06 -1.22E-05)	4.16E-06 (2.0E-06 -7.0E-06)	5.10E-06 (2.0E-06 -1.60E-05)	4.2E-06 (3.0E-06 -6.0E-06)	6.0E-06 (4.0E-06 -9.0E-06)	2.1E-06 (1.0E-06 -7.0E-06)
Encounter rate (n/l)	2.97E-04	2.66E-05	6.36E-06	1.26E-05	2.90E-06	1.02E-05	3.78E-05	2.69E-05	7.40E-06
Mean density/km² (95%CI)	38.48 (35.54 -44.75)	2.60 (1.66 -4.06)	0.52 (0.36 -0.74)	1.51 (1.03 -2.21)	0.69 (0.41-1.16)	1.98 (0.64-6.11)	8.92 (5.82-13.68)	4.50 (2.93-6.92)	3.56 (1.04-12.24)

4. REFERENCES

Amin, R., Klair, H., Wacher, T., Ndjassi, C. O. N. S. T. A. N. T., Fowler, A., Olson, D., & Bruce, T. (2021) Estimating forest antelope population densities using distance sampling with camera traps. *Oryx*, 1-7.

Banerjee, K. (2005). Estimating the ungulate abundance and developing the habitat specific effective strip width models in Kuno Wildlife Sanctuary, Madhya Pradesh. Dissertation submitted in partial fulfillment of the degree of M.Sc. Forestry, Forest Research Institute, Dehradun. pp. 170.

Buckland, S. T. (1985). Perpendicular distance models for line transect sampling. *Biometrics*, 177-195.

Buckland, S. T., Anderson, D. R., Burnham, K. P., Laake, J. L., Borchers, D. L. and Thomas, L. (2001) *Introduction to distance sampling*. New York, USA: Oxford University Press.

Buckland, S. T., Anderson, D. R., Burnham, K. P., & Laake, J. L. (2005). Distance sampling. *Encyclopedia of biostatistics*, *2*.

Chaudhari L.K. (2005). Kuno-palpur management plan. Madhya Pradesh Forest Department.

Hayward, M.W., Hofmeyr, M., O'Brien, J., Kerley, G.I.H., (2006). Prey preferences of the cheetah Acinonyx jubatus: morphological limitations or the need to capture rapidly consumable prey before kleptoparasites arrive? *Journal of Zoology (London)* 270, 615–627. doi:10.1111/j.1469-7998.2006.00184. x.

Howe, E. J., Buckland, S. T., Després-Einspenner, M. L., & Kühl, H. S. (2017). Distance sampling with camera traps. *Methods in Ecology and Evolution*, *8*(11), 1558-1565.

Jhala, Y. V., Qureshi, Q., Gopal, R., & Amin, R. (2013). Field Guide: Monitoring tigers, co-predators, prey and their habitats. *Technical publication of National Tiger Conservation Authority, Government of India, New Delhi and Wildlife Institute of India, Dehradun, India.*

Jhala, Y. V., Qureshi, Q., & Yadav, S. P. (2020). Status of leopards in India, 2018. *National Tiger Conservation Authority, Government of India, New Delhi, and Wildlife Institute of India*. Dehradun. Technical Report TR/2020/16.

Karanth, K. U., & Nichols, J. D. (Eds.). (2017). Methods for monitoring tiger and prey populations. *Springer*.

Rodgers, W.A., Panwar, H.S. and Mathur, V.B. (2002). Wildlife Protected Area Network in India: A Review (Executive Summery). *Wildlife Institute of India, Dehradun.*

Rowcliffe, J. M., Field, J., Turvey, S. T., & Carbone, C. (2008). Estimating animal density using camera traps without the need for individual recognition. *Journal of Applied Ecology*, *45*(4), 1228-1236.

Marcus Rowcliffe, J., Carbone, C., Jansen, P. A., Kays, R., & Kranstauber, B. (2011). Quantifying the sensitivity of camera traps: an adapted distance sampling approach. *Methods in Ecology and Evolution*, *2*(5), 464-476.

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Supplement A.

Table S1. Summary of prey species model parameters (line transect distance sampling) in Kuno National Park

Category	Chital	Sambar	Chowsingha	Nilgai	Wild Pig	Langur	Peafowl	Feral Cattle
Number of spatial replicates	39	39	39	39	39	39	39	39
Number of observations (n)	104	14	8	4	3	20	8	17
Effort (L) km	152	152	152	152	152	152	152	152
Density (D_i) per km^2 (S.E)	23.43 (4.67)	1.95 (0.65)	0.55 (0.23)	0.18 (0.11)	0.40 (0.22)	7.97 (2.94)	0.85 (0.40)	1.24 (0.44)
D_i Coefficient of Variation (% CV)	19.94	33.49	41.56	62.77	56.56	36.92	47.39	35.55
Group Density(D_s) per km^2 (S.E)	5.25 (0.92)	0.74 (0.19)	0.47 (0.17)	0.19 (0.11)	0.43 (0.24)	1.25 (0.34)	0.49 (0.22)	0.82 (0.25)
D_s Coefficient of Variation (% CV)	17.57	26.60	37.33	60.53	56.33	27.25	44.62	31.21
Probability of Detection (p)	0.47	0.40	0.37	0.34	0.22	0.32	0.24	0.13
Goodness of Fit (ψ-p)	0.50	0.53	0.43	0.078	0.59	0.14	0.54	0.62
Effective Strip Width (ESW)	65.95	61.49	55.29	69.10	45.17	52.27	52.85	68.03
Group Encounter rate (n/L)	0.69	0.092	0.052	0.026	0.039	0.13	0.052	0.11
AIC value	970.4944	1614.855	533.9037	611.1349	1258.29	628.0615	2334.890	1728.970
Model	Half normal	Hazard rate	Half normal	Hazard rate	Half normal	Hazard rate	Half normal	Hazard rate
Model adjustment term	Simple polynomial	Cosine	Cosine	Cosine	Cosine	Cosine	Cosine	Cosine

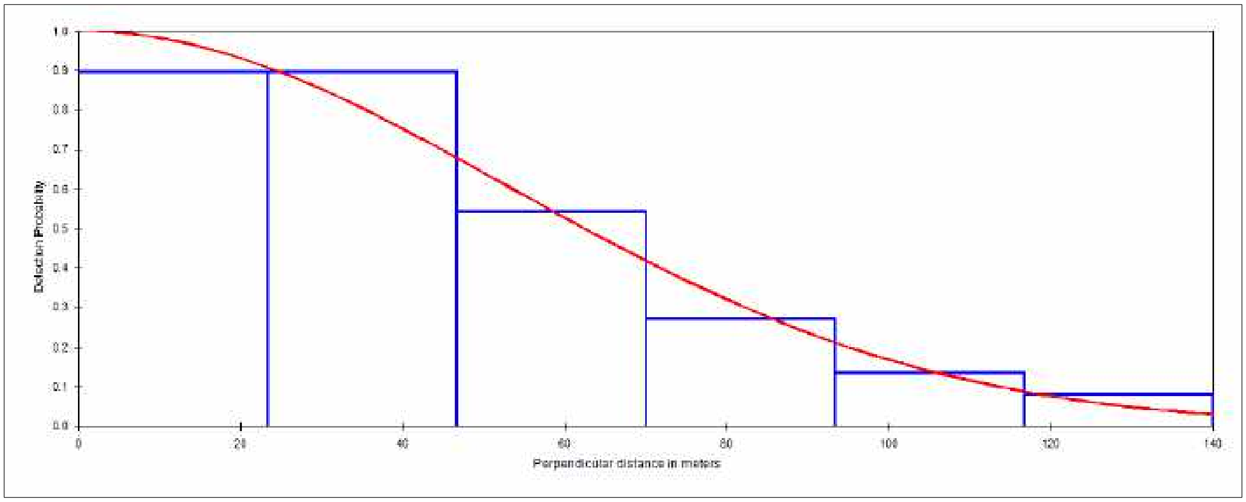
Supplement B.

Detection function curves for prey species(line transect distance sampling) in Kuno National Park

B.1. Chital in Kuno NP

Species: Chital

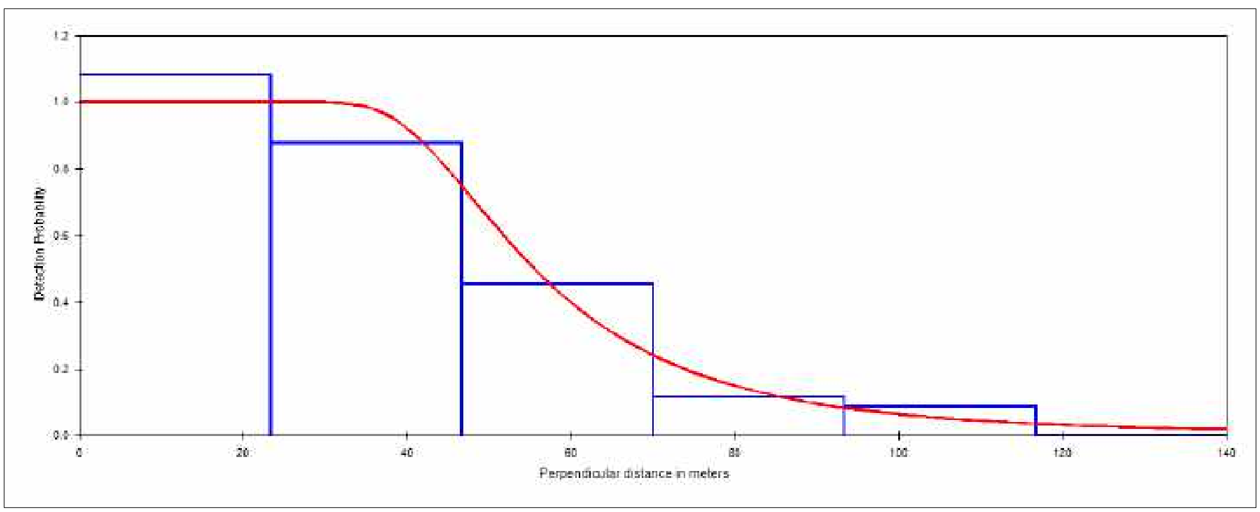
Fitted model: Half normal key model with cosine adjustment term. (ψ^2 –p = 0.50, p= 0.47)



B.2. Sambar in Kuno NP

Species: Sambar

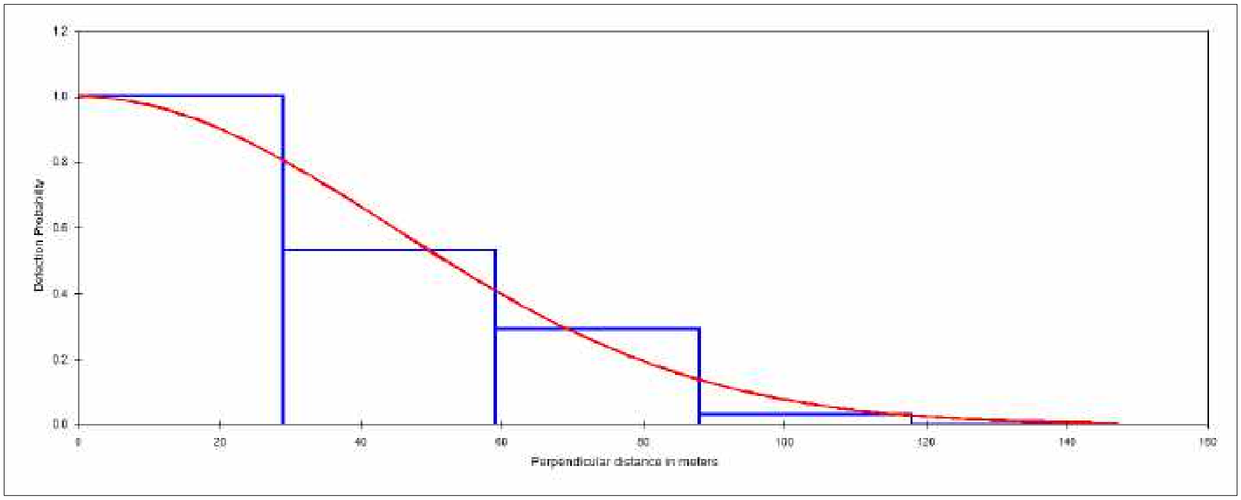
Fitted model: Hazard rate key model with cosine adjustment term. (ψ^2 -p= 0.53, p= 0.40)



B.3. Four-horned antelope in Kuno NP

Species: Four-horned antelope

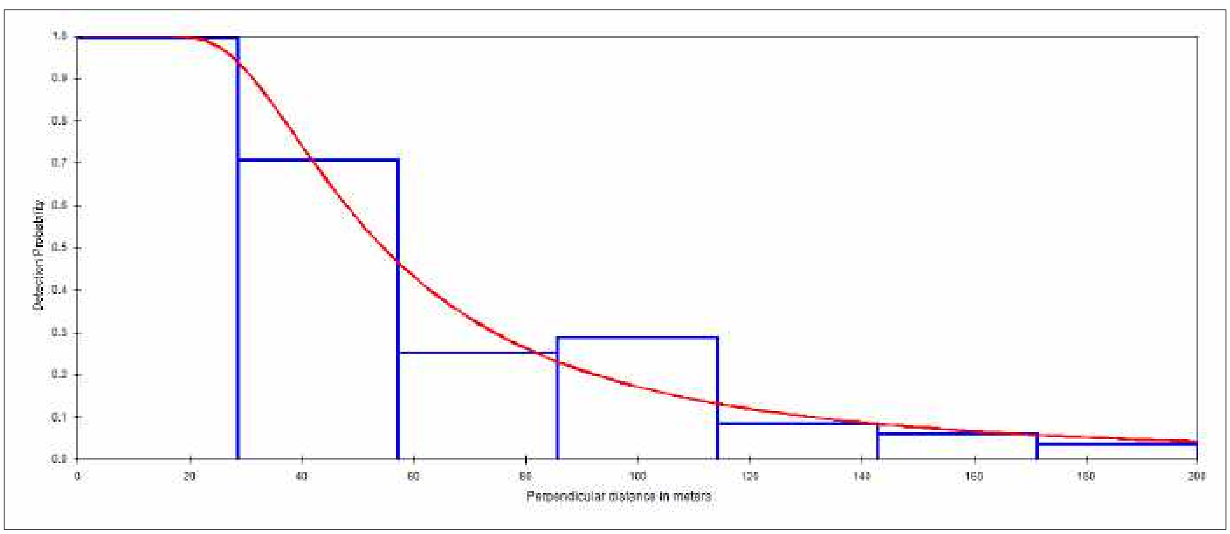
Fitted model: Half normal key model with cosine adjustment term. (ψ^2 -p= 0.43, p= 0.37)



B.4. Nilgai in Kuno NP

Species: Nilgai

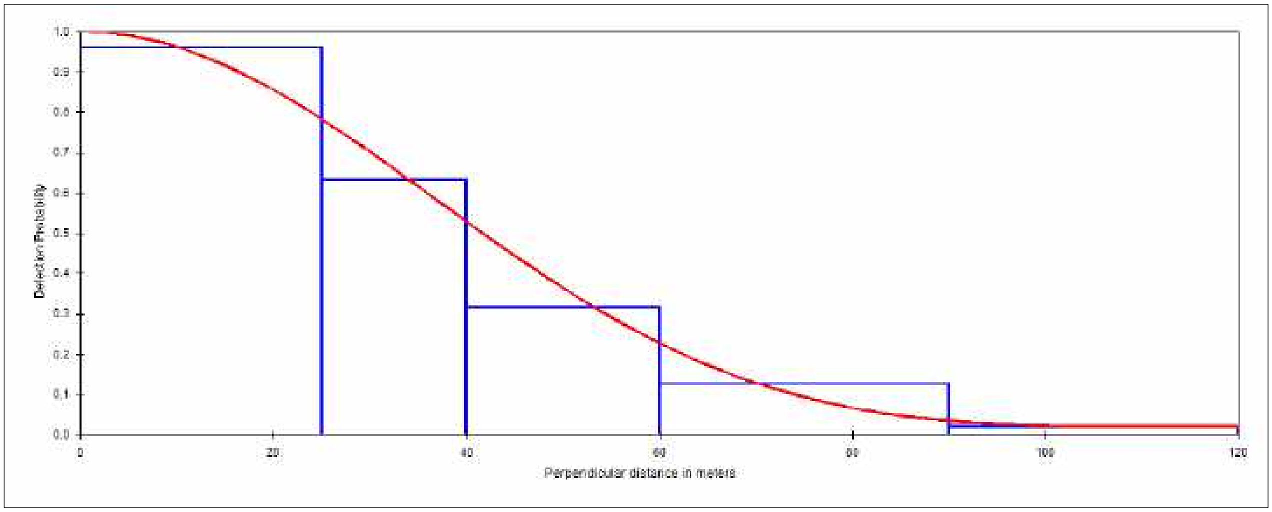
Fitted model: Hazard-rate key model with cosine adjustment term. (ψ^2 -p= 0.78E-01, p= 0.34)



B.5. Wild Pig in Kuno NP

Species: Wild Pig

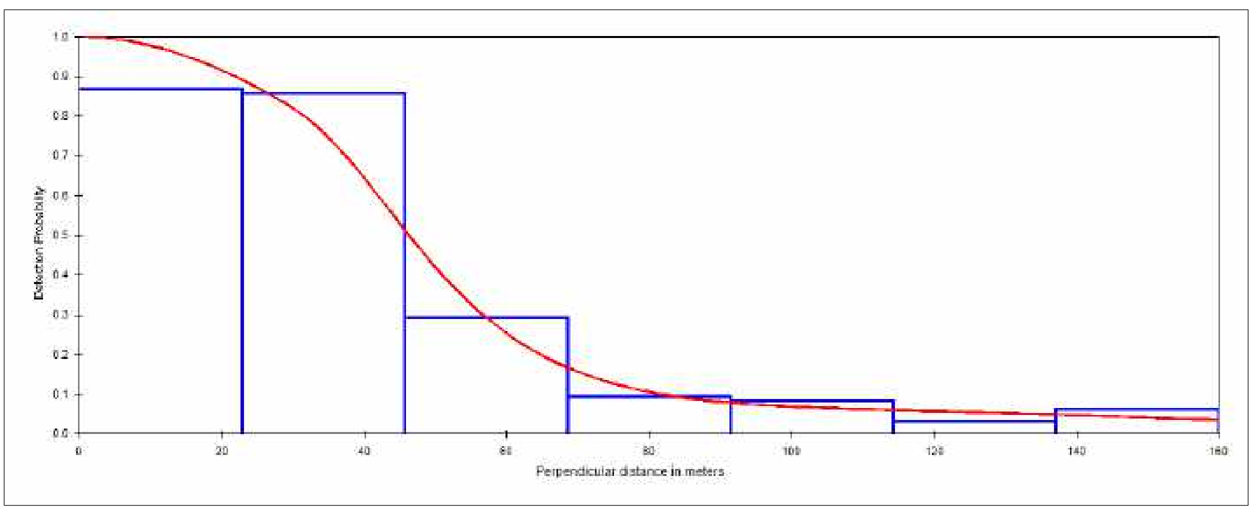
Fitted model: Half normal key model with cosine adjustment term. (ψ^2 -p= 0.59, p= 0.22)



B.6. Langur in Kuno NP

Species: Langur

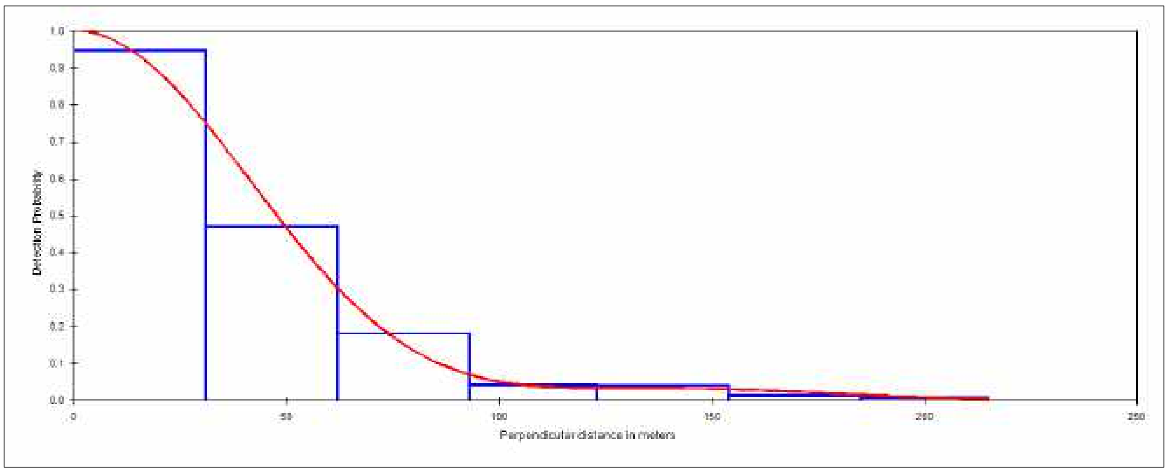
Fitted model: Hazard rate key model with cosine adjustment term. (ψ^2 -p= 0.14, p= 0.32)



B.7. Peafowl in Kuno NP

Species: Peafowl

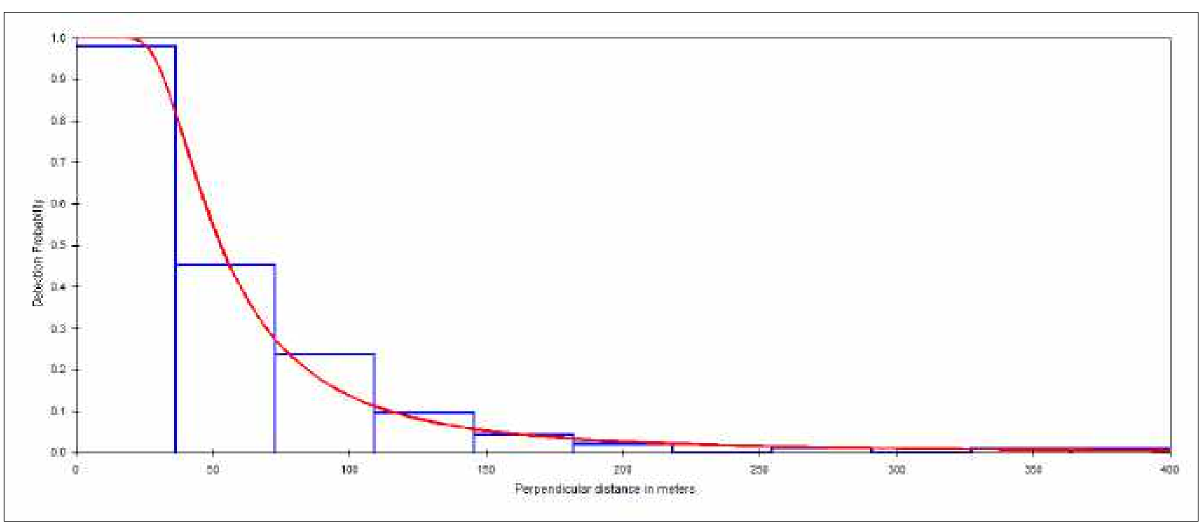
Fitted model: Half normal key model with cosine adjustment term. (ψ^2 -p= 0.54, p=0.24)



B.8. Feral Cattle in Kuno NP

Species: Feral Cattle

Fitted model: Hazard rate key model with cosine adjustment term. (ψ^2 -p= 0.62, p= 0.13)



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4 Annexure

Population Habitat Viability Analysis (PHVA)

All scenarios were run with the default inbreeding depression and density dependence option provided in VORTEX 9.93. Population persistence (probability of extinction), stochastic rate of increase (r), and population size for a period of 50-75 years were evaluated. For each of the following scenarios, 500 simulations were performed:

Population Habitat Viability Analysis (PHVA) analysis under the following scenarios showed persistence of cheetah within acceptable risk of extinction (< 10%) for the next 50 years.

1) Carrying capacity (K) for a single population of Kuno having current capacity of 20 cheetahs which increases with good management and protection resulting in prey restoration across the NP, at a rate of 5% increment over the next 10 years.

2) Cub mortality from 50%

3) Adult mortality not exceeding 15%

4) Supplementation for the next 10 years of >4 individuals per year (2 males and 2 females).

The PHVA was most sensitive to carrying capacity-

(a) If this could be enhanced by augmentation of wild prey, Kuno has recorded remarkable prey recovery from a density of 5 cheetal to over 66 per km^2 between 2005-2014. The current population can rebound back to 2014 densities and beyond with good protection and management.

(b) Cub mortality was the second relevant parameter determining cheetah persistence. The 50% mortality is a conservative estimate considering the current leopard densities in Kuno National Park. Subsequent to reintroduction, if cub mortality of >50% is observed, it would be a matter of concern and appropriate management interventions maybe required.

(c) The adult survival limits were also extremely conservative since the cheetahs for release are all behaviorally exposed and adapted to avoid predation by large carnivores and observed survivorship of these cheetahs in the presence of lions and hyenas is higher. If adult cheetahs experience mortality >15%, it would then be a matter of concern for management to intervene.

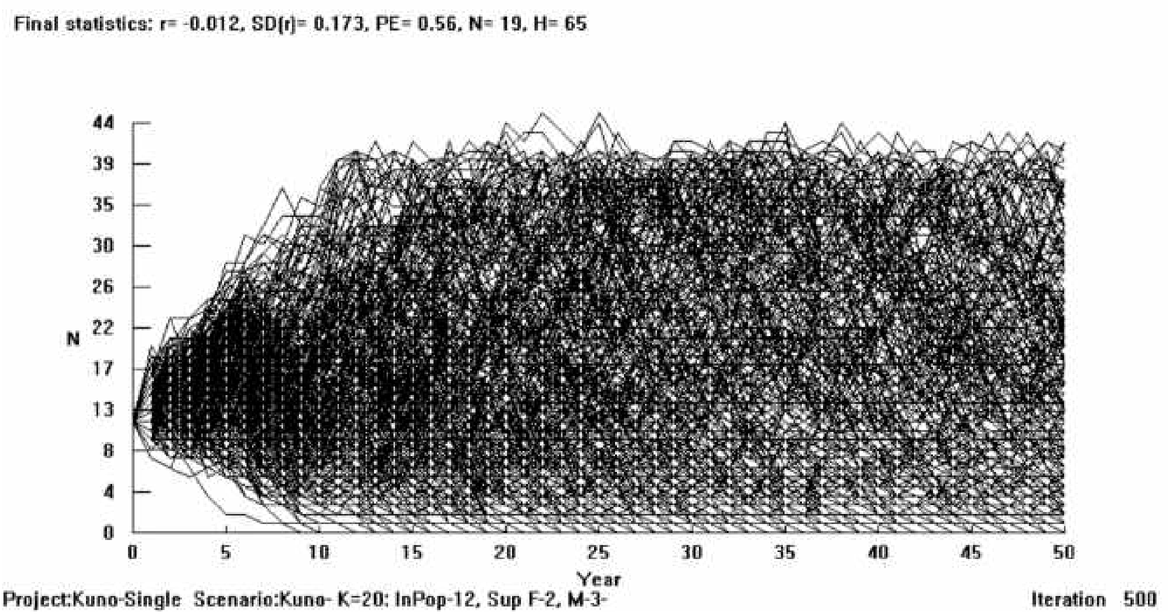

Figure 4A-1. No supplementation after initial population of 12 cheetah released. Carrying capacity (K) = 20 with 10% increment over 10 years. Cub mortality 60%. This scenario has high probability of extinction (56%).

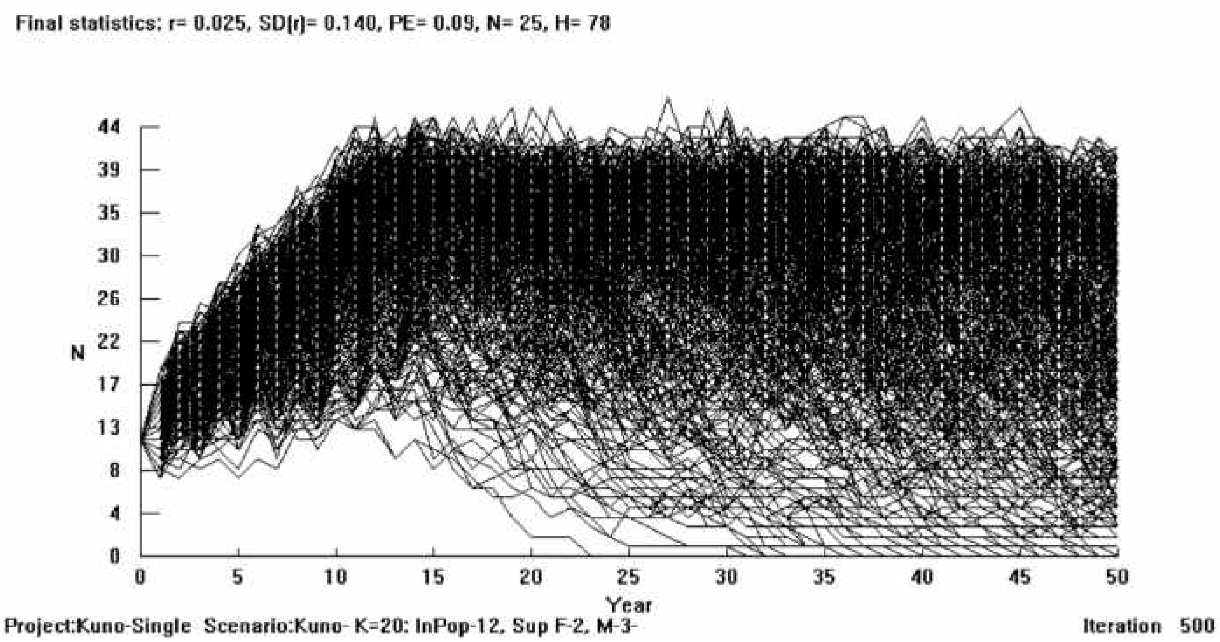

Figure 4A-2. Carrying capacity (K) fixed at 20, supplemented by 3 cheetahs (1 female, 2 males) every alternate year for 15 years. Cub mortality 60%. Population has low risk of extinction (9%).

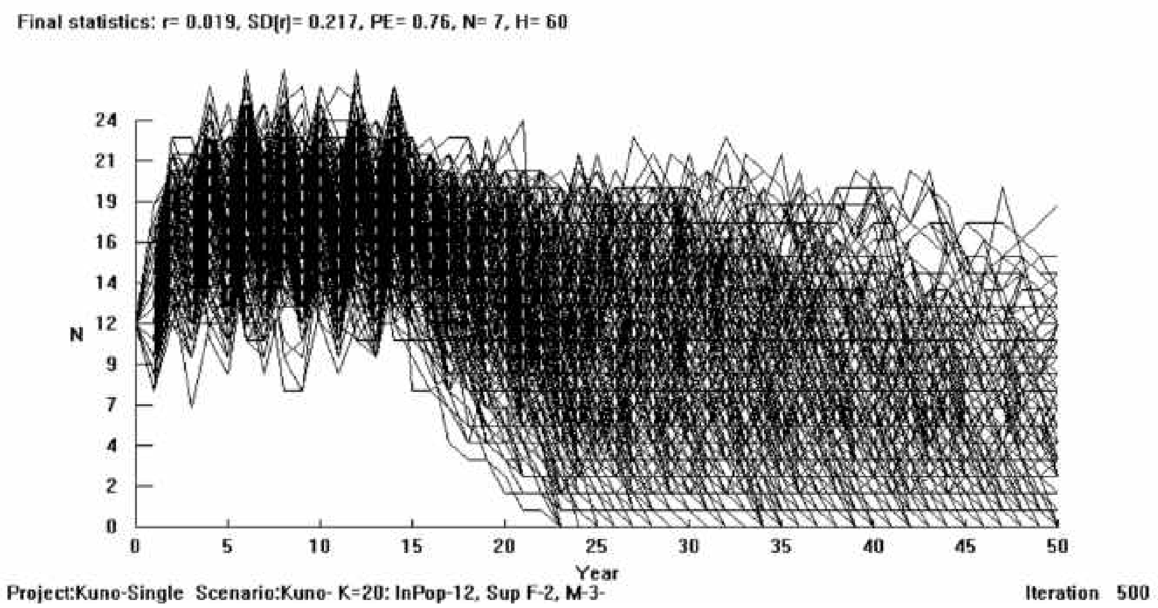

Figure 4A-3. Carrying capacity (K) fixed at 20, 4 cheetahs (3 males, 2 females) supplemented for 15 years every alternate year, cub mortality at 70%. High risk of extinction (76%) in 50 years.

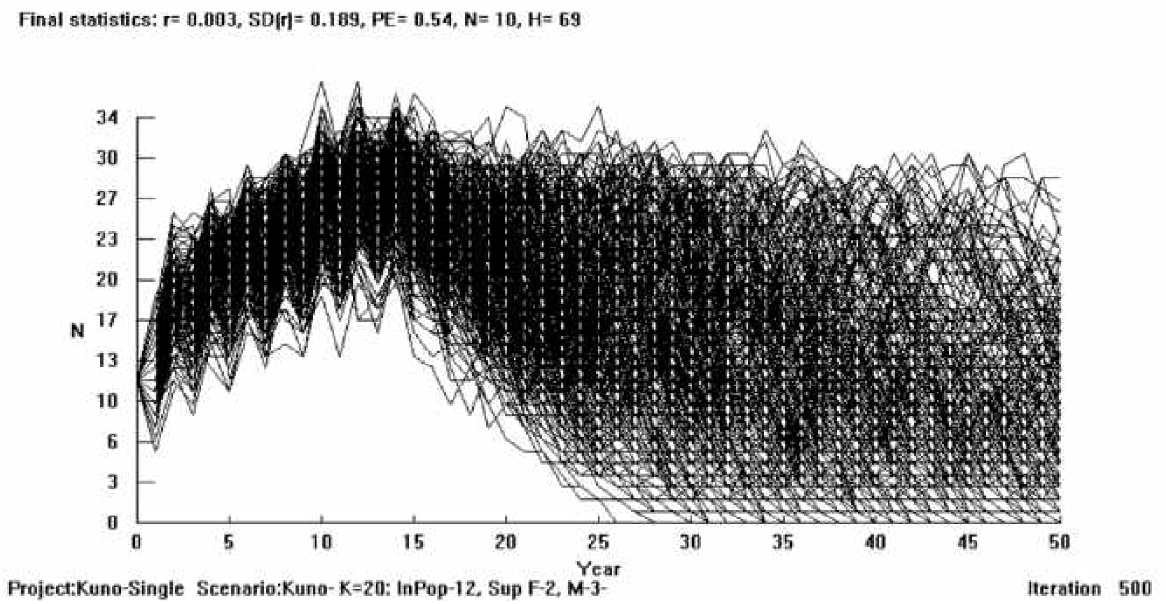

Figure 4A-4. Carrying capacity (K)= 20 increased to 30 in 10 years, cub mortality 70%, Supplemented with 6 cheetahs (2 females, 4 males) every alternate year. Still a high risk of extinction (54%).

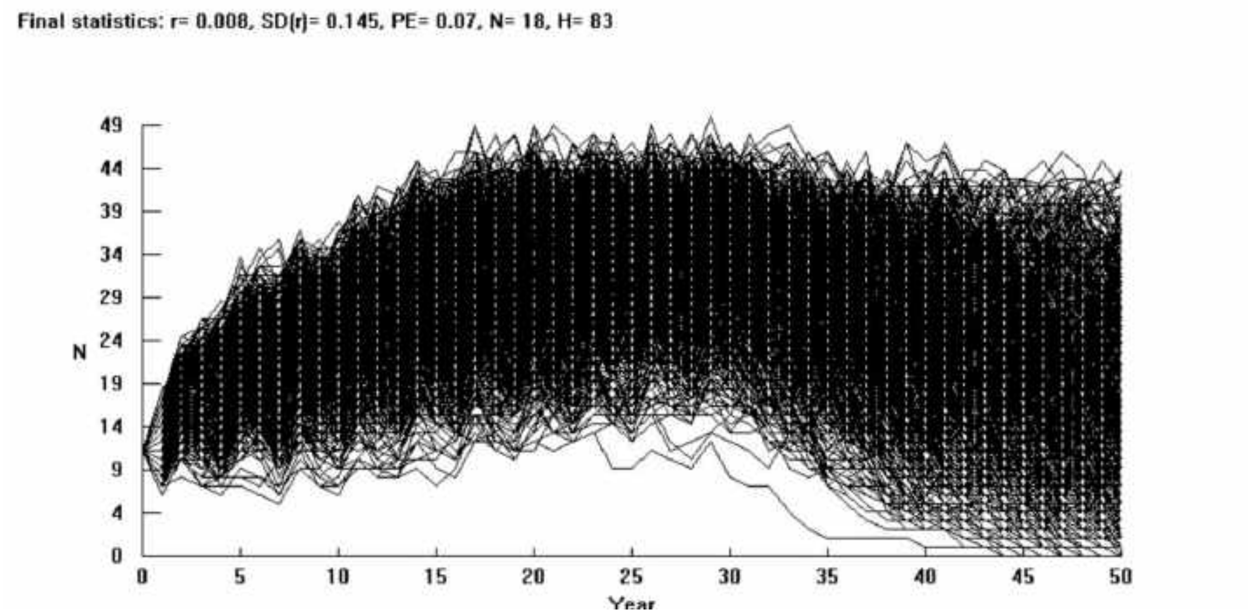

Figure 4A-5. Carrying capacity (K) = 20 increases to 31 in 15 years, initial population 12, cub mortality 60%, adult mortality 12-15%, supplementation of 4 (2 males, 2 females) cheetahs every 3 years for 30 years and female breeding density dependent. Low extinction probability of 7%.

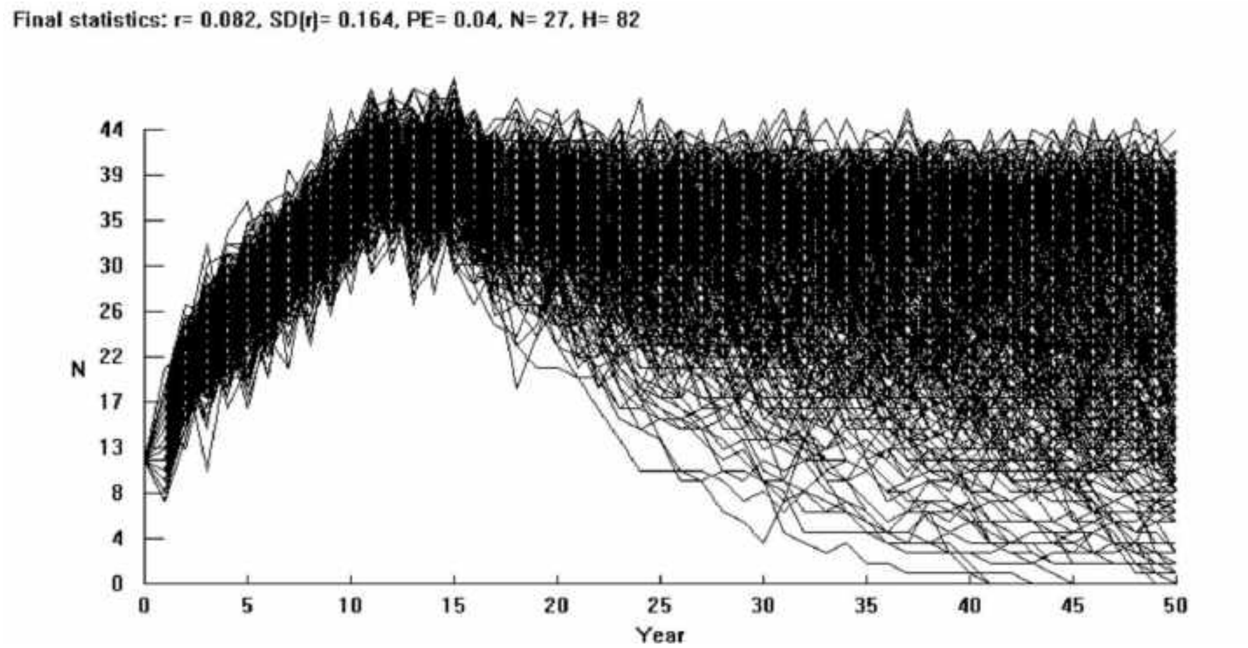

Figure 4A-6. Kuno as a single population, initial population 12, cub mortality 60%, juvenile mortality 15%, adult mortality 12-15, supplementation for 10 years with 3 females and 2 males annually, initial carrying capacity (K) = 20 increases to 35 in 10 years and all adult females breed with 10% environmental variability (EV). Low extinction probability of 4%

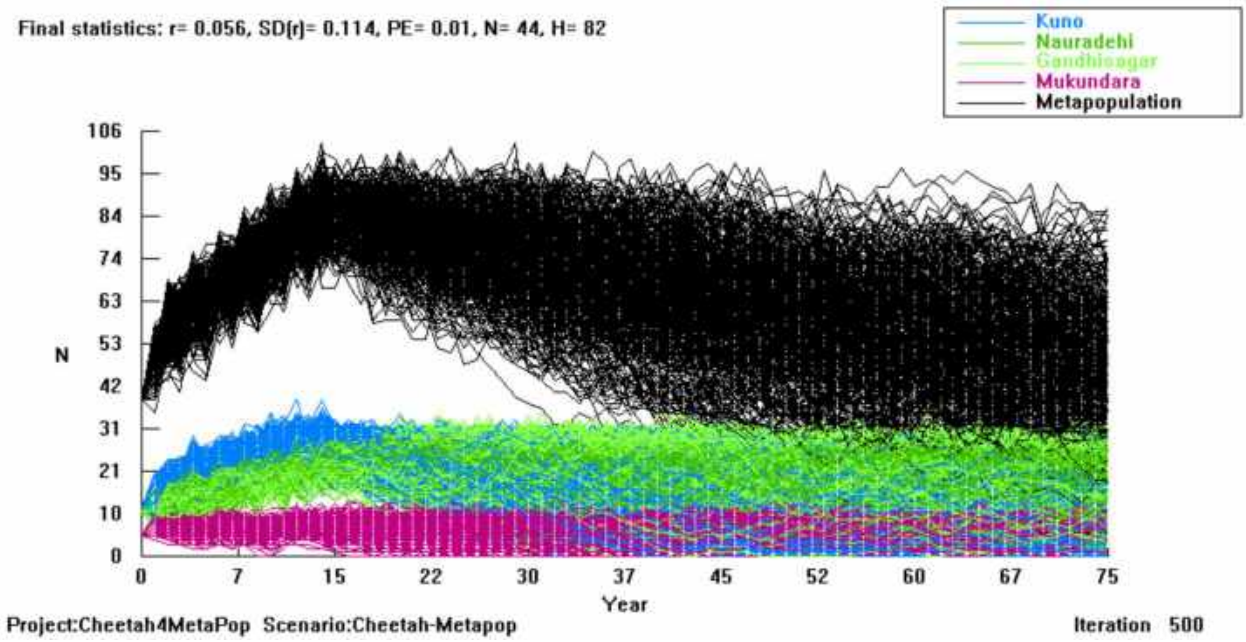

Figure 4A-7. Four populations managed as a metapopulation in India carrying capacity (K) = 8-30, cub mortality 30-60%, adult mortality 12-15%, supplementation from southern Africa for 15 years. Almost zero probability of extinction of the metapopulation.

5 Annexure

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October 3, 2021,

To **South African /Namibia/India Ministries of Nature**

Re: Suitability of Cheetahs from Southern Africa for Cheetah Re-introduction in India.

We are writing today to explain clearly the cumulative genetic data which show that cheetahs from South Africa and Namibia (*Acinonyx jubatus jubat*us) are fully suitable and appropriate for transport and re-introduction into habitats of India selected for cheetah restoration.

We are all trained and experienced in genetic analysis and have contributed to the development and publication of research data related to cheetah subspecies natural history, relatedness, and genetic distance. In general, there are **three types of molecular genetic data** that have been developed and interpreted around cheetah subspecies relationships and historic divergence: 1.) mitochondrial DNA sequence and variants; 2.) short tandem repeat (STR a.k.a. microsatellite) nuclear markers; and 3.) full genome sequence of cheetah subspecies.

Each of these genetic approaches reveal distinctive molecular features that discriminate between cheetah subspecies: *Acinonyx jubatus jubatus, A. j. raineyi, A. j. hecki, A. j. soemmeringii, and A. j. venaticus*. The estimated genetic distance among cheetah subspecies (which allows an assessment of the time elapsed since historic divergence among subspecies) corresponds to a recent time since all subspecies shared a common ancestor, on the order of **10-20,000 years** ago (for sure <50,000 yrs. ago).

For context, this time interval is rather recent and indicative of free gene flow or reproductive compatibility. Consider that genetic distance estimates between principal human ethnic groups indicate they diverged from each other ~90,000 years ago. African vs. Asian leopards diverged 500-600,000 years ago. African vs. Asian lions diverged 100,000 years ago. The five living tiger subspecies diverged 110,000 years ago. Asian and African cheetahs are much closer and diverged more recently, likely due to a species wide population bottleneck that reduced all the world's cheetah numbers during the late Pleistocene, around 10-20,000 years ago.

The relatively close genetic distance between all cheetah subspecies means that no single subspecies is more or less different from the Asiatic cheetah (*A. j. venaticus)*, the closest geographical subspecies to the extinct Indian Cheetah. This means that there is **no compelling or robust genetic reason for choosing any single living subspecies as being significantly closer to Indian cheetah for restoration.**

The 2021 IUCN-CMS document entitled "**Conservation of the Cheetah Acinonyx jubatus in Asia and North Eastern Africa**" is misleading and incorrect in stating that *A. j. soemmeringii*, would be preferable to other subspecies based on closeness to *A. j. venaticus.* We have advised Urs Breitenmoser, Co-Chair of the IUCN Cat Specialist Group who prepared this document, of this error and he has agreed to release a statement of clarification. We expect that this revision will happen shortly.

All this means that southern African cheetahs (*A. j. jubatus)* are equally suitable in genetic terms to the other subspecies (namely *A. j. soemmeringii or* to *A. j. venaticus)* for re-introduction in India as proposed. For a reintroduction, it is important that the founding population is sourced from a genetically diverse population which can provide sufficient number of individuals over a sustained period of time, while at the same time does not have detrimental impacts on the source population. Because of the abundance of available wild born, behaviorally appropriate and genetically diverse cheetahs in South Africa and in Namibia, these individuals should in our view be considered favorably for this conservation measure.

This communication was written by Drs. OBrien and Marker, edited and approved by all co-signers

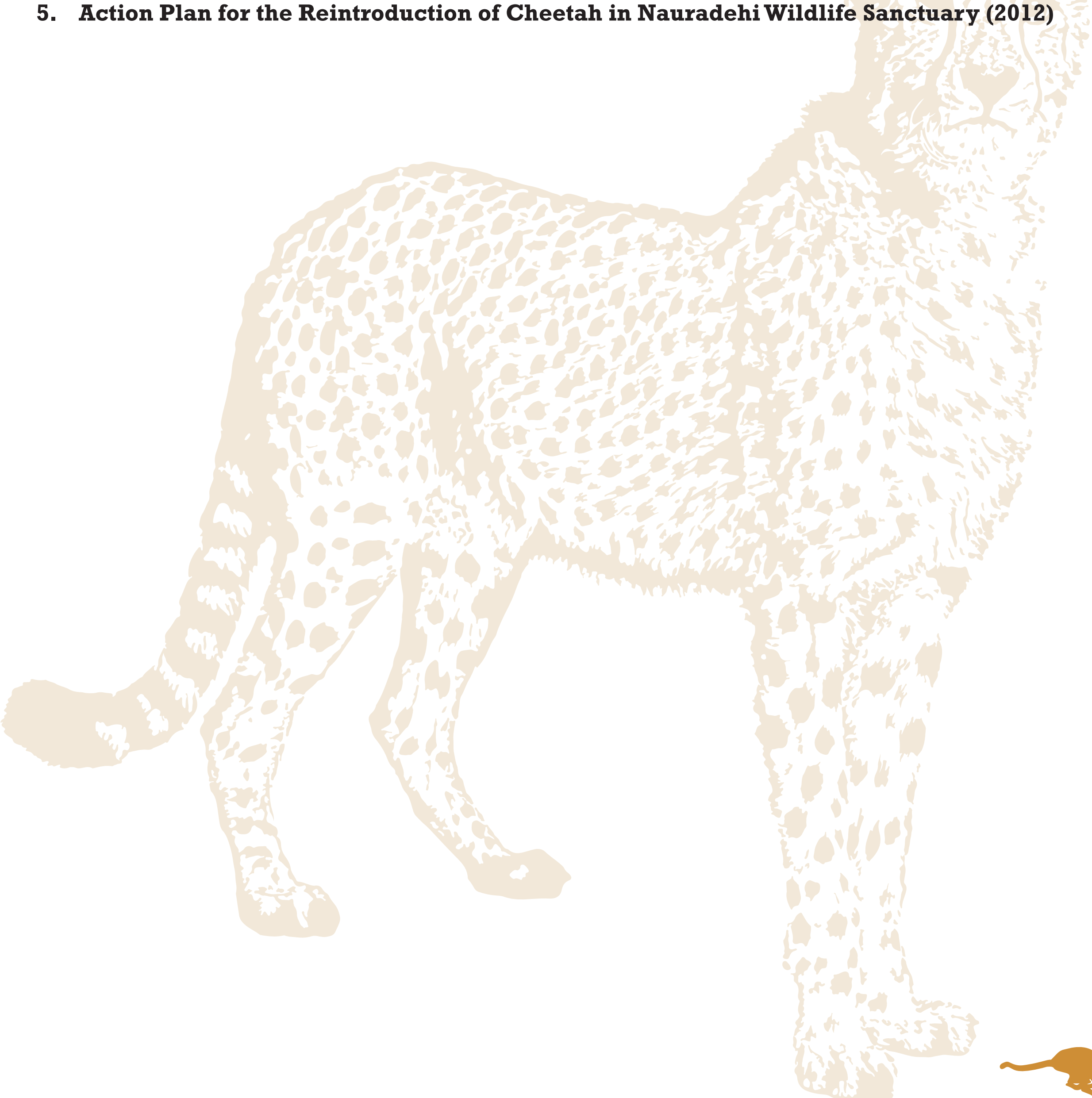
Dr. Stephen J. O Brien- **Nova Southeastern University**
Dr. Laurie Marker
Dr. Anne Schmidt-Küntzel
Dr. Bruce Brewer
- **Cheetah Conservation Fund**
Dr. Klaus Peter Koepfli - **George Mason University**
Dr. Warren Johnson- **Smithsonian Institution**
Dr. Carlos Driscoll
Dr. Pavel Dobrynin
- **ITMO University**

References

- Antunes, A., Troyer, J.L., Roelke, M.E., Pecon-Slattery, J., Packer, C., Winterbach, C., Winterbach, H., Hemson, G., Frank, L., Stander, P., Siefert, L., Driciru, M., Funston, P.J., Alexander, K.A., Prager, K.C., Mills, G., Wildt, D., Bush, M., O'Brien, S.J., Johnson, W.E.: The evolutionary dynamics of the lion Panthera leo revealed by host and viral population genomics. PLoS Genet. 2008 Nov;4(11): e1000251.
- Charruau P., Fernandes C., Orozco-Terwengel P., Peters J., Hunter L., Ziaie H., Jourabchian A., Jowkar H., Schaller G., Ostrowski S., Vercammen P., Grange T., Schlötterer C., Kotze A., Geigl E.M., Walzer C., Burger P.A. Phylogeography, genetic structure and population divergence time of cheetahs in Africa and Asia: evidence for long-term geographic isolates. 2011 *Mol Ecol*. 20:706-24.
- Dobrynin P, Liu S, Tamazian G, Xiong Z, Yurchenko AA, Krasheninnikova K, Kliver S, Schmidt Küntzel A, Koepfli KP, Johnson W, Kuderna LF, García-Pérez R, Manuel Md, Godinez R, Komissarov A, Makunin A, Brukhin V, Qiu W, Zhou L, Li F, Yi J, sssll C, Antunes A, Oleksyk TK, Eizirik E, Perelman P, Roelke M, Wildt D, Diekhans M, Marques-Bonet T, Marker L, Bhak J, Wang J, Zhang G, O'Brien SJ. Genomic legacy of the African cheetah, Acinonyx jubatus. Genome Biol. 2015 16: 277. doi: 10
- Durant SM, Mitchell N, Groom R, Pettorelli N, Ipavec A, Jacobson AP, Woodroffe R, Böhm M, Hunter LT, Becker MS, Broekhuis F, Bashir S, Andresen L, Aschenborn O, Beddiaf M, Belbachir F, Belbachir-Bazi A, Berbash A, Brandao de Matos Machado I, Breitenmoser C, Chege M, Cilliers D, Davies-Mostert H, Dickman AJ, Ezekiel F, Farhadinia MS, Funston P, Henschel P, Horgan J, de Iongh HH, Jowkar H, Klein R, Lindsey PA, Marker L, Marnewick K, Melzheimer J, Merkle J, M'soka J, Msuha M, O'Neill H, Parker M, Purchase G, Sahailou S, Saidu Y, Samna A, Schmidt-Küntzel A, Selebatso E, Sogbohossou EA, Soultan A, Stone E, van der Meer E, van Vuuren R, Wykstra M, Young-Overton K. The global decline of cheetah Acinonyx jubatus and what it means for conservation. Proc Natl Acad Sci U S A. 2017 Jan 17;114(3):528-533. doi: 10.1073/pnas.1611122114. Epub 2016 Dec 27. PMID: 28028225; PMCID: PMC5255576.
- Driscoll, C. A., Menotti-Raymond, M., and O'Brien, S.J.: Genomic microsatellites as evolutionary chronometers: A test in wild cats. Genome Res. 12: 414-423, 2002.
- Johnson, W.E., Eizirik, E., Murphy, W.J., Pecon-Slattery, J., Antunes, A., Teeling, E. and O'Brien, S.J.: The late Miocene radiation of modern felidae: A genetic assessment. Science.311:73-77. 2006.
- Liu YC, Sun X, Driscoll C, Miquelle DG, Xu X, Martelli P, Uphyrkina O, Smith JLD, O'Brien SJ, Luo SJ. Genome-Wide Evolutionary Analysis of Natural History and Adaptation in the World's Tigers. Curr Biol. 2018 Dec 3;28(23):3840-3849.e6. doi: 10.1016/j.cub.2018.09.019.
- Luo, S.-J., Kim, J.-H., Johnson, W.E., van der Walt, J., Martenson, J., Yuhki, N., Miquelle, D.G., Uphyrkina, O., Goodrich, J.M., Quigley, H.B., Tilson, R., Brady, G., Martelli, P., Subramaniam, V., McDougal, C., Hean, S., Huang, S.-Q., Pan, W., Karanth, U.K., Sunquist, M., Smith, J.L.D., and O'Brien, S.J.: Phylogeography and genetic ancestory of tigers (Panthera tigris). PLoS Biology 2:2277-2293, 2004.
- Marker, Laurie, Lorraine K. Boast, Philip J. Nyhus, Anne Schmidt-Kuentzel, Cheetahs: Biology and Conservation Academic Press 2017 New York 596 pp.
- O'Brien SJ, Roelke ME, Marker L, Newman A, Winkler CA, Meltzer D, Colly L, Evermann JF, Bush M, Wildt DE. Genetic basis for species vulnerability in the cheetah. Science. 1985 Mar 22;227(4693):1428-34. doi: 10.1126/science.2983425. PMID: 2983425.
- O'Brien, Stephen J. Warren E. Johnson, Carlos A. Driscoll, Pavel Dobrynin, Laurie Marker; **2017** Conservation Genetics of the Cheetah: Lessons Learned and New Opportunities. Journal of Heredity 108 (6), 671-677MS774
- Paijmans JLA, Barlow A, Becker MS, Cahill JA, Fickel J, Förster DWG, Gries K, Hartmann S, Havmøller RW, Henneberger K, Kern C, Kitchener AC, Lorenzen ED, Mayer F, OBrien SJ, von Seth J, Sinding MS, Spong G, Uphyrkina O, Wachter B, Westbury MV, Dalén L, Bhak J, Manica A, Hofreiter M. African and Asian leopards are highly differentiated at the genomic level. Curr Biol. 2021 May 10;31(9):1872-1882.e5. doi: 10.1016/j.cub.2021.03.084. Epub 2021 Apr 12. PMID: 33848458
- Prost, S., Machado, A. P., Zumbroich, J., Preier, L., Mahtani-Williams, S., Meissner, R., Guschanski, K., Brealey, J. C., Fernandes, C., Vercammen, P., Hunter, L. T. B., Abramov, A. V., Godsall-Bottriell, L., Bot-triell, P., Dalton, D. L., Kotze, A., Burger, P. A. Conservation Genomic Analyses of African and Asiatic Cheetahs (Acinonyx jubatus) Across Their Current and Historical Species Range. bioRxiv 2020.02.14.949081; doi: https://doi.org/10.1101/2020.02.14.949081 submitted for publication
- Uphyrkina, O., Johnson, W., Quigley, H., Miquelle, D., Marker, L., Bush, M., and O'Brien, S.J.: Phylogenetics, genome diversity and the origin of modern leopard, Panthera pardus. Mol. Ecol. 10:2617-2633, 2001.

Appendices

1. **Asiatic Cheetah Acinonyx jubatus venaticus in India: A Chronology of Extinction and Related Reports (2019)- Divyabhanusinh and Raza Kazmi, Journal of the Bombay Natural History Society, Vol. 116:2019**
2. **List of Participants in the Consultative Meeting on Reintroduction of Cheetah in India- Gajner, Rajasthan, India on 9th & 10th September,2009**
3. **Action Plan for the Reintroduction of Cheetah in Kuno Wildlife Sanctuary (2011)**
4. **Action Plan for the Reintroduction of Cheetah in Shahgarh Landscape (2011)**
5. **Action Plan for the Reintroduction of Cheetah in Nauradehi Wildlife Sanctuary (2012)**



Appendix 1

ASIATIC CHEETAH *ACINONYX JUBATUS VENATICUS* IN INDIA: A CHRONOLOGY OF EXTINCTION AND RELATED REPORTS[1]

DIVYABHANUSINH[2,*] AND RAZA KAZMI[3]

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The cheetah in India has been recorded in history from before the Common Era onwards. It was taken from the wild for coursing blackbuck for centuries, which went towards its depleting numbers through the ages. From the 16th century onwards, detailed records of its interaction with human beings became available as it was recorded by the Mughals and other kingdoms in the Deccan. However, the final phase of its extinction coincided with the British Imperial rule, and the British added to the woes of the animal. Its extinction became inevitable and this paper records the process extensively. The last cheetahs were shot in India in 1947, however, credible reports continued to be recorded from the Indian subcontinent up to the 1990s. This paper also records other related matters, such as a black cheetah, a cheetah attack on a human being, and cheetah material available in India.

Key words: cheetah, chronology, extinction, British, India, Indian subcontinent

Background

The cheetah in the Indian subcontinent had a brush with human beings very early on in Ancient times. It was a cat easy to tame, to keep as a pet, and hunt antelope with. This cat does not attack humans as a rule unless provoked, though we have recorded one instance of an unprovoked attack described later in the paper. It is one of the only two cat species which were used for hunting. The other was the Caracal *Caracal caracal* (Hussain 1891: pp. 316–317, 326–327; A.H. Morton *pers. comm*. 1993).

The cheetah is found in cave paintings at Kharvai and Karabad in Madhya Pradesh, as also at Chaturbhujnath in the upper Chambal valley. These paintings are dated between 2500 to 2300 BCE (Divyabhanusinh 1995: p. 6; Divyabhanusinh and Ranjitsinh 2013). Strabo, the geographer of the ancient world and a contemporary of Emperor Augustus (63 BCE–14 CE), has given a detailed description of a royal procession in India. Though his work is dated to the 1st century CE, he relied on earlier records. He noted that it included tame *pardalis* and *leontes* (Jones 1966: p. 122; Mc Crindle 1901: pp. 75–76). The references obviously are to spotted felids and to lions. Only a tame cheetah would walk in processions, as it was easily tamed. No leopard, on the other hand, would walk peacefully among noisy crowds, given its unpredictable and fretful nature. Claudius Aelianus who lived in Rome in the 2nd century CE, a contemporary of Emperor Hadrian, recorded that Indians brought to their king domesticated *pantheras* and *oryxes* with four horns (Mc Crindle 1901: c XIV, p. 144; Scholfield 1959: Vol. III, p. 235). Again, leopards are not likely to give up their fretful nature to be tamed for court appearances. The reference is to cheetahs, whereas the *oryxes* refer to four-horned antelope *Tetracerus quadricornis.* It is not out of place to mention here that as late as the early 20th century, Emperor Haile Selassie of Ethiopia kept tame cheetahs and lions while holding court in his palace.

While cheetahs were tamed so early in India, the earliest reference to coursing blackbuck *Antilope cervicapra* with them is from the 12th century CE from *Manasollasa*, the chronicle of court activities of King Someshvara III of Kalyani, which detailed this mode of hunting (Shrigondekar 1939: 4. 17-15-1724, Vol. II, pp. 303–304). Firoz Shah Tughlaq, Sultan of Delhi (1351–1388), is recorded to have had so many *yuz-palang* – cheetahs, *siahgush* – caracals, and *shir* – lions in his menagerie at one time, along with other animals and birds, that it was beyond human imagination (Hussain 1891: pp. 316–317, 326–327; A.H. Morton, *pers. comm*. 1993). The Mughal Emperor Akbar has been recorded to have kept 1,000 cheetahs in his menagerie and collected as many as 9,000 of them during his half century reign from 1556 to 1605 (Rogers and Beveridge 1980: Vol. I, p. 204; Blochmann 1873: Vol. I, p. 298). Emperor Jehangir recorded in his autobiography the first and only instance upto the 20th century of a cheetah breeding in captivity anywhere in the world, in 1613 CE (Rogers and Beveridge 1980: Vol. I, p. 240). It was an exceptional event, more so as it was accidental as the cheetah slipped out of its collar on its own.

All this goes to show that the range of the cheetah was spread all over the Subcontinent, and they were to be found in substantial numbers. However, while their prey base and habitat survived till much later, removal of cheetahs – both males and females – from the wild in large numbers over centuries, and their inability to breed in captivity during this period, appear to have taken a heavy toll, resulting in their fast depleting numbers by the end of the 18th century. It is not out of place to mention here that throughout Emperor Aurangzeb's reign, which ended in 1707, the Mughal Empire maintained an elaborate administrative set up to catch cheetahs from the wild (Ali 1930: p. 130). Even Tipu Sultan of Mysore was survived by 16 cheetahs, their keepers and paraphernalia, from his menagerie as late as 1799 (Buddle 1990: pp. 22–24) (Fig. 1).

By the time the British started recording their existence from about the last decades of the 18th century, cheetahs were making their last stand, leading upto their total extinction in the Subcontinent towards the end of the 20th century, which leads us to the chronology which follows.

Fig. 1: "Hunting Leopards ready for the chase"
This lithograph was published by Smith, Elder & Co. of London and is dated 1858. The location of the scene is not known, though the fountain design suggests a Mughal garden and the headgear of the cheetah keepers suggests the Deccan

Chronology of Extinction

Arguably the best method to document this march towards extinction in the Subcontinent would be to examine and note as many references to the cheetah in various records as possible. Towards that end, a chronology was prepared by Divyabhanusinh (DS) for his book in 1995 (Divyabhanusinh 1995: pp. 215–223). Its third edition appeared in 2006, in which DS included the new finds he had come across since 1995 (Divyabhanusinh 2006: pp. 196–197). In the meantime, Professor Mahesh Rangarajan came out with his seminal paper on the role of the State in the extermination of the cheetah (Rangarajan 1998). We shall come to his important conclusions later. Raza Kazmi (RK) examined state/provincial level documents of Jharkhand (part of erstwhile undivided Bihar) and neighbouring states, and produced a substantial amount of new material which was published in 2012 (Kazmi 2012). RK continued to research the subject and has come up with yet more records (Kazmi 2014). The authors feel that the time is ripe to combine all the material till date in the chronology which follows (Table 1) and draw conclusions therefrom.

Table 1: Chronology of Extinction

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	1772	Surat, Gujarat	Coursing with cheetahs	Forbes, 1813	
	1772	-do-	Two tame cheetahs with author's friend	-do-	2
	1780	Calcutta, West Bengal	One cheetah painted by Zayn-al-din	Kossak, 1997	1
	1799	Mysore, Karnataka	Sixteen cheetahs used by Tipu Sultan, three of them sent to King George III	Buddle, 1990	16
	1800	Calcutta, West Bengal	One cheetah painted for Marquis of Wellesley	Painting in BL	1
2	c. 1800	India	Coursing with cheetahs	Williamson, 1807	
	1803	Thanjavur, Tamil Nadu	One cheetah painted by an artist of Raja Sarfojee of Thanjavur	Painting in BL	1
2	c. 1815	Bangalore, Mysore State, Karnataka	Rajah of Mysore and Hon'ble Mr A.H. Cole (British Resident) send several cheetahs to the races for them to be speared	Bevan, 1839	
	1818	Maharashtra	Six cheetahs speared	Burton, 1959	6

Table 1: Chronology of Extinction (*contd.*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	c. 1825	Farukkabad (now Farrukhabad), U.P.	Coursing with cheetahs	Johnson, 1827	
	c. 1825	Jalna, Maharashtra	Tame cheetah kills donkey	D'Ewes, 1858	1
2	c. 1827	Agra, U.P.	Coursing with cheetahs	Mundy, 1833	
	1829	Rajkot, Gujarat	One cheetah speared	T.U., 1829	1
	1830	Deesa, Gujarat	Two cheetahs speared	Anonymous, 1830	2
	1830	Sholapur, Maharashtra	Coursing with cheetah named "Lukshmee"	S.M.S., 1830	1
	c. 1835	Chota Nagpur, Jharkhand	Cheetah/hunting leopard exists	Spry, 1837	
2	1835	Agra, U.P.	Coursing with a cheetah seen near Agra	Parks, 1850	
2	c. 1837	India	Coursing with cheetahs	Caunter, 1837	
	1837	Lucknow, U.P.	Two cheetahs accompany Lord Auckland	Dunbar, 1955	2
	c. 1839	Kutch, Gujarat	Cheetahs found in the state of Kutch	Postans, 1839	
2	1839–40	Kulladghee, Karnataka; and found in Bombay Presidency, i.e. Sind (now in Pakistan), Gujarat, and Maharashtra	Saw one tame cheetah; coursing with cheetahs	Hamilton, 1892	1
2	c. 1840	Agra, U.P.	Coursing with two cheetahs	Vigne, 1844	
2	c. 1840	Bharatpur, Rajasthan	Coursing with cheetahs	Orlich, 1842	
2	c. 1840	Punjab	Coursing with cheetahs	Orlich, 1842	
2	1845	Lucknow, U.P.	Coursing with cheetahs	Hoffmeister, 1858	
	1850	Mahall Gorasi, M.P.	One cheetah shot	Fraser, 1881	1
	1850	Burhanpur, M.P.	One cheetah seen	-do-	1
2	c. 1850	Lucknow, U.P.	Cheetah fights as sport	Sharar, 1965	
	c. 1850	Seonee (now Seoni), M.P.	Cheetahs reported	Sterndale, 1877	
	c. 1850	Indore, M.P.	One pet cheetah. One black cheetah seen (details follow in the text)	Wilkinson & Wilkinson, 1896	2
	1852	Kooakhera (Kuvakhera), Rajasthan	One dead cheetah killed by a tiger seen	Rice, 1857	1
	c. 1855	Kathiawar, Gujarat	Five cheetahs seen, chased on horseback in Saurashtra	Rice, 1884	5
	1856	Indore, M.P.	Coursing with two cheetahs	Cummings, 1871	2
2	1857	Banda, U.P.	Coursing with cheetahs	Halliday, 1957	
	c. 1859	Alirajpur, M.P.	One cheetah seen, chased on horseback	Cummings, 1871	1
	c. 1859	Border between Dohad (Gujarat) and Sirdarpur (M.P.)	Two cheetahs seen, one shot	-do-	2
	c. 1860	Jaipur, Rajasthan	Photograph of two cheetahs with keepers	Fabb, 1986	2
	c. 1860	Madurai, Tamil Nadu	Cheetahs reported	Nelson, 1868	
2	c. 1860	Baroda, Gujarat	Coursing with cheetahs	Newall, 1867	
2	c. 1860	India	Coursing with cheetahs common among wealthy Indians; A cheetah's price is between Rs 150/- and Rs 250/-	Shakespear, 1860	
2	c. 1860	Kolhapur, Maharashtra	Coursing with cheetahs	Campbell, 1864	

Table 1: Chronology of Extinction (*contd.*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	c. 1860	Central India	Several cheetahs shot, but not common	Forsyth, 1889	
	c. 1860	Northern Circars, Hyderabad State (now Andhra Pradesh)	Cheetah "not at all rare", one shot (taped at 7 ft)	Pollok, 1896	1
	c. 1860	South India	Old male cheetah killed near the author's camp (a leopard was also shot by him at the same camp)	McMaster, 1871	1
	c. 1860	Chiccary State (Charkhari State), Bundelkhand (now in U.P.)	Coursing with cheetah (finest cheetah specimen the author saw)	-do-	1
	c. 1860	Bundelkhand(?) (now in U.P.)	One large male cheetah speared by a sportsman the author knew, author saw the skin	-do-	1
10	1863–66	Vizagapatnam, (now Visakhapatnam), A.P.	Rewards paid for 85+ tigers, 365 cheetahs and panthers	Carmichael**,** 1869	
	1864	Sardarpur, near Dohad, Gujarat	Two cheetahs sighted, one of them shot	-do-	2
	1865	Baroda, Gujarat	Coursing with two cheetahs (leopards mentioned separately)	Rousselet and Buckle, 1882	2
	28th Dec., 1865	Pursad village, Rajasthan	Author sees a cheetah prowling near the camp in search of dogs	-do-	1
	1864–77	Mysore State, Karnataka	Two skins seen	Sanderson, 1878	2
	c. 1867	Jalna, Maharashtra; Sagar, M.P.	Cheetahs met with, observed a pair stalking a nilgai; brought up a cub.	Jerdon, 1867	3
	c. 1867	Central and parts of southern India, Khandesh (Maharashtra), Sind (now in Pakistan), Rajputana (Rajasthan), Punjab	Cheetahs reported	-do-	
	c. 1870	Nellore, A.P.	Cheetahs reported	Boswell, 1873	
	c. 1870	South India	Author's friend kept a tame cheetah	Pollock, 1894	1
	1871	Kottamangalam, Coimbatore, Tamil Nadu, Bolampatti, Coimbatore, Tamil Nadu	Three cheetah skins One cheetah skin	Morris, 1936	3 1
	c. 1872	Kutch, Gujarat	One cheetah seen	Stoliczka, 1872	1
	Oct. 1872 to Sept. 1873	North West Provinces (NWP), now U.P. Mirzapur district, U.P.	Eight 'Chitas' killed for reward of Rs 37-8 annas; four 'Tendua' (leopard) also listed separately	NAI, H(P) Jan.1875, A, 286–311, No. 296: H.J.A. Sparks, Offg Under Secy, Oudh, 20th Dec., 1873	8
	1874	Tirunelveli district, Tamil Nadu	16 cheetahs killed for reward of Rs 287/-, at Rs 18/- each, thrice the NWPs rate; leopard and cheetah are listed separately	NAI, H(P), May 1877, A, 60–85, No. 60: C.A. Galton, Secy, 20th Dec., 1876	16
	1874	Modoopore (Madhopur), Murshidabad district, West Bengal	One cheetah killed	Raoul, 1893	1
	1875	Bellary district, Karnataka	Five cheetahs for Rs 61/-, at Rs. 12/- each; 18 leopards too.	NAI, H(P), Dec. 1877, A, 269–92, No. 269; C.G. Master, 21st Sept., 1877	5
	1875	Tirunelveli, Tamil Nadu	16 cheetahs killed; leopards listed separately	-do-	16
	c. 1875	Somij village in Saranda Forests, Jharkhand	Two cheetahs killed	Smith, 1904	2

Table 1: Chronology of Extinction (*contd.*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	20th Nov., 1875	Baroda, Gujarat	Coursing with cheetahs	Fayrer, 1879	
2	16th Dec., 1875	Madras (now Chennai), Tamil Nadu	Coursing with cheetahs	-do-	
2	21st Jan., 1876	Jammu, Jammu & Kashmir	Coursing with cheetahs	-do-	
	28th Jan., 1876	Agra, U.P.	Cheetah shot	-do-	1
	1876	Madras Presidency	135 cheetahs and 507 leopards killed (the former figure is suspect, except for eight in Bellary where leopards given separately). North Arcot (40), but leopards are not listed separately. The former figure is close to the 1876 one. The total may be taken as 19, as calculated by the author. Coimbatore (21), but no listing of leopards at all.	NAI, H(P), Dec. 1878, A, Nos 249–80, No. 286: Board of Revenue Proceedings, 2nd Aug., 1878	19
	c. 1877	Central India	One cheetah seen	Gerrard, 1903	1
	c. 1877	Palamau, Jharkhand	Cheetahs occasionally found	Hunter, 1877	
	c. 1878	Dhrangadhra, Gujarat	Cheetahs encountered occasionally	Watson, 1878	
	1879	India	Two cheetahs arrive in U.K.	*Saturday Review*, 17th May, 1879	2
	c. 1880	Deccan	Four cheetahs trapped by Vardhis (Pardhis) witnessed by 'Deccan Bear'	*The Asian Age*, 22nd July, 1880, quoted in Seshadri, 1969	4
	c. 1880	Jeraikela village, Jharkhand	Cheetah takes away pet deer	Smith, 1904	1
	c. 1880	Bendee village, Saranda Forest, Jharkhand	Cheetah enters a hut, kills a calf and tries to take it away	-do-	1
	c. 1880	Palamau, Jharkhand	Cheetahs shot in Palamau	Baker, 1887	1
	c. 1880	Punjab, Rajputana, Central India, Deccan	Cheetahs reported	Blanford, 1888	
		Deoghar, Santhal Pargana, Jharkhand	One skin seen	-do-	1
		Sambalpur, Orissa	-do-	-do-	1
	c. 1880	Sind, Rajputana, Punjab, Central, Southern, and N.W. India	Cheetahs reported	Murray, 1884	
	c. 1880	Rajkot, Gujarat	Six cheetahs speared by William Loch; six cheetahs sighted by Col. Edmund A. Hardy out of which he shot one and speared three	Newall, 1887	12
	April, 1880	Visakhapatnam, A.P.	O.B. Irvine, Agent of Governor in Visakhapatnam, and his assistant Willock mauled by the cheetah of Raja of Vizianagaram during a cheetah coursing hunt. Irvine dies of his wounds; the only known record of a human being killed by a cheetah. (Detailed quote follows in the text.)	Anonymous, 1881; Nott, 1886	1

Table 1: Chronology of Extinction (*contd.*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
	1880–82	Saranda, Jharkhand	Cheetahs kill seven dogs belonging to Mervin Smith	Smith, 1904	1
	1882	Berrambadi Forest, Mysore (now Karnataka)	Five cheetahs seen; one cheetah shot	Russell, 1900	6
2	1883	Faridkot, Punjab	Coursing with cheetahs	Kinloch, 1885	
	c. 1884	Central, Southern India, north-west from Khandesh through Sind and Rajputana to the Punjab, commonest in Jaipur and Hyderabad (in the Deccan)	Cheetahs reported	Sterndale, 1884	
20	1884	Kathiawar (Saurashtra), Gujarat	Not more than 20 cheetahs left	Fenton c. 1924	
	1884	Tanga (Thanga hills) Kathiawar, Gujarat	Roughly 20 cheetahs believed to survive in this rugged country (See Fenton, c. 1924)	Anonymous, 1935	
	1884–1902	-do-	Nine cheetahs speared/ shot	-do-	9
	c. 1885	Palamau, Jharkhand	One cheetah shot	Baker, 1887	1
	1887	Chhindwara, M.P.	One female and four cheetah sub-adults shot/speared	Hicks, 1910	5
2	1887	Hyderabad, Telangana	Coursing with cheetahs	Larking, 1888	
	1887	Junction of Moyar and Bhavani rivers, west of Sathyamangalam, Coimbatore district, Tamil Nadu	One cheetah shot, five killed for rewards. The area also had wolf, nilgai, bustard, florican, blackbuck, antelope.	Nicholson, 1887	6
		Bhavani taluqa	Cheetah and tiger reported		
	c. 1888	Deoghar, Jharkhand	Cheetah skin seen	Blanford, 1888	1
2	1889	Jaipur, Rajasthan	Coursing with cheetahs	O'Shea, 1890	
	1889	North Arcot (area now split between Tamil Nadu and Andhra)	Two cheetah cubs for a total of Rs 25/- bounty	NAI, H(P) Dec. 1890, A, Nos. 360–407, No. 363, p. 32: H.L. Davidson, Collector, North Arcot to Secy, Board, May 1890	2
	c. 1890	Deoghar, Jharkhand	Two cheetahs shot	Braddon, 1895	2
	c. 1890	Southern India	Cheetahs rare. Author saw cheetahs occasionally, never shot one	Pollock, 1894	2
	1890	Melghat Forest, Maharashtra	Three cheetah skins seen	Burton, 1920	3
	c. 1890	Akola, Maharashtra	One cheetah shot	King Martin, 1935	1
	1890–95	Attikalpur, Mysore (Karnataka)	One cheetah seen	Morris, 1935	1
	1891	Hyderabad, Telangana	Photographs of tame cheetah with four dead blackbuck	Worswick, 1980	1
2	1892–93	Kapurthala, Punjab	Coursing with cheetahs observed	Gardner, 1895	
2	1892–93	Alwar, Rajasthan	Tame cheetahs seen	-do-	
	1892	Akola district, Maharashtra	Lived, bred, preyed on antelope and gazelle, trapped by villagers and upcountry rajas	King Martin, 1935	
2	1892	Hyderabad (Telangana)	Coursing with cheetahs	Jung, 1893	
2	c. 1892	India	Coursing with cheetahs	Kipling, 1892	
	c. 1892	Punjab, Rajputana, Central India upto Bengal	Cheetahs reported	Sanyal, 1892	

Table 1: Chronology of Extinction (*Contd.*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
2	1893	Marsan, Aligarh, U.P.	Coursing with cheetahs	Jung, 1945	
	1894	Rajkot, Gujarat	Female cheetah and her four cubs shot (See Fenton, c. 1924)	Anonymous, 1935	
	1894	Dhamangaon, Maharashtra	Two or three cheetahs seen, one shot	Burton, 1920	4
	1894	Melghat forests, Maharashtra	One cheetah shot	Anonymous, 1935	1
	1894–1919	Mirzapur, U.P.	Five cheetahs shot	Allen, 1919	5
	1895	Wano (province not mentioned)	One cheetah shot	Anonymous, 1935	1
	c. 1895	Coimbatore district, Tamil Nadu	A.C. Hill, Divisional Engineer, Madras Railway Company, reared a cub taken from the forests of Coimbatore for coursing	Clay, 1901	1
	c. 1896	South Canara, Karnataka	Author bought a cheetah cub from “a couple of junglewallahs”. Raised the said cub for hunting (coursing) in Deccan for three years. Price of a cheetah caught from the wild: “Anything you can agree upon, from ten rupees up.”	Clay, 1901	1
	1896	Berar (now Amravati Division), Maharashtra	Two cheetah cubs found, reared	Rodon, 1897	2
	Early 20th century	Nandikottur, Kurnool district, A.P.	Cubs captured; pair of adults, known to Chita Pardhis, a tribe of specialist cheetah trappers	Manakadan, 1988	6
	1901	Madura (now in Tamil Nadu), South Canara (now in Karnataka)	One killed for reward; three more for reward of Rs 50/-	NAI, H(P) Sept. 1902, A, Nos. 281–99, No. 281, pp. 6–7: L. Davidson, Secy, Board of Revenue, 13th March, 1902	4
	1901	South Canara, Karnataka	Three killed, listed in 1903 file	-do-	
	1900–17	Surguja, Chhattisgarh	Two cheetahs shot	Maharaja Madaneshwar Saran Singh Deo of Surguja, *pers. comm.*, 1994	2
	1903	Madura, Tirunelveli, Tamil Nadu	Three cheetahs, no reward paid, one killed, skin taken as trophy	NAI, H(P) Oct. 1903, A, Nos. 237–55, No. 237: Resn., Rev. Dept, 10th March, 1903	4
	1903	South Canara, Karnataka	Three cheetahs, no reward paid	NAI, H(P) Dec. 1904, A, 50–66, No. 50, Rev. Dept, Madras, Proc.: 25th March, 1904	3
	1903	Nowgong, M.P.	One cheetah shot	Stockley, 1928	1
2	c. 1903	Hyderabad, Telangana	Coursing with cheetahs	Forbes-Lindsay, 1903	
	1903–23	Central Provinces (now M.P., Chhattisgarh, and Vidarbha region of Maharashtra)	Three cheetahs procured; cheetahs negligible in number	Dunbar Brander, 1923	3
	1904	Sihawa, Raipur district, Chhattisgarh	Two cheetahs shot	Nelson, 1909	2
	1905	Unknown	One cheetah coursing blackbuck painted	Harrington Bird, 1905	1
	c. 1905	Kothal, Kolhapur, Maharashtra	One cheetah caught	Shahaji Maharaj, 1994	1

Table 1: Chronology of Extinction (*Contd.*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
	c. 1907	Central India, Rajputana, Punjab	Cheetahs reported	Lydekker, 1907	
	1907	Wankaner, Gujarat	One cheetah shot	M.K. Ranjitsinh, *pers. comm*. 1993	1
	c. 1907	Palamau, Jharkhand	Cheetahs occasionally met with	O'Malley, 1907	
	1910	Ghatbori and Hiwarched Forests (now Maharashtra)	Recorded as present, none killed, 'only a few' in Ajanta hills	Nelson, 1910	2
	1910	Durg district, Hemgir, Orissa	Uncommon	Lowrie, 1910	
	c. 1910	Hemgir, Orissa	Two cheetahs shot, two seen	Cobden-Ramsay, 1910	4
	c. 1910	Palkot, Jharkhand	One cheetah shot	-do-	1
	c. 1910	Palkot and Biru hills, Jharkhand	Cheetahs or "Hallett's Rock Panther" common(?); eight leopards/panthers obtained from this area	Hallett, 1917	
	c. 1910	Wankaner, Gujarat	Two cubs died after capture with mother, latter was released back into the wild	M.K. Ranjitsinh, *pers. comm*.1993	3
2	1911	Hyderabad, Telangana	Coursing with cheetahs	Hardinge, 1933	
	c. 1911	Rewa, M.P.	One cheetah shot by Lord Hardinge	Finn, 1929	1
	1912	Buldana district, Berar, Maharashtra	One cheetah reported, its mate believed trapped by Pardhis, only tracks seen	Burton, 1920	2
	c. 1912	Bellary district, Karnataka	One cheetah caught	Shahaji Maharaj, 1994	1
	1914	Ranipur, Betul, M.P.	Heard of at camp, not seen	King Martin, 1935	1
	c. 1914	Central India	Cheetahs reported	Ajaigarh, 1914	
	c. 1914	Mysore State, Karnataka	Cheetah found	Playne, 1914–15	
	c. 1914	Chikmangalur, Karnataka	Cheetah found	-do-	
2	c. 1915	Patiala, Punjab	Coursing with cheetahs	Baden-Powell, 1915	
	1916	Nagpur, Yavatmal districts, Maharashtra	Permission to trap cheetah for Nizam, Hyderabad. The file is missing in the National Archives of India	IOL, Agri & Forests, p/9912, June 1916, B, 12. BL	
	1916	Mirzapur, U.P.	One cheetah skin	Allen, 1919	1
	1918	Mirzapur, U.P.	One cheetah shot	Anonymous, 1935	1
	1919	Mirzapur, U.P.	One cheetah shot	-do-	1
	c. 1919	Chhindwara district, M.P.	Two cheetahs sighted, one female shot	"Silver Hackle", 1929	2
	c. 1919	North of Bombay Presidency, Sind, Rajputana, northern districts of Central Provinces, possibly Punjab	Cheetahs reported	-do-	
	c. 1920	Northern India, Punjab, Rajputana, Central India, Central Provinces, almost upto Bengal	Cheetahs reported	Burke, 1920	
	c. 1920	Central Provinces	Princes try trapping but fail	Hewett, 1938	
2	c. 1920	India	Coursing with cheetahs	Woodyat, 1922	
	?	India	One skin	Daphne M. Hills, Natural History Museum, London, *pers. comm.* to K.S. Samar Singh, 1984	1
	c. 1923	Nagar-Untari, Garhwa district, Jharkhand	Cheetahs(?) carrying off children from neighbourhood	Tallents, 1926	
	1924	Prabhas Patan, Saurashtra, Gujarat	One cheetah shot	Desai, 1983	1

Table 1: Chronology of Extinction (*contd.*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
	1925	Rewa, M.P.	Three cheetahs shot, one cheetah escaped	Bikaner, 1926	4
	c. 1925	Jalna, Maharashtra	A pair of cheetahs reported, one trapped by Pardhis. None seen by author though tracks present	Burton, 1928	1
	1926	Harrari Jagir, Chhindwara, M.P.	One cheetah shot	Richardson, 1929	1
	c. 1926	Palamau, Jharkhand	Cheetah occasionally met with	Tallents, 1926	
	1927	Mirzapur, U.P.	One old cheetah killed, skin examined	Finn, 1929	1
2	c. 1930	Jaipur, Rajasthan	Coursing with cheetahs	Wood, 1934	
10	c. 1932	Gwalior State (now part of M.P.)	50 to 60 cheetahs survive in the State according to the Officer in Charge of the Gwalior Shikar Department	Thompson, 1932	
	c. 1932	Indore State (now part of M.P.)	Cheetahs found	-do-	
	c. 1932	Hyderabad State, Telangana	Indian cheetahs unobtainable in most Princely States, some princes now sourcing them from Hyderabad State	-do-	
	c. 1932	Rajputana, Central India, Central Provinces, Punjab	Cheetahs reported	Alexander & Martin-Leake, 1932	
	1932	Talcher, Orissa	One cheetah shot	Lothian, 1951	1
	?	United Provinces, (now Uttar Pradesh/U.P.)	One cheetah shot while stalking a Sambar	Anonymous, 1935	1
	c. 1934	Hyderabad State	Cheetahs found, live in holes in rocks or among accumulations of rocks and boulders	-do-	
	c. 1935	Seoni plateau, M.P., Saugor (Sagar), M.P. and Berar (now Amravati Division, Maharashtra)	Still believed to exist in parts of these landscapes	-do-	
	c. 1935	Hyderabad State, Telangana	A few cheetahs still remain	Sálim Ali, 1935	
	c. 1935	Palamau, Jharkhand	Cheetahs believed to survive in this area	Houlton, 1949	
	c. 1936	Deccan	Three cheetah skins seen (probably shot much earlier)	Burton, 1936	3
	1936	Surguja, Chhattisgarh	One cheetah shot	Maharaja Madaneshwar Saran Singh Deo of Surguja, *pers. comm.*, 1994	1
	1939	Orissa	One cheetah shot	Anonymous, *pers. comm.*, 1993	1
	c. 1939	India	Cheetahs almost extinct	Pocock, 1939	
	1940	Visavadar, Gir, Saurashtra, Gujarat	One cheetah shot	Desai, 1983	1
	1941	On the boundary of Rewa State, now part of M.P.	Two male cheetahs shot	Van Ingen & Van Ingen, 1942	2
	1947	Koriya State (now Koriya district, Chhattisgarh)	Three cheetahs shot	Van Ingen & Van Ingen, 1948	3
	c. 1948	India	Cheetah's existence doubtful	Prater, 1948	
	1951	Ramgarh, Koriya district, Chhattisgarh	One female cheetah, which appeared pregnant, sighted by Raja Saheb of Korea	M. Ram Chandra Singh Deo of Korea, *pers. comm.* to M.K. Ranjitsinh, 1987	1

Table 1: Chronology of Extinction (*contd.*)

Tally of cheetahs generally reported	Date	Location	Remarks	Source	Tally of cheetahs counted
	1951	Orissa-Andhra Pradesh border	One cheetah sighted, reports of cheetahs from villagers	Seshadri, 1969	
	1952	Chittoor district, A.P.	One cheetah sighted	Kirkpatrick, 1952	
	1954	Bahawalpur, Pakistan	One cheetah sighted	Stephan, 1954	1
	1957	Hyderabad, Telangana	Cheetah fell into a well	Abid Hussain, *pers. comm*. to DS, 1992	1
	1967	Between Turripani and Ramgarh (both now in Guru Ghasidas National Park), Koriya district, Chhattisgarh	One cheetah sighted	M. Ram Chandra Singh Deo of Korea, *pers. comm*. to M.K. Ranjitsinh, 1987	1
	1968	Turbat, Baluchistan, Pakistan	One cheetah shot	Roberts, 1977	1
	1967–68	Between Surguja (in Chhattisgarh) and Sidhi (in M.P.)	A pair of cheetahs sighted	Maharaja Madaneshwar Saran Singh Deo of Korea *pers. comm.* to Maharawalji Digveerendrasinh of Vansda, 1990	2
	1972	Mekran Coast(?) Baluchistan, Pakistan	One cheetah skin	Roberts, 1977	1
	c. 1975	Danto village, Hazaribagh, Jharkhand	One cheetah sighted	Philomina Imam, *pers. comm*. to Raza Kazmi, 2018	1
	1977–78	Baluchistan, Pakistan	Cheetahs reported	N. Hussain, *pers. comm*., 2000	
	c. 1985	Baluchistan, Pakistan	One cheetah(?) sighted	-do-	
	1997	Unknown	Cheetah skin coat for sale in Islamabad	-do-	1
	1997	Chagai Plains, Baluchistan, Pakistan	One cheetah shot	-do-	1
	1997	Ormara, Baluchistan, Pakistan	One cheetah seen; one cheetah female with two cubs seen	-do-	4
Total: 108					**Total: 306**

Grand Total: 414

Table 1 gives a figure of 306 cheetahs which were accounted for in the Subcontinent between 1772 and 1997, that is within a time span of two centuries and a quarter. At the outset it is necessary to note that in many cases the dates mentioned in the preceding table are those of the year of publication of the work, as specific dates are not mentioned in many of them. Many cities and towns have been mentioned in the table, such as Calcutta, Lucknow, Rajkot, etc. Such locations signify the surrounding areas where cheetahs were found, or were brought to royal courts, and similar official establishments, and so on.

We have included here only the references to cheetahs seen in specific localities, where they were shot, painted, or their skins were seen, and those for which bounties were paid by the government. There were some instances which looked doubtful initially, but on closer examination we concluded that they were credible enough for inclusion. An explanation for including some records and not including some in the count of the cheetahs is called for in cases which are detailed below:

Mrs Postans' general record of cheetahs in Kutch, Gujarat of c. 1839 and S.H. Desai's record of a cheetah each in 1924 and 1940 in Kathiawar were discounted by M.K. Ranjitsinh (Ranjitsinh, M.K. *pers. comm.* 1994) and DS earlier, as cases of mistaken identities with leopards. However, F. Stoliczka saw a cheetah in Kutch in 1872, 33 years after Mrs Postans' record. Hence, we have noted her record but not included any number in this count. Similarly, Kirkpatrick's record of a 1952 sighting in Chittoor district, Andhra Pradesh, has been considered to be doubtful. Seshadri too records a sighting of cheetah in 1951 from the Odisha-Andhra border, which is probably the same incident as recorded by Kirkpatrick. Thus, we have not included both Kirkpatrick's and Seshadri's reports in our count.

On the other hand, on examining again Desai's records in his book "Gir" (Desai 1983), it was noted that he has written separate sections on leopards and cheetahs. He states that one was killed near Prabhas Patan in 1924, while another was shot by Police Constable Pirmohmed Najarmohmed in 1940. The animal was 4' 3" in height (this measurement is an error) and 6' 9½" in length. So we have accepted these reports. DS had earlier discarded this record as being doubtful.

Similarly, DS had earlier only recorded 6 cheetahs being referred to by Maj. Gen. D.J.F. Newall (Newall 1887) in his book, but on re-examining the reference the authors found that Maj. Gen. Newall in fact refers to two separate incidents of two different groups of six cheetahs each being pursued between the area of Rajkot and Porbander. In the first case, William Loch, formerly of the 1st Bombay Lancers, speared 6 cheetahs off one horse. In the second instance, sometime later, Newall's friend Col. Edmund A. Hardy chanced upon six cheetahs asleep under a large tree. He shot one of them, speared three others while two escaped. Thus, the tally of cheetahs for this particular reference has been updated to 12 instead of six as it used to be in the earlier works of DS.

Fig. 2: Stained glass of a cheetah in an hunting ground. This decorative window was made specifically for Thakor Saheb Jaswantsinhji of Limbdi (Gujarat), c. 1886, and is in the Digbhuvan Palace in the town. Here the cheetah has been brought for the hunt in a palanquin; usually they were transported on a bullock cart. Courtesy: Thakor Saheb Chattrasalsinhji of Limbdi

We have accepted the figure of 20 cheetahs in Kathiawar (Saurashtra, Gujarat) given by Lt Col. L.L. Fenton, because he knew the area well and had hunted cheetahs in the locality. He goes on to record that from 1884 to 1900, 10 cheetahs were shot by various British Officers. He also records that five more were accounted for by C.A. Waddington, Principal, Rajkumar College; George Hancock, a police officer; himself and others (Fenton c. 1924: pp. 80–81). We have not counted these animals separately, but have included them in the omnibus figure of 20. A stained glass illustration for Kathiawar shows that the cheetah being taken to the field in a palanquin which is unusual (Fig. 2).

There is the tantalizing record of 50 to 60 cheetahs living in Gwalior State, as per the Shikar Khana In-Charge, c. 1930. Records from large princely states are usually accurate enough. However, erring on the safe side, we decided to not add this large figure to our count, but we have given an arbitrary figure of 10 animals only, and have included it in our table. Actually, Jaipur State was known to have obtained cheetahs from the wild from Gwalior State during this period, according to the information given to DS by the late Mohammad Azizuddin, son of one of the last cheetah trainers of Jaipur State, in 1984.

There is an even more tantalizing record from Vizagapatnam district of rewards being paid during 1863 to the first 6 months of 1866, for not less than 85 tigers, and 365 cheetahs and panthers. Since cheetahs have been mentioned specifically, we cannot ignore this reference. We have, therefore, given an arbitrary figure of 10 animals.

There are several specific references in various sources to localities where coursing with cheetahs was prevalent, but exact numbers of cheetahs are not given. It is not possible to discount these as totally unreliable, because coursing with cheetahs requires a large establishment of space, trained persons, and resources. Hence, such references cannot be baseless. Therefore, we have given an arbitrary figure of two animals per reference. However, to err on the safe side, we have not included in our count all other general references to the existence of cheetahs from various localities, as they do not appear to be records of actual sightings.

If one is to allow just two cheetahs per reference on coursing with cheetahs, add 20 from Kathiawar, another 10 to Gwalior State, and 10 more from Vizagapatnam mentioned above, the earlier mentioned tally of 306 cheetahs would jump to 414 (as in Table 1) during this period. We leave these figures to the judgment of the reader.

Up to the middle of the 20th century, Indian princes and other potentates continued the age old tradition of coursing blackbuck with cheetahs. Most prominent among them were the Chhatrapati Maharaja of Kolhapur State and the Maharaja of Bhavnagar State. Kolhapur had 35 of them in the 1920s (Cutting 1947: p. 167) and there is a photograph of 11 with their keepers in front of their stable (Pathan 1921: p. 17). Bhavnagar had 5 cheetahs in 1940, though earlier they had as many as 30 (Craighead and Craighead 2001: p. 77). DS's research has shown that Indian princes had started importing cheetahs after 1918 from Africa, as very few of them were available in India. These animals have not been included in our count. It is, of course, quite possible that Kolhapur could have had a couple of cheetahs from India, since Chhatrapati Shahaji Maharaj records a cheetah being caught from the wild as late as c. 1912, as will be noticed from the table.

Philomena Imam's report of Hazaribagh, c. 1975, is interesting. She comes from a well-known family of shikaris who later became conservationists. In a casual conversation with RK over her younger days in the village, she started narrating the incident of her encounter with a "chita". Initially, RK thought she was talking of a leopard, but as the story progressed and she described the 'jizz' (general information of size and shape), RK realized that she seemed to be describing a cheetah rather than a leopard. Nonetheless, he showed her a picture of a leopard, which she immediately dismissed, specifying that the cat in the photo was a "tendua bagh", not a "chita bagh" that she was talking about. She then explained how the "chita bagh" was also a spotted cat like the "tendua bagh", but the spots on the former were solid dots like a "bindi", unlike those on leopard which had a yellow area inside their spots. She also kept stressing that the most easily recognizable feature of the "chita bagh", however, was a single black stripe running below each of its eyes up to its mouth, which looked to her like "do aansu" (two tear drops), thus accurately describing the cheetah's tear marks. She finally said that the "tendua bagh" is still seen sometimes by her friends and relatives in the village, but the c. 1975 sighting was the last time she saw a "chita bagh", and has never heard of any of her acquaintances in the village seeing one since either. This is especially interesting to note, since RK's paper also described the first known record of a cheetah from Hazaribagh district, written in 1877 by Sir W.W. Hunter, who described the animal as being known as "sona chita" in the district. RK had also remarked how the first Gazetteer of Hazaribagh, published in 1917, however, had made no mention of cheetahs in the district. This record then becomes, to our knowledge, the last visual record of the cheetah from India.

Then there is the irksome case of cheetahs mentioned by Major Henry Bevan in his two-volume account (Bevan 1839), much of which is on his shikar exploits during his service years in India. He has clearly noted that cheetahs were different from leopards. Yet, throughout his narrative, the descriptions of his shikar locations, behaviour of animals, etc., suggest that what he calls cheetahs were probably leopards. The authors, therefore, have discarded all these references save in two instances. In one, he says that cheetahs were caught by the Raja of Mysore and sent to the races to be speared. In another instance, he describes his participation in coursing blackbuck with three cheetahs.

It is not possible for us to explain all the entries in the table. But each entry of cheetah numbers that we have considered can be evaluated by the reader himself through a perusal of the sources given in the preceding table for each entry.

During the British period, numerous books were written on shikar. Kenneth P. Czech's bibliography (Czech 2003) lists about 1,000 books written and published on big game hunting, small game hunting, pig sticking, etc., in Asia between 1780 and 1980. DS estimates that of these, close to 600 were on the Indian subcontinent. Very few of these books have references or records of cheetahs. An effort has been made to access as many of these as possible, particularly all those that were likely to have material on cheetahs. Similarly, innumerable travelogues, memoirs, etc. were written, which are even more difficult to access, though again an effort was made to reach as many as possible. In addition to travelogues and shikar books, RK examined obscure periodicals, Gazetteers, other government publications, and provincial records, initially focusing on Jharkhand, Bihar, and adjoining states for his 2012 paper and then in subsequent years expanding the scope of the aforementioned sources to a few other states. These gave startling results. Prof. Mahesh Rangarajan's search through archival material in the National Archives, Delhi, recorded substantial numbers of cheetahs and highlighted the hitherto unknown fact of them being destroyed by bounty hunters at the instance of the government (Rangarajan 1998). A search through regional records across the Subcontinent, an examination of records in regional archives, and material in regional languages would undoubtedly open vast vistas of information. These are, as would be obvious, beyond the reach of the authors. That said, Table 1 given above is the result of decades of compilation and is extensive. If an enquiry is pursued to expand it to search new sources, it is quite possible that a large number of cheetahs would be accounted for. After all, finding all of them in their final phase of existence on the Subcontinent within an area of 4,114,770 sq. km over a period of two and a quarter centuries is beyond the capacities of the authors.

On the basis of the tabulated information, the accompanying map shows the range of the cheetah in its final phase of existence on the Subcontinent (Fig. 4). Today, less than 40 cheetahs survive in Iran and none are reported from Fars adjoining Baluchistan (Farahdinia *et al*. 2016). It is, therefore, very unlikely that any may cross over into the Subcontinent now, except perhaps a skin as part of illegal trade.

CHEETAH SKINS, SKULLS, ETC. IN INDIA

It is not out of place to record here the details of cheetah skins, skulls, etc. available in India (Table 2a–d).

Table 2a: Zoological Survey of India, Kolkata (Dr Sujit Chakraborty, Z.S.I, *pers. comm.* 1991)

No.	Specimen No.	Locality	Date of Collection	Collector/Donor	Remarks
1.	2579	Not indicated	12.07.1857	W. Routledge, animal dealer from Calcutta	Skull
2.	2597	-do-	05.08.1875	-do-	Disarticulated skeleton
3.	7271	Africa	Not indicated	Calcutta Zoo	Skull
4.	7349	Not indicated	-do-	-do-	Skull, mandible broken
5.	13011	-do-	-do-	Not indicated	Complete skeleton
6.	15608	-do-	-do-	Babu H.M. Roy	Skull lower jaw
7.	17627	-do-	-do-	Calcutta Zoo	Skull

All our enquiries have established that cheetahs were imported by Indian princes and others in the post 1918 period. Specimen nos. 1 and 2 would be from India.

Table 2b: Indian Museum, Kolkata (Dr A.K. Sanyal, Z.S.I., *pers. comm.* 1994)

No.	Specimen No.	Locality	Date of Collection	Collector/Donor	Remarks
8.	Not indicated	C.P. (Central Provinces, roughly the area of Madhya Pradesh, Chhattisgarh, and Vidarbha region of Maharashtra)	1898	R. Ward & Co.	Fully mounted specimen

The above specimen collected from C.P. in 1898 would be from India.

Table 2c: Bombay Natural History Society, Mumbai

No.	Specimen No.	Locality	Date of Collection	Collector/Donor	Remarks
9.	M.5738 BNHS 6187	Victoria Garden (Veermata Jijabai Bhosale Udyan)	07.viii.1936	Superintendent, Victoria Garden	Skull
10.	M.6081 BNHS 6232	-do-	Not indicated	Not indicated	Skull
11.	M.982 BNHS 6229	Pushtikoh Range, Afghanistan	07.vii.1917	Capt. John Napier	Skull and skin

Specimen no. 11 is the only one of an Asian Cheetah from outside India in the Subcontinent.
(Information collected from BNHS by DS)

Table 2d: Lallgarh Palace, Bikaner

No.	Specimen No.	Locality	Date of Collection	Collector/Donor	Remarks
12.	Not indicated	Rewa, Madhya Pradesh	1925	Maharaja of Bikaner	Skin with mounted head, Male
13.	-do-	-do-	-do-	-do-	-do- Male
14.	-do-	-do-	-do-	-do-	-do- Female
15.	-do-	Serengeti Plains	?	-do-	-do-
16.	-do-	-do-	?	-do-	-do-
17.	-do-	-do-	?	-do-	?

Several rich people such as the zamindars of Bengal had menageries of their own, and specimen no. 6 (Table 2a) could be from one such and would be from India. The cheetah skull multivariate analysis done by the late Dr Colin P. Groves showed that the Ward (Table 2a) and Roy (Table 2b) donations fall close to the measurements of an Indian cheetah's skull in the Natural History Museum, London (Colin P. Groves, *pers. comm.* 1991).

Of the six trophies listed in Table 2d, five are displayed on the walls of Lallgarh Palace. Trophies at numbers 12, 13, and 14 (all displayed) are obviously from India. Maharaj Kumar (later Maharaja) Sadul Singhji of Bikaner shot one male cheetah on the "Plains-Tanganika" (Tanzania) in 1932. He shot two more males on "Serengata [sic] Plains" (Serengeti Plains, Tanzania), one in 1933 and another in 1934. DS has seen two of these three trophies in the palace. It is not clear if a third trophy exists. It is not clear which two animals, of the three, the trophies represent. (Information obtained by DS from the Bikaner royal family.)

Tala and Koriya Cheetah trophies

Two cheetahs were shot by the late Th. Mordhajsingh of Tala in 1941 in the territory of a neighbouring state on the border of Rewa State (now in M.P.). Unfortunately, these are lost according to information given by the late sportsman K.K. Singh (*pers. comm.* 1991). One of these was a fully mounted specimen (Van Ingen and Van Ingen 1942).

Maharaja Ramanuj Pratap Singh Deo of Koriya shot three cheetahs within the territory of the former Koriya State in 1947. Two trophies were made of the skins with mounted heads. The present whereabouts of these are not known to the authors. The third was fully mounted. It is now in the Palace at Baikunthpur, Koriya district, Chhattisgarh (M. Ram Chandra Singh Deo, *pers. comm.* to M.K. Ranjitsinh, 1993).

Van Ingen & Van Ingen, Mysuru

This world renowned firm of taxidermists had a complete cheetah skeleton acquired from the Mysore Zoo. The late Mr E. Joubert Van Ingen informed DS in 1991 that this was of an animal from Africa. Since the firm has wound up and the three Van Ingen brothers, De Witte, E. Jobert, and Botha have passed on, the authors could not ascertain the whereabouts of this specimen.

Unique cheetah behaviour and an aberrant form of cheetah

Though what the authors record here is not entirely relevant to the story of the extinction of the cheetah from the Indian subcontinent, two of RK's finds are too important to leave unrecorded.

The authors' searches into cheetah records over the last three decades and more had not revealed a single instance of an unprovoked attack on a human being by a cheetah in captivity. However, there is one instance of an enraged cheetah which turned on a human being. The event has been recorded by J.F. Nott which we quote in toto, for the sake of brevity:

"There are exceptional specimens however, and accidents have happened by placing too much confidence in the harmless character even of these animals, for "Smoothbore", writing to the *Field* in May, 1880, describes a death of one gentleman and serious injury to another. Messrs O.B. Irvine, acting collector of Vizagapatnam, and Mr Willock, also a civilian, went out with the Rajah of Vizagapatnam to hunt antelope with a hunting cheetah. The animal proved sulky and would not hunt, so Mr Irvine proposed they should hunt it. The cheetah was enlarged [released] and was soon lost sight of: but, whilst the party was following it up, the cheetah suddenly sprang from behind a bush, where it was crouching, on Mr Irvine, injuring him severely. Mr Willock came to his assistance, but he also was speedily rendered *hors de combat*. The result was that Mr Irvine died within a couple of days, and for some time it was thought Mr Willock was recovering. Mr Irvine's death is universally regretted, as he was well known and a general favourite throughout the Presidency. I have never heard of an accident of this sort before. The hunting cheetah (*Felis jubata*) is generally a most good-tempered and tractable animal, and is led about with a chain and collar like a dog." (Nott 1886: pp. 94–95)

Coming to aberrant forms of the cheetah, it will be remembered that there has been only one record of a "white" cheetah which arrived at Emperor Jehangir's court in 1608. And there is a report of a "Wooly cheetah" from Beaufort West, Cape Colony, South Africa reported in 1877 which had a "grayish yellow" pelage. These were instances of albinism and incipient albinism (Divyabhanusinh 2006: pp. 41, 208–209).

The melanistic form of the cheetah, on the other hand, is better known as the King Cheetah which is now bred in captivity in South Arica and elsewhere. However, a totally black cheetah has been reported only once. In their book on their adventures in India, THE MEMOIRS OF THE GEMINI GENERALS, the authors have a separate section on the cheetah. In this section Maj. Gen. Johnson Wilkinson records his brother Maj. Gen. Osborn Wilkinson's account of the latter's friend and a brother army officer, Sir William Turner's encounter with a black cheetah which we quote in toto:

"One day I had, as usual, given the racing horses their gallops, and on proceeding to the house I entered the drawing-room, and found Mrs. E… had just preceded me. She was alone, in abject terror, and scrunched up into the smallest possible space at the corner of her sofa. I observed the tail of some animal protruding from underneath the sofa. It was a cheetah, a species of leopard supposed to be more or less domesticated, I believe, which had escaped from its cage. I at once rushed to the rescue. Catching hold of the tail I dragged the brute from his lair, till I got him well outside the room, and then I let go my hold, and he bolted, where I cannot remember, but I have no doubt he was soon captured and safely lodged in his cage.

"How far these hunting cheetahs are to be trusted I know not; but my Twin's sporting companion and brother officer, Sir William Turner, describes cheetahs or leopards in their wild state as most destructive, 'destroying dogs, goats, bullocks, deer, etc. in great numbers, but like all the rest of the feline tribe, are sneaking, cowardly creatures, seldom appearing except at night, when they spring with tremendous bounds upon their prey, fastening on his throat and easily pulling him to the ground, where they quietly suck his blood. They seldom do more the first night, but having drained his veins retire to their lair for the day, returning the next night to feast upon the carcase. At times they are more daring, and spring upon their prey in broad daylight and close to a village.' In illustration of this animal's want of pluck in face of his enemy, man, I repeat a story told by Sir W. Turner, which, I think, shows that he at all events did not suffer from any such 'want'. He writes, 'I was out walking before breakfast with one of our officers. He had a walking stick and I a gun, which I had just discharged, when a mouse deer sprang out of some bushes and crossed the road in front of us; my dog Whiskey saw it, and immediately gave tongue in chase [barked], but had hardly run a hundred yards when her [*sic*] cry was changed into a sharp yelp, as if in pain or fright. For a moment we stood still, at a loss to imagine what had occurred. Laying down the gun, and snatching my friend's stick, I rushed into the jungle, and again heard [a] short, stifled yelp not far from me. On reaching the spot there stood a black cheetah with his paw upon the dog, curling up his lips with deep low growls. I felt that I was no match for him with a stick, but was determined that he should not have the dog without a fight; and leaping over the intervening bushes struck at the cheetah with the stick. With one bound he was off, leaving the dog lying on the ground. I carried the dog to a tank that was near, and washed the wounds. Although it recovered it was long before I could get it to leave my heels and again take to the jungle. Poor Whiskey! He [*sic*] was taken some months after by an alligator.'

"To return to my tale, the cheetah I tackled made no sort of resistance whilst I was hauling at him, beyond digging his claws into the carpet, just as a refractory dog or cat might do under similar circumstances. At every pull I gave he turned his head towards me slightly, and I think showed his teeth and snarled, as if remonstrating with my unceremonious mode of ejecting him, and this was all he did." (Nott 1886: pp. 101–102).

The passage quoted above makes it clear that the authors knew what they were talking about, though they have called a cheetah as a leopard and included in its prey base a bullock (which is too big to be brought down by a single cheetah though a coalition could do the necessary). Unfortunately, the book does not give the location of the incident. A leopard in any case is not likely to give up its kill to a person on foot armed only with a stick. Further, the small mouth of the cheetah would have been the cause of the survival of the dog. The authors, therefore, conclude that the reference here is to a cheetah.

CONCLUSIONS

It is apparent from the accompanying map that cheetahs continued to be found in very low densities throughout their wide range across the Subcontinent during this period, despite depleting numbers. Also, the map shows that cheetahs in their most preferred habitat such as the grasslands and semi-arid tracts of Kathiawar (Saurashtra, Gujarat) and elsewhere came under severe pressure earlier than those found on the edges of forests, including sal forests and grassy glades within them in Central India.

During this period, cheetahs were subjected to their being taken from the wild for coursing blackbuck by Pardhi tribals and others for their princely patrons. That apart, they were also being targeted by British and Indian "sportsmen", as is evident from the preceding table.

This brings us to Prof. Mahesh Rangarajan's crucial research. His search through archival records found that the British government gave rewards for the destruction of not only adult cheetahs, but also for their cubs from about 1871 onwards. He points out that not less than 70 of them were killed between then and 1925, which is on an average 1.30 animals per year. Compare this figure with the information from Table 1. A total of 306 were accounted for between 1772 and 1997, that is an average of 1.36 per year, or if we take the larger figure of 414 after adding another 108, then we get an average of 1.84 per year. This was the last stand of a very dispersed, fragmented population. Prof. Rangarajan goes on to point out that the administrative policy of British India "played a major role in its extinction". (Rangarajan 1998). Some observers have also often pointed out the lack of cheetah references in the writings of colonial hunters, and the fact that even the sum total of the scarce colonial records that exist of their killings is a very small number when compared

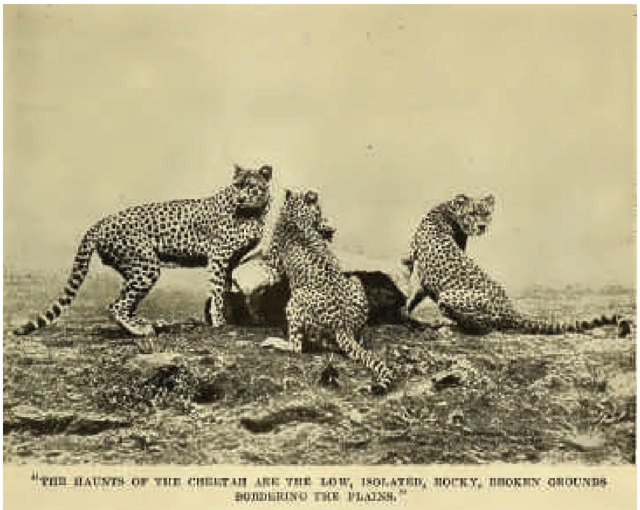

Fig. 3: "The haunts of the cheetah are the low, isolated, rocky, broken grounds bordering the plains." This picture is dated 1885 and was published by Charles E. Clay in 1901 in *Outing* magazine of New York. These are Asiatic cheetahs. Of note are the tips of the tails which are black, unlike most tips of African animals which are white. Clay's article talks of the Deccan region, but does not give the location of the picture

to the number of tigers, leopards, and wolves being killed during the same period. Some of the reasons behind this seeming anomaly are as follows.

First of all, as must be evident by now to the readers, cheetahs were already scarce by the time the British consolidated their rule in India. They had become even scarcer by the time the so-called "golden era" of shikar literature began – around the 1870s and thereafter, right upto the end of British rule – surviving in critically low densities across their range in India (Fig. 3). Thus, encounters with cheetahs of such writers would naturally be uncommon, and so then would be their mention in contemporary hunting literature. Another factor to be considered is that in those days there used to be a lot of ambiguity regarding the nomenclature of cheetahs and leopards. Edward B. Baker, an early author on shikar, suggested that the word "leopard" should be applied to the "cheetah" while what is generally called a "leopard" should only be called a "panther" (Baker 1887: p. 193). Baker's work was one of the standard texts on the wildlife of the Bengal Presidency for decades, and could have caused many other authors – especially the generalist authors of Gazetteers and compilers of various government reports detailing animals destroyed every year across the province – to classify cheetahs as leopards and leopards as panthers. And Baker's opinion was not an isolated one – R.A. Sterndale echoed the same view in his book on the natural history of the Subcontinent (Sterndale 1884: pp. 179–184) and so did a number of other authors across India. Finally, the cheetah was rarely, if ever, considered a "worthy trophy" by most big game hunters, with them preferring the larger cats over the lissom cheetah (Kazmi 2016).

While most of the above factors explain the fewer numbers of cheetah killed, compared to tigers and leopards, a contemporary parallel to this situation can be drawn from the situation of the Asiatic cheetah in Iran. The cheetah population of Iran was estimated at around 400 individuals in the early 1960s. This population, spread over a vast area in Iran in very low densities, despite being in steady decline over the decades, has still managed to survive for close to 60 years now. So it is wholly plausible that a small population of cheetahs (hypothetically not numbering more than a couple of thousand animals across India by the 1850s) could have lingered on for close to a century, till the last three animals were shot in December 1947. There are, though, credible sighting reports as recorded in Table 1 of cheetahs upto the winter of 1967–68, and the one of c. 1975, from India; and DS has obtained records upto 1997 from Pakistan.

The accompanying map shows that the range of the cheetahs was spread all over the Subcontinent, but they were found in small numbers and in isolated groups wherever blackbuck were found. This by itself surely caused them to reach the tipping point towards their doom. That apart, factors mentioned here earlier, such as their removal from the wild for coursing antelope and their inability to breed in captivity until the second half of the 20th century, pushed them further in that direction and sealed their fate. Their habitats and prey survived them, their disappearance was not the cause of the cheetah's extinction. Asia's lions, which preferred similar habitats and shared the same range as that of the cheetahs above the River Narmada, became extinct in India (apart from the relict population of the Saurashtra peninsula) long before the cheetah. The last possible report of a lion outside Saurashtra was from Bolan Pass in Baluchistan in 1921 (Pocock 1936).

The cheetah's story in Asia may well be ending, unless they are reintroduced into India from Africa, as Iran's population numbering about 40 – which is on the verge of extinction – receives urgent much needed in-situ and ex-situ protection. It is the only mammal so far lost in the plains of the Indian subcontinent. It would be the flagship species if reintroduced, which would ensure the regeneration and protection of grasslands and semi-arid tracts that are home to faunal and avifaunal heritage of such habitats which have received scant attention from the State in India so far.

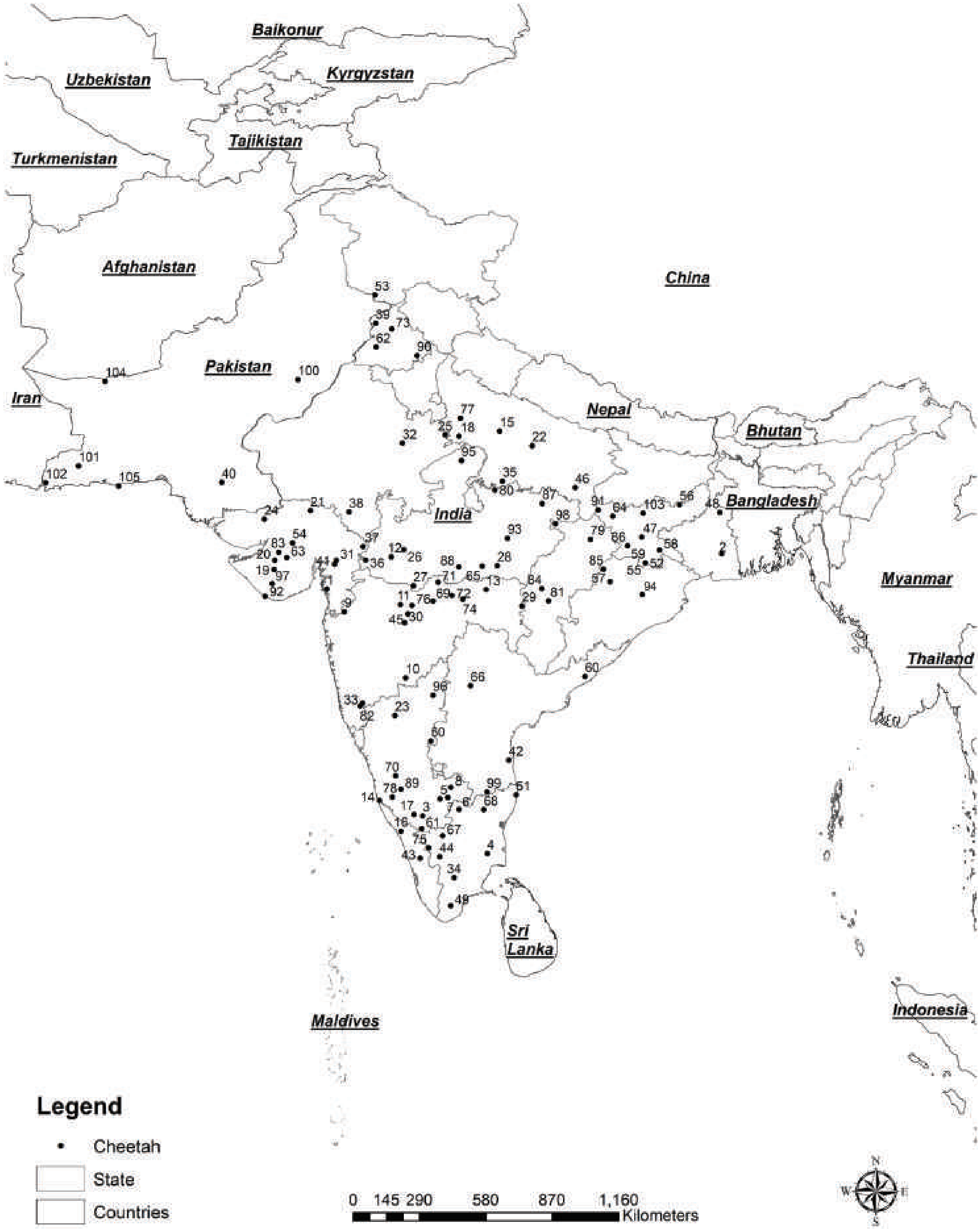

Fig. 4: Range of the Asiatic cheetah during the British period and after in the Indian subcontinent

Key to Fig. 4

S. No. Place Year	S. No. Place Year
1 Surat, Gujarat 1772	53 Jammu, Jammu & Kashmir 1876
2 Calcutta, West Bengal 1780, 1800	54 Dhrangadhra, Gujarat 1878
3 Mysore, Karnataka 1799, 1864–77, 1914	55 Bendee, Jharkhand 1880
4 Thanjavur, Tamil Nadu 1803	56 Deoghar, Jharkhand 1880, 1888, 1890
5 Savanadurga, Karnataka 1812	57 Sambalpur, Odisha 1880
6 Ryacottah, Tamil Nadu 1812	58 Jeraikela, West Singhbhum, Jharkhand 1880
7 Bangalore, Karnataka 1815	59 Saranda, West Singhbhum, Jharkhand 1880–82
8 Nandidurg, Karnataka 1815	60 Visakhapatnam, Andhra Pradesh 1880
9 Rhowra, Maharashtra 1816	61 Berambadi, Karnataka 1882
10 Sholapur, Maharashtra 1816, 1830	62 Faridkot, Punjab 1883
11 Ajanta Ghat, Maharashtra 1817	63 Tanga, Gujarat 1884
12 Khandesh, Madhya Pradesh 1817	64 Palamau, Jharkhand 1877, 1880, 1885, 1907, 1926, 1935
13 Nagpur, Maharashtra 1818, 1916	65 Chhindwara, Madhya Pradesh 1887, 1919, 1926
14 Kannur, Karnataka 1819	66 Hyderabad, Andhra Pradesh 1887, 1890–1910, 1891, 1892, 1903, 1911, 1914, 1932, 1934, 1935, 1957
15 Farrukhabad, Uttar Pradesh 1825	67 Moyar-Bhavani River, Tamil Nadu 1887
16 Cotiady, Kerala 1825	68 North Arcot, Tamil Nadu 1889
17 Hunsur, Mysore, Karnataka 1825	69 Akola, Maharashtra 1890
18 Agra, Uttar Pradesh 1827, 1835, 1840, 1876	70 Attikalpur, Karnataka 1890–95
19 Kathiawar, Gujarat 1829–1910, 1884–1902	71 Melghat, Maharashtra 1890, 1894
20 Rajkot, Gujarat 1829, 1880, 1894	72 Berar, Akola, Maharashtra 1892, 1896, 1910
21 Deesa, Gujarat 1830	73 Kapurthala, Punjab 1892–93
22 Lucknow, Uttar Pradesh 1837, 1845	74 Dhamangaon, Maharashtra 1894
23 Kulladghee, Karnataka 1839–40	75 Coimbatore, Tamil Nadu 1895
24 Kutch, Gujarat 1839, 1872	76 Buldhana, Maharashtra 1896, 1912
25 Bharatpur, Rajasthan 1840	77 Marsan, Aligarh, Uttar Pradesh 1896
26 Indore, Madhya Pradesh 1850, 1856, 1932	78 South Canara, Karnataka 1896, 1901, 1903
27 Mahall Gorasi, Burhanpur, Madhya Pradesh 1850	79 Surguja, Chhattisgarh 1900–17, 1936, 1941
28 Seonee (Seoni), Madhya Pradesh 1850, 1925	80 Nowgong, Madhya Pradesh 1903
29 Banda, Maharashtra 1857	81 Sihawa, Raipur, Chhattisgarh 1904, 1905
30 Jalna, Maharashtra 1858, 1867, 1925	82 Kothali, Kolhapur, Maharashtra 1905
31 Baroda, Gujarat 1860, 1875, 1878	83 Wankaner, Gujarat 1907, 1910
32 Jaipur, Rajasthan 1860, 1889, 1930	84 Durg dist., Chhattisgarh 1910
33 Kolhapur, Maharashtra 1860	85 Hemgir, Odisha 1910
34 Madurai, Tamil Nadu 1860, 1901, 1903	86 Palkot, Jharkhand 1910
35 Charkhari State, Uttar Pradesh 1860	87 Rewa, Madhya Pradesh 1911–25, 1925, 1927
36 Alirajpur, Madhya Pradesh 1863	88 Ranipur, Betul, Madhya Pradesh 1912
37 Sardarpur, Dahod, Gujarat 1864	89 Chikmangalur, Karnataka 1914
38 Pursad, Rajasthan 1865	90 Patiala, Punjab 1915
39 Punjab 1867–1900, 1880	91 Nagar-Untari, Garhwa, Jharkhand 1923
40 Sind, Pakistan 1867–1900	92 Prabhas Patan, Gujarat 1924
41 Etola, Gujarat 1870	93 Jabalpur, Madhya Pradesh 1925
42 Nellore, Andhra Pradesh 1870	94 Talcher, Odisha 1932, 1939
43 Bolampatti, Kerala 1871	95 Gwalior State, Madhya Pradesh 1932
44 Kottamangalam, Tamil Nadu 1871	96 Deccan, Karnataka 1936
45 Jafrabad, Jalna, Maharashtra 1871	97 Visavadar, Gujarat 1940
46 Mirzapur, Uttar Pradesh 1872–73, 1894–1919, 1916, 1918, 1919, 1927	98 Koriya, Chhattisgarh 1947, 1951, 1967, 1967–68
47 Chota Nagpur, Jharkhand 1874	99 Chittoor, Andhra Pradesh 1952
48 Madoopore, Murshidabad, West Bengal 1874	100 Bahawalpur, Pakistan 1954
49 Tirunelveli dist., Tamil Nadu 1874, 1875	101 Turbat, Pakistan 1968
50 Bellary dist., Karnataka 1875, 1912	102 Makran Coast, Pakistan 1972, 1977–78, 1985
51 Madras Presidency, Tamil Nadu 1875, 1876	103 Danto, Hazaribagh, Jharkhand 1975
52 Somij, Jharkhand 1875	104 Chagai Plains, Pakistan 1997
	105 Ormara, Pakistan 1997

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ARCHIVES

BL: British Library: Oriental & India Office Collections.
IOL: India Office Library and Records, London: Agriculture and Forests (89912)
NAI, H(P): National Archives of India, New Delhi: Home (Public) Department

REFERENCES

AJAIGARH, SAWAI MAHARAJA SIR RANJOR SINGH OF (1914): Yudhabodha Mrigayabinoda. Standard Press, Allahabad.

ALEXANDER, R.D.T. & A. MARTIN-LEAKE (1932): Some Signposts to Shikar. Bengal Nagpur Railway, Calcutta.

ALI, SÁLIM (1935): The Wild Animals of the Indian Empire and the Problems in their Preservation: No. 8 Hyderabad State. *J. Bombay Nat. Hist. Soc. 38(1)*: 74–83.

ALI, SYED NAWAB (ED.) (1930): *Mirat-i Ahmedi* of Ali Muhammad Khan. Oriental Institute, Baroda, p. 130.

ALLEN, G.O. (1919): Caracal (*Felis caracal*) and Hunting Leopard (*Cynaelurus jubatus*) in Mirzapur, U.P. *J. Bombay Nat. Hist. Soc. 26(4)*: 1041.

ANONYMOUS (1830): Hunting near Deesa. *Oriental Sporting Magazine 1(8)*: 393–395. Henry S. King Co., London, 1873.

ANONYMOUS (1881): Report on the Administration of the Madras Presidency, during the year 1880–81. Government Press, Madras.

ANONYMOUS (1935): The Wild Animals of the Indian Empire and the Problems in their Preservation: Part III. *J. Bombay Nat. Hist. Soc. 37*: 114–115.

BADEN-POWELL, SIR ROBERT (1915): Indian Memories: Recollections of Soldiering, Sport, etc. Herbert Jenkins Ltd, London.

BAKER, EDWARD E. (1887): Sport in Bengal and How, When and Where to Seek It. Ledger, Smith & Co., London.

BEVAN, MAJOR H. (1839): Thirty Years in India, Or a Soldier's Reminiscences of Native and European Life in the Presidencies, from 1808 to 1838. 2 vols. Pelham Richardson, London.

BIKANER, M.K. SADULSINGHJI OF (1926): Big Game Diary. (Unpublished)

BLANFORD, W.T. (1888): The Fauna of British India, Mammalia, Vol. I. Taylor & Francis, London.

BLOCHMANN, H.I. (1873): The Ain-i Akbari by Abul Fazl. Vol. I, 2nd edn, revised and edited by Lt Col. D.C. Phillot. Oriental Reprints, New Delhi, 1977.

BOSWELL, A.C. (1873): A Manual of Nellore. Government Press, Madras.

BRADDON, SIR EDWARD (1895): Thirty years of Shikar. William Blackwood & Sons, Edinburgh.

BUDDLE, ANNE (1990): Tigers Round the Throne: The Court of Tipu Sultan (1750–1799). Zamana Gallery, London.

BURKE, W.S. (1920): The Indian Field Shikar Book. Thacker, Spink & Co., Calcutta.

BURTON, BRIG. GEN. R.G. (1920): The Hunting Leopard (*Cynaelurus jubatus*). *J. Bombay Nat. Hist. Soc. 27(2)*: 397–398.

BURTON, BRIG. GEN. R.G. (1928): Sport & Wild Life in the Deccan: An Account of Big-game Hunting During Nearly Forty Years of Service in India. Seeley Service & Co. Ltd, London.

BURTON, BRIG. GEN. R.G. (1936): The Tiger Hunters. Hutchinson & Co., London.

BURTON, LT. COL. R.W. (1959): The Voice of the Cheetah or Hunting Leopard (*Acinonyx jubatus* Erxleben). *J. Bombay Nat. Hist. Soc. 56(2)*: 317–318.

CAMPBELL, COL. WALTER (1864): My Indian Journal. Edmonston & Douglas, Edinburgh.

CARMICHAEL, DAVID FREEMANTLE (Comp. & Ed.) (1869): A Manual of the District of Visagapatam in the Presidency of Madras. W. Thomas, Madras.

CAUNTER, REV. HOBART (1837): The Oriental Annual: Lives of the Moghul Emperors. Charles Tilt, London.

CLAY, CHARLES E. (1901): The Hunting Leopard of India. *Outing: An illustrated magazine of sport, travel, adventure and country life 37 (October 1900–March 1901)*: 706–709. [Edited by Caspar Whitney. The Outing Publishing Company, New York, London]

COBDEN-RAMSAY, L.E.B. (1910): Feudatory States of Orissa. *Bengal Gazetteers*. Bengal Secretariat Book Depot. Reprinted by Firma K.L.M. Pvt. Ltd, Calcutta, 1982.

CRAIGHEAD, JOHN H. & FRANK C. CRAIGHEAD JR (2001): Life with an Indian Prince. Archives of American Falconry, Bois, Idaho. xx +278 pp.

CUMMINGS, LT. COL. W. GORDON (1871): Wild Men & Wild Beasts: Scenes in Camp and Jungle. Edmondston & Douglas, Edinburgh.

CUTTING, SUYDAM (1947): The Fire Ox and Other Years. Collins, London. 393 pp.

CZECH, KENNETH P. (2003): An Annotated Bibliography of Asian Big Game Hunting Books, 1780 to 1980. Land's Edge Press, St Cloud, Minnesota. 254 pp.

DESAI, SHAMBHUPRASAD HARPRASAD (1983): Gir. Prabhas Prakashan, Junagadh.

D'EWES, J. (1858): Sporting in Both Hemispheres. 2nd edn. G. Routledge & Co., London.

DIVYABHANUSINH (1995): The End of a Trail: The Cheetah in India. Oxford University Press, New Delhi.

DIVYABHANUSINH (2006): The End of a Trail: The Cheetah in India. 3rd edn. Oxford University Press, New Delhi.

DIVYABHANUSINH & M.K. RANJITSINH (2013): Lion and Cheetah in India: A Critique. *J. Bombay Nat. Hist. Soc. 110(1)*: 3–21.

DUNBAR BRANDER, A.A. (1923): Wild Animals in Central India. Edward Arnold & Co., London.

DUNBAR, JANET (1955): Golden Interlude: The Edens in India, 1836–1842. John Murray, London.

FABB, JOHN (1986): The British Empire from Photographs: India. B.T. Batsford Ltd, London.

FARAHDINIA, MOHAMMAD, HASAN AKBARI, MORTEZA ESLAMI & MOHAMMAD ALI ADIBI (2016): A review of ecology and conservation status of Asiatic Cheetah in Iran. *Cats in Iran, Special Issue No. 10, Cat News IUCN/SSC.* Kora, Switzerland.

FAYRER, SIR J. (1879): Notes of the Visits to India of Their Royal

Highnesses The Prince of Wales and Duke of Edinburgh 1870–1875-6. Kerby & Endean, London.

Fenton, Lt. Col. L.L. (c. 1924): The Rifle in India, Being the Sporting Experiences of an Indian Officer. W. Thacker & Co., London.

Finn, Frank (1929): Sterndale's Mammalia of India. Thacker, Spink & Co., Calcutta. pp. 96–98.

Forbes, James (1813): Oriental Memories: Selected and abridged from a series of familiar letters written during seventeen years of residence in India, etc. White, Cochrane & Co., London.

Forbes-Lindsay, C.H. (1903): India: Past and Present. Vol. I. The C.H. John C. Winston Co., Philadelphia.

Forsyth, Capt. J. (1889): The Highlands of Central India: Notes on their forests and wild tribes, natural history, and sports. New edn, Chapman & Hall Ltd, London.

Fraser, Lt. Col. T.G. (1881): Record of Sport and Military Life in Western India. W.H. Allen & Co., London.

Gardner, Mrs Alan (1895): Rifle and Spear with the Rajputs: Being the narrative of winter's travel and sport in Northern India. Chatto and Windus, London.

Gerrard, Lt Gen. Sir Montague (1903): Leaves from the Diary of a Soldier and Sportsman. John Murray, London.

Hallett, M.G. (1917): Bihar and Orissa District Gazetteers: Ranchi, Patna. Superintendent, Government Printing, Bihar and Orissa, Patna.

Halliday, Emma (1857): Letter dated 7th April to Spencer Wyndham. Collection of Raleigh Trevelyan.

Hamilton, Gen. Douglas (1892): Records of Sport in Southern India chiefly on Annamullay, Nielgherry and Pulney Mountains, etc. R.H. Porter, London.

Hardinge, Lord (1933): On Hill and Plain. John Murray, London.

Hewett, J.P. (1938): Jungle Trails in Northern India, Reminiscences of Hunting in India. Methuen, London.

Hicks, F.C. (1910): Forty Years Among the Wild Animals of India: From Mysore to the Himalayas. Pioneer Press, Allahabad.

Hoffmeister, W. (1858): Travels in Ceylon and Continental India; including Nepal and other parts of the Himalayas, to the borders of Tibet. William P. Kennedy, Edinburgh.

Houlton, J.W. (1949): Bihar the Heart of India. Orient Longmans, Bombay.

Hunter, W.W. (1877): A Statistical Account of Bengal, Vol. 16, Districts of Hazaribagh and Lohardaga. Trübner & Co., London.

Hussain, Maulvi Vilayat (1891): The Tarikh-i-Firoz Shahi of Shams Siraj Afif. The Asiatic Society, Calcutta.

Jerdon, T.C. (1867): The Mammals of India: A Natural History of all the Animals known to inhabit Continental India. John Wheldon, London.

Johnson, Douglas (1827): Sketches of Indian Shikar with observations on Animals, etc. Robert Jennings, London.

Jones, Horace Leonard (Tr.) (1966): The Geography of Strabo. Harvard University Press. Cambridge, Mass.

Jung, Major Nawab Afsar (1893): Shikar Nama of Nizam, Hyderabad. Tr. by Siraj A. Taher (Unpublished).

Jung, Nawab Qutub Yar (1945): Shikar. Rahimiya Press, Hyderabad. Tr. by Siraj A. Taher (Unpublished).

Kazmi, Raza (2012): Jharkhand's Last Hunting Leopards. Special Feature. *Zoo's Print XXCII(4)*: 1–36.

Kazmi, Raza (2014): The Hunting Leopard of Saranda. *Sanctuary Asia 25(2)*: 44–49.

Kazmi, Raza (2016): Where the wild things were. *Indian Express*, October 02, 2016. New Delhi.

King Martin, D. (1935): The Ways of Man and Beast in India. Wright and Brown, London.

Kinloch, Col. A.A. Alexander (1885): Large Game Shooting in Thibet, The Himalayas and Northern India. Thacker Spink & Co., Calcutta.

Kipling, John Lockwood (1892): Beast and Man in India: A popular sketch of Indian Animals in relation with the People. Macmillan & Co., London.

Kirkpatrick, K.M. (1952): A Record of the Cheetah *(Acinonyx jubatus* Erxleben) in Chittoor District, Madras State. *J. Bombay Nat. Hist. Soc. 50(4)*: 931–932.

Kossak, Steven (1997): Indian Court Painting: 16th–19th Century. The Metropolitan Museum of Art, New York.

Larking, Col. Cuthbert (1888): Bandobast and Khabar: Being reminiscences of India. Hurst and Blackett Ltd, London.

Lothian, Sir Arthur Cunningham (1951): Kingdoms of Yesterday. John Murray, London.

Lowrie, A.D. (1910): Central Provinces, District Gazetteers, Drug District. Vol. A, Descriptive. B.M. Press, Calcutta.

Lydekker, R. (1907): The Game Animals of India, Burma, Malaya and Tibet. 2nd edn. Revised by J.G. Dollman, Rowland Ward Ltd, London, 1924.

Manakadan, R. (1988): 'Shikaris of Nandikottur'. *Hornbill (2):* 18–20.

Mc Crindle, John Watson (1901): Ancient India as described in Classical Literature. Philo Press, Amsterdam, 1971.

McMaster, Andrew Cooke (1871): Notes on Jerdon's Mammals of India. Higginbotham, Madras.

Morris. R.C. (1935): Distribution of the Hunting Leopard (*Acinonyx jubatus* Erxl.) in South India. *J. Bombay Nat. Hist. Soc. 38(2)*: 386–387.

Morris. R.C. (1936): Further record of the distribution of the Cheetah (*Acinonyx jubatus* Erxl.) in South India. *J. Bombay Nat. Hist. Soc. 38*: 610.

Mundy, Captain (1833): Pen and Pencil Sketches, being the Journal of a Tour of India. Vol. I, 2nd edn. John Murray, London.

Murray, James (1884): The Vertebrate Zoology of Sind: A systematic account of all the known species of mammals, bird and reptiles inhabiting the province. Richardson & Co., London.

Nelson, J.H. (1868): The Madura Country – A Manual. Asylum Press, Madras.

Nelson, A.E. (1909): Central Provinces, District Gazetteers, Raipur District, Vol. A, Descriptive. Byculla Press, Bombay.

Nelson, A.E. (1910): Central Provinces, District Gazetteers, Buldana District, Vol. A, Description. B.M. Press, Calcutta.

Newall, Capt. J.T. (1867): Hog-Hunting in the East and other Sports. Tinsley Brothers, London.

Newall, Maj.-Gen. D.J.F. (1887): The Highlands of India: Vol. II, being a chronicle of field sports and travel in India. Harrison & Sons, London.

Nicholson, F.A. (1887): Madras District Manuals. Vol. II. Edited by Rev. H.A. Stuart, Coimbatore, Madras.

Nott, John Furtune (1886): Wild Animals Photographed and Described. Sampson Low, Marston, Searle & Rivington, London.

O'Malley, L.S.S. (1907): Bengal District Gazetteers: Palamau. The Bengal Secretariat Book Depot, Calcutta.

Orlich, Leopold Von (1842): Travels in India, including Sind and the Punjab. 2 vols. Longman, Brown, Green and Longmans, London.

O'shea, F. Bernard (1890): A Winter Tour in India and Ceylon with a Kathiawar Prince. Times of India Steam Press, Bombay.

Pathan, A.R. (1921): Kolhapur Shikar Album containing Beautiful Illustrations of Wild Beasts and Birds. A.R. Pathan, Royal Photographer, Kolhapur.

Parks, Fanny (1850): Wanderings of a Pilgrim in Search of the Picturesque, During Four and Twenty Years in the East; with Revelations of Life in the Zenana. 2 vols. Pelham Richardson, London.

Playne, Somerset (Compiled by), Bond, J.W. (Assisted by) and Wright,

Arnold (Edited by) (1914–15): Southern India: Its History, People, Commerce, and Industrial Resources. The Foreign and Colonial Compiling and Publishing Co., London.
Pocock, R.I. (1936): The Lion in Baluchistan. *J. Bombay Nat. Hist. Soc. 38(2)*: 381–382.
Pocock, R.I. (1939): The Fauna of British India including Ceylon & Burma. Mammalia. Today & Tomorrow's Printers & Publishers, New Delhi, Reprint 1985.
Pollock, Lt. Col. A.J.O. (1894): Sporting Days in Southern India: Being reminiscences of twenty trips in pursuit of game, chiefly in the Madras Presidency. Horace Cox, London.
Pollok, Fitz William Thomas (1896): Fifty Years' Reminiscences of India; A Retrospect of Travel, Adventure and Shikar. Edward Arnold, London & New York.
Postans, Mrs Marianne (1839): Cutch; or Random Sketches taken during a residence in one of the northern provinces of Western India, etc. Smith, Elder & Co., London.
Prater, S.H. (1948): The Book of Indian Animals. Bombay Natural History Society, Bombay.
Raoul (1893): Reminiscences of Twenty years 'Pig sticking in Bengal'. W. Thacker Spink & Co. Calcutta.
Rangarajan, Mahesh (1998): The role of administration in extinction: fresh evidence of the Cheetah (*Acinonyx jubatus)* in India. *J. Bombay Nat. Hist. Soc. 95(2)*: 328–332.
Rice, William (1857): Tiger-shooting in India: Being an account of hunting experiences on foot in Rajpootana during the hot season, from 1850 to 1854. Smith, Elder & Co., London.
Rice, William (1884): "Indian Game," (From Quail to Tiger). W.H. Allen & Co., London.
Richardson, J.M. (1929): The Hunting Leopard (*Cynaelurus jubatus*) in the Central Provinces. *J. Bombay Nat. Hist. Soc. 34(1)*: 235.
Roberts. T.J. (1977): The Mammals of Pakistan. Ernest Benn Ltd, London.
Rodon, Major G.S. (1897): The Young of the Hunting Leopard. *J. Bombay Nat. Hist. Soc. 11*: 544–546.
Rogers, Alexander & Henry Beveridge (1980): The Tuzuk-i-Jahangiri or Memoirs of Jahangir. Munshiram Manoharlal Pvt. Ltd, New Delhi, 1980.
Rousselet, Louis & Lt. Col. Charles Randolph Buckle (1882): India and its Native Princes, Travels in Central India and in the Presidencies of Bombay and Bengal. Bickers and Son, London.
Russell, C.E.M. (1900): Bullet and Shot in Indian Forest, Plain, and Hill. W. Thacker and Co., London.
Sanderson, G. (1878): Thirteen Years among the Wild Beasts of India: Their Haunts and Habits from Personal Observation; With an Account of the Modes of Capturing and Taming Elephants. W.H. Allen & Co. Ltd, London.
Sanyal, Ram Brahma (1892): A Hand-Book of the Management of Animals in Captivity in Lower Bengal. Bengal Secretariat Press, Calcutta.
Scholfield, A.F. (Tr.) (1959): Aelian: On the Peculiarities of Animals. Harvard University Press, Cambridge, Mass.
Seshadri, Balakrishna (1969): The Twilight of India's Wildlife. John Baker Publishers, London.
Shahaji Maharaj, Maj. Gen. H.H. Chhatrapati (1994): His Highness Shri Shahu Chhatrapati Maharaja's Shikar and Conservation. *In*: P.B. Salunkhe (Ed.): Chhatrapati Shahu, the Pillar of Social Democracy. Government of Maharashtra Education Department, Bombay, pp. 220.
Shakespear, Capt. Henry (1860): The Wild Sports of India: With remarks on the breeding and rearing of horses, and the formation of light irregular cavalry. Smith, Elder & Co., London.
Sharar, Maulana Abdul Halim (1965): Guzashta Lucknow. Lucknow Bhuvan Vani Trust, Lucknow.
Shrigondekar, G.K. (Ed.) (1939): Mānasollāsa of King Somesvara. Vol. II. Oriental Institute, Baroda.
'Silver Hackle' (A.G. Suttleworth) (1929): Jungle Lore and the Rifle: Being notes on shikar and wild animals. Thacker, Spink & Co., Calcutta.
S.M.S. (1830): Description of the Hunting Leopard. *The Oriental Sporting Magazine II(X)*: 7–9. Henry S. King & Co., London, 1873.
Smith, Mervyn A. (1904): Sport and Adventure in the Indian Jungle, with illustrations from original drawings and photographs. Hurst & Blackett Ltd, London.
Spry, Henry Harpur (1837): Modern India; with illustrations of the resources and capabilities of Hindustan. 2 vols. Vol. I. Whittaker & Co., London.
Stephan, Ian (1954): Bahawalpur State. *Geographical: The Royal Society Magazine*, November, p. 328.
Sterndale, Robert A. (1877): Seonee or Camp Life on the Satpura Range; a tale of Indian adventure. Sampson Low, Marston, Searle & Rivington, London.
Sterndale, Robert A. (1884): Natural History of the Mammalia of India and Ceylon. Thacker, Spink & Co., Calcutta.
Stockley, Lt. Col. C.H. (1928): Big game shooting in the Indian Empire. Oxford University Press, Bombay.
Stoliczka, F. (1872): Notice of the mammals and birds inhabiting Kachh. *Journal of the Asiatic Society of Bengal XLI (CLXXVII)*: 211–260.
Tallents, P.C. (1926): Bihar and Orissa District Gazetteers: Palamau. Rev. edn. Superintendent, Government Printing, Patna.
Thompson, Edward (1932): *London Times* (as quoted in Extinct and Vanishing Mammals of the Old World. American Committee for International Wild Life Protection, New York, 1945).
T.U. (1829): Cheetah Hunt. *The Oriental Sporting Magazine 1(3)*: 103–105. Henry S. King & Co., London, 1873.
Van Ingen & Van Ingen (1942): Letter to the Curator, Natural History Museum, Darjeeling. *Journal of the Bengal Natural History Society 16*: 72–76.
Van Ingen & Van Ingen (1948): Interesting Shikar Trophies: Hunting Cheetah *Acinonyx jubatus* (Schreber). *J. Bombay Nat. Hist. Soc. 47(4)*: 718–719.
Vigne, G.T. (1844): Travels in Kashmir, Ladakh, Iskardo, the Countries adjoining the mountain-course of the Indus, and the Himalaya, north of the Panjab. 2 vols. Vol. I. Indus Publications, Karachi, 1987.
Watson, Major J.W. (1878): Statistical Account of Dhrángadhrá; being the Dhrángadhrá contribution to the Káthiáwár portion of the Bombay Gazetteer. Education Society Press, Byculla, Bombay.
Wilkinson, Osborn & Johnson Wilkinson (1896): The Memoirs of the Gemini Generals, Personal Anecdotes, Sporting Adventures and Sketches of Distinguished Officers. A.D. Innes & Co., London.
Williamson, Capt. Thomas & Samuel Howitt (1807): Oriental Field Sports; being a complete, detailed and accurate description of the wild sports of the East. Edward Orme, London.
Wood, Lt Col. H.S. (1934): Shikar Memories: A record of sport and observation in India and Burma. H.F. & G. Witherby, London.
Woodyat, Maj. Gen. Nigel (1922): My Sporting Memories: Forty Years with Note Book and Gun. Herbert Jenkins Ltd, London.
Worswick, Clark (1980): Princely India, Photographs by Raja Deen Dayal, 1884–1910. Hamish Hamilton, London.

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Appendix 2

Appendix 2

List of participants in the consultative meeting on reintroduction of cheetah in India- Gajner, Rajasthan, India on 9th & 10th September, 2009

1.Shriji Arvind Singh Mewar, Chief Guest
2. Rajesh Gopal- Member Secretary, National Tiger Conservation Authority
3. P. R. Sinha- Director, Wildlife Institute of India
4. Anmol Kumar- Deputy Inspector General, MoEF, Government of India
5. R. S. Negi- Chief Wildlife Warden, Government of Madhya Pradesh
6. R. N. Mehrotra- Chief Wildlife Warden, Government of Rajasthan
7. B. N. Srivastava- Chief Wildlife Warden, Government of Gujarat
8. N. K. Bhagat- Chief Wildlife Warden, Government of Chhattisgarh
9. Stephen J. O' Brien- Chief, Laboratory of Genomic Diversity, National Cancer Institute, USA
10. Y. V. Jhala- Scientist, Wildlife Institute of India
11. Laurie Marker- Executive Director, Cheetah Conservation Fund, Namibia
12. Bruce Brewer- General Manager, Cheetah Conservation Fund, Namibia
13. Divyabhanusinh Chavda- President, WWF India
14. Asad Rahmani- Director, Bombay Natural History Society
15. Urs Breitenmoser- Co-Chair, IUCN Cat Specialist Group
16. Richard Kock- Co-Chair, IUCN Veterinary Specialist Group
17. Mark R. Stanley Price- Visiting Fellow, WILDCru, Oxford University; IUCN Reintroduction Group
18. T. P. Singh- Head, ELG I, International Union for Conservation of Nature
19. Annie Beckhelling- Founder, Cheetah Outreach, South Africa
20. Deon Cilliers- Scientist, Endangered Wildlife Trust, South Africa
21. Devaka Weerakoon- International Union for Conservation of Nature
22. Biren Bhutia- International Union for Conservation of Nature
23. Rajpal Singh- Wildlife Expert, Rajasthan
24. M. K. Ranjitsinh- Chairman, Wildlife Trust of India
25. Vivek Menon- Executive Director, Wildlife Trust of India
26. Rahul Kaul- Director, Wildlife Trust of India
27. N. V. K. Ashraf- Director, Wildlife Trust of India

Appendix 3

Action Plan for the Reintroduction of the Cheetah (*Acinonyx jubatus*) in Kuno-Palpur Wildlife Sanctuary Madhya Pradesh

Cheetah Task Force
Madhya Pradesh Forest Department
Wildlife Institute of India
2011

Cover page Photos:
Cheetah photograph by Chris Johns (National Geographic photograph)
Kuno Wildlife sanctuary photograph by Bipin CM

Action Plan for the Reintroduction of the Cheetah (*Acinonyx jubatus*) in Kuno-Palpur Wildlife Sanctuary, Madhya Pradesh

Principal Investigators

Dr.H.S.Pabla | Dr. M.K. Ranjitsinh | Dr. Y.V. Jhala

Madhya Pradesh Forest Department Personnel

Dharmendra Shukla | Anand Kumar | Ashok Mishra

Cheetah Task Force

Dr. Divyabhanusinh Chavda

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Dr. Laurie Marker (CCF Namibia)

Wildlife Institute of India Research Team

Aarti Singh
Bipin CM
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Agencies

Cheetah Task Force | **Madhya Pradesh Forest Department** | **Wildlife Institute of India**

National Tiger Conservation Authority

2011

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Appendix

Action Plan for the Reintroduction of the Cheetah (*Acinonyx jubatus*) in Kuno-Palpur Wildlife Sanctuary Madhya Pradesh

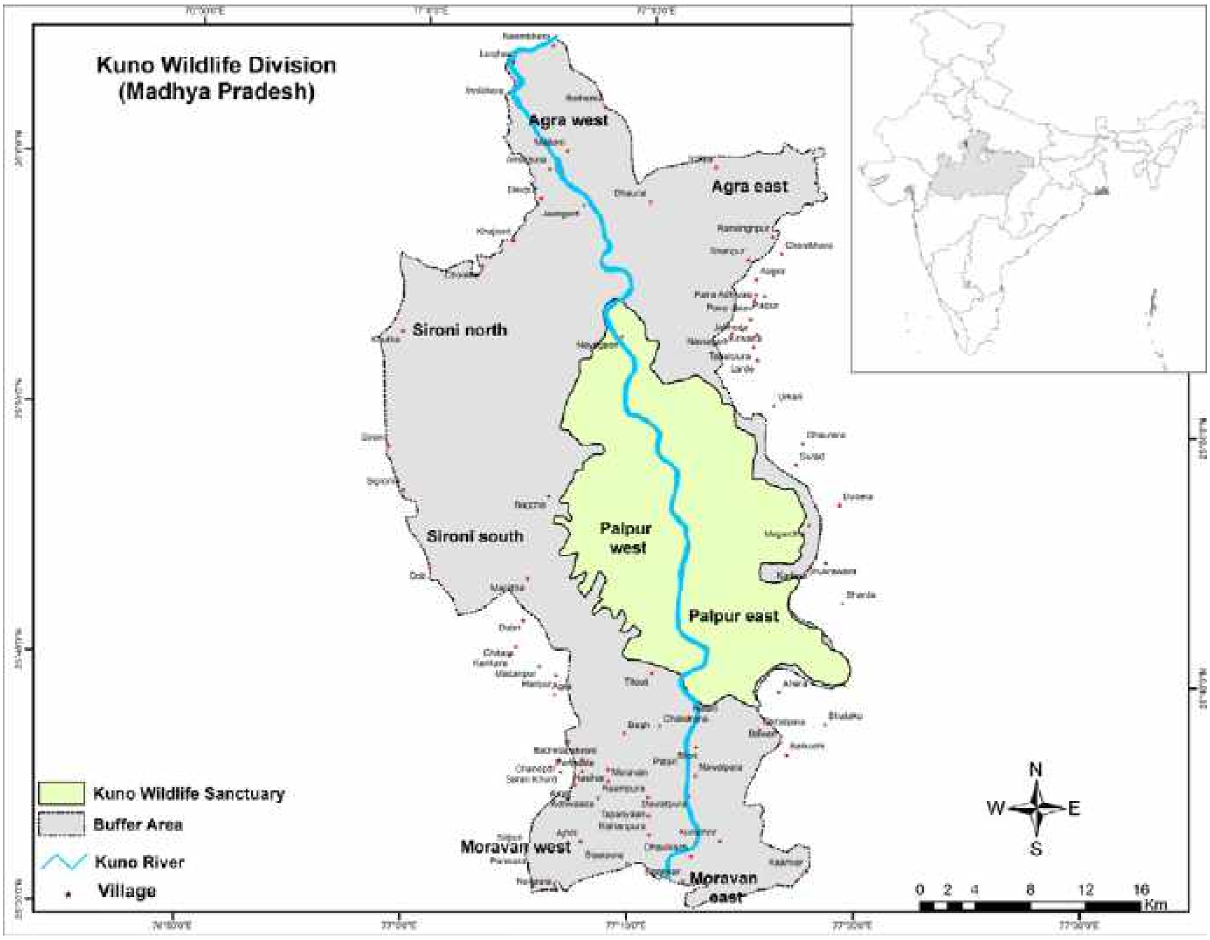
Background

Cheetah (*Acinonyx jubatus venaticus*), which has been an integral part of the Indian heritage, folklore and culture since times immemorial, went extinct in India by the middle of the twentieth century. This loss has been attributed, apart from overhunting of the species and its prey, to the loss of its primary habitat, the arid and semi arid grasslands to their conversion into agriculture. This is the only recorded extinction of a large mammal in India, in historical times, as the country has been able to save all other major species, despite exploding human population and consequent pressure on natural resources. The country has been able to preserve several critical ecosystems in the name of iconic flagship species such as the tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*), gharial (*Gavialis gangeticus*), the great one-horned rhinoceros (*Rhinoceros unicornis*), amongst others that inhabit such habitats. However, the grassland and scrub-thorn forest ecosystems have been declining as they are generally considered a wasteland by the public and a *blank* by forest departments. As nearly all the productive grasslands have been converted into croplands, the principal prey of the cheetah in these habitats, the blackbuck (*Antilope cervicapra*), is also living a very precarious life due to its conflict with the agrarian communities.

The Government of India (GoI) started contemplating the reintroduction of the cheetah, as a means of reviving and preserving the remaining grasslands and dry forest systems of India, in 2009, when a meeting of national and international experts was called at Gajner, Rajasthan, on September 9th and 10th to discuss the prospects. The participants supported the idea wholeheartedly and proposed a nationwide assessment of potential reintroduction sites. The task of carrying out this assessment was entrusted to the Wildlife Institute of India (WII) and the Wildlife Trust of India (WTI). Dr. Y.V. Jhala, a senior faculty member of WII and Dr. M.K. Ranjitsinh, Chairman WTI, carried out a rapid assessment of ten potential sites, encompassing the states of Rajasthan, Madhya Pradesh (MP), Gujarat, Chattisgarh and Uttar Pradesh, in terms of the size and quality of the available habitat, prey base, scope of future development etc. and recommended that three sites, Kuno-Palpur and Nauradehi Wildlife Sanctuaries in MP, and Shahgarh area in Rajasthan, as the most promising ones. Although the Shahgarh area in Rajasthan is the largest potential cheetah habitat available in the country, but currently it has no legal protection under the Wildlife (Protection) Act, 1972. The Nauradehi Sanctuary has adequate prey base but has 52 villages in it, nearly 15 of which will need immediate relocation, involving large investments and other inputs. The Kuno Wildlife Sanctuary (WLS) in north western MP has been adjudged as ready in most respects for immediate reintroduction of cheetah, as it has adequate prey base, and virtually no human population within it and a relatively low human population in the adjoining forests, which are fairly open. Therefore, it was decided to begin the reintroduction of this species in India with the Kuno Wildlife Sanctuary. The GoI constituted the Cheetah Task Force (CTF) under the chairmanship of Dr. M.K. Ranjitsinh to steer and facilitate the process of reintroduction, on 1st September, 2010.

Consequent to the decision to start the process in the Kuno WLS, the Wildlife Institute of India carried out a fresh assessment of the status of the prey base in the Sanctuary, in the summer of 2011 and found it to be nearly 27-50 animals per sq km (**Annexure I**), which is similar to many good Protected Areas of the country. A team consisting of Dr. Ranjitsinh, Dr. Divyabhanusinh Chavda, Dr. YV Jhala, accompanied by the eminent cheetah expert, Dr. Laurie Marker, Director of the Cheetah Conservation Fund (CCF) in Namibia, along with the senior forest officers of the State (Dr. H.S. Pabla, Principal Chief Conservator of Forests (PCCF), Sh. D.Shukla, Additional PCCF, Sh. A. Kumar, Chief Conservator of Forests (CCF) and Sh. A. Mishra, Divisional Forest Officer (DFO)), extensively toured the Sanctuary, on 6-9 August 2011, and produced this Project Document, after detailed discussions.

Fig. 1: Kuno Wildlife Division



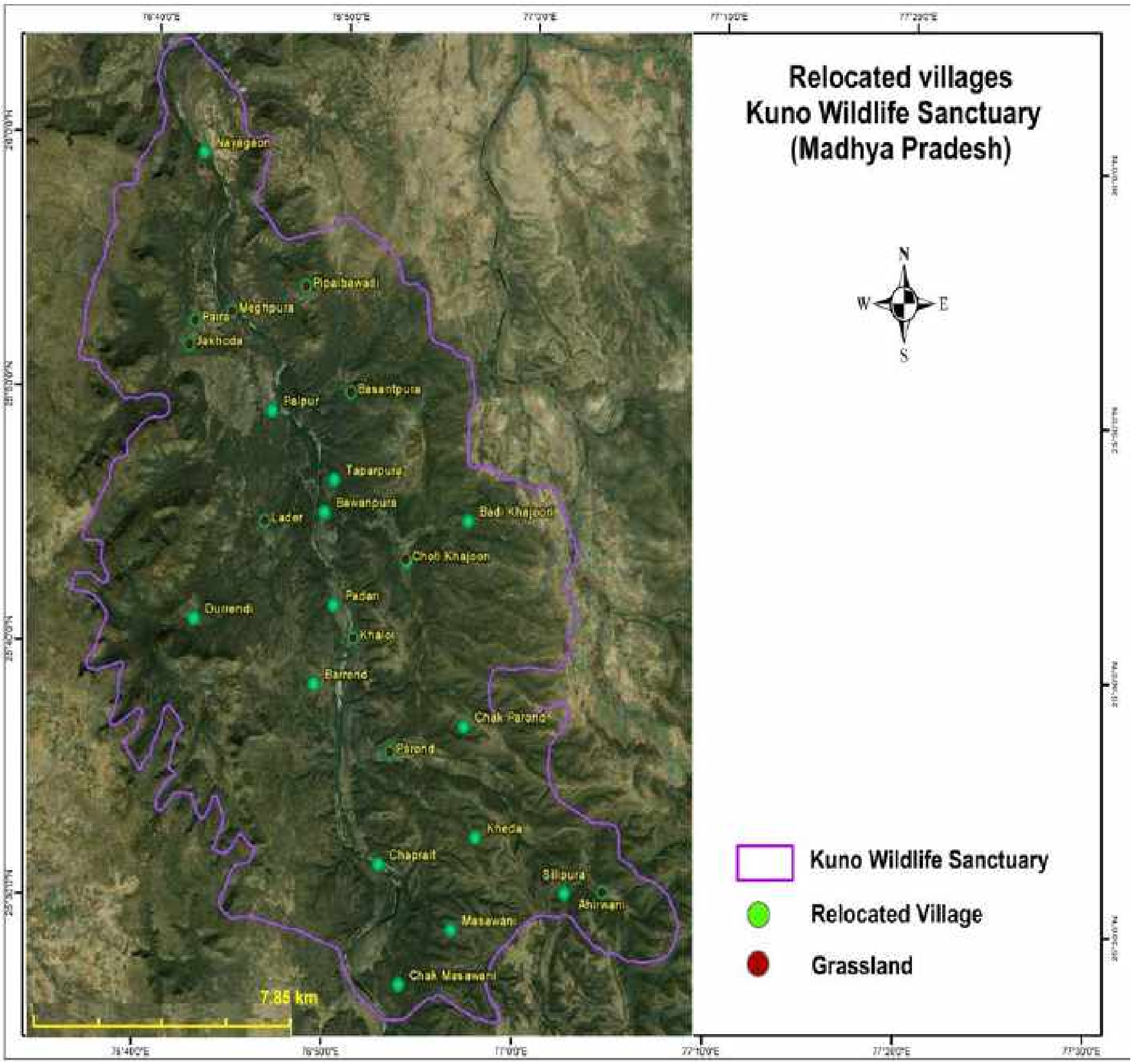
The Kuno WLS (344.68 sq km) was one of the important hunting reserves of the Gwalior rulers and was notified as a WLS in 1981 (Fig. 1). The Sanctuary is classified under the Semi-arid – Gujarat Rajputana (zone 4B) biogeographic zone (Rodgers *et al.* 2002). It is a dry deciduous forest, consisting mainly of *Anogeissus pendula*, *Acacia catechu* and *Boswellia serrata* communities and their associated flora. The average maximum summer temperature has been reported as 42.3° C, while the lowest winter temperatures are between 6 and 7° C (Chaudhary 2001). The average annual rainfall in the area is about 760 mm (Banerjee 2005).

Fig.2: Images of the Kuno Wildlife Sanctuary in the two seasons.

a. Summer season b. Rainy season

It is almost free from human habitation, as 23 of the 24 villages that existed here have already been relocated outside, as a part of the lion reintroduction programme of GoI, which unfortunately could not happen. The sites of the relocated villages have evolved into large grasslands, extending in size to as much as 1500 ha in some cases (Fig. 3). The terrain of the Sanctuary is flat and undulating with some hillocks dotting the landscape. The density of the forests varies, as expected, but, significantly, the forest floor in most forest types supports rather luxuriant growth of grasses and other fodder plants. The dominant tree species, *Anogeissus pendula*, itself is a very important fodder species of the region. The Sanctuary is inhabited by all the usual animals of the region, such as leopard (*Panthera pardus*), wolf (*Canis lupus*), jackal (*Canis aureus*), Indian fox (*Vulpes bengalensis*), striped hyena (*Hyaena hyaena*) among carnivores and spotted deer (*Axis axis*), sambar deer (*Rusa unicolor*), nilgai (*Boselaphus tragocamelus*), chinkara (*Gazella bennetti*), wild pig (*Sus scrofa*), chowsingha (*Tetracerus quadricornis*) and blackbuck (*Antelope cervicapra*), amongst herbivores.

Fig. 3: Location of villages that were relocated and the resulting availability of grassland in Kuno WLS



The perennial Kuno river flows through the middle of the Protected Area (PA), providing assured water supply to the denizens throughout the year. The potential of the PA to support high densities of wild animals can be adjudged from the fact that a former maharaja of Kolhapur is believed to have shot 28 tigers in a hunt lasting just 32 days, in 1950's. The PA had a small tiger population until 2004-2005, but now it reports only occasional presence of tigers dispersing from the Ranthambhore Tiger Reserve of Rajasthan, which is only about 60 km away. One tiger, identified as T-38 of Ranthambhore, has been resident in the Sanctuary for several months now. Occasional presence of wild dog (*Canis alpinus*) is also reported from the Sanctuary.

The predominant community of people in this area is Sahariya tribe, which is a subcaste of the Gonds, reside all around the Sanctuary. The Bhil community, original residents of Jabhua and Ratlam districts in Madhya Pradesh, have settled on the north-west, west and south- western side of the park. The Moghiya tribe, notorious for their hunting abilities, though low in numbers, dwells all around the park (Appendix 7). Pastoralist communities in the area are Gurjar and Yadav who also practise agriculture. The other communities are Dhakad, Jatav and Thakur, who own some of the largest agricultural holdings. It is possible to extend the habitat that is free from any human habitation to nearly 600-700 sq km by relocating only 3 more villages (Bagcha, Jaangarh & Maratha) and about 35 households of Nayagaon village which had been relocated and thereafter come back to the old site within the Sanctuary, although the total landscape which can ultimately be inhabited by cheetah may be more than 3000 sq km in Sheopur, Shivpuri and Morena districts (Ranjitsinh & Jhala, 2010). The adjoining forests covering nearly 970 sq km (the buffer zone) are already managed and administered by the Sanctuary management, extending the current habitat availability to more than 1200 sq km.

Research into cheetah biology and ecology has greatly increased our understanding of the fastest land animal and education programmes for schools and the farming community help change public attitudes to allow predator and humans to co-exist (Cheetah Conservation Fund). The local communities should be made aware of the fact that cheetah is one carnivore whose conflict with humans and livestock reports throughout the world has been minimal. Cheetahs are the least dangerous of big cats- there is no record of a wild cheetah ever killing a human- and they create fewer problems (IUCN SSC Cat Specialist Group). In Namibia, research shows that cheetahs were only responsible for 3% of livestock losses to predators (Marker, 2002). The co-existence of the locales with the wildlife will play a crucial role in making a larger forested landscape available for the cheetah as well as better management of wildlife too.

Large Carnivores

The Kuno Wildlife Sanctuary was selected as the second home of the Asiatic lion (*Panthera leo*) (Johnsingh *et. al*., 2006), for which 23 of the 24 villages situated within the Sanctuary have already been relocated. However, the Asiatic Lion introduction proposal has met with a deadlock with the Gujarat Government's unwillingness to part with "their" Lions. The issue is sub judice with the Supreme Court of India. In the event, Honourable Supreme Court rules in favour of introducing Lion into Kuno then the question arises if such an introduction would be detrimental for the cheetah. Lions compete with cheetah for food as well as often kill them in Africa. However, lions and cheetah have coexisted in India in the past and do coexist currently in several parts of Africa. Therefore, if there is sufficient prey and cover lion and cheetah can potentially coexist in the Kuno-Sheopur-Shivpuri landscape as well. The caveat being that lions should be brought into Kuno only after the reintroduced cheetah population has established and bred successfully for some years. By this time, the prey base in Kuno WLS would have substantially increases to support a high diversity and abundance of large population of carnivores including cheetahs, lions, tigers and leopards. Cheetahs being least dominant of these carnivores would sometimes be killed by these carnivores, but that would be a natural process and management by appropriate supplementation and recruitment from the introduced population would compensate these.

If the plan to introduce lions in this Sanctuary materialises, this will be the only place where all the four big cats of the region could be resident. The reintroduction of cheetah in no way compromises the prospects of reintroducing lions or promoting tiger occupancy within the landscape. These three large carnivores have been sympatric in historical times (Divyabhanusinh, 2006) and the restorative inputs in Kuno will make the habitat more suitable for such efforts in the future. Sheopur- Shivpuri landscape has historically been tiger country. This landscape was contiguous with Kailadevi- Ranthambore landscape and still retains some habitat connectivity (Jhala *et al* 2011). Habitat management with restorative inputs and protection should assist in developing this corridor connectivity between these two important landscapes further thus resuming the objective of Tiger conservation as well and facilitate the metapopulation structure between Ranthambore and Kuno WLS.

A buffer zone management strategy for Shivpuri-Sheopur-Kuno needs to be developed in line with the National Project Tiger areas landscape management plan guidelines. These guidelines emphasise incentives and enhancement of livelihood of resident communities, compensation for livestock kills, mitigation of human-wildlife conflicts and curtailment of high impact developmental activities.

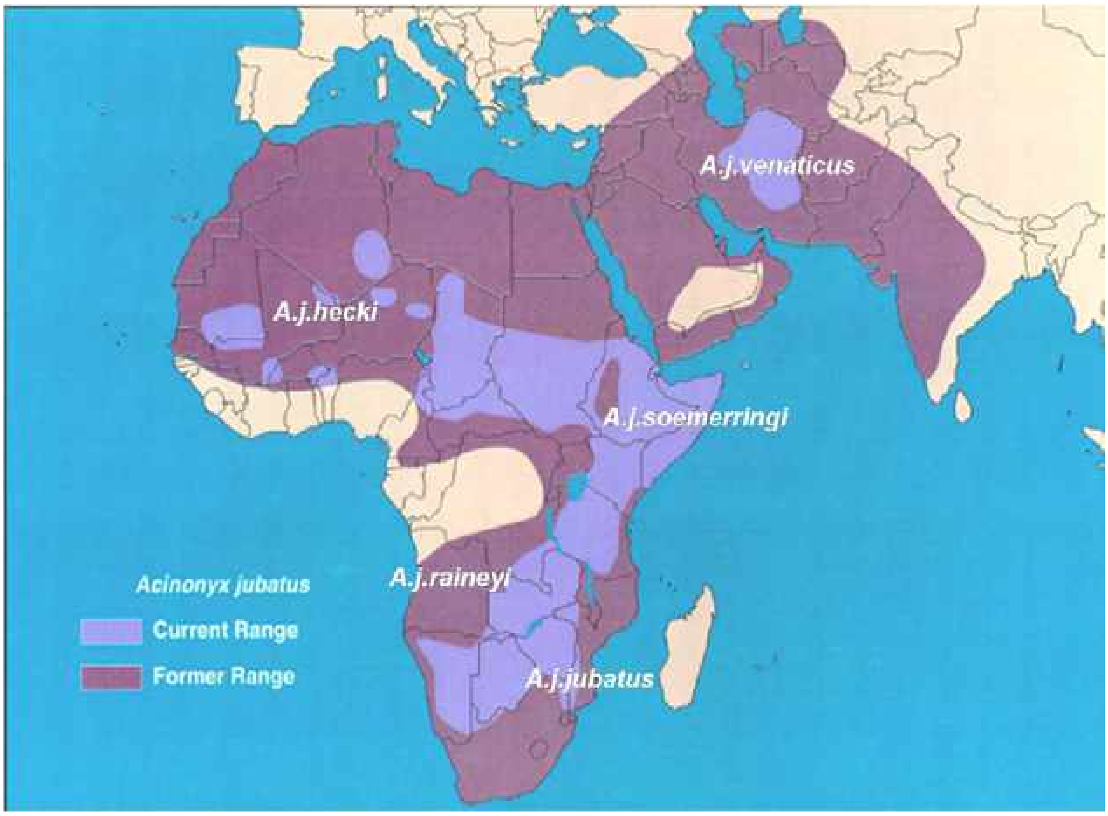
Leopards are already there in Kuno in significant numbers. The density of leopards is about 3 animals/100km^2 (Jhala & Qureshi, 2006 unpub.). It is necessary to clarify that all these predators can co-exist, if adequate prey base and other resources are available.

As tigers and leopards live compatibly in Indian forests, lions and cheetahs are found together in Africa. All the species have co-existed in India for several thousand years before the explosion in human population disrupted this equilibrium. All these species are adapted to share the same habitat and have carved their distinct ecological niches. There will be occasional conflicts and just as lions and tigers sometimes kill leopards, an occasional cheetah too will be killed by these large carnivores, as often happens in Africa. But such deaths due to conflict or non-target poaching will not jeopardize the reintroduction project once cheetah populations are established. Perhaps the delay in the arrival of the lions was ordained by destiny to facilitate the return of the cheetah to the country.

Iranian Cheetah or the African Cheetah

The Asiatic Cheetah being extinct from its earlier distribution in India (Divyabhanusinh, 2006) is now only known to occur with certainty in Iran (IUCN Red List of Threatened Species, 2011). The census population of cheetahs in Iran is estimated at 60-100 (Hunter et al., 2007).

Fig.4 The biogeographical distribution of Cheetah



Approximately 10000 cheetahs live in the African continent, but the largest population is now found in Namibia, primarily only on commercial farm lands and is estimated at 2000 to 3000, (Marker *et al*. 2003) followed by South Africa. It is natural to believe that the founder stock for Indian reintroduction programme should, preferably, be sourced from Iran, rather than from Africa, as the former are genetically closer to the extinct Indian cheetah (Charruau *et al*, 2011). However, Iran does not have the capacity to spare any animals for the Indian reintroduction programme as they do not have even a single animal for their own captive breeding programme. Moreover, at least till recently, cheetahs were believed to have very limited genetic diversity and all cheetahs, including the Iranian stock, were considered to have segregated in very recent times. Recent studies (Charruau *et al*, 2011) have demonstrated more genetic variations within cheetah lineages. In any case, the question of genetics would have been more relevant if there was any risk of the new genes swamping a local population. As there is no existing cheetah population in India, this risk is automatically obviated.

This issue was thoroughly debated by the CTF and a conclusion reached that India will source cheetah from Southern Africa (Namibia and South Africa), which can provide India substantial numbers of suitable cheetah for several years. Cheetahs from Southern Africa have the maximum genetic diversity observed among extant cheetah lineages which is an important attribute for founding population stock. Besides, Charruau *et. al*'s. (2011) data suggests that the Southern African cheetah (*Acinonyx jubatus jubatus*) were the ancestral stock from which all the modern day cheetah lineages arose. Further these cheetah populations are genetically the most diverse.

Compliance with IUCN Guidelines

The project is fully compliant with ‘IUCN/SSC Guidelines for Re-introductions’. The guidelines define re-introduction ‘as an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct’. The proposal is fully in conformity with this definition. As per the guidelines, there can be one or multiple objectives for re-introduction; this proposal conforms to the following objectives stated in the guidelines to enhance the long-term survival of a species; to maintain and/or restore natural biodiversity. The reintroduction of the cheetah will restore the role of this top order carnivore in the ecosystem and subsequently restore the balance that such carnivores bestow on ecosystemic and community functions (Smith & Bangs, 2009).The proposal also meets another recognized objective, viz. ‘to provide long-term economic benefits to the local and/or national economy’ to some extent. The guidelines recommend a multidisciplinary approach and prefer wild stock as the founder population. The IUCN guidelines also recommend that ‘where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these’. The proposal is fully compliant with this aspect as well since Kuno WLS has a good protection regime demonstrated by a five fold increase in its ungulate population over six years (Appendix 2.6). Significant improvements in the protection infrastructure of Kuno are also proposed in the project. Other elements of the guidelines, related to selection of the stock, legal requirements, policies of the relevant governments etc. shall be complied with as and when required. IUCN was a participant in the Gajner meeting where the project was conceived.

Mortality and Supplementation of Cheetahs

Even successful reintroduction projects go through a series of ups and downs and one of the factors that we have to reckon with is the mortality of cheetahs before release and after release. There can be deaths from accidents, diseases, intraspecific fights etc. before release. After release, the mortality can occur due to injury from hunting of prey, poisoning, poaching, road hits, as well as from other predators (especially to cheetah cubs). Not all deaths after release should be a cause of worry. Mortality of reintroduced cheetah is expected in spite of all the efforts taken to minimize risks. Appropriate publicity needs to be done prior to the commencement of the project, so that all the stakeholders, public and officials are aware of this eventuality and it should not put the project in bad light or consider it a failure due to cheetah deaths. Supplementation of initial founders may be needed annually or once in five years for managing the demographic and genetic composition of the reintroduced population.

Project Goal and Objectives

The project aims to establish a free-ranging breeding population of cheetahs in and around the Kuno WLS of Madhya Pradesh. The carrying capacity of the Kuno WLS was estimated to be nearly 27 cheetahs (Ranjitsinh & Jhala, 2010). The two to three established populations of cheetah in India are proposed to be managed as a meta-population with occassional “immigrants” brought in from Southern Afica, as and when needed (Ranjitsinh & Jhala, 2010). Within this larger goal, the project will strive to achieve the following objectives:

a. Provide adequate security to local flora and fauna.

b. Revive and maintain the grassland and open forest systems existing in the PA in an optimum productive state and thereby evolve management techniques and practices for better conservation of these habitats in the state.

c. Build the capacity of the forest department of MP in the field of habitat and prey management, in view of the emerging needs.

d. Build the capacity of the MP forest department in mass translocation of herbivores, particularly blackbuck, nilgai and spotted deer, in view of the emerging need for protection of crops and scientific management of wildlife populations.

e. Conserve and enhance the faunal diversity, especially the threatened species, such as the gharial and the chowsingha and provide a future safe haven for even more endangered species such as the caracal, great Indian bustard and the lesser florican.

f. Generate benefits for the local people through the development of wildlife tourism and ancillary activities.

g. Develop the capacities of the local communities to co-exist with wild animals, particularly large carnivores.

Action Plan

The process of reintroduction is proposed as follows:

1. Government of India (GoI), Ministry of Environment and Forests (MoEF) and the Cheetah Task Force (CTF) shall take the initiative to create a formal framework for collaboration between the GoI and Governments of Namibia and/or South Africa, through the Ministry of External Affairs (MEA), in order to facilitate the collaboration of the agencies/individuals participating in the project. Scope for using any existing agreements for collaboration between the countries shall be explored by MoEF/ CTF/MEA.
2. MoEF shall issue an initial import permit for minimum 20 cheetahs on the recommendation of CTF from Namibia and/or South Africa, under the CITES regulations. The Cheetah Conservation Fund (CCF) in Namibia and And Beyond (AB), a safari and wildlife management company in South Africa, have indicated their willingness to donate the founder stock during preliminary discussions. MoEF/ CTF shall also liaise with other relevant agencies/departments of GoI to facilitate the import of the animals. Member Secretary-CTF/MOEF/MEA shall send the import permits, and other necessary documentations if any, to the agencies supplying the animals, as soon as possible, under intimation to the GoI and the high commissioners of India and Namibia/South Africa.
3. The chosen donor organizations and suppliers in Nambia and South Africa, in cooperation with the concerned Indian High commissioners, shall procure the necessary export permits from their respective government agencies. They shall

make the arrangements for shipping the animals to India through an airline to be designated by CTF.

4. A cohort of upto 10-12 cheetahs that are ideal (young age group that is genetically diverse, behaviourally sound- eg. not overly imprinted to humans, capable of hunting wild prey and socially tolerant of each other) for reintroduction shall be imported from Namibia or South Africa, as a founder stock during the first year. An existing coalition of wild males shall be selected while the selected females shall also be known to each other as far as possible. The animals' lineage and condition shall be checked in the host country, to ensure that they are not from an excessively inbred stock and in the ideal age group, so as to conform to the needs of a founding population.
5. The selection of animals suitable for release will be the responsibilities of the chosen donors/experts in Namibia and South Africa and will be verified by CTF/WII.
6. The selected animals shall be collected from different locations, as the case may be, and prepared for transportation, after necessary vaccinations and health checks etc, as per international protocols, and the animals shall be delivered to the designated airlines. A veterinarian from the donor agency and if need be, one representative from India (MP Forest Department (MPFD)/CTF) shall accompany the shipment, along with necessary supplies and equipment.
7. The animals shall be housed, in the existing fenced enclosure of 25 ha in the Jakhoda grassland of Kuno WLS. The enclosures should not have any corners and should be rounded. Males and females shall be kept in separate but adjoining compartments so that they are able to know each other before release. An existing enclosure available at the selected location will be suitably repaired and modified to house the imported animals. The location of the enclosure is such that the cheetahs can see for some distance to understand the environment and the presence of prey, before release. The height of the fence will have to be raised to about 2.5 metres, from the existing height of approximately 1.5 metres and a line or two of power fence shall have to be fitted at the top to discourage any attempts by leopards to enter the enclosure. Adequate water and shade exists in the enclosure but will be suitably augmented as needed. In the 2nd phase of the plan, the existing fenced enclosure of 25 ha will be increased to 100 ha in case the project envisages holding a breeding population within the enclosure.
8. Natural prey within the enclosure will ensure that cheetah become accustomed to hunting Indian prey species before their release.
9. These animals shall be released into the main enclosures, after a short stay in a smaller enclosure (1-2 ha) for the purposes of inspection.
10. The males shall be radio collared and soft released from the main enclosure after an appropriate period (2-6 weeks). They are expected to establish a coalition territory after exploring and investigating the available habitat, but would tend to return to the enclosure to meet the females. The presence of females in the main enclosure shall ensure that the males do not wander too far away, after their exploration instinct is satiated. Their movements shall be monitored 24 hours a day by the local staff, assisted by a team of researchers from WII. If any animal tends to get into undesirable environment, it will be brought back into the Sanctuary. Darting will be done if absolutely essential, by qualified trained personnel.
11. The females shall be released, after radio collaring, 1-4 weeks after the males, depending upon the state of the males' comfort in the new environment. The females shall be monitored and kept under observation through radio telemetery, as in the case of males described above.
12. Elephants are effectively used to manouver, approach and capture tigers. However, elephants are likely to cause severe damage to the forests of Kuno and therefore are not the ideal choice for Kuno landscape. Though cheetah can be approached on foot, it may be difficult to get close to shy and skittish animals that may need to be recaptured in case they stray too far from the safety of protected forests. In such

cases we propose to try out horses and camels that are better suited to the terrain and vegetation of Kuno. Two trained horses and camels will be stationed at three to four different well spaced and strategically located sites (Range HQ). This placement is essential as horses and camels would be able to operate within a range of 15km radius from these central locations and if cheetahs disperse within these areas, then these horses and camels could be used to track and approach them. The horses and camels would also be useful for purposes of patrolling.

13. An experienced cheetah expert from Namibia or South Africa shall stay at the project site, from before the arrival of the cheetah upto about two months after the release of the females from the enclosure, to advise and assist the authorities in coping with any unwarranted situations, to care for the cheetah in captivity, opine on their readiness and that of the habitat for the release and to help monitor the animals after their release. He/ She will also train the local staff.
14. Genetic management of the reintroduced population is proposed by substituting the male coalition by a different coalition after F1 generation sired by the first male coalition is over 1.5 years of age. Females will be supplemented as required in consultation with CTF and technical advisors.
15. Expecting approximately 5% growth rate in the released population, incorporating natural mortality, births and annual supplementation, the released population should reach carrying capacity level in about 15 years.
16. Boundaries of the potential cheetah habitat, abutting on human habitation shall be secured through proper fencing if needed, in consultation with the affected people, to minimise conflict, poaching and straying of released cheetahs into human habitat.
17. The release site has adequate prey base to support the cheetah, along with other existing predators such as leopards, wolves, jackals, hyenas, and occasional tigers. However, the rather sudden increase in the predator population in the area may lead to some unexpected effects on certain prey species. The response of the prey species to the increased predation shall be monitored through WII researchers to understand the new dynamics. However, prey availability in the Sanctuary shall also be augmented through translocation of substantial number of blackbuck and nilgai from the crop fields of adjoining districts. A fully equipped animal capture unit will be created under the project, for this purpose. Possibility of public private partnership (PPP) in animal capture shall also be explored and expertise from Namibia and South Africa or elsewhere, to India for the group capture and translocation of animals such as nilgai and blackbuck, would be arranged by the CTF with the concurrence of WII and the Goverment of MP.
18. Availability of prey base shall be assessed each year by the WII biologists to be attached to the project and supplementation of prey will be decided on the basis of this annual assessment.
19. A veterinary unit will be created under the project by the Government of MP, to care for the breeding stock within the breeding enclosure as well as to manage the released animals, in cases of straying, injury, conflict etc.
20. A large number of field staff posts are vacant (1 Range Officer, 5 foresters and 42 forest guards). All these vacant field posts would be filled up by January 2012. In the filling up of vacant posts the guidelines issued by General Administration Department (G.A.D) of the government of MP, by which there would be relaxation of minimum recruitment requirements for Primitive Tribes such as the Sahariyas, should be adopted and as far as possible the recruitment must be from relocated villages.
21. All new posts in the field, which have been advocated as essential and those found necessary by the state government, foreign experts and CTF, would be created and filled by the state government within 3-6 months. Here again, recruitment should be as far as possible from the local communities, The people of Mongia and Sahariya tribe will be employed on daily wages. In this regard experience of Nagarjunasagar-

Srisailam Tiger Reserve could be taken into account where efforts are being taken to work with and employ the locale Chenchu tribals to protect forest

22. Representatives from the core group of Cheetah task force shall be sent on a study tour of cheetah reintroduction sites/programmes in Africa. The action plan for reintroduction may be finalised/ modified on the basis of the learning from this study tour. The composition of the team would be decided by the CTF.
23. A project implementation team consisting of The Chief Conservator of Forests, in charge of the project, Divisional Forest Officer, assistant conservator (s), range officer (s), deputy rangers, foresters and to the extent possible the forest guards shall be selected on the basis of their interest, commitment and capabilities and shall be posted for a minimum period of at least 3 years and if possible upto 5 years. The senior members of the team, including the project biologist and veterinarian, would be sent on a training tour to selected cheetah reintroduction sites in Africa as early as possible. The composition of the team would be decided by the CTF. The training shall be conducted in batches. The senior members who would be trained abroad would train the junior staff of the Sanctuary. The entire staff working for the Sanctuary shall be paid a ‘Project Allowance’ at par with the allowance paid to the staff working for Project Tiger.
24. A team of two well-known cheetah experts shall be created to advise the project planning and implementation. Ms. Laurie Marker of CCF and Mr. Les Carlisle from And Beyond, South Africa, have shown interest in advising the project. Both of these have vast experience in cheetah conservation and management. The services and help of their organisations as advisors and contributors to the project may be obtained by CTF, who would then also negotiate the terms of their involvement. The reintroduction of the cheetah offers unique opportunity to understand the role of top predators in ecosystems. Research in all aspects of system recovery and interactions including ecology of the reintroduced cheetah should be addressed by WII.
25. Some of the families of the Nayagaon village within the Sanctuary, which were relocated, have come back after recieving compensation on the ground that they are not satisfied with the land alloted to them. They must be satisfied and moved out again.
26. Villages Bagcha, Jaangarh and Maratha adjoining the Sanctuary shall be relocated as per the National Tiger Conservation Authority (NTCA) norms, if they are willing, during the first phase of the cheetah reintroduction project, at the earliest. This will enlarge the inviolate core and available habitat to more than double the size of the current Sanctuary. The Sanctuary boundaries would be extended to cover the areas of the villages that would be translocated by December 2013.
27. All dogs in the surrounding villages shall be vaccinated against rabies periodically, to prevent the contagion from reaching the cheetah and to prevent infection of the local human population. Persons bitten by dogs or jackals would be inoculated against rabies.
28. The project shall also include assistance to the villages already relocated from the Sanctuary to develop their stakes in the project. Local communities shall be incentivized and sensitized to co-exist with wildlife, particularly predators, through proper training and communication programmes. Suitable NGOs will be involved in this task.
29. A decision to fence a large part of the reserve so as to hold a breeding population of cheetah as a source for further supplementation of the reintroduced population shall be taken only after a consensus on the issue is reached and if in the first attempt of reintroducing free ranging cheetah, an unacceptable proportion strays out of the PA. Suitable fence shall be erected on the Sanctuary boundary wherever it abuts sensitive areas for eg. High human population, high intensity agriculture etc. The length of the boundary fence would be determined by experts of the MPFD and of the WII.

30. Sustainable and conservative tourism subservient to the conservation needs of the Sanctuary and of the project shall be encouraged so that jobs and business opportunities for the local people can be created and the project and the Kuno Sanctuary get adequate public support. An attempt to generate revenues through brand building, marketing, sponsorships, merchandising shall be made, through private partnerships, but in complete consonance with the conservation activities and prerequisites. In I[st] phase of the plan, a site specific tourism policy will be developed and implemented through appropriate Government mechanisms.
31. Local NGOs, district administration and people's representatives shall be briefed regularly about the value of the project to the local ecology and economy and their support shall be earnestly solicited. One or more reputable local NGOs, active in the rural development and conservation fields in the area, shall be encouraged and supported to develop and implement a suitable strategy for the project and for the welfare of the local commmunities, in order to improve its interface with the local stakeholders and to improve their quality of life.
32. Adaptation of capture, translocation and release techniques for nilgai, blackbuck and chital with the assistance of foreign expertise and concurrent training of local staff will be initiated in January 2012, involving support and participation of WII and other concerned organization.
33. The actual group capture and translocation of blackbuck, nilgai and release into PA will commence not later than, December 2012.
34. There are no known or historically recorded attacks by cheetah on humans. Cheetah may predate small livestock like sheep and goats. A mechanism will be developed that will ensure that all livestock predated by cheetah will be compensated at market rates in a timely fashion so as to reduce any hostility from local communities living in and around Kuno WLS.

Project Duration

This is proposed to be an ongoing activity after reintroduction, without an 'end-of-project' situation in sight in the foreseeable future. However, the first phase of the project is devised, for the sake of convenience alone, for a period of **five years.**

Project Costs

Approximate cost of the project is estimated to be Rs.91.65 cr. Broad estimates of cost for Phase-I (first 5 years) of the project are given in **Annexure-II.** Detailed estimates shall be prepared after the project is formally approved, as proposed here. Actual expenses will vary from year to year, based on adaptive annual action plans that will be prepared, based on the progress of previous years.

Financing the Project

The entire cost of relocation, habitat management/restoration, sourcing and tranportation of cheetah, fence, enclosure and housing/veterinary facility construction, monitoring and research cost, additional staff allowance, protection (equipment and logistics) shall be borne by the GoI. The State government shall provide the staff salaries and general management of the Protected Area.. The funding from Central government will be based on the framework and guidelines of the Project Tiger scheme of GOI.

Revenues

There is potential for earning significant revenues from the project from filming, photodocumentation, merchandising, sponsorship and tourism on a competitive basis. This income shall be credited to the Vikas Nidhi of the Sanctuary and shall be spent on its management as well as for assisting the local communities, as per the system already prevailing in the State of MP. A proactive approach to market the project as a brand shall be adopted to promote conservation as an economic activity, after fully ensuring that it in no way hampers the conservation interest and priorities of the project and of the Sanctuary.

Development of Tourism

The project can generate significant tourist interest which will create new opportunities for employment and businesses for the local people, besides generating revenues for the government. Therefore, proper emphasis on sustainable ecotourism in the region would be given, which will give priority to the local people in employment and which will be subservient to the long term conservation interests of the project and of the Sanctuary, The State Government will prepare a five to ten year site specific tourism policy (which will address the land-use and development of the surrounding areas as well). It will be documented separately apart from action plan for the reintroduction of cheetah in kuno wildlife sanctuary, which would be approved by CTF. A documentation and filming policy guidelines will be drafted. Separate guidelines for news channels and for profession process documentation will be listed.

Annual Review

The progress of the project shall be reviewed every year by a committee appointed by GoI and nominated by CTF, consisting of experts, and decision makers from the state and central governments and the WII.

Tentative Time Line

Task	2011				2012						2013
	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	DEC	D EC
Project Preparation by WII and MPFD, in Consultation with the CTF	X										
Project Approval by the GoI		X									
Disbursement of Funds to State		X									
Study Tour of Planning Team			X								
Training/ Study Tour of Implementation Team				X	X						
Creation of Infrastructure			X	X							
Training of Staff by CCF Ranger				X	X						
Import of Cheetahs					X						
Release of Males into the Wild						X					
Release of Females into the Wild							X	X			
Preparation of Tourism Plan						X					
Fencing of Village Boundaries								X	X		
Filling up of Vacant Posts			X	X	X						
Relocation of Villages										X	
Extension of PA Boundary											X

Annexure I

Survey to assess prey base, human disturbance, perceptions and attitudes of local people towards wildlife

a) Prey base estimation

Methods:-

Field methods;

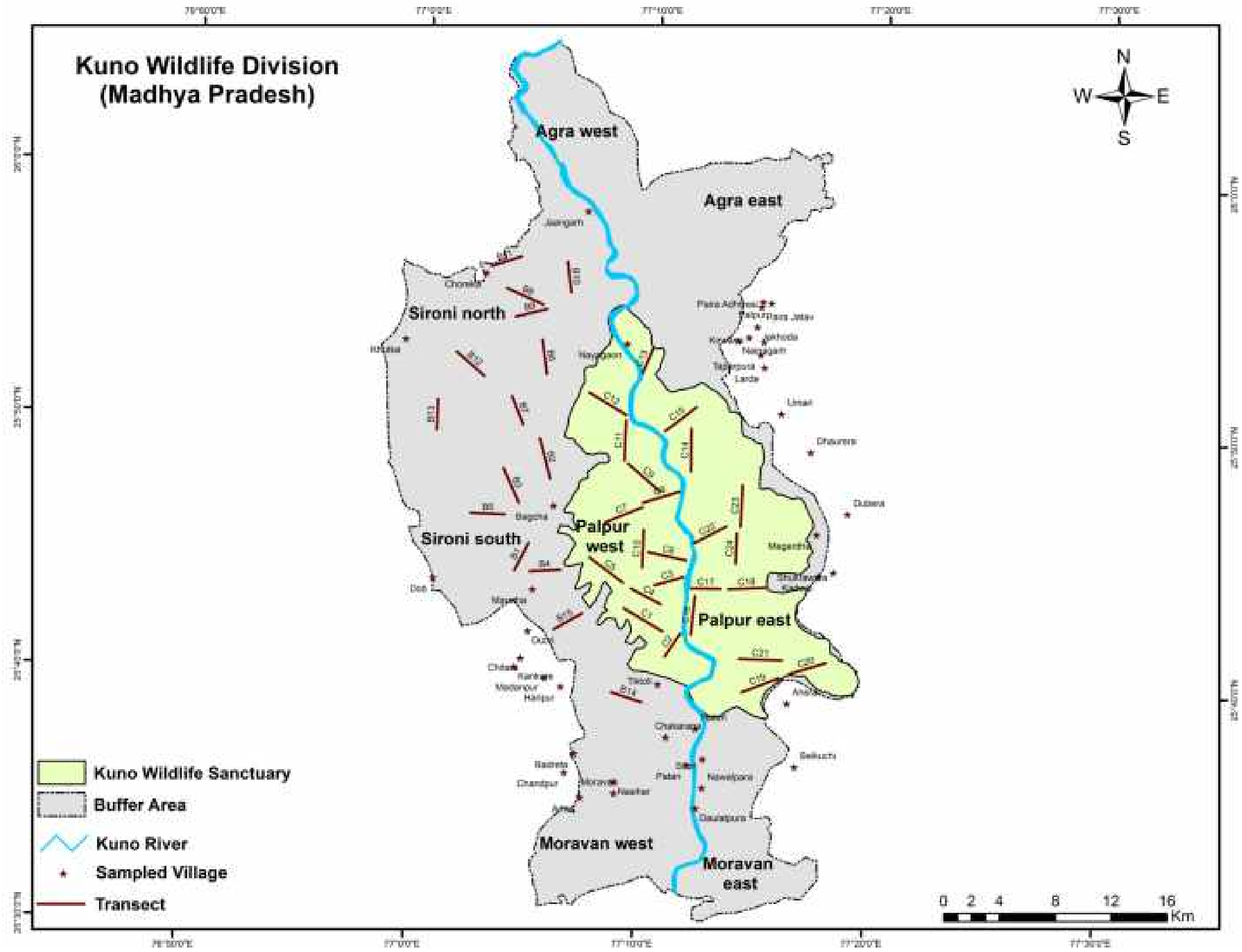
The sampling protocol designed for monitoring tigers, co-predators, prey and their habitat (Jhala *et al.,* 2009) was used for this survey.

Prey base density estimation: To estimate population density of prey, line transects sampling method was used (Buckland *et al*. 2001). Considering a forest beat as a sampling unit, fixed line transects of length ranging from 2-3 kms were walked. A total of 39 line transects, 24 in the Sanctuary and 15 in the buffer zone, were sampled during the months of April and May 2011 (Fig. 3). Start and end locations were recorded using GARMIN© 72 GPS unit. Sighting distance to the prey was measured using a laser range finder (Bushnell pro 800).

Pellet and dung plots: At every 400m on the transect line and perpendicular to the transect line a 20m × 1m strip transect was laid. The entire plot was scanned for pellets and dung of all the prey species and identified to the species level. The pellets and dung pats were counted and the quantity was recorded. All together 239 plots were sampled.

b) Measure of human disturbance levels: A 15m radius circular plots was laid at every 400m on the transect line. Human disturbance indicators such as wood cutting, lopping, direct and indirect signs of human and livestock presence were documented. The number of trees cut and lopped were categorised into three types; low (1-2 trees cut / lopped), medium (3-5 trees cut / lopped) and high (>6 trees cut / lopped). Dominant tree, shrub, herb, grass, weed/ invasive species were recorded. Canopy density, shrub and herb density along with weed/ invasive abundance were also recorded. A total of 160 plots in the Sanctuary and 79 plots in the buffer area were sampled.

Fig. 5: The 39 transect lines sampled to measure prey base and human disturbance levels and the 41 villages surveyed to assess perceptions and attitudes of local people towards wildlife in and around Kuno Wildlife Division



c) Survey to assess perceptions and attitudes of the local people towards wildlife:

A questionnaire was used to survey to assess the attitudes and perceptions of the people living in and around the wildlife Sanctuary towards wildlife and forests. The questionnaire was divided into five sections.

1. Demographic variables
2. Household characteristics
3. Livelihood and interactions with wildlife.
4. Facilities available.
5. Dependency on forest and knowledge about wildlife.

Villages within 10 kms from the Sanctuary boundary were surveyed. Villages were randomly selected. Interviews were conducted in 40 villages around the Sanctuary and one settlement inside the Sanctuary (Fig.3). Respondents were randomly chosen. About 4-10% of the households in all the villages were interviewed. In the three villages which were earlier identified for relocation as part of the Asiatic lion translocation project, about 20- 30% of the households were interviewed. A total of 270 interviews were conducted to assess the socio-economic and perceived conflict levels.

The survey was carried out from April to June 2011. 58% of the respondents were males and 42% were females. All the respondents were above 15 years of age.

Analysis;

Line transect data was analysed using the software DISTANCE 6.0.

Since the number of sightings was low, to calculate densities prey was categorised into five types:

Categories of prey:
1) All prey species: Chital, chinkara, chowsingha, feral cattle, domestic cattle, hare, langur, nilgai, peafowl, sambar and wildpig.
2) All prey species excluding langur: Chital, chinkara, chowsingha, feral cattle, domestic cattle, hare, nilgai, peafowl, sambar and wildpig.
3) Cheetah prey species: Chital, chinkara, chowsingha, hare, nilgai calf, peafowl and sambar fawn.
4) Chital
5) Langur

Assessing the attitudes and perceptions towards wildlife:

The perceptions and attitudes towards wildlife was analysed using the responses of the questionnaire. Responses for crop depredation, livestock depredation, trapping, bushmeat consumption, presence of guns as proxy for possibility of poaching were collated. For each of the above mentioned parameters bar charts were made to assess the levels of perceived conflict with wildlife.

Results:-

a) Prey density estimates:

Kuno WLS

The density of all prey species in the wildlife Sanctuary is 85.91/ km^2 ± 23. The density of cheetah prey species is 38.99/ km^2 ± 13.23. Chital is the most abundant prey with a density of 35.87/ km^2 ± 11.7. The growth in chital population since 2005 is shown in Appendix 2.6. Blackbuck is reported in the area, but was not sighted during line transect sampling. The summary of the prey density model parameters in Kuno WLS are shown in Appendix 1 and the detection function curves are shown in Appendix 2.

Kuno WLS and the sampled buffer area

The density of all prey species in the Sanctuary and the sampled buffer area is 70.08/ km^2 ± 18.14. The density of cheetah prey species is 26.69/ km^2 ± 8.49. Even though chital was not sighted during line transect sampling in the buffer area, it still is the most abundant prey with a density of 23.95/ km^2 ± 8.2. The summary of the prey density model parameters in Kuno WLS and the sampled buffer area are shown in Appendix 3 and the detection function curves are shown in Appendix 4.

b) Human Disturbance:

In 32 plots inside the Sanctuary, signs of human disturbances such as lopping, woodcutting, grass/ bamboo cutting and signs of human/ livestock were found (Fig. 4- 10). Majority of these plots are situated near the boundary of the Sanctuary close to the villages Maratha, Bagcha, Tiktoli, Ahera and Nayagaon (Fig. 4).

Fig. 6: Plots with human disturbances in Kuno WLS and sampled buffer area

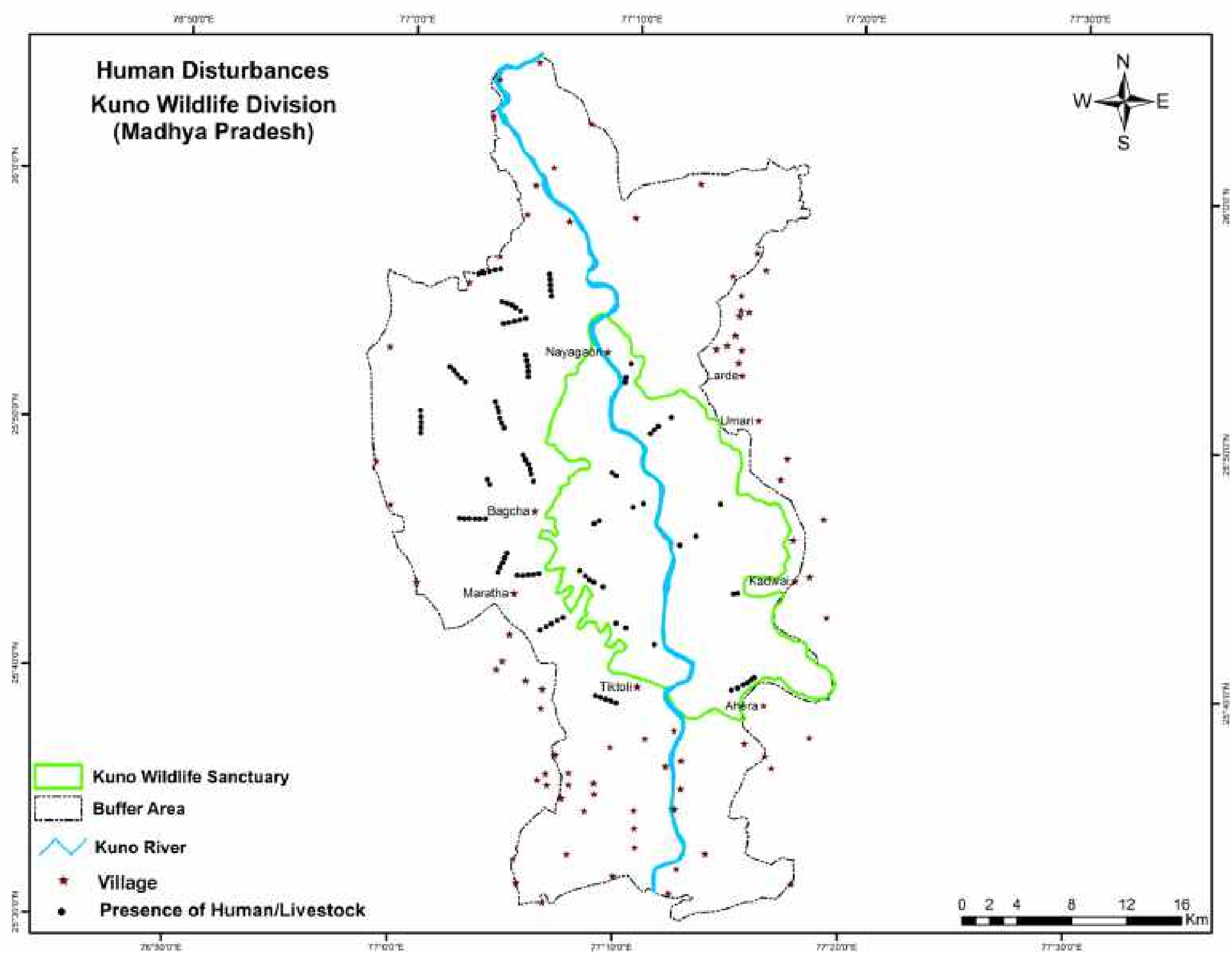


Fig. 7: Plots with presence of woodcutting in Kuno WLS and sampled buffer area

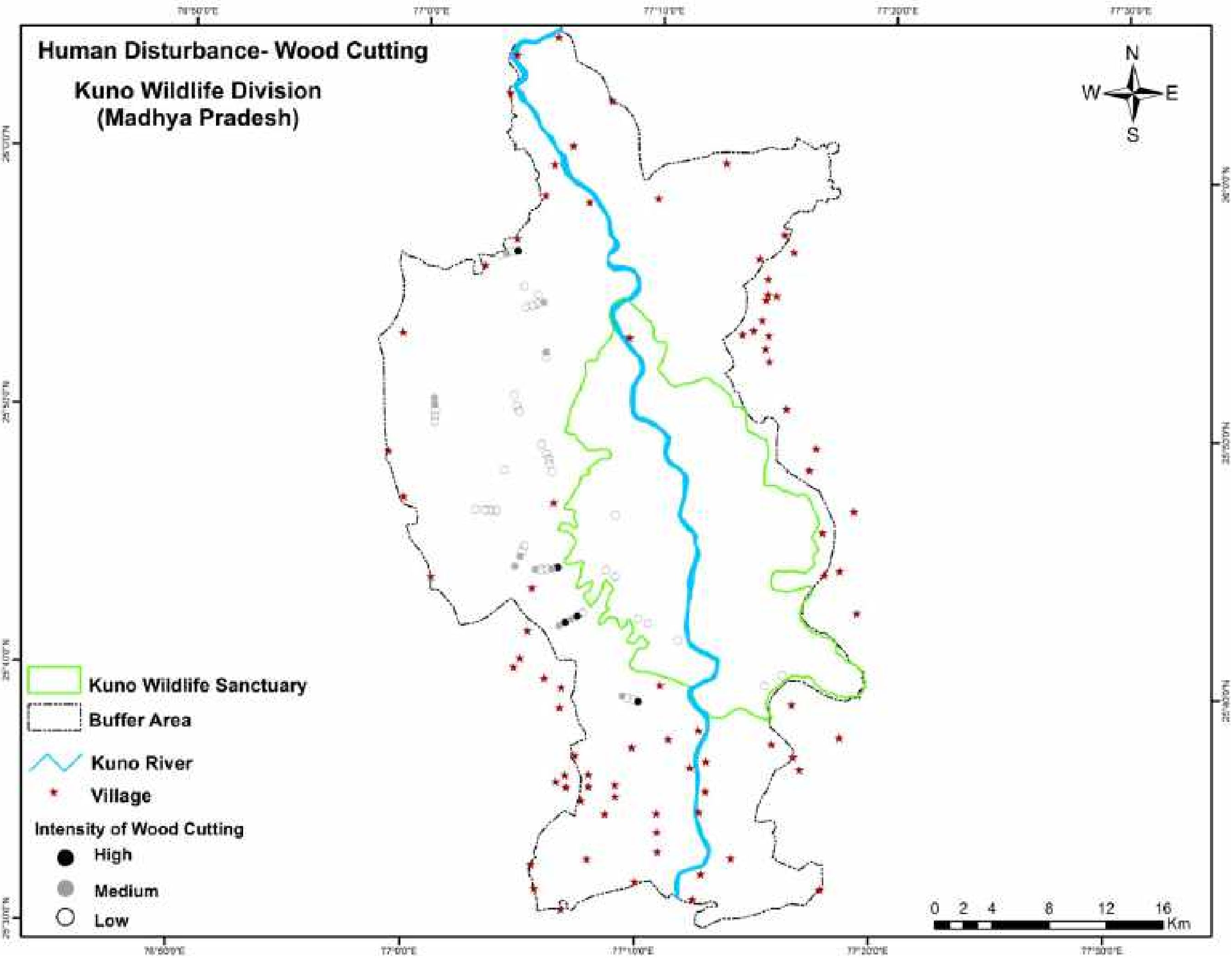


Fig. 8: Plots with presence of lopping in Kuno WLS and sampled buffer area

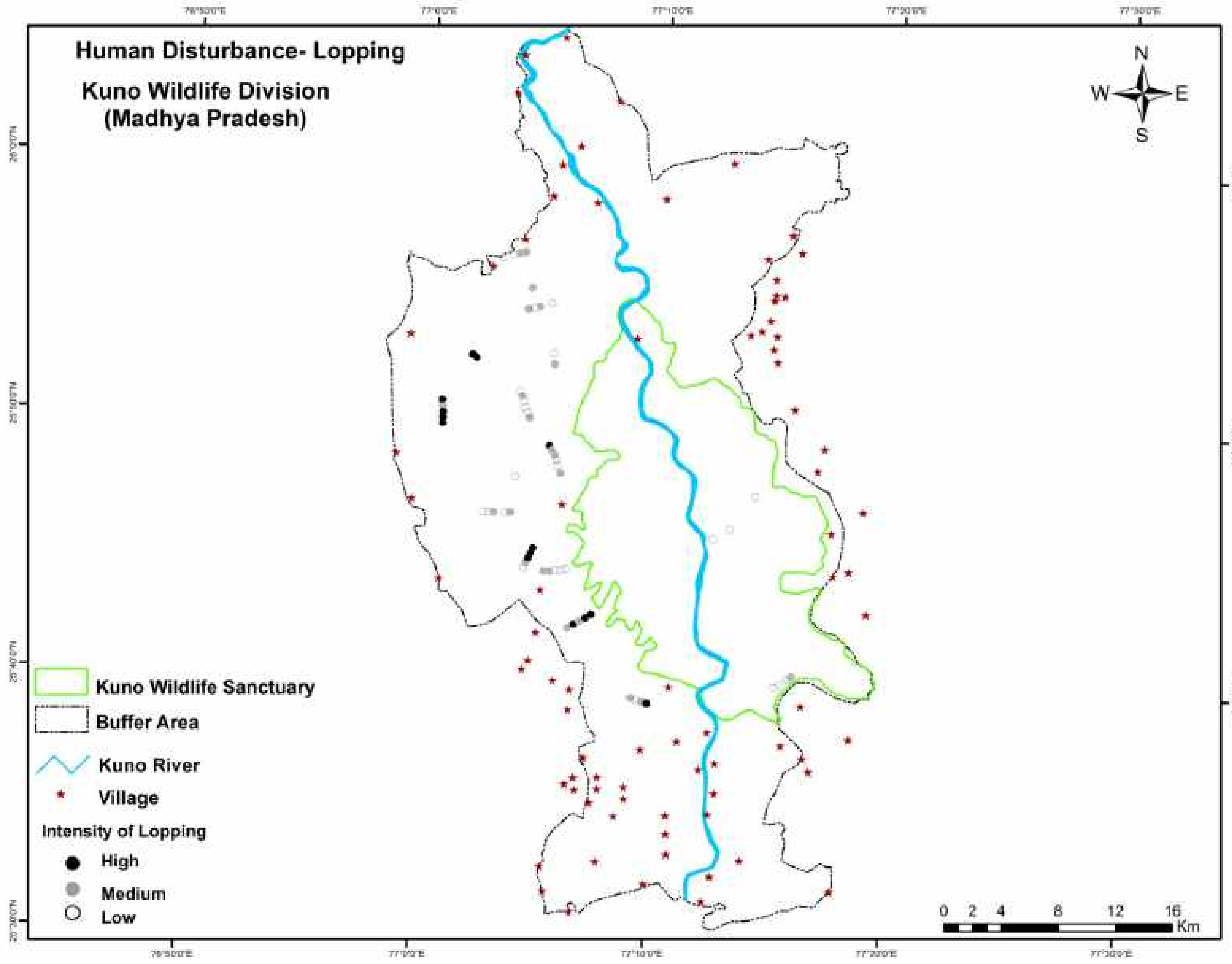


Fig. 9: Plot with presence of grass / bamboo cutting inside Kuno WLS

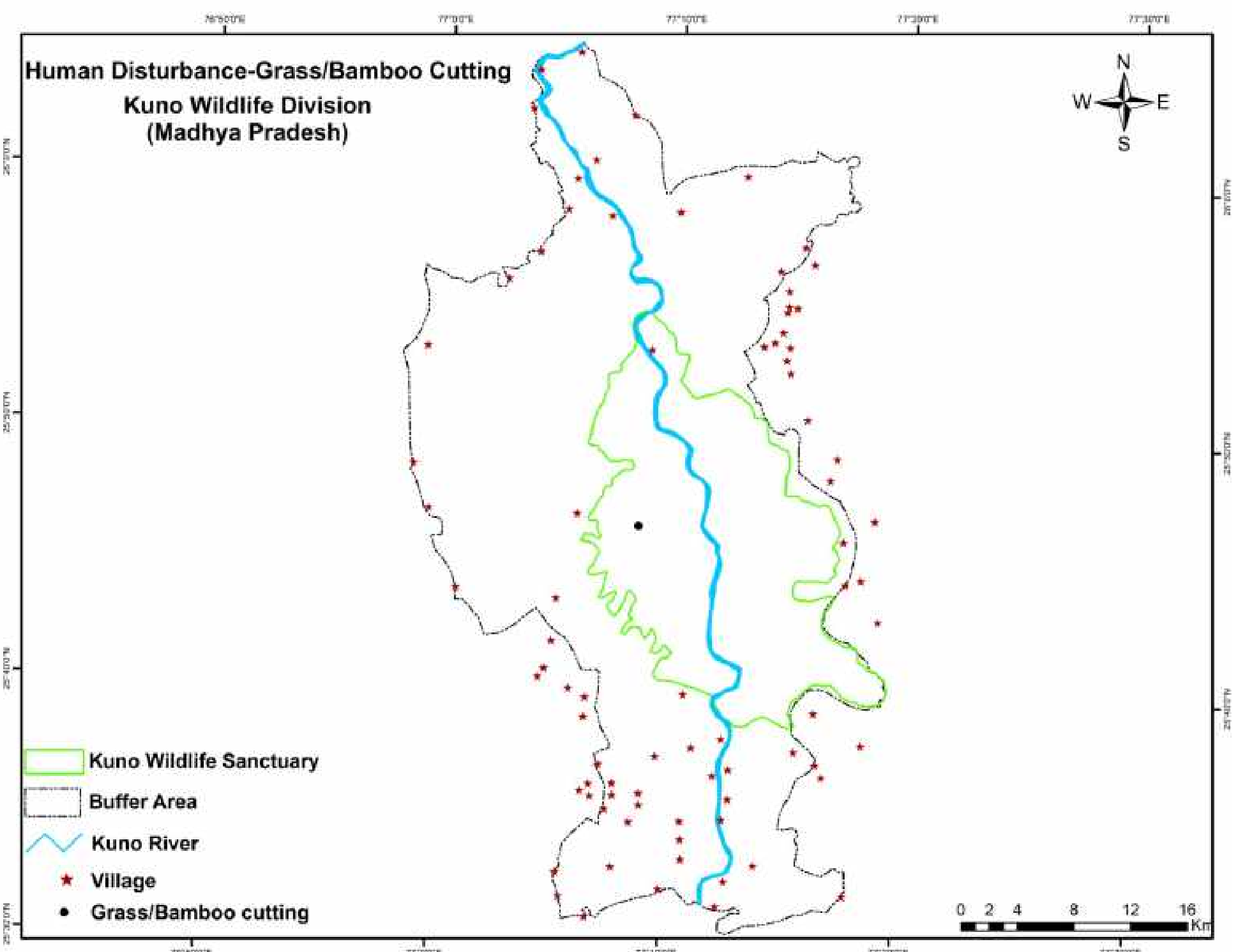


Fig. 10: Plots where people were seen outside Kuno WLS in the buffer area during sampling in buffer area

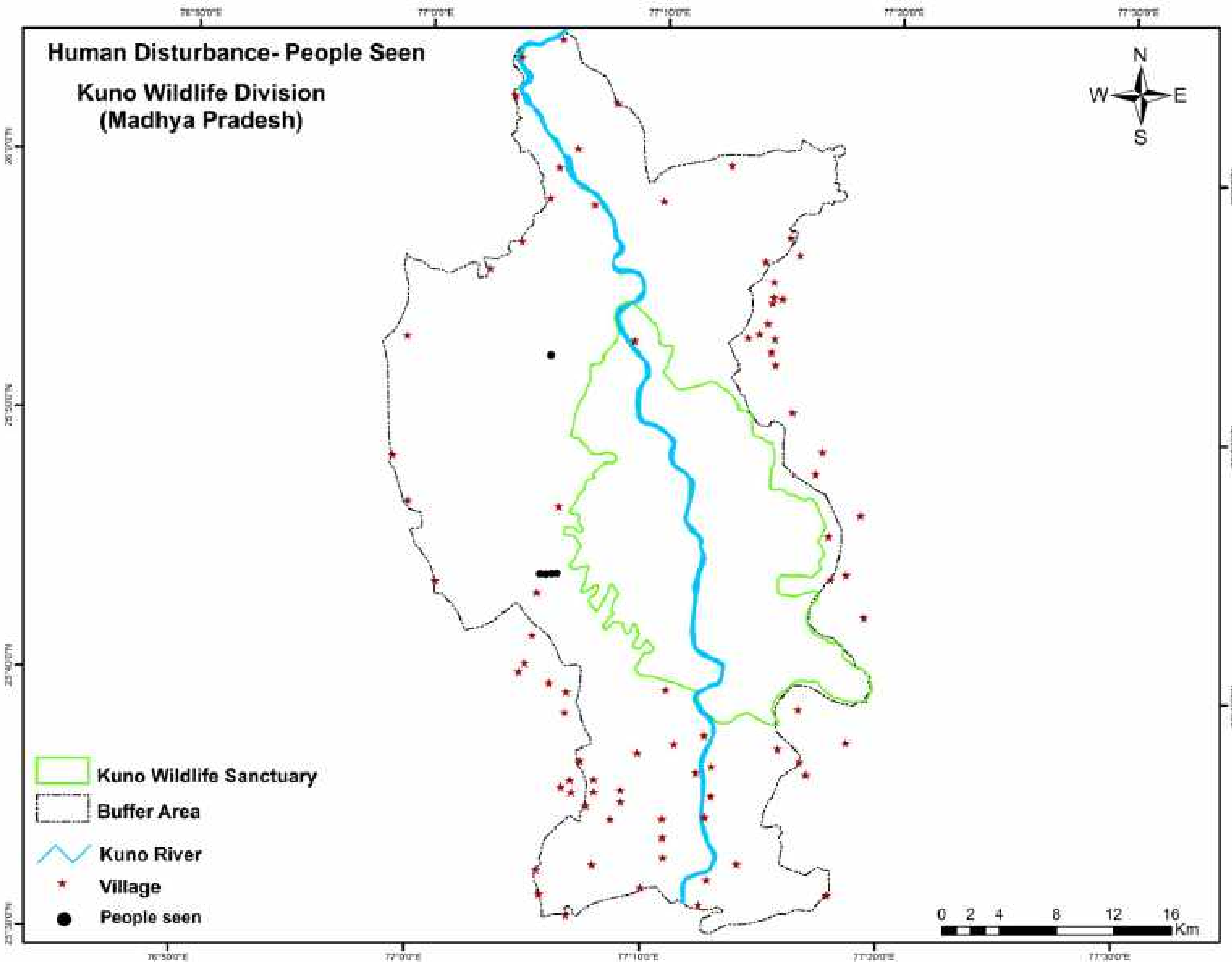


Fig. 11: Plots where livestock was seen outside Kuno WLS during sampling in the buffer area

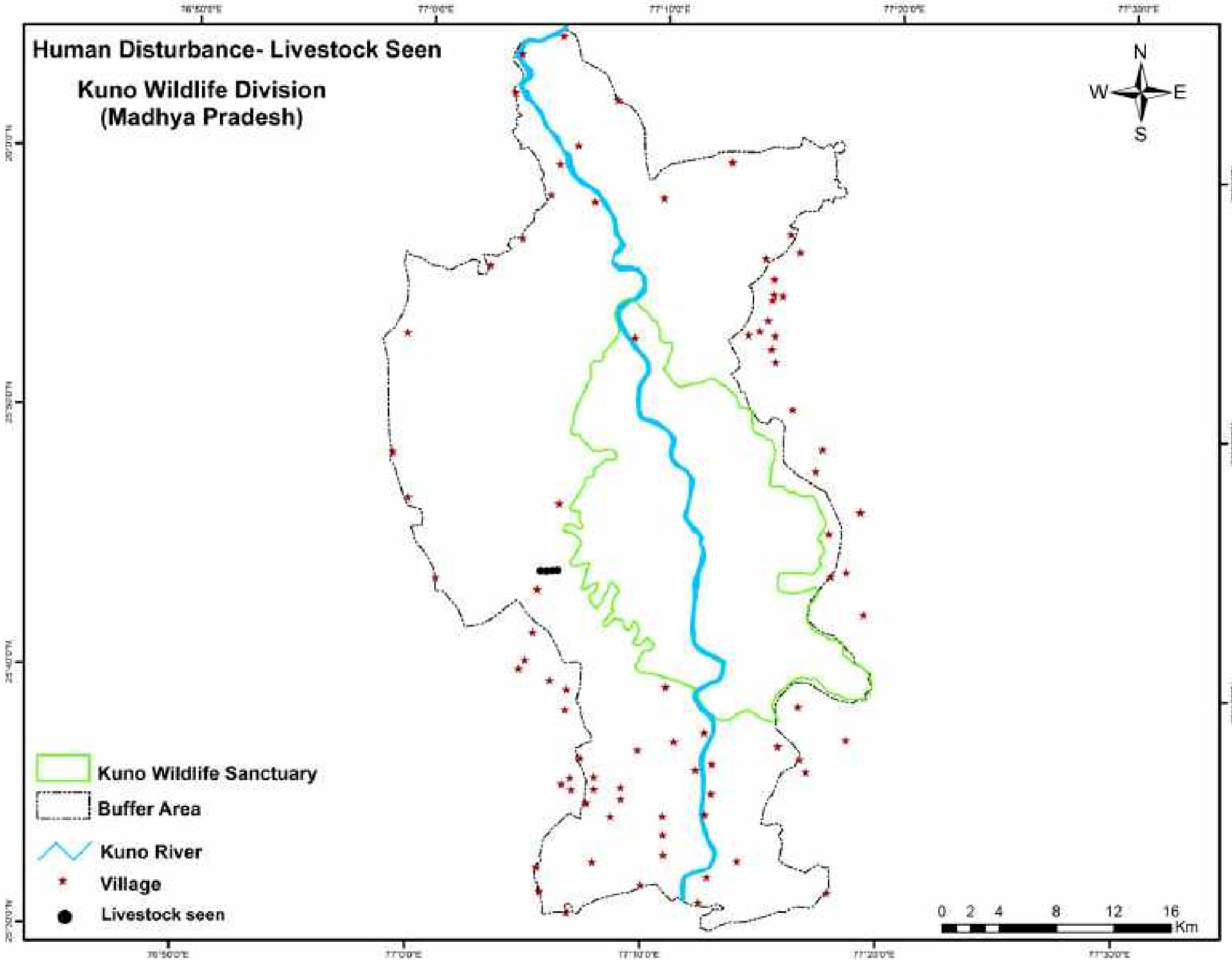
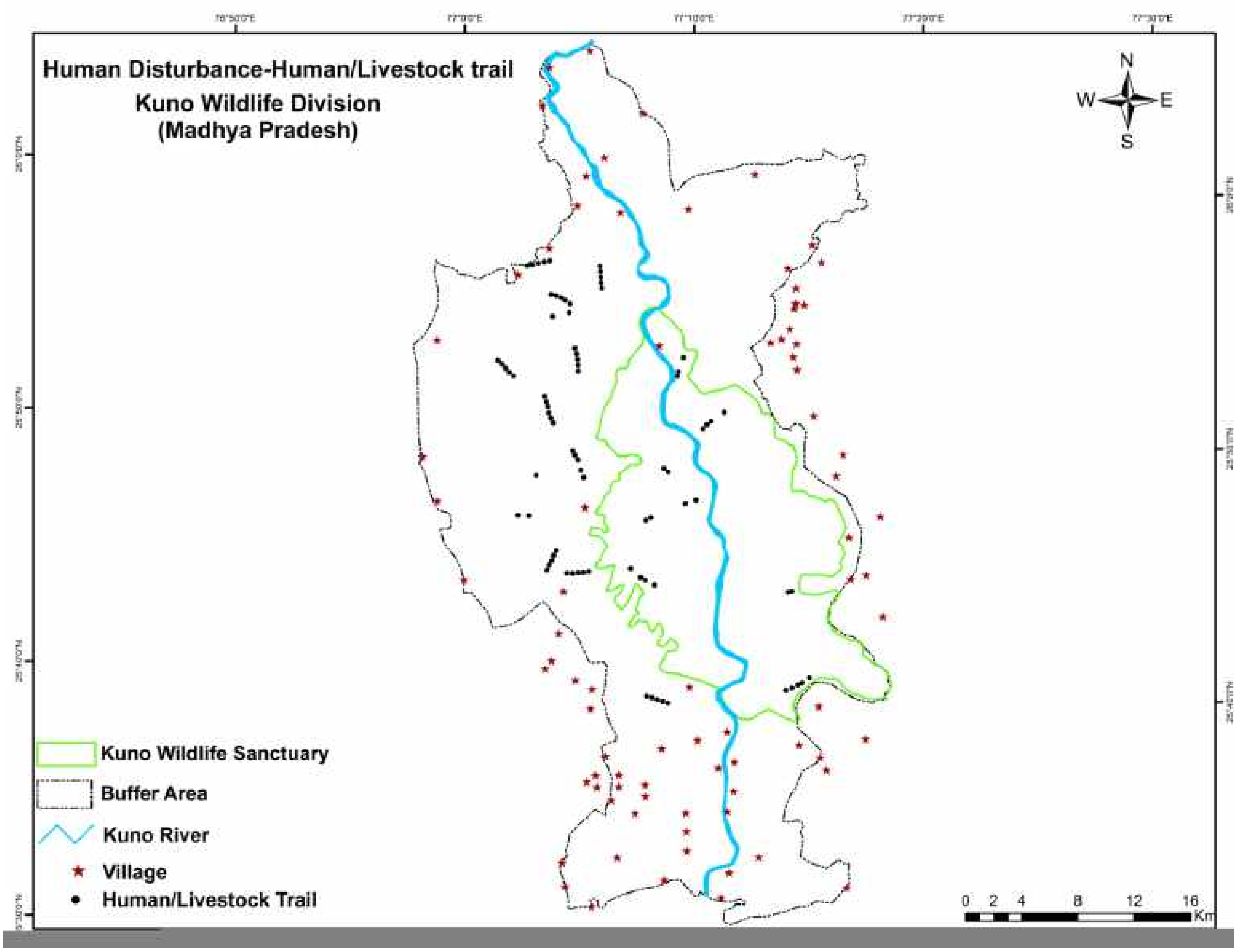


Fig. 12: Plots with presence of human / livestock trail in Kuno WLS and sampled buffer area

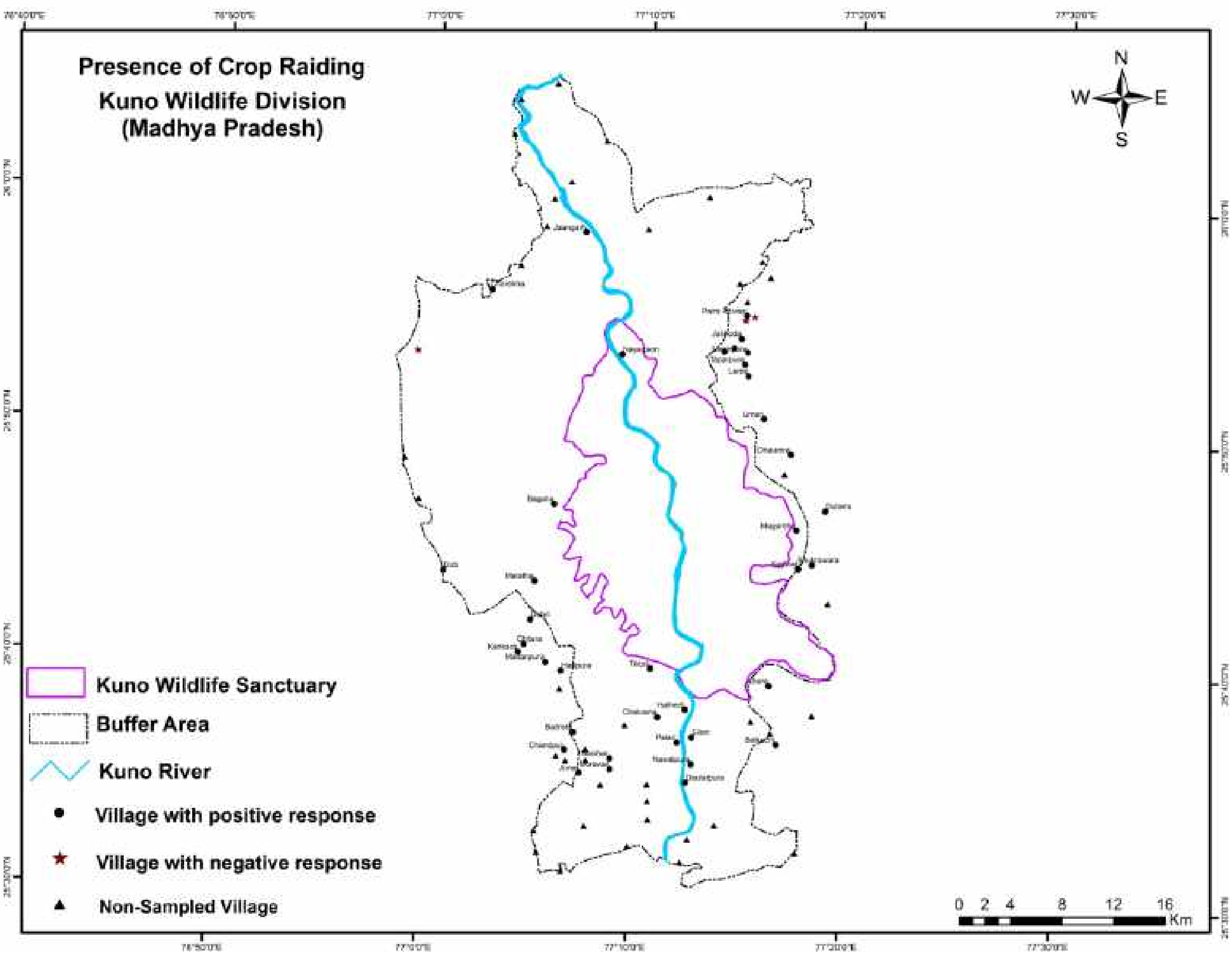


c) Perceptions and attitudes of local people towards wildlife:

Conflict with wildlife: The responses for crop depredation, livestock depredation, trapping, bushmeat consumption, presence of guns as proxy for possibility of poaching are quantified as follows,

Crop depredation: The prevalence of crop damage is widespread in the area. Almost all the villages i.e., in 38 villages out of the 41 villages sampled people have suffered crop depredation by wild animals (Fig. 11). 65.2% of the people interviewed have faced problem of crop raiding mainly by wild pig (98.29%). The other species responsible according to the respondents are chital (30.11%), hare (15.9%), nilgai (12.5%), langur (6.25%), sambar (4.54%) and jackal (3.97%). (Appendix 5.1)

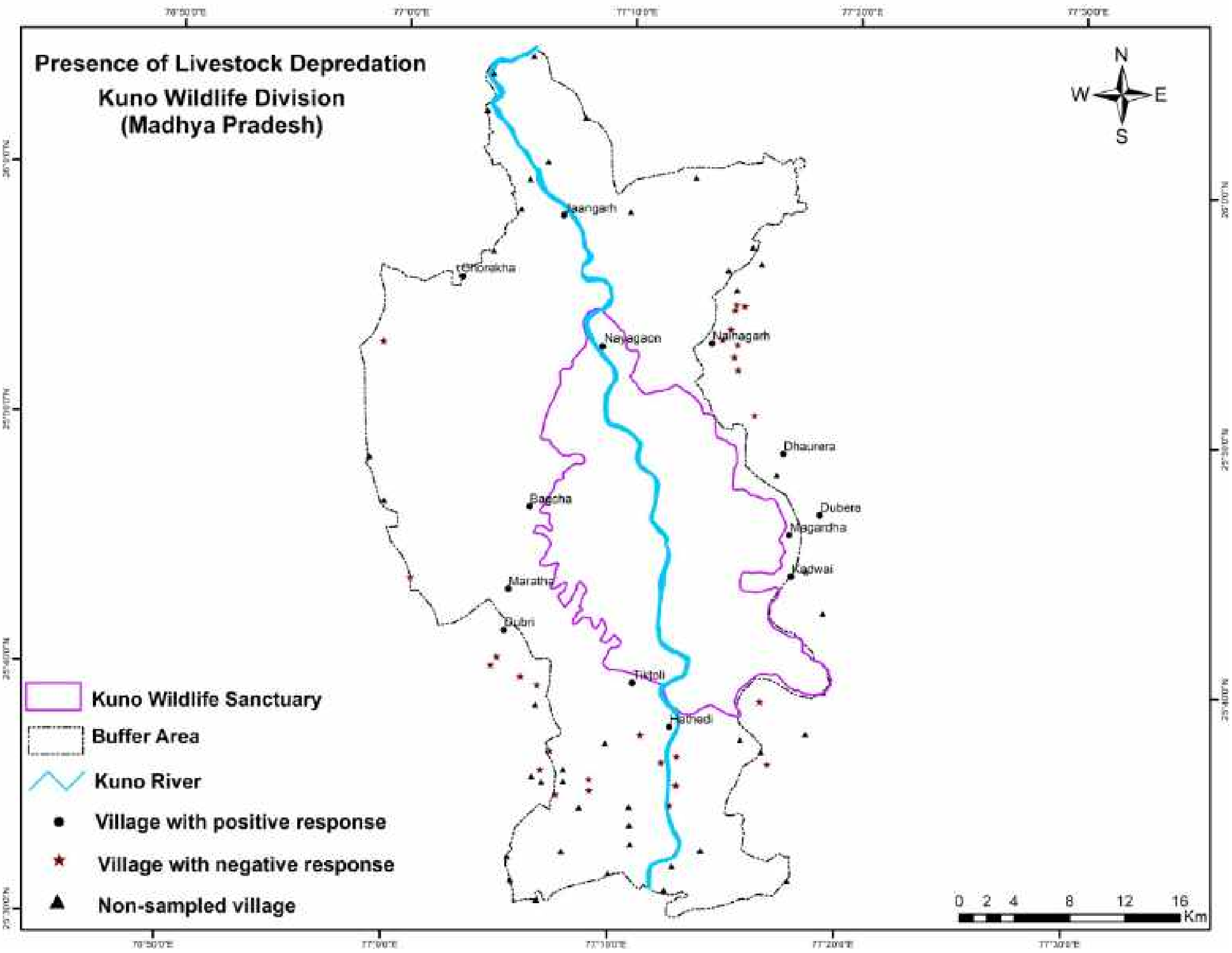
Fig. 13: Surveyed villages in and around Kuno Wildlife Division with presence of crop raiding according to respondents



Livestock depredation: During the survey, only 9.25% of the respondents reported that they had lost livestock to carnivores in the last one year. These incidences have occurred in 13 villages out of the 41 villages sampled (Fig. 12). According to the respondents most of the attacks are by leopards (35.71%) and wolves (25%). (Appendix 5.2)

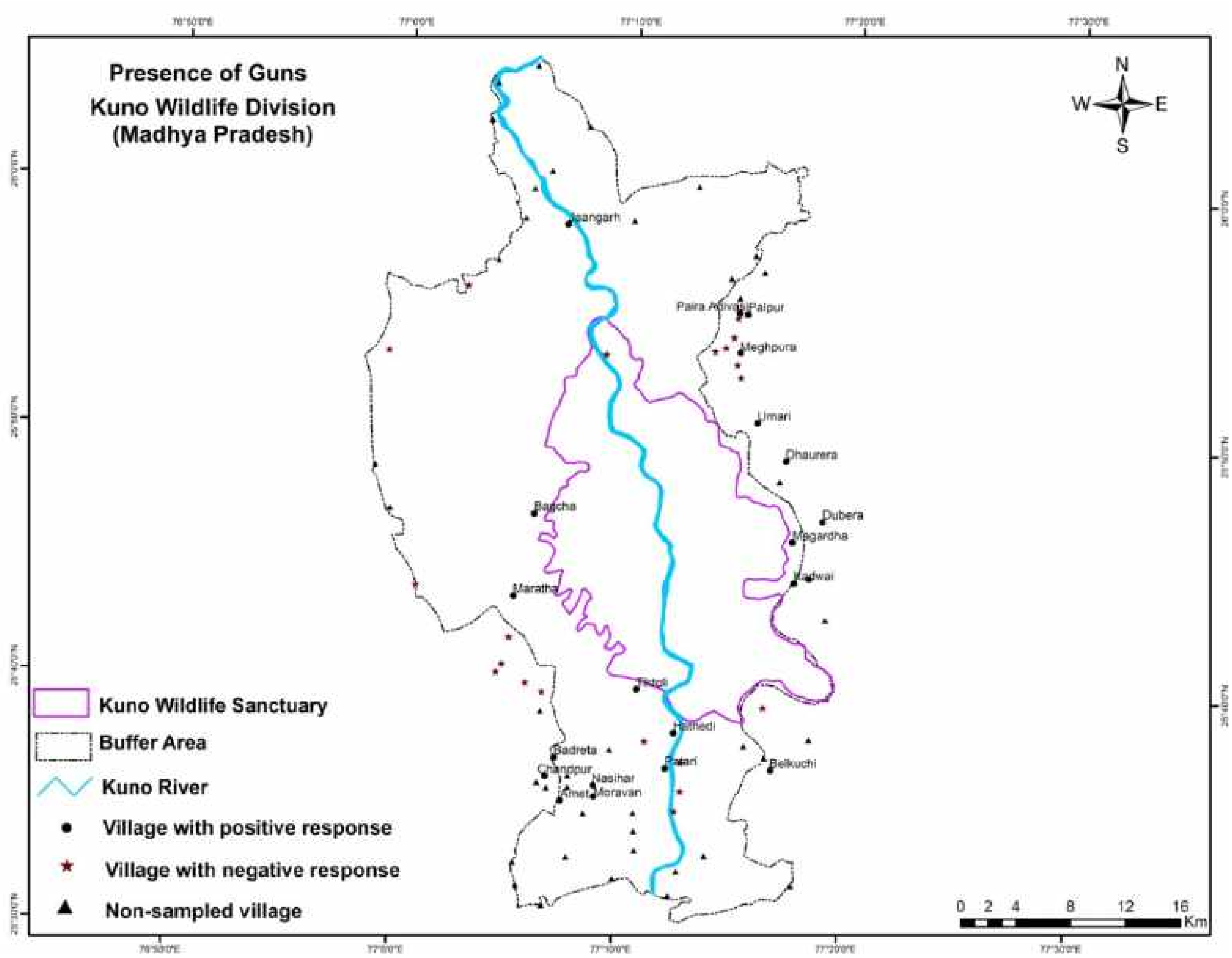
The low percentage of positive response for livestock depredation might not be portraying the actual scenario in the region. Most of the respondents graze their livestock in the nearby forest and this is where majority of the livestock depredation occurs. Grazing is restricted inside the Sanctuary and in some parts of the buffer area. This could be the reason that the respondents were probably not completely honest while replying about livestock depredation. As they are aware that they will not be compensated for livestock kill, within the PA and hence do not report the loss therein.

Fig. 14: Surveyed villages in and around Kuno Wildlife Division where respondents have lost livestock to carnivores



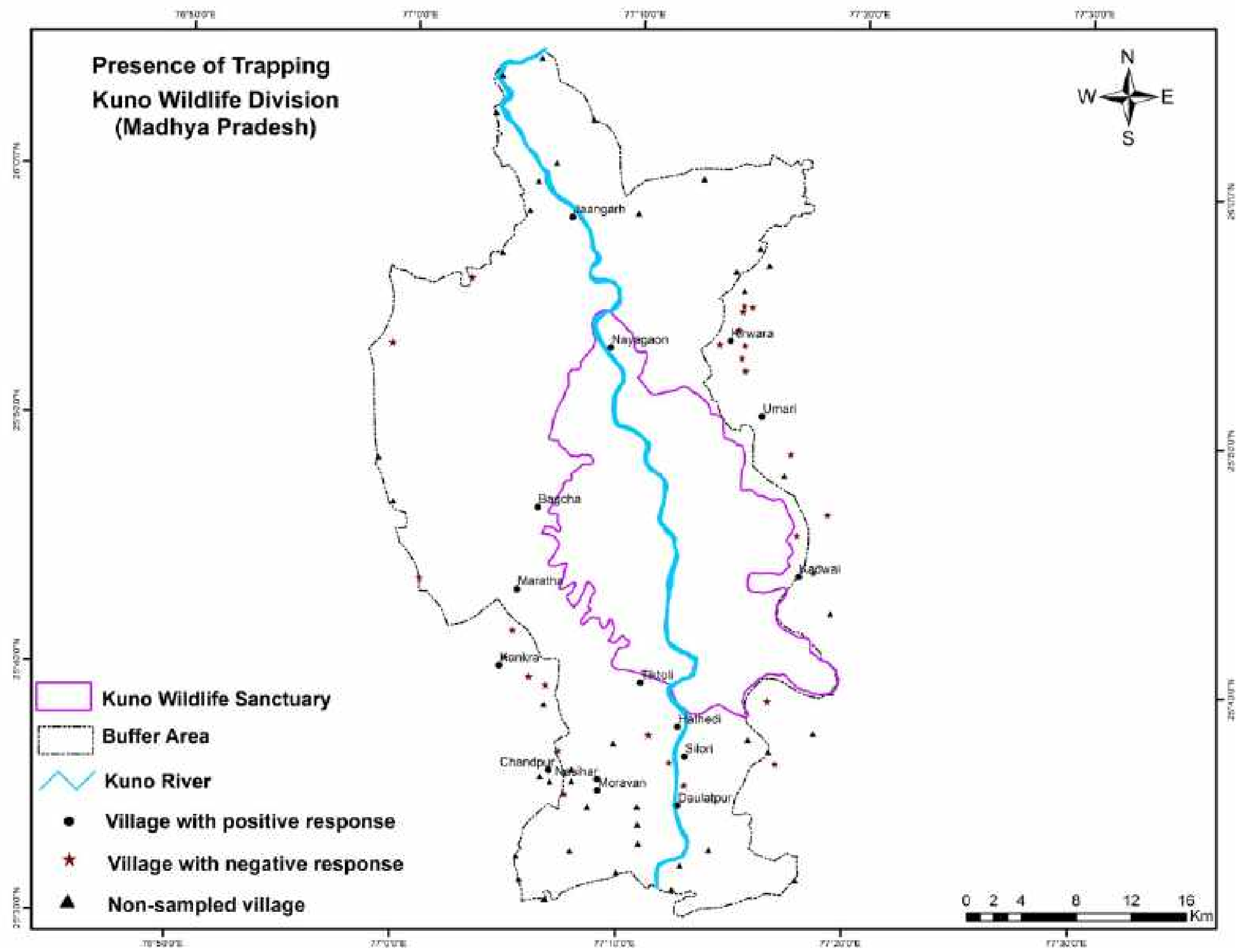
Presence of guns: 20.3% of the respondents accepted either owning guns or presence of guns in the village (Appendix 5.3). In 21 villages out of the 41 surveyed villages people own guns (Fig. 13). In more than half the villages sampled (51.22%), people possess guns. Only 1.11% of the respondents revealed that guns are being used for hunting. In areas surrounding Kuno WLS, dacoits are still at large and people keep guns with or without license for self-defence. Poachers and illegal possessors of guns would in any case not admit the possession of weapons. Hence, the reported presence of guns could be far lesser than the actual presence of guns.

Fig. 15: Surveyed villages in and around Kuno Wildlife Division where people own guns according to respondents



Trapping: As a measure to stop crop raiding or for bushmeat, 6.67% of the interviewees responded in the affirmative to trapping wild animals (Appendix 5.4). These respondents belong to 15 villages out of the 41 villages that were sampled (Fig. 14).

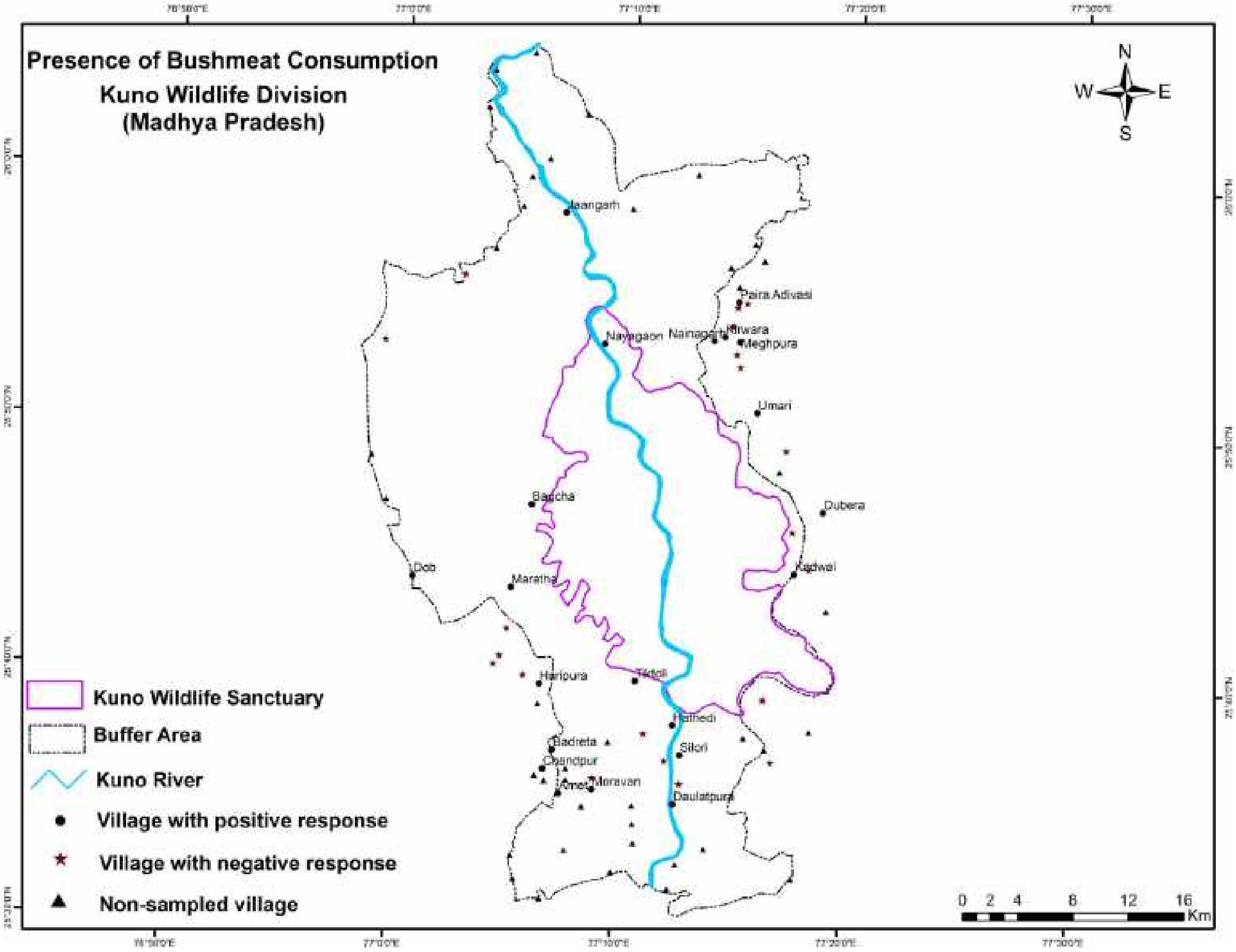
Fig. 16: Surveyed villages in and around Kuno Wildlife Division where people trap wild animals according to respondents



Meat consumption: In the 41 villages that were sampled, 77.78% of the respondents accepted that either them or other people in their village consumed meat (Appendix 5.5). Majority of the meat-eating respondents (97.14%) said that they consumed meat from domestic animals such as goat and chicken.

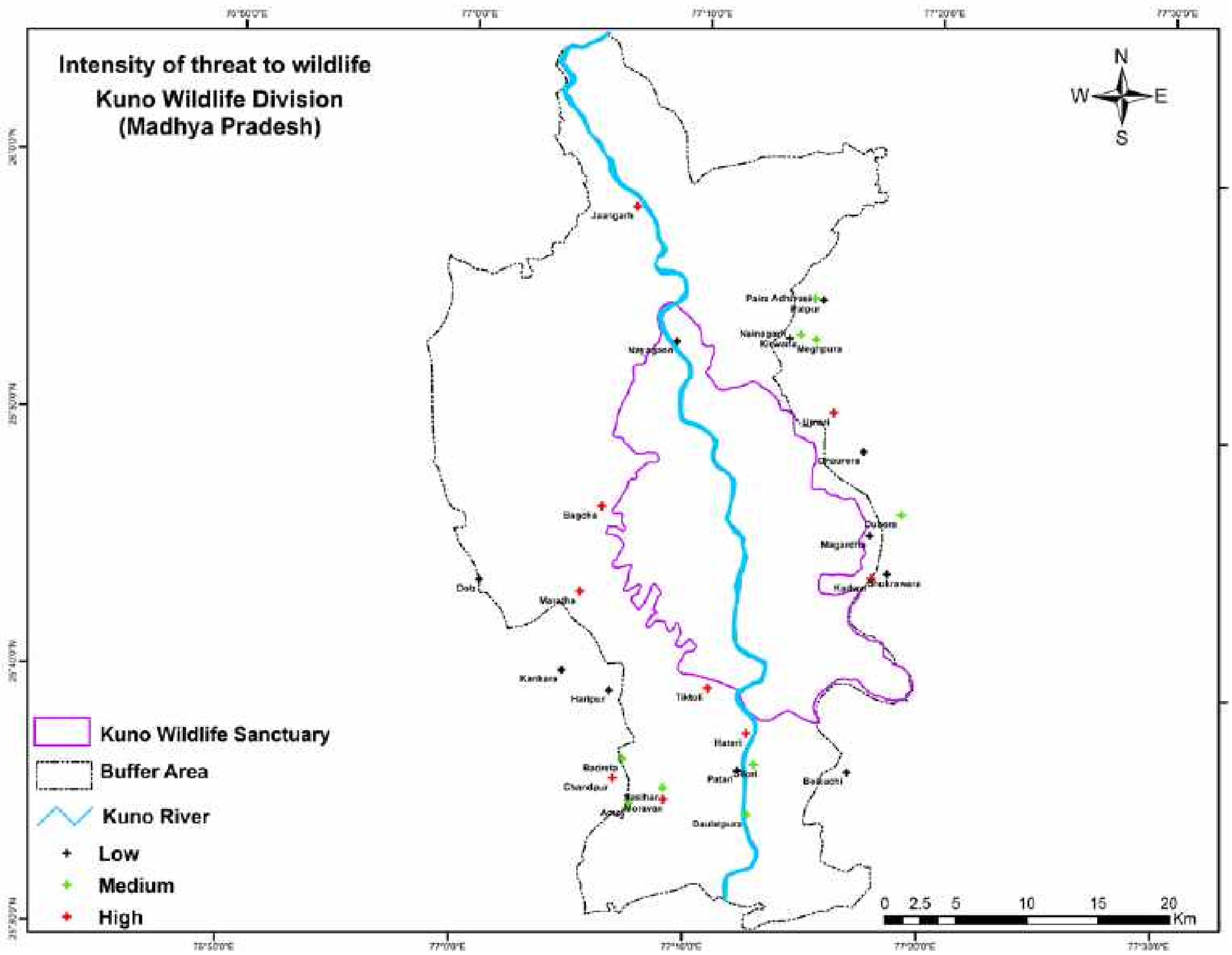
Bushmeat consumption: Out of the meat eating population, 15.71% owned up that either they or the villagers consumed bushmeat (Appendix 5.6). This proportion of respondents was from 21 villages out of the 41 that were sampled (Fig.15).

Fig. 17: Surveyed villages in and around Kuno Wildlife Division where people consume bushmeat according to respondents



According to the respondents, in the villages Bagcha, Jaangarh, Kadwai, Maratha, Tiktoli, Chandpur, Moravan, Hathedi and Umari people own guns, trap wild animals and consume bushmeat. Based on the prevalence of firearms, affirmative consumption of bushmeat and attitude towards snaring and trapping, threat perception was computed as low, medium and high (Fig. 16). In the above mentioned first five villages people have also faced problems of crop and livestock depredation by wild animals.

Fig. 18: Surveyed villages which were percieved as threat to park management due to their habit of poaching wildlife for subsistence consumption

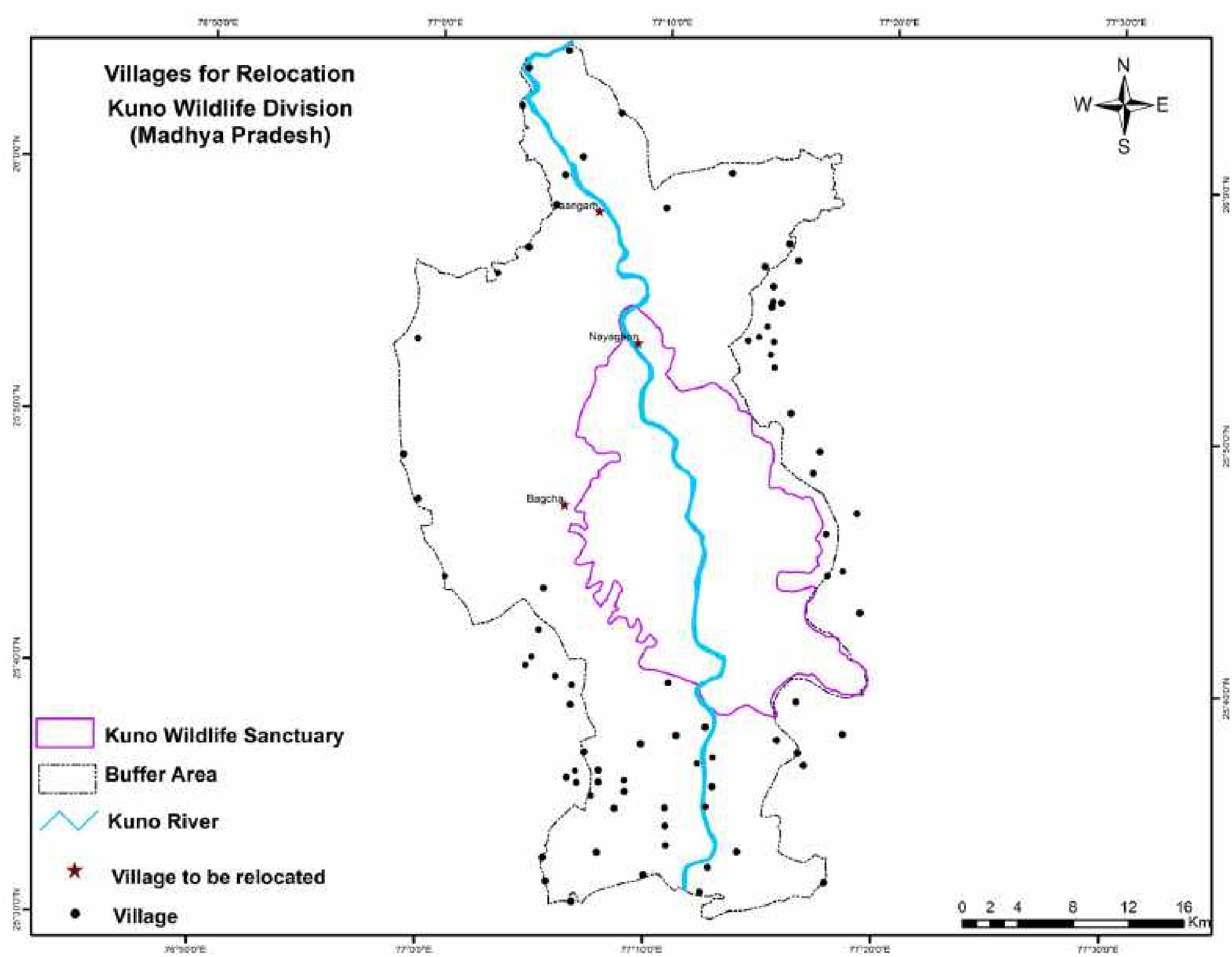


Willingness for relocation: 47.8% of the respondents were ready to relocate if adequate land or money was provided. Whereas, 37. 4% answered in negative (Appendix 6.1) and 5% were not sure.

In the three villages which were earlier identified for relocation (Fig. 17) as part of the Asiatic lion translocation project, the percentage of respondents who were willing to relocate is as follows;

Bagcha- 82.35 %, Jaangarh -74.07%, Nayagaon – 40% (Appendix 6.2)

Fig. 19: The three villages for relocation in Kuno Wildlife Division



Literature cited:

Banerjee, K. (2005). Estimating the ungulate abundance and developing the habitat specific effective strip width models in Kuno Wildlife Sanctuary, Madhya Pradesh. Dissertation submitted in partial fulfillment of the degree of M.Sc. Forestry, Forest Research Institute, Dehradun. pp. 170.

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. & Thomas, L. (2001). Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York. U.S.A.

Caro, T.M. (1994). Cheetahs of Serengeti plains: Group living in an asocial species. University of Chicago Press. Chicago. U.S.A.

Charruau, P., Fernandes, C., Orozco-Terwengel, P., Peters, J., Hunter, L., Ziaie, H., Jourabchian, A. Jowkar, H., Schaller, G., Ostrowski, S., Vercammen, P., Grange, T., Schlotterer, C., Kotze, A., Geigl, E. M., Walzer, C. & Burger, P. A. (2011). Phylogeography, genetic structure and population divergence time of cheetahs in Africa and Asia: evidence for long-term geographic isolates. Molecular Ecology, 20: 706-724. doi:10.1111/j.1365-294X.2010.04986.x

Chaudhari L.K. Kuno-palpur management plan

Cheetah Conservation Fund (2011). http://www.cheetah.org

Divyabhanusinh Chavda (2006). The End of a trail- The cheetah in India. 3rd ed., Oxford Publishing House.

Durant,S., Marker, L., Purchase, N., Belbachir, F., Hunter, L., Packer, C., Breitenmoser-Wursten, C., Sogbohossou, E. & Bauer, H. (2008). Acinonyx jubatus. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on 29 November 2011.

Eaton, R.L. (1974) The Cheetah: The biology, ecology and behaviour of an endangered species. Robert E. Kreiger publishing Co., Malabar, Florida, 1982.

Gopal, R., Sinha, P.R., Mathur, V.B., Jhala, Y.V. & Qureshi, Q. (2007). Guidelines for preparation of tiger conservation plan. The National Tiger Conservation Authority, Ministry of Environment and Forests, New Delhi, India.

Hunter, L., H. Jowkar, H. Ziaie, G. Schaller, G. Balme, C. Walzer, S. Ostrowski, P. Zahler, N. Schaurre, and K. Kashiri. (2007). Conserving the Asiatic cheetah in Iran: Launching the first radio-telemetry study. Cat News 46:8-11.

IFAW, Panthera, IUCN/SSC Canid Specialist Group, IUCN/SSC Cat Specialist Group, Wildlife Conservation Society. (2011). The fading call of the wild - A status update on 15 species of disappearing wild cats & canids

Jethva, B.D. & Jhala, Y.V. (2003) Sample size considerations of food habit studies of wolves from scats, Mammalia 68 (4), pp. 589-591.

Jhala, Y.V., Qureshi, Q., Gopal, R. & Amin. R. (2009). Field guide: Monitoring tigers, co-predators, prey and their habitats. Third ed. Technical publication of National Tiger Conservation Authority, New Delhi and Wildlife Institute of India, Dehradun.

Jhala,Y.V., Qureshi, Q., Gopal, R. and Sinha, P.R. (2011).Status of Tigers, Co-Predators and Prey in India,2010. National Tiger Conservation Authority, Govt. of India, New Delhi, and Wildlife Institute of India, Dehradun. TR 2011/003 pp-302.

Johnsingh, A.J.T., Qureshi, Qamar. and Goyal, S.P. (2006). Assessment of prey populations for lion re-introduction in Kuno Wildlife Sanctuary, central India. Report submitted to Government of India and Government of Madhya Pradesh. Wildlife Institute of India, Dehradun – 248 001. pp32.

Marker, L. (2002). Aspects of Namibian Cheetah (Acinonyx jubatus) Biology, Ecology and Conservation Strategies. PhD. Thesis, Department of Zoology, University of Oxford.

Ranjitsinh, M. K. & Jhala, Y. V. (2010) Assessing the potential for reintroducing the cheetah in India. Wildlife Trust of India, Noida, & Wildlife Institute of India, Dehradun, TR2010/001.

Rodger, Panwar and Mathur.(2002)

Smith, D. W. & Bangs, E. E. (2009) Reintroduction of wolves to Yellowstone National Park: History, values and ecosystem restoration. Pages 92-125 in Hayward, M.W & Somers, M.J. (Eds.) Reintroduction of top-order predators. ZSL & Blackwell Publishing Ltd. West Sussex U.K.

Annexure II **Project Cost Estimates**

Item	**Unit**	**No.**	**Unit Cost (Rs. Lacs)**	**Year I**	**Year II**	**Year III**	**Year IV**	**Year V**	**Total Cost**	**Remarks**
Expenses in Source Country										
Transportation cages	No.	10	0.25	2.50					2.50	
Misc. Costs: Permits, Local Transportation, vaccination, Health checkups etc.	No.	10	0.25	2.50					2.50	
Cost of Cheetahs	No.	10	1.00	10.0					10.00	May be donated.
Sub-Total Expense in Source Country										**15.00**
International Transportation of Animals	LS			20.0					20.00	
Local Transportation from Airport to Kuno Including Handling charges.	No.	10	0.50	5.00					5.00	
Holding Fence at Jakhoda and Palpur	LS	2		100.00					100.00	There are two existing fences each approximately 25 ha. Both will be repaired and modified suitably to prepare the requisite compartments, for males, females and prey animals. The height shall also be increased to 2.5 meters. Two lines of electric fence shall be installed on top.

Item	Unit	No.	Unit Cost (Rs. Lacs)	Year I	Year II	Year III	Year IV	Year V	Total Cost	Remarks
Staff Costs										
Biologist-1	PA		5.00	5.00	5.00	5.00	5.00	5.00	25.00	The same biologist and the vet. must stay with the project for its entire duration. The costs are averaged for the entire period and include all staff related expenses including salaries, allowances etc.
Veterinarian-1	PA		5.00	5.00	5.00	5.00	5.00	5.00	25.00	
Asstt. Veterinarian-1	PA		2.50	2.50	2.50	2.50	2.50	2.50	12.50	
Office Assistant-1	PA		1.20	1.20	1.20	1.20	1.20	1.20	6.00	
Watchmen-2	PA		0.60	1.20	1.20	1.20	1.20	1.20	6.00	
Drivers-10	PA		1.20	12.00	12.00	12.00	12.00	12.00	60.00	
Plumber cum Electrician-1	PA		1.20	1.20	1.20	1.20	1.20	1.20	6.00	
Vehicles, Equipment and Supplies										
Field Vehicles-4WD Scorpios	No.	2	12.00	24.00					24.00	
Field Vehicles-4WD Bolleros	No	2	8.00	16.00					16.00	
Animal Capture and Mass Transportation Vehicles: 2	No.	2	30.00	30.00	30.00				60.00	Animal Transport vehicles shall have to be suitably modified to meet the specialized requirements of the project.
4WD Recovery Vehicle for Animal Capture	No.	2	8.00	8.00	8.00				16.00	
Multipurpose Vehicles (truck & Tractor)	No.	2	8.00	8.00	8.00				16.00	
Misc. Capture Equipment and Tools winches, and implements	LS		10.00	10.00	10.00	10.00	10.00	10.00	50.00	
Operational Costs of Animal Capture (Labour, POL, misc.)	No.	5000	0.01	10.00	15.00	15.00	15.00	10.00	65.00	
Veterinary Equipment Computers and Consumables.	LS		10.00	10.00	10.00	10.00	10.00	10.00	50.00	

Item	Unit	No.	Unit Cost (Rs. Lacs)	Year I	Year II	Year III	Year IV	Year V	Total Cost	Remarks
Monitoring (By WII)										
Vehicles-2	No.	**2**	8.00	16.00					16.00	
Radio Collars and Accessories	No.	15	2.00	15.00	15.00				30.00	
Researchers: 4	PA	4	2.00	8.00	8.00	8.00	8.00	8.00	40.00	
Field Assistants-6	PA	6	1.00	6.00	6.00	6.00	6.00	6.00	30.00	
Drivers-2	PA	2	1.00	2.00	2.00	2.00			6.00	
Operational Costs (POL and Other Field Consumables)	LS			4.00	4.00	4.00	4.00	4.00	20.00	
Computers, Stationary, GPS, Binoculars, equipment, etc.	LS			2.00	1.00	1.00	1.00	1.00	6.00	
Travel (including International) and Other Misc. Costs	LS			4.00	4.00	1.50	1.50	1.50	12.50	
Sub-Total Monitoring (WII)										**160.50**
Publicity and PR	LS			10.00	5.00	5.00	5.00	5.00	30.00	
Maintenance of Vehicles	LS			20.00	20.00	20.00	20.00	20.00	100.00	
Misc. and Unforeseen Costs	LS			10.00	10.00	10.00	10.00	10.00	50.00	
Travel Costs (including International Travel)	LS			10.00	10.00	10.00	5.00	5.00	40.00	
Capture, restraint and tranquilization, Equipment, Drugs, other consumables	LS			10.00	5.00	5.00	5.00	5.00	30.00	
Support to Local People (Eco development)	LS			50.00	50.00	50.00	50.00	50.00	250.00	
Strengthening of Protection Infrastructure										
Construction of Patrolling Camps	No.	8	5.00	5.00	20.00	15.00			40.00	
Construction of Range Assistant Quarters.	No.	2	8.00		8.00	8.00			16.00	

Construction of Range Offices	No.	2	8.00				8.00	8.00	16.00	
Solar Lights in Patrolling Camps	No.	100	0.25		6.25	6.25	6.25	6.25	25.00	
PDAs and GPSs	No.	100	0.25		6.25	6.25	6.25	6.25	25.00	
Wireless Equipment	No.	50	0.25	2.50	2.50	2.50	2.50	2.50	12.50	
Internet Cost	LS			10.00					10.00	
Horses & Camels	No.	9, 4	0.8;0.4	6.00	2.80				8.80	
Horse & Camel Maintenance	LS			2.50	3.25	3.25	3.25	3.25	15.50	
Camera Traps	No.	100	0.06	6.00					6.00	
Ex-Servicemen/Laborers for Patrolling	No.	50	0.70	35.00	35.00	35.00	35.00	35.00	175.00	
Import of 6 cheetah	LS					10.00	10.00		20.00	
Relocation of 3 villages	Families	500	10.00	1500.00	2500.00	2500.00			6500.00	
Consultancy	LS		20.00	20.00	20.00	20.00	20.00	20.00	100.00	
Project Allowance for Staff	Persons	200	0.25	10.00	60.00	60.00	60.00	60.00	250.00	
Merchandising and Marketing	LS			5.00	5.00	5.00	5.00	5.00	25.00	
Boundary Fencing Along Villages	Km	50	12.00		300.00	300.00			600.00	
Livestock Predation Compensation	LS	50	0.02	1.00	1.00	1.00	1.00	1.00	5.00	Considering 1 sheep/goat killed per week
Unforeseen Contingencies	LS			6.00	18.00	18.00	18.00	18.00	78.00	
Grand Total.				**2060.10**	**3237.15**	**3175.85**	**353.85**	**338.85**	**9165.80**	

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Annexure III

Results of the fact finding mission to the Kuno Wildlife Sanctuary, MP, India, 6-9 August, 2011, as it relates to the proposed re-introduction of cheetah to the reserve.

Dr. Laurie Marker, Executive Director, Cheetah Conservation Fund

1. Introduction

A consultative meeting on Cheetah reintroduction in India was held in Gajner, Rajasthan on the 9th and 10th September 2009 which was attended by conservation organizations including members of the World Conservation Union's (IUCN) Cat Specialist Group, Veterinary Specialist Group and Re-introduction Specialist Group as well as other international cheetah experts, as well as officials from Central and State Government. The cheetah has been extinct in India for over 60 years. Reintroduction of cheetahs back into India will bring attention to grassland and open forest habitat and further the species conservation. Restoring the ecological integrity of the environments, create an opportunity for scientific research and environmental education and add value to tourism.

Surveys conducted by Ranjitsinh & Jhala (2010) from the Wildlife Trust of India and the Wildlife Institute of India identified a total of 10 potential sites for cheetah reintroductions and provided recommendations pertaining to each site. After conducting surveys of the areas, the Wildlife Institute of India, short-listed three sites, Shahgarh area in Rajasthan, Kuno Palpur and Nauradehi Sanctuaries in Madhya Pradesh, as possible habitats for reintroduction of cheetah.

The Kuno Wildlife Sanctuary (KWS) (see Figure 1), an area of 344.68 km^2 ranked highest due to the restoration efforts conducted in the past three years preparing for potential lion reintroductions. KWS has low village/ human settlements since relocations were conducted and, it was estimated that the area could potentially sustain a population carrying capacity of between 27 – 32 cheetahs (Ranjitsinh & Jhala, 2010). In April and May of 2011 a follow up survey was conducted by the Wildlife Institute of India showing that the prey base has increased since the previous survey was conducted in 2005 (Jhala, in prep).

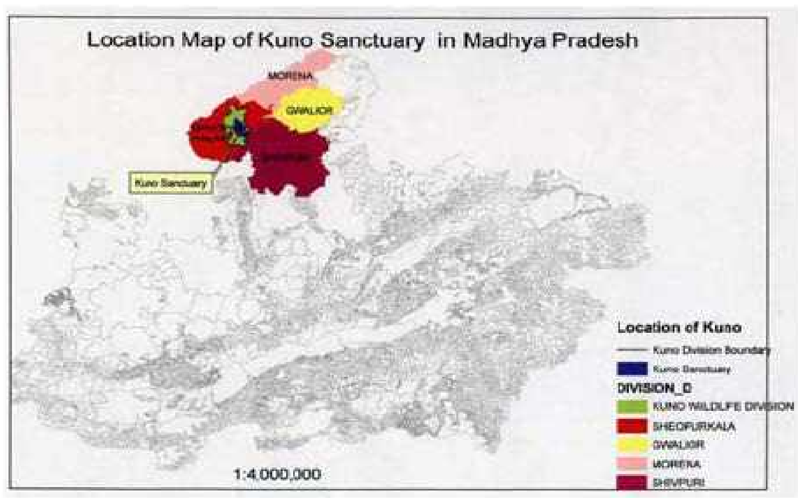


Figure 1. Location Map of Kuno Wildlife Sanctuary (Ranjitsinh & Jhala , 2010).

The KWS is part of the Sheopur – Shivpuri forested landscape has been strategically chosen due to its suitable habitat. The entire buffer area around the Park is ~ 3200 km^2 which continues into a full forest habitat of ~ 6830 km^2 area. It is believed that the area has potential for an established naturally breeding population of free-ranging cheetahs (Ranjitsinh & Jhala, 2010). There are 169 villages around this area – and several villages within the reserve have been re-located. Figure 2 shows a map of the major villages around KWS and the three within and around KWS that are slated for re-location.

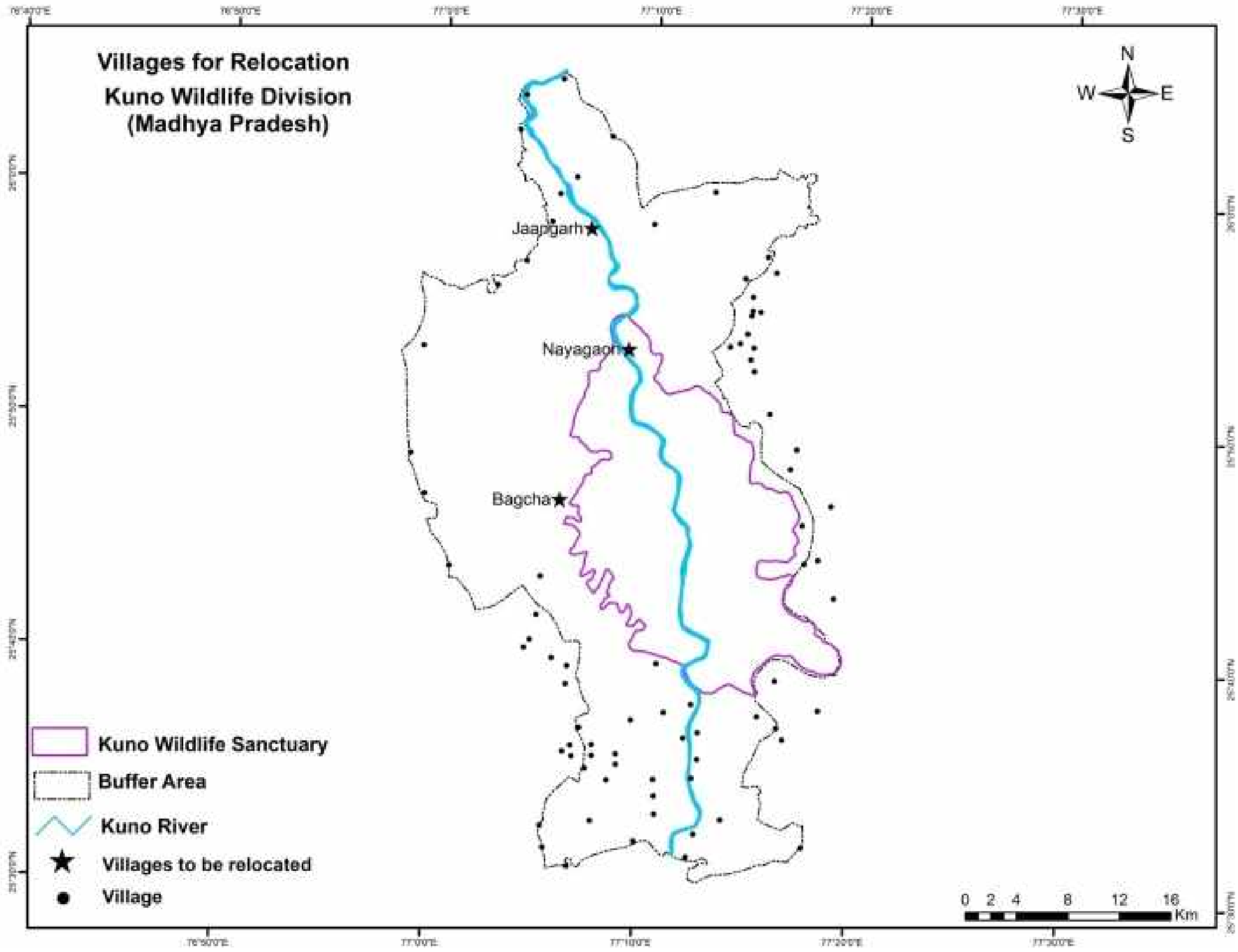


Figure 2. Three villages that are slated for re-location within KWS and villages surrounding KWS (Jhala, in prep).

Although cheetah are genetically very similar (O'Brien 1985, Driscoll, 2002), regional differences in suitable habitat characteristics such as adequate prey, prey species diversity, inter-specific large predator relations and human wildlife conflict may affect a successful reintroduction. It was against this background that an assessment and fact finding mission to the Kuno Wildlife Sanctuary and surrounding area was conducted from 6 -9 August 2011 in order to determine the suitability of the area for cheetah reintroductions and was conducted by the principal Cheetah Task Force (see Photo 1) and myself, Dr. Laurie Marker, Director of the Cheetah Conservation Fund. During this time, various consultative meetings were held, resulting into the development of an action plan.

Photo 1. Cheetah Task Force members with the author.

Itinerary

August 6 – Chairperson and members of Indian Cheetah Task Force, Dr's. Ranjitsinh, Divyabhanusinh Chawda , and Yadvendradev Jhala along with Dr. Laurie Marker, Director of the Cheetah Conservation Fund from Namibia, Africa, travelled by train from Delhi to Gwalior then drove with Forest Department officials to Kuno Wildlife Sanctuary. Meeting was held with NGO's and Forestry Department staff at Kuno Wildlife Sanctuary headquarters outside the Sanctuary. Introductions were made to Dr. H. S. Pabla, Principal Chief Conservator of Forest (Wildlife) and Chief Wildlife Warden, Madhya-Pradesh, Dharmendara Shukla, Additional Principal Chief Conservator of Forest (Wildlife), Anand Kumar, Chief Conservator of Forests, and Ashok Shukla, Divisional Forest Officer of Kuno Wildlife Division, and Bipin, Research Biologist for the Wildlife Institute of India (WII) who were then a part of the KWS survey team (see Photo 2).

August 7 – Survey the West side of the Kuno Wildlife Sanctuary to look at prospective holding areas and release sites for cheetah.

August 8 - Survey the East side of the Kuno Wildlife Sanctuary and to look resettled villages outside of the Sanctuary.

August 9 - Depart for Gwalior

Photo 2. KWS survey team 6 – 8 August 2011.

Field trip investigation methods

Rapid survey methodologies were utilized and observation surveys were conducted on both sides of the Kuno (east and west) using prominent routes over a three day period. Figure 3 shows the route taken by the Cheetah Task Force from Gwalior (in the east) during the three day survey to and around KWS.

Figure 3. GPS points of KWS and surrounding areas taken by Dr. Marker during 3 day assessment trip to the area 6-9 August, 2011.

In addition, interviews were conducted with the park officials and visits to cheetah holding facilities were done. Due to the limited number of days spent and long distances covered, it was not possible to use rigorous scientific methods like Distance sampling. Rapid assessment was done using encounter rates along travelled routes. The WII team had earlier assessed the area using robust, scientific methods like line transects, Distance sampling and Socio- economic surveys and this report was made available to me. Although, the vehicle was mostly in motion, GPS locations, video and pictures were taken throughout. Observations of features such as wildlife, livestock, other domestic animals, water availability, villages/settlements and people were recorded and a GPS file was created. Animal sightings were quantified according to species, cluster size, sex, age category (calf, juvenile, adult).

Kuno Wildlife Sanctuary (KWS)

Weather

The time of the survey corresponded with the Monsoons and the hot, wet season. It rained heavily on the 7^{th} and 8^{th} of August during our travels. The KWS area gets ~ 1000 mm of rain per year, and maximum temperatures get to ~45 – 48 °C during May- July (Jhala, pers comm.).

The rainy season (monsoon) is July through Sept with temperatures up to 31 °C

Cold Dry season is Sept – Jan and the temps can get to 7 °C or even 0 °C.

Hot Dry season is Feb – early June – where it ranges 35 to 48 °C. Early showers in mid June.

This is important to predict when breeding will occur for the newly re-introduced cheetahs and how to plan for this.

Field observations

The survey in the Sanctuary resulted in a travel effort of 287.85km, or equivalently 50 sector points distributed over a 5 km interval (see Figure 4).

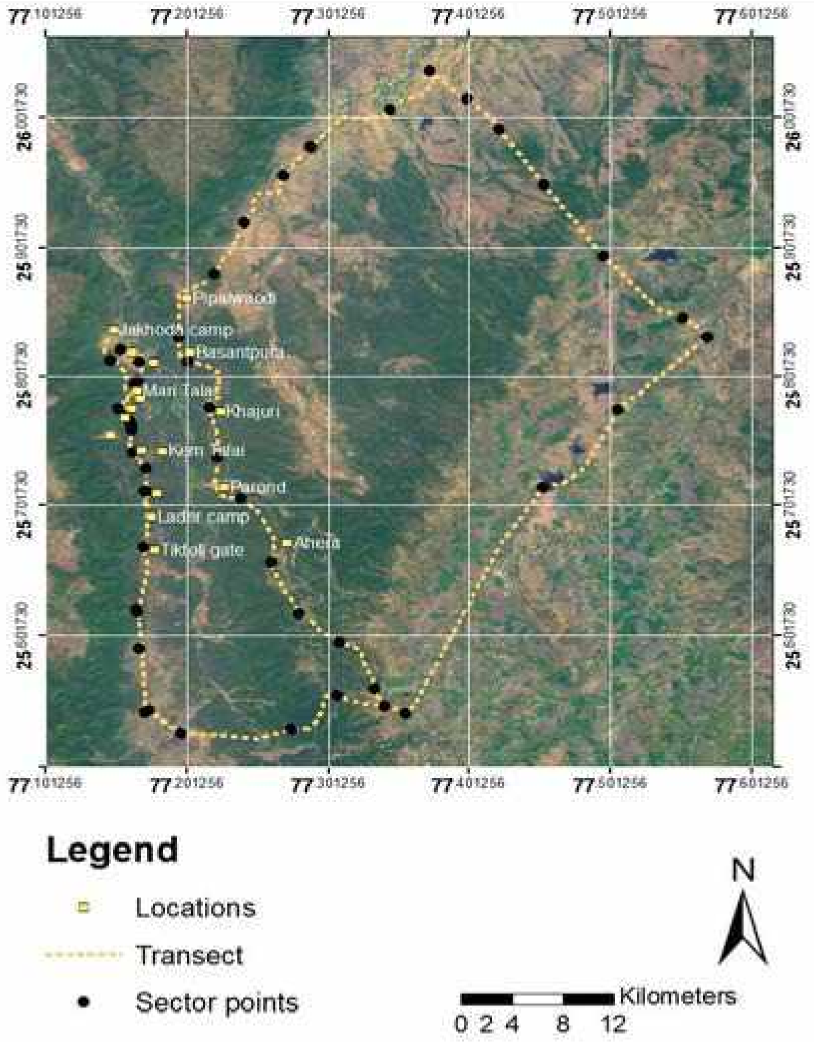


Figure 4. Locations and details of the Rapid Survey Zone in the KWS and surrounding in relation to 10 km (0.1 degree) grid squares, August 2011.

The elevation through the Sanctuary averaged 300.97 meters above sea level. The transect route went through various habitat types including thick bush, open grasslands, forests, hilly and riparian vegetation (Table 1).

Table 1. Habitat features along the surveyed route in the KWS (L. Marker, 2011).

	N sectors	N 0.10° grids	Total sectors seen	% sectors seen
Rivers	50	13	39	78.00%
Waterhole			3	6.00%
Creek			5	10.00%
Dam/lake			3	6.00%
Forest			1	2.00%
Park savannah			5	10.00%
Open savannah			1	2.00%
Thick bush			4	8.00%

Given this diversity, this area is expected to serve as an important refuge for biodiversity protection. Rivers and other water bodies such as waterholes, dams and creeks were prominently sighted. The

Kuno River (Photo 3) flows through the entire length of the Sanctuary, and the water from the river is expected to be widely accessible for wildlife throughout the year; however the river becomes a stream during the dry season.

Photo 3: The Kuno River, that flows through the middle of the KWS during the monsoons (Aug) (Photo, L. Marker).

Figure 5 shows the water availability through the Sanctuary. I was shown three perennial water holes where pipelines provide water year around (see photo 4).

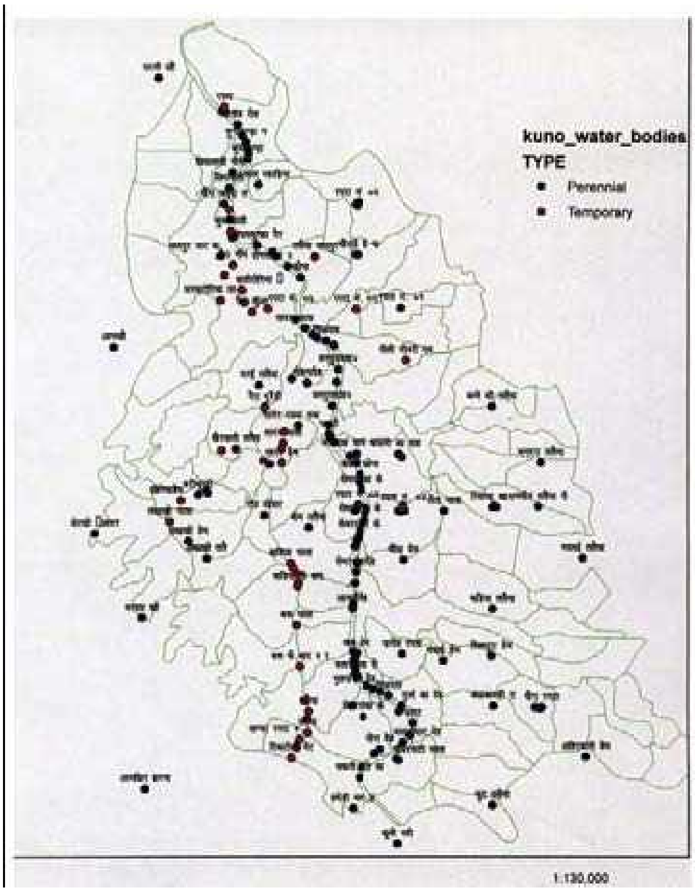


Figure 5. Water availability through the KWS (Jhala, in prep).

Photo 4. One of three perennial water holes visited during survey that has year around water (photo, L. Marker).

Vegetation
The vegetation types occur in the forms of grasslands, slopes, woodlands, aquatic and riparian and open savannah under the northern tropical deciduous forest classification.

Photo 5: Representative photos from throughout Kuno (Photos by L. Marker).

The Sanctuary offers promising suitable habitat such as the open woodlands and grasslands as rewarding patches for increased hunting efficiency (see Photos 5). In Namibia, cheetahs are known to utilize open areas intensively, however, visitations to thick bush habitat is common (see Photo 6 of Namibian cheetah habitat).

A. Open **B. Dense**

Photos 6. Pictures from Namibia illustrating the open (a) and dense (b) savannah vegetation structure where cheetahs are known to inhabit (Photos CCF).

Wildlife sightings

During the trip, at least 50% of the listed wildlife prey species in the KWS were confirmed present. Species identified included the nilgai, chital, chinkara, sambar, wild boar and jackal. Other additional species recorded within the Kuno landscapes included the four horned antelope which I did not see personally, but one of our team did sight one and I was told that they are present in the reserve. Chital were recorded with the highest total number of individuals and compared to the rest of the species, had a higher encounter index per kilometre (Table 2). Although no density estimates were derived from this survey, updated survey reports on wildlife statistics in the reserve in 2011 revealed the chital to have the highest density of 35.87 ± 11.7 ind./km^2 , whereas all potential prey were estimated at 38.99 ± 13.23 ind./km^2 (Jhala, 2011). Increase in prey densities were shown to have occurred since 2005 (Jhala, 2011).

Table 2. Sighting of common wildlife in the Kuno landscape, India (L. Marker, 2011, Cheetah Conservation Fund).

	Total sectors seen	% sectors seen (n=50)	Total 0.10° grids scored (n=13)	% 0.10° grids scored	Total individuals seen	ind./1km index
Chinkara	3	6.0%	2	15%	7	0.024
Chital	13	26.0%	2	15%	371	1.289
Sambar	1	2.0%	1	8%	28	0.097
Jackal	4	8.0%	3	23%	5	0.017
Nilgai	14	28.0%	3	23%	33	0.115
Wild Pig	1	2.0%	1	8%	2	0.007

As an exercise, Kuno Wildlife Sanctuary game densities were compared to the game densities from the Cheetah Conservation Fund research site in Namibia using annual waterhole count data from the Waterberg Conservancy (Table 3) (Marker, 2010). As indicated, four primary species in the CCF research site showed a positive trend of increase between the years. The average prey density for these species was estimated to be 3.6 ± 1.65 and 6.24 ± 2.99 ind. /km^2. The prey densities for the

KWS were higher than those from Namibia, a factor which may be due to counting methods and regional differences in climatic condition and diverse habitat. Thus, as the CCF site supports a cheetah population of 12 to 14 cheetahs in competition with other predators (leopard, jackal, and hyena) it is believed that given these high densities, natural prey will be adequate for the reintroduced cheetah population.

Table 3. Density estimates for cheetah prey in the Waterberg Conservancy in Namibia, 2008 – 2010.

Common name	Density/10km^2			Density 1 km^2		
	Mean	SD	95% CI	Mean	SD	95%CI
Kudu	46.00	41.64	47.12	4.60	4.16	4.71
Oryx	58.30	14.11	15.96	5.83	1.41	1.60
Eland	48.30	48.81	55.23	4.83	4.88	5.52
Warthog	54.17	24.80	28.07	5.42	2.48	2.81
Red hartebeest	30.20	16.07	18.18	3.02	1.61	1.82

CCF has been conducting camera trapping survey to estimate cheetah densities and population dynamics within a 367.75 ± 68.85 km^2 study site since 2005. The number of known adult individual in this area averaged 9.75 ± 3.24, or equivalently a density of 0.03 ± 0.05 ind./km^2. As indicated in the reintroduction plan, the KW landscape has a potential to support at least 27 or with additional habitat, 32 individuals (Ranjitsinh & Jhala, 2010). Therefore, the density of known individuals provided by this estimate would be 0.08 ind./km^2 and 0.07 ind./km^2 (with additional habitat of 120km^2). CCF camera trapping estimates were mainly biased towards the males and with the application of a known correction factor the density of known individuals is likely to increase. Studies of cheetah density in the Kruger National Park in South Africa, where the rain fall and habitat are similar to that of KWS, show a similar density of 0.020 ind./ km^2 (Mills, 1998, Broomhall, 2001).

Domestic animals

The total number of known feral cattle in the reserve is estimated to be 2500 but mostly bulls. A total of 989 cattle were observed around the buffer of the reserve during the trip resulting in a high encounter rate index (Table 4). There were also a high number of water buffalo more on the outskirts of the buffer area. The presence of other animals such as donkeys, domestic pigs and goats were also confirmed. Domestic dogs were abundant including feral individuals and could pose a risk to cheetahs due to diseases such as rabies and canine distemper (the cheetah is susceptible to both). It is suggested that vaccinations and sterilizations of the dogs should be implemented prior to the release in order to reduce disease risks around the Sanctuary. Vaccinations and sterilizations of domestic dogs should be repeated annually.

Table 4. Livestock sightings encountered (L. Marker, 2011, Cheetah Conservation Fund).

	Total sectors seen	% sectors seen (N=50)	Total 0.10° grids scored (N=13)	% 0.10° grids scored	Total individuals seen	ind./1 km index
Buffalo	2	4.0%	1	7.7%	16	0.056
Cattle	18	36.0%	8	61.5%	989	3.436
Goats	5	10.0%	3	23.1%	381	1.324

Cheetah holding area

During the survey, three areas were shown as possible release sites. The first was in too thick of bush to settle the cheetahs well, as they could not see the surrounding area. This area was originally fenced for the re- introduction of lions and was in a valley with lots of tall trees. This area, however, could be a very short term holding area if some major repairs were made to the fencing. This area could also be used for re-introduction of wildlife prey species to the Sanctuary.

The second area did not have any infrastructure, however, the habitat was open and would be a good area for holding cheetahs prior to release due to the visibility.

The third area (see Photo 7) was a resettled homestead. The area is very open with hills/mountains surrounding the valley. There were two houses near a 50 hectare holding facility (~ 1.5 meter high fence) that had been constructed as an enclosure for grazing experimental studies to determine how a non grazed area differs from the area where wildlife could graze. During the visit, this enclosure was occupied by over 200 abandoned cattle. This enclosure could be used for holding cheetahs if the fencing was made higher and shade and smaller holding areas added to the enclosure – in addition, the enclosure would need to be split for holding male and female cheetahs. Making this enclosure ready should not take more than a couple months.

Photo 7: Area around 3rd site for cheetah housing – this was the preferred site (Photo by L. Marker)

It has been recommended that the enclosure be divided and males put in one side and females in the other side. The current fence is not high enough, so repair is necessary to raise the height from the current ~ 1.5 meter high to 2.5 meters (see Photo 8) and a line or two of power fence shall have to be fitted at the top to discourage attempts by leopards to enter the enclosure. Additional repairs should insure that there is an adequate water supply and shade. The team all preferred this site over the other two sites, as it is very open with good visibility, allowing the cheetahs to see and get to know the area before release.

Before the cheetahs would arrive, this fenced area would need to be checked carefully to make sure that it would hold the cheetahs. After release, the surrounding mountains would be explored by the cheetahs allowing them to see into distant areas of the reserve.

Photo 8: Current fence at selected cheetah holding area (Photo by L. Marker).

The Plan as discussed with the Cheetah Team

The Cheetahs

The cheetah reintroduction plans are at an advanced stage with a total of 10 individuals proposed by the Cheetah Conservation Fund to be sourced from either Namibia or South Africa. This first group of cheetahs needs to settle into the reserve learns to find the appropriate prey to hunt and kill, and to begin breeding. The success of this first group of cheetahs will be in their off-spring learning how to hunt and to begin breeding.

Males - A coalition (bonded group) of 3 to 4 males to begin with. This will allow the males to get to know the area, hunt more successfully, and provide enough animals if there is an injury to one of the male cheetahs. The males should be at least 4 to 5 years of age, as they would be dominant and looking to hold territory

Females – A group of up to 6 females and suggested that they known to each other – females have home ranges that over-lap other females, so there is a strong social bond between them. The females should be over 2.5 years of age. The selected animals should be from different backgrounds to expand the diversity of the original founder population. A professional from the donor agency and one or two representatives of the MPFD shall accompany the shipment, along with necessary supplies and equipment.

Transportation

The cheetahs will be transported by air to India and by truck from the airport to the KWS. Transport Crates have to be of the type approved by the International Air Transport Authority (IATA). Crates will cost approximately US$900 each.

The cheetahs will be anaesthetized prior to transport for a final exam and fitting of satellite telemetry collars.

The radio-collars need to be placed on the cheetahs so that once they are released in India; they will have them already attached in case of escape or long distance movement.

There is no need to tranquilize the cheetahs during travel. However, selecting the fastest and safest route for travel will be important. A skilled/trained team is a necessity to travel with the cheetahs.

Ideally a direct route will be taken from Johannesburg to India – and then to Gwalior, where transport vehicles will be available to drive the cheetahs to KWS. Over-land travel would be best during the coolest time of the day – however, time is the critical factor. The drive from the Gwalior airport to KWS will be approximately 5 to 6 hours.

Housing of Cheetahs at Kuno Wildlife Sanctuary Prior to Release

A 50 ha area has been selected where the cheetahs will be housed prior to release. The location of the enclosure is such that the cheetahs can see for some distance to understand the environment and the presence of prey, before release.

Males and females will be kept in separate but adjoining compartments so that they are able to know each other before release. An existing enclosure available at the selected location will be suitably repaired and modified to house the imported animals. .

These animals will be released into the main enclosures, after a short stay in a smaller fence (1-2 ha) for the purposes of inspection. All cheetahs will be satellite collared.

The males will be released from the large fenced enclosure after a few weeks to one month. It would be expected that they will explore their area very extensively over the next month, after investigating the available habitat but would return regularly to the enclosure to see the females. The presence of females in the fence will ensure that the males do not wander too far away, after their exploration instinct is satiated.

Their movements will be monitored daily by a team of researchers from WII and CCF with assistance from local Kuno Park staff. If an animal gets into undesirable environment, it will be brought back into the Sanctuary through darting.

The females will be released 1-2 months after the males, depending upon the state of the males comfort in the new environment. The females will be monitored and kept under observation through satellite telemetry, as in the case of males described above.

The founding stock should start breeding in about 6 months (gestation period: approx. 90 days) and approximately 20 cubs (average litter size: 3-5) can be expected from the first round of littering, by the end of the first year (This assumes all the females come immediately in estrus, which is very likely).

Prey

The animals should be fed on natural prey while in the holding compound. Feeding of meat can be done as well – the meat can be buffalo meat; a calcium supplementation should be used on the meat, and excess fat needs to be taken off, as cheetahs need a lean meat diet. In addition, it is not recommended to feed chicken, as salmonella can be a severe problem.

Community Support

Local communities should be counseled in living in harmony with wildlife, particularly predators, through proper training and communications programmes.

Potential areas of high conflict of wildlife with local communities should be fenced suitably.

Sustainable tourism shall be encouraged so that jobs and business opportunities for the local people can be created. An attempt to generate revenues through brand building, marketing, sponsorships, and merchandising shall be made, through private partnerships, with the conservation activities. The Cheetah Conservation Fund will be available to assist local NGO's with this aspect of the re-introduction programme, as lessons learned from Namibia and other cheetah ranges countries can have benefits to the success of the cheetah reintroduction to Kuno Wildlife Sanctuary.

Staffing, Research and Infrastructure Needs

CCF will arrange to provide a Ranger trained in cheetah reintroduction research to monitor the cheetahs prior to and following the reintroduction. A period of at least two months will be used to train local rangers as well as Wildlife Institute of India researchers in cheetah monitoring and behaviour. During this time, the CCF ranger, trained in anti-poaching, will also provide training to the KWS rangers in this aspect. Food and housing will be necessary as well as access to reliable transportation at all times. Reliable communications are also a necessity.

Currently there is no internet or phone access though out the KWS. Phone service is over an hour away from the KWS main base in the middle of the Sanctuary. Internet access is also not available until reaching the Forest Department office on the outer border of the Sanctuary. It is very important that internet and/or phone access is available within the Sanctuary for availability to outside council in case of emergency.

It is recommended that enthusiastic and committed rangers will be selected for the job. Through proper training, these rangers will become the Cheetah Team and be very important to the success of the project.

A forest department trained veterinarian should be available at all times in case of an emergency. The veterinarian will be trained in darting methods as well as proper use of emergency and immobilization drugs.

Training of some staff may take place at the Cheetah Conservation Fund in Namibia depending on training needs. In addition, CCF will help with training on the ground at the KWS to others that are not trained in Namibia or South Africa.

Recommendations and way forward

Data collected from the rapid survey conducted in August of the Kuno Wildlife Sanctuary by the Cheetah Task Force team provided a great deal of insight into the habitat, prey availability and local community lifestyle and proximity to the KWS cheetah release area. The area is suitable for cheetah currently, and under the timeline stated by the Cheetah Task Force team cheetahs could be placed in re-introduction camps as early as January 2012.

CITES Permits will be required for the export of cheetahs from either Namibia or South Africa. In order to start the process the KWS will need to obtain a CITES import permit from the Scientific Authority of India. This import permit will not be a blanket; it will need information about the individual animals that are to be imported. Once the Indian CITES import permit is issued, CCF can apply for a CITES export permit in Namibia, or a South African partner will have to apply for the CITES export permit from South Africa.

It is recommended that government relations be developed between Namibia and India so that cheetahs could be donated to this project with the blessing and support of the Namibian government. CCF is currently gathering information about animals for possible export to India.

Obtaining cheetahs from South Africa will be a bit different, as the cheetahs may have to be purchased, as most of the cheetahs are in private reserves and not under the government's ownership. Cheetahs will need to be identified for this process.

Either way, India needs to provide an Import permit in order to get an export permit from either Namibia or South Africa.

Conclusion:

On the basis of my assessment, I believe that the site (Kuno and its surrounding landscape) is appropriate for attempting the reintroduction of the cheetah in India. The habitat and prey base meet the requirement of the species. The Indian team of managers, bureaucrats, and scientists seem to be addressing the major issues of concern to the best of their ability within the limits of logistic feasibility and practicality. I believe the reintroduction has a fair chance of success and should go ahead as planned. Incorporating some of the suggestions in this report will assist in smooth running of the project. CCF will be a willing partner in this endeavor of India.

References

Broomhall, L. S. 2001. Cheetah *Acinonyx jubatus* in the Kruger national park: A comparison with other studies across the grassland-woodland gradient in African savannas. Department of Zoology and Entomology. University of Pretoria, Pretoria, SouthAfrica.

Driscoll CA, Menotti-Raymond M, Nelson G, Goldstein D,O'Brien SJ. 2002. Genomic microsatellites as evolutionary chronometers: a test in wild cats. Genome Res. 12:414–423.

Jhala, Y.V. 2011, Cheetah reintroduction phase 2- interim report .

Marker, L. 2010, CCF Annual Report. www.cheetah.org.

Mills, M. G. L. 1998. Cheetah ecology and behaviour in east and South Africa. Pages 18-22 in B. L. Penzhorn, editor. Symposium on Cheetahs as Game Ranch Animals, Onderstepoort, South Africa.

O'Brien, S. J., M. E. Roelke, L. Marker, A. Newman, C. A. Winkler, D. Meltzer, L. Colly, J.F. Evermann, M. Bush, and a. Wildt et. 1985. Genetic basis for species vulnerability in the cheetah. Science 227:1428-1434.

Ranjitsinh, M.K. & Jhala, Y.V. 2010. Assessing the potential for reintroducing the cheetah in India. Wildlife Trust of India, Noida, & Wildlife Institute of India, Dehradun. TR2010/001.

Appendix 1:

Summary of prey species model parameters in Kuno WLS

Category	All prey species	All prey species excluding langur	Cheetah prey species	Chital	Langur
Number of spatial replicates	24	24	24	24	24
Number of observations (n)	120	98	69	49	22
Effort (L) km	68.03	68.03	68.03	68.03	68.03
Density (D_i) / km^2 ± Standard Error (S.E)	**85.91 ± 23**	**62.34 ± 18.6**	**38.99 ± 13.23**	**35.87 ± 11.7**	**15.62 ± 5.61**
D_i Coefficient of Variation (% CV)	26.8	29.85	33.7	32.5	35.95
Group Density(D_s) / km^2 ± S.E	15.6 ± 3.6	13.29 ± 3.59	9.6 ± 2.9	7.0 ± 1.9	2.45 ± 0.76
D_s Coefficient of Variation (% CV)	22.82	29.85	30.13	32.54	31.02
Probability of Detection (p)	0.28	0.27	0.26	0.39	0.43
Goodness of Fit (ψ-p)	0.86	0.72	0.93	0.91	0.87
Effective Strip Width (ESW)	56.46	54.17	52.98	51.42	65.83
Group Encounter rate (n/L)	1.76	1.44	1.01	0.72	0.32
AIC value	383.27	310.64	210.56	128.7	64.48
Model	Hazard rate	Hazard Rate	Hazard rate	Half normal	Half normal
Model adjustment term	Simple polynomial	Cosine	Simple polynomial	Cosine	Cosine

Categories of prey;

All prey species: Chital, chinkara, chowsingha, feral cattle, hare, langur, nilgai, peafowl, sambar and wild pig

All prey species excluding langur: Chital, chinkara, chowsingha, feral cattle, hare, nilgai, peafowl, sambar and wildpig.

Cheetah prey species: Chital, chinkara, chowsingha, hare, nilgai calf, peafowl and sambar fawn.

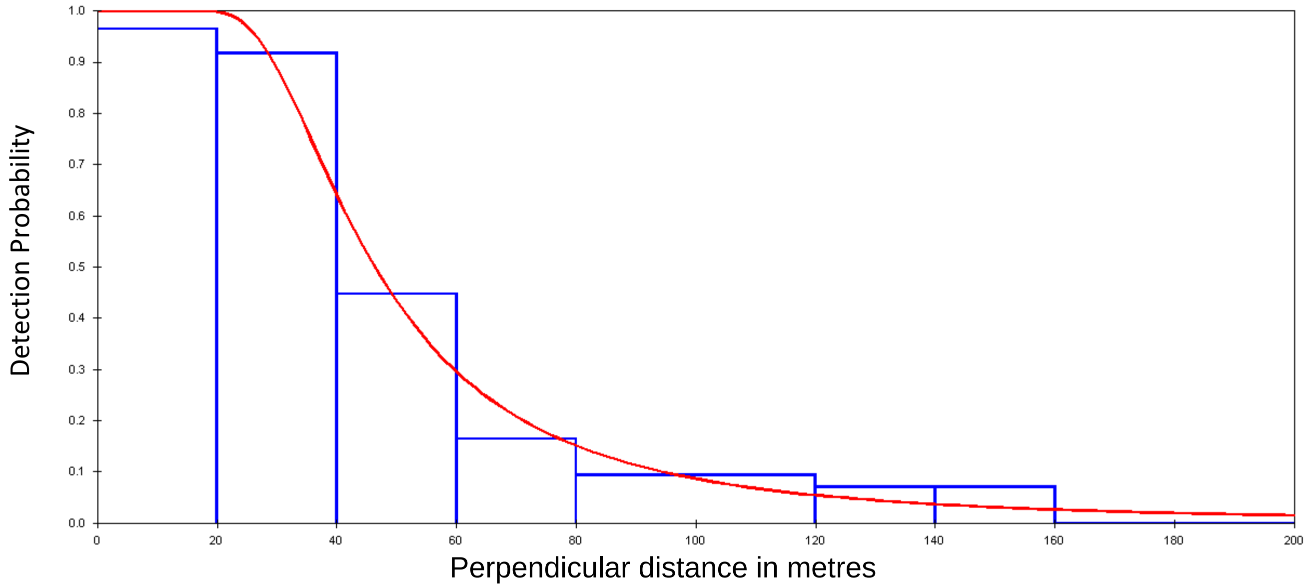
Appendix 2:

Detection function curves for prey species in Kuno WLS

2.1: All prey species in Kuno WLS

Species: Chital, chinkara, chowsingha, feral cattle, hare, langur, nilgai, peafowl, sambarand wildpig.

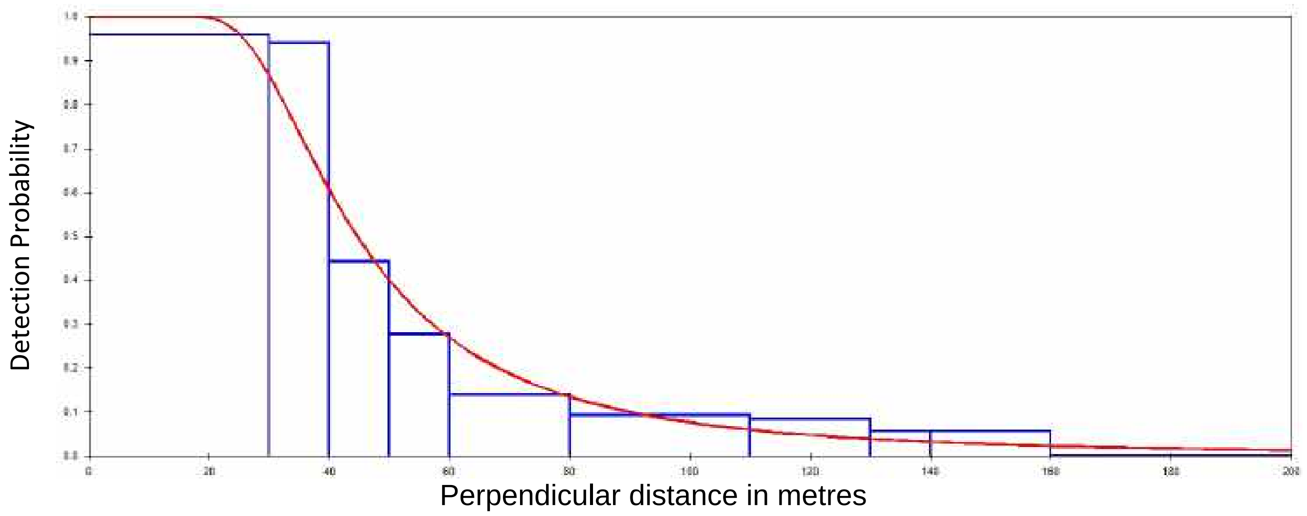
Model: Hazard rate with simple polynomial adjustment term. (ψ^2 – p = 0.86, p = 0.28)



2.2: All prey species excluding langur in Kuno WLS

Species: Chital, chinkara, chowsingha, feral cattle, hare, nilgai, peafowl, sambar and wildpig.

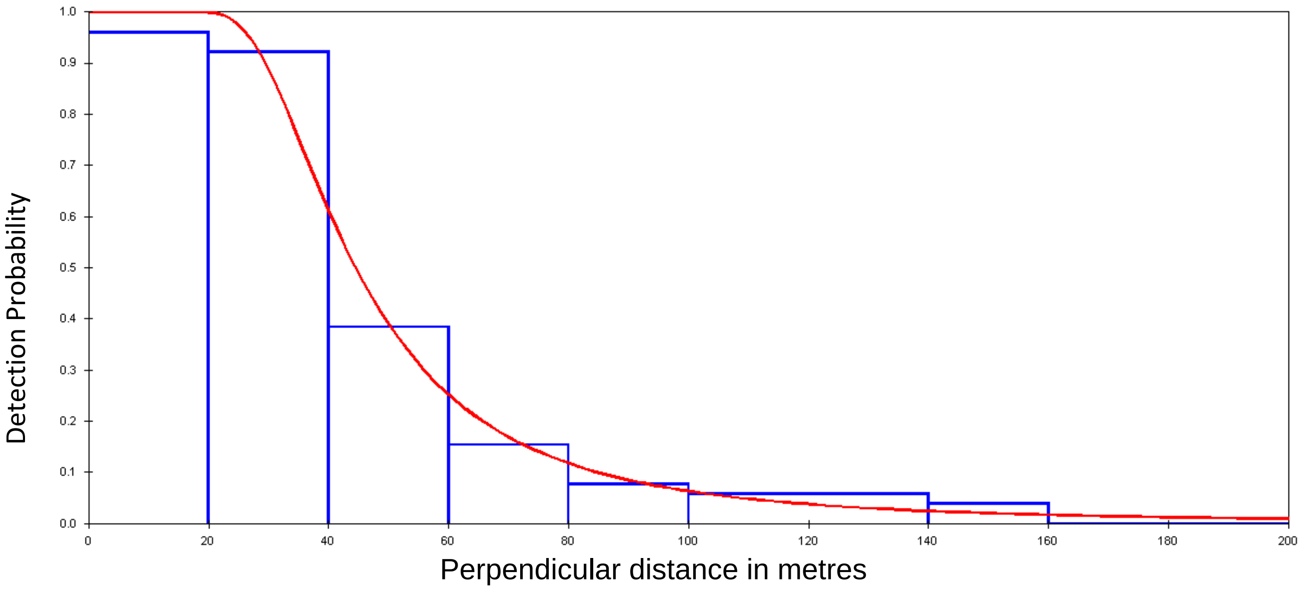
Model: Hazard rate with cosine adjustment term (ψ^2 – p = 0.72, p = 0.27)



2.3: Cheetah prey in Kuno WLS

Species: Chital, chinkara, chowsingha, hare, peafowl, nilgai calf and sambar fawn.

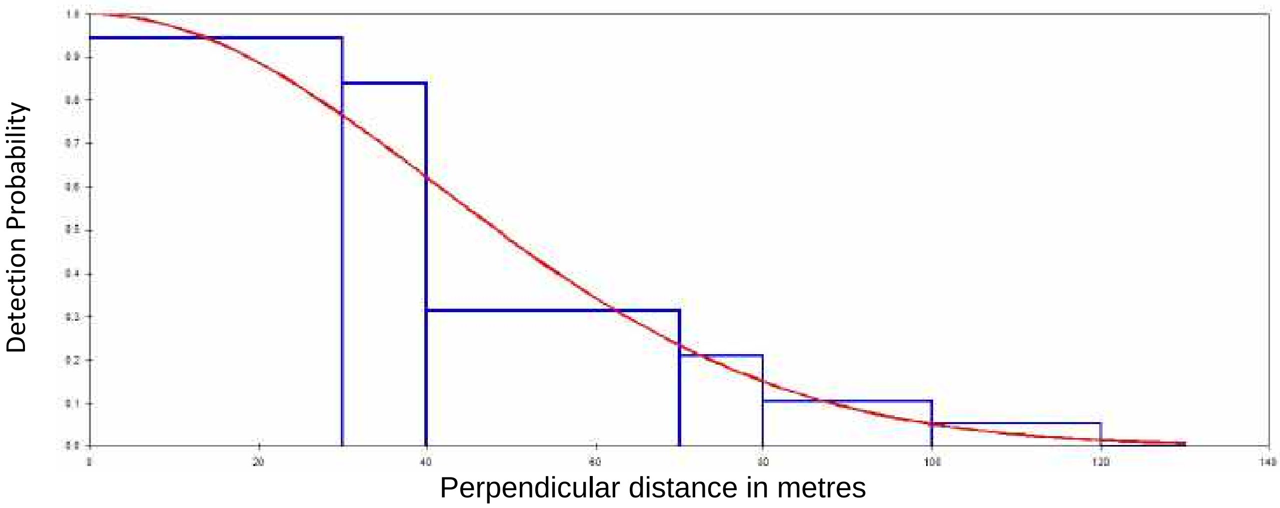
Model: Hazard rate with simple polynomial adjustment term. (ψ^2 – p = 0.93, p = 0.26)



2.4: Chital in Kuno WLS

Species: Chital

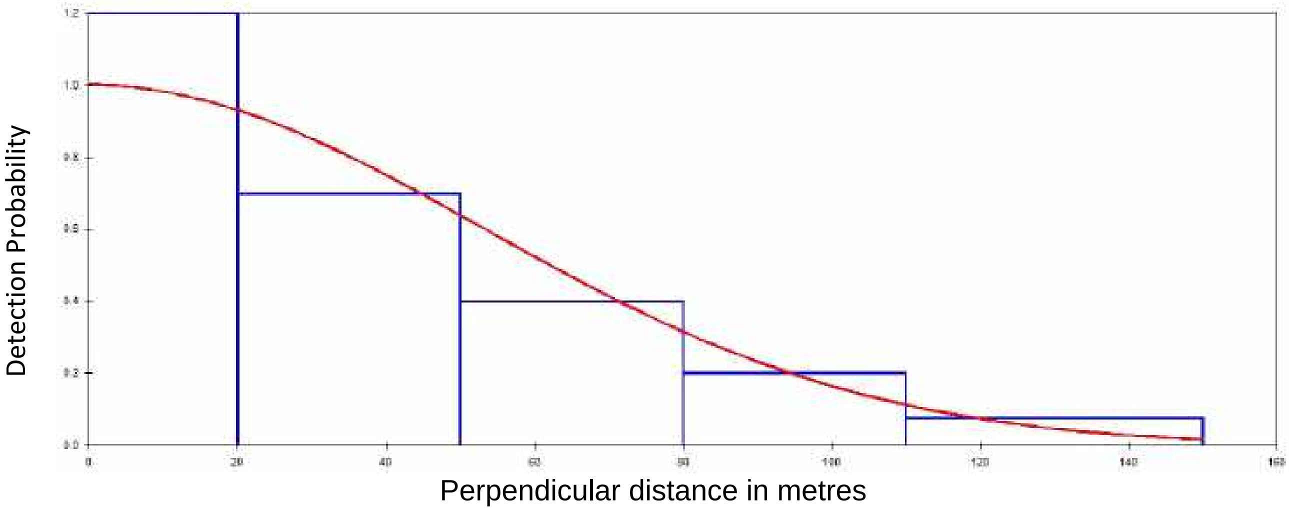
Model: Half normal with cosine adjustment term. (ψ^2 – p = 0.91, p = 0.39)



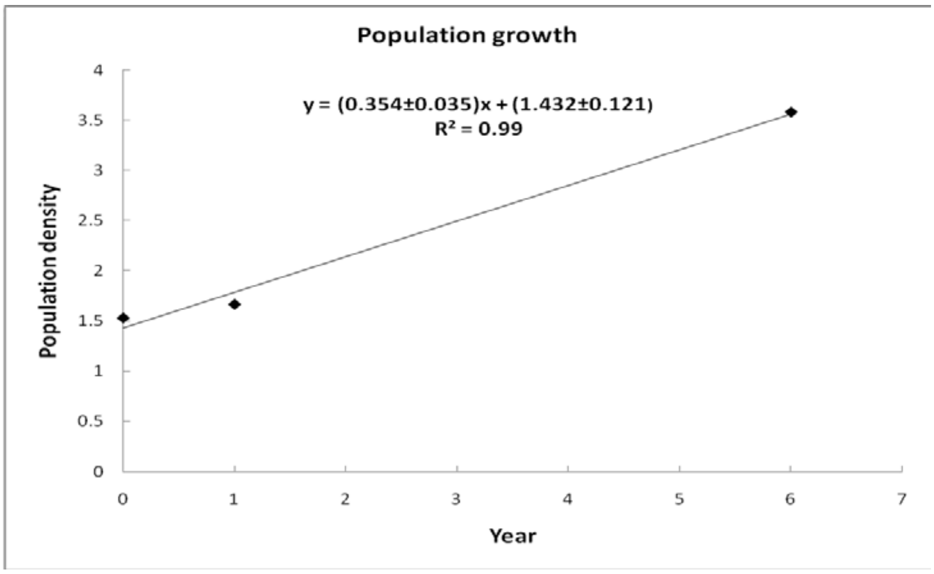
2.5: Langur in Kuno WLS

Species: Langur

Model: Half normal with cosine adjustment term. (ψ^2 – p = 0.87, p = 0.43)



2.6: Chital population in Kuno WLS since 2005



S. no.	Year	Chital population density
1	2005	4.63 ± 1.03 (Banerjee, K. 2005)
2	2006	5.3 ± 1.78 (Jhala & Qureshi, 2006. Unpub.)
3	2011	35.87 ± 11.7(Present survey)

Appendix 3:

Summary of prey species model parameters in Kuno WLS and sampled buffer area

Category	**All prey species**	**All prey species excluding langur**	**Cheetah prey species**	**Chital**	**Langur**
Number of spatial replicates	39	39	39	39	39
Number of observations (n)	120	111	69	49	30
Effort (L) km	102.03	102.03	102.03	102.03	102.03
Density (D_i) / km^2 ± Standard Error (S.E)	**70.08 ± 18.14**	**5 4.41 ± 15.9**	**26.69 ± 8.49**	**23.95 ± 8.2**	**15.02 ± 4.33**
D_i Coefficient of Variation (% CV)	25.9	29.22	31.8	34.25	28.87
Group Density(D_s) / km^2 ± S.E.	13.2 ± 2.99	11.06 ± 2.66	7.15 ± 2	4.67 ± 1.41	2.24 ± 0.5
D_sCoefficient of Variation (% CV)	22.64	24.12	28.08	30.26	25.05
Probability of Detection (p)	0.29	0.25	0.27	0.36	0.36
Goodness of Fit (ψ-p)	0.9	0.73	0.97	0.9	0.98
Effective Strip Width (ESW)	52.6	49.05	53.31	4.67±1.41	65.4
Group Encounter rate (n/L)	1.39	1.08	0.76	0.47	0.29
AIC value	305.56	327.21	235.78	128.78	88.99
Model	Hazard rate	Half normal	Hazard rate	Half normal	Half normal
Model adjustment term	Cosine	Cosine	Simple polynomial	Cosine	Cosine

Categories of prey;

All prey species: Chital, chinkara, chowsingha, feral cattle, domestic cattle, hare, langur, nilgai, peafowl, sambar and wild pig.

All prey species excluding langur: Chital, chinkara, chowsingha, feral cattle, domestic cattle, hare, nilgai, peafowl, sambar and wildpig.

Cheetah prey: Chital, chinkara, chowsingha, hare, nilgai calf, peafowl and sambar fawn.

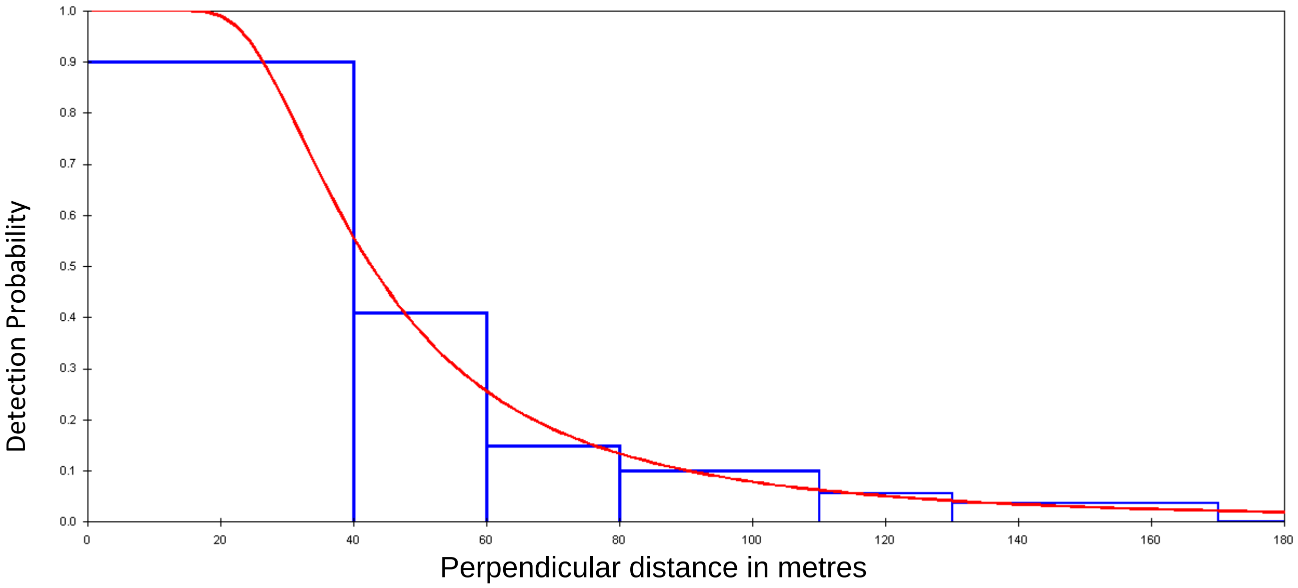
Appendix 4:

Detection function curves for prey species in Kuno WLS and sampled buffer area

4.1: All prey species in Kuno WLS and sampled buffer area

Species: Chital, chinkara, chowsingha, feral cattle, domestic cattle, hare, langur, nilgai, peafowl, sambar and wildpig.

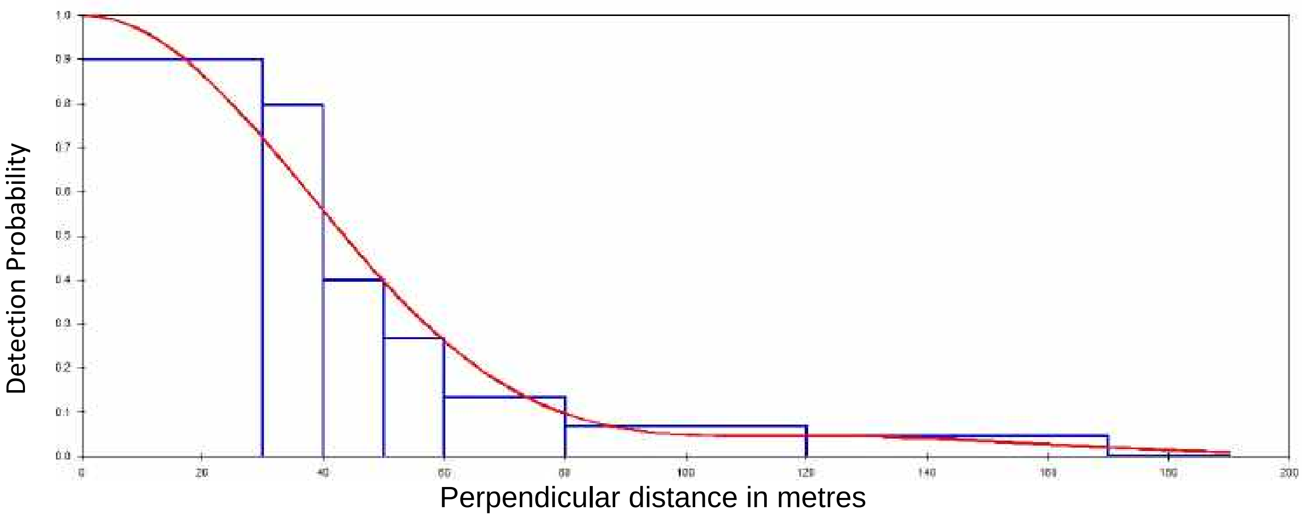
Model: Hazard rate with cosine adjustment term. (ψ^2 – p= 0.9, p = 0.29)



4.2: All prey species excluding langur in Kuno WLS and sampled buffer area

Species: Chital, chinkara, chowsingha, domestic cattle, hare, nilgai, peafowl, sambar and wild pig

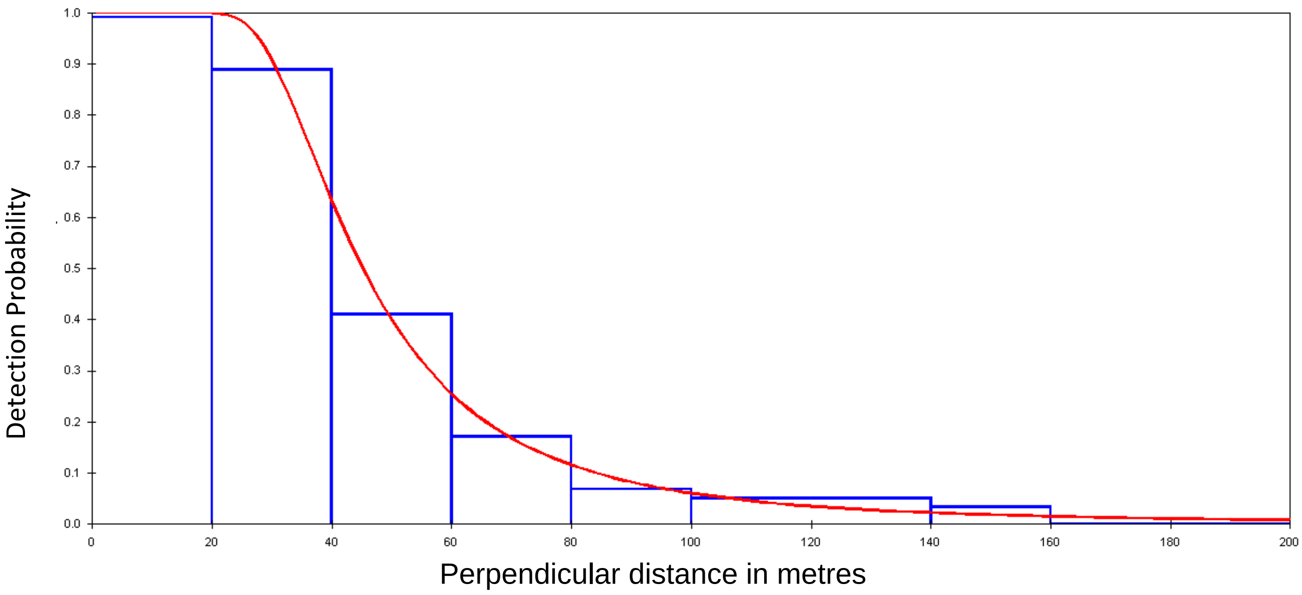
Model: Half normal with cosine adjustment term. (ψ^2 – p= 0.73, p = 0.25)



4.3: Cheetah prey in Kuno WLS and sampled buffer area

Species: Chital, chinkara, chowsingha, hare, peafowl, nilgai calf and sambar fawn.

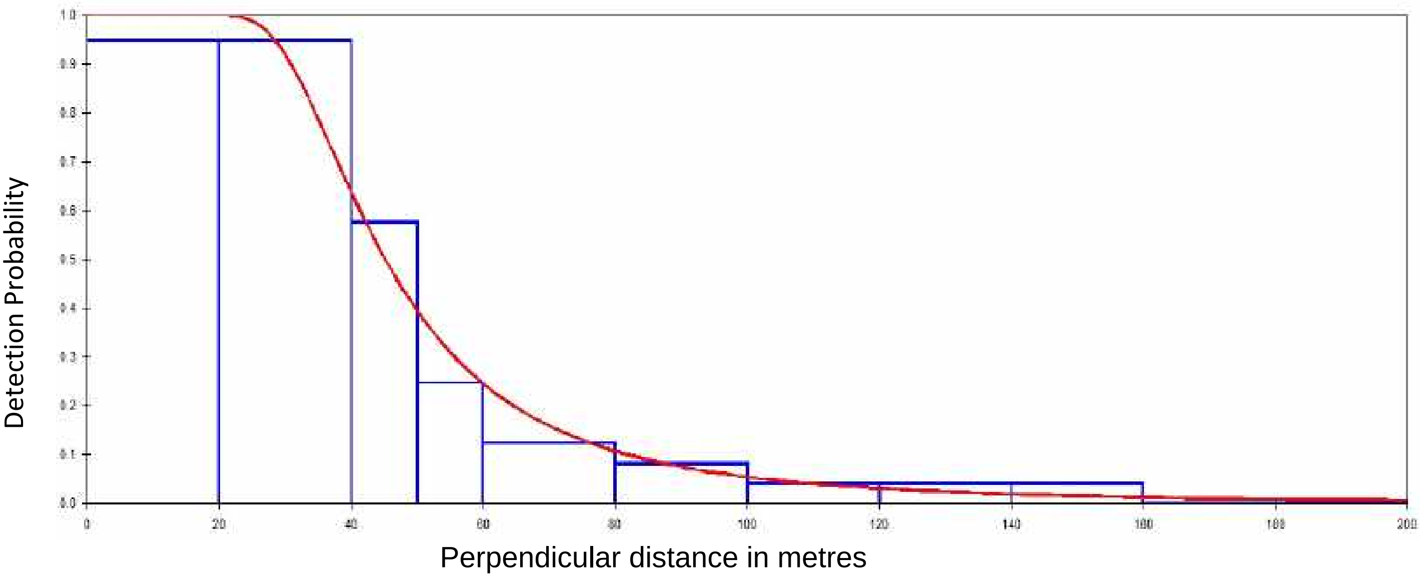
Model: Hazard rate with simple polynomial adjustment term. (ψ^2 – p= 0.97, p = 0.27)



4.4: Chital in Kuno WLS and sampled buffer area

Species: Chital

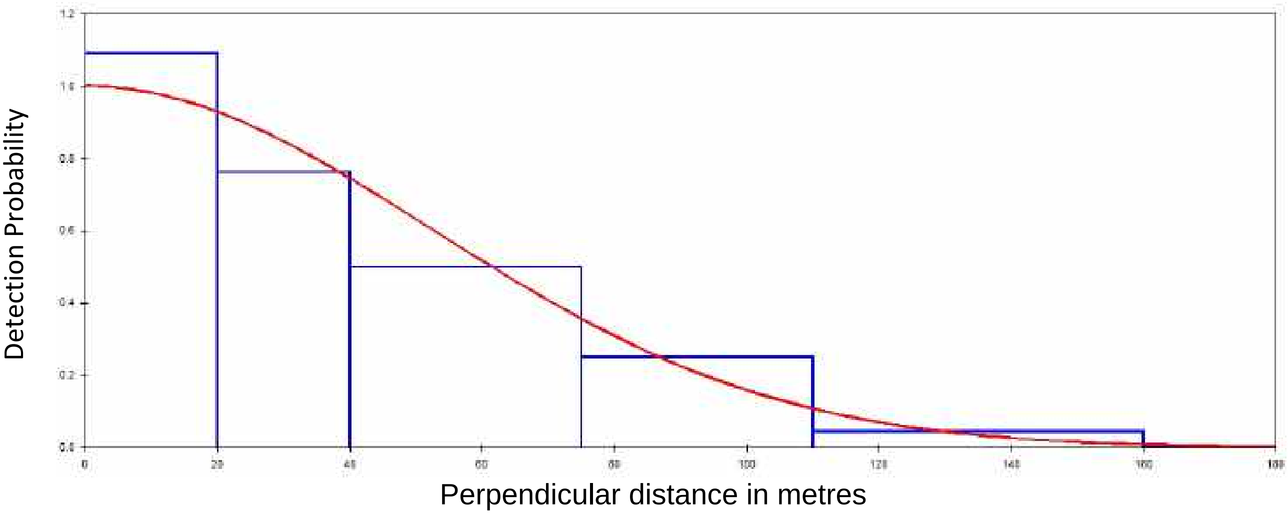
Model: Half normal with cosine adjustment term. (ψ^2 -p= 0.9, p= 0.36)



4.5: Langur in Kuno WLS and sampled buffer area

Species: Langur

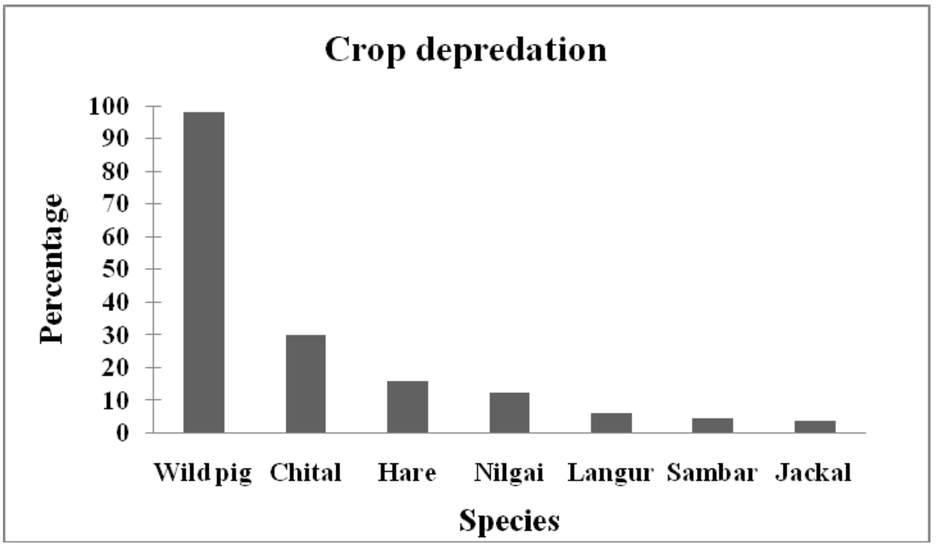
Model: Half normal with cosine adjustment term. (ψ^2 – p= 0.98, p = 0.36)



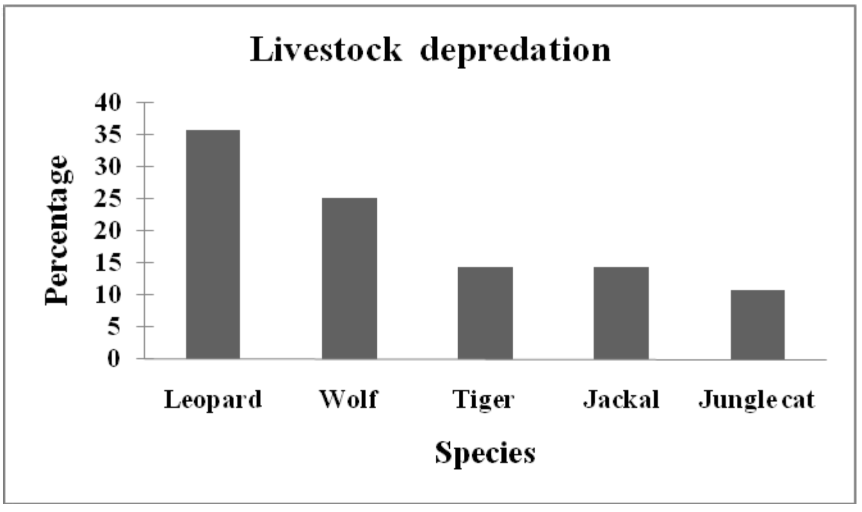
Appendix 5:

Perceptions and attitudes of local people towards wildlife

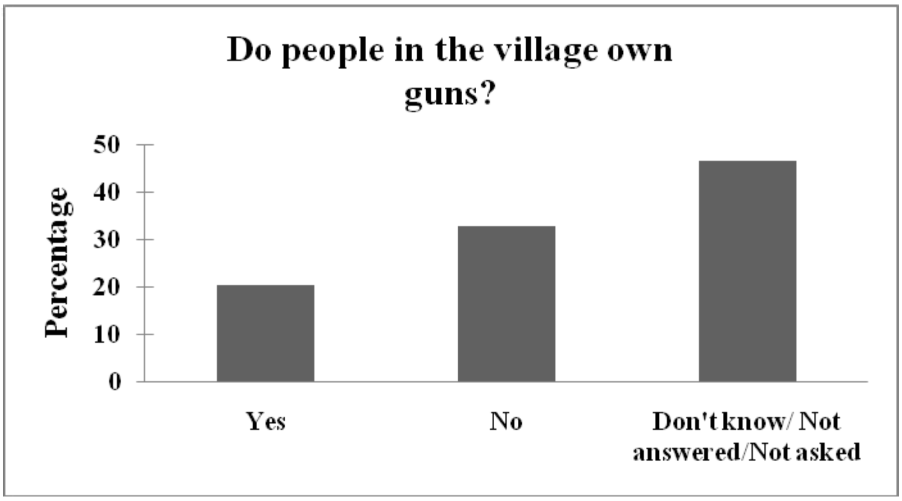
5.1: Percentage of respondents providing information about wild animals responsible for crop depredation (n=176)



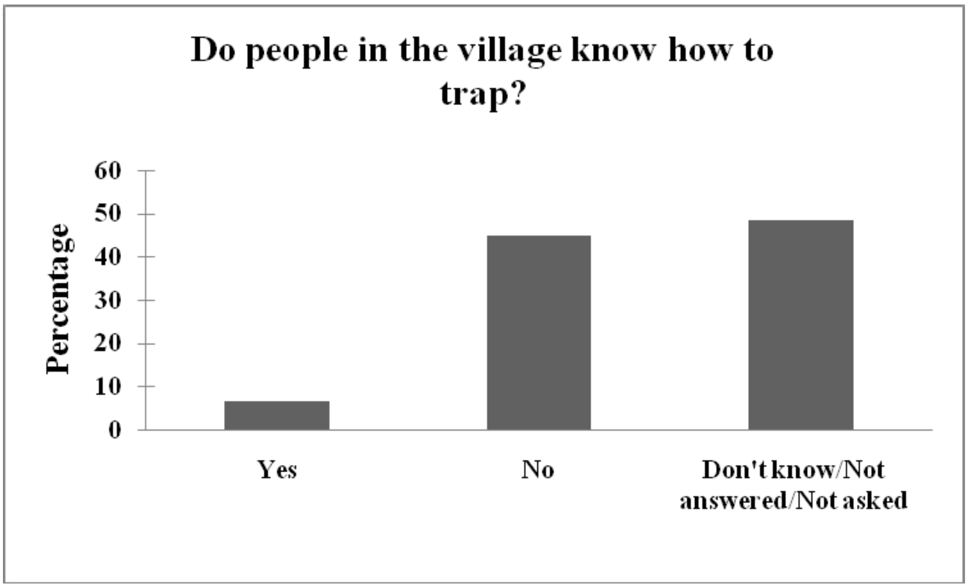
5.2: Percentage of respondents who have suffered livestock loss to various carnivores (n= 25)



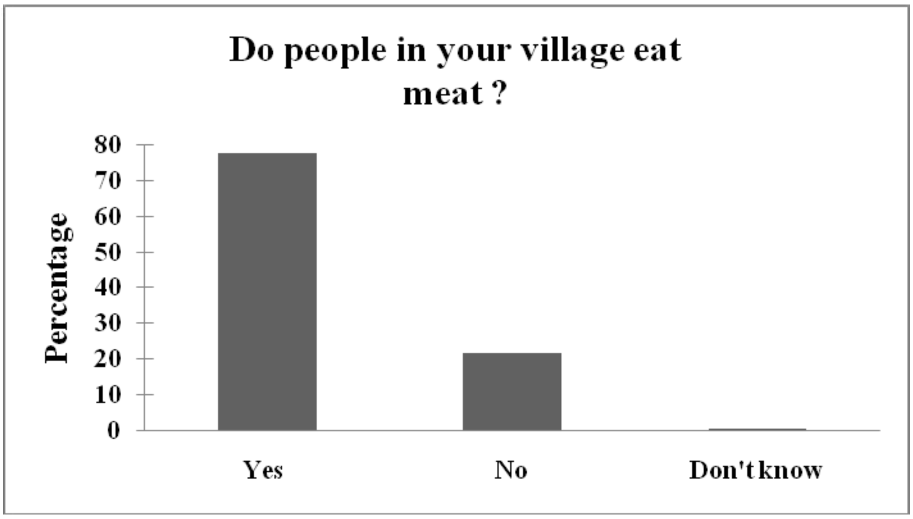
5.3: Percentage of respondents reporting about the presence of guns in the village (n=270)



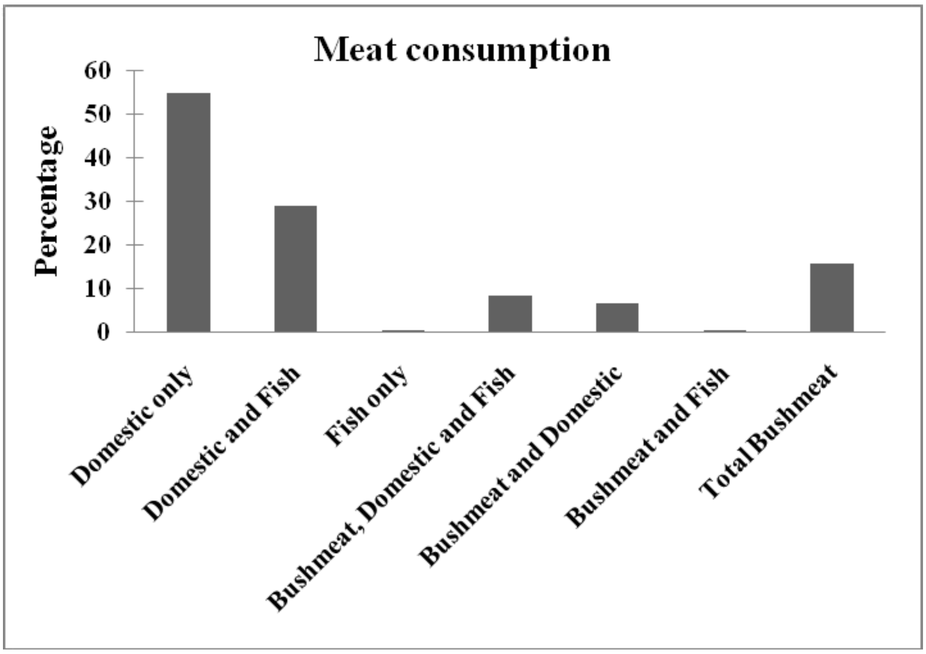
5.4: Percentage of respondents providing information about people in the village trapping wild animals (n=270)



5.5: Percentage of respondents reporting about meat consumption in the village (n=270)



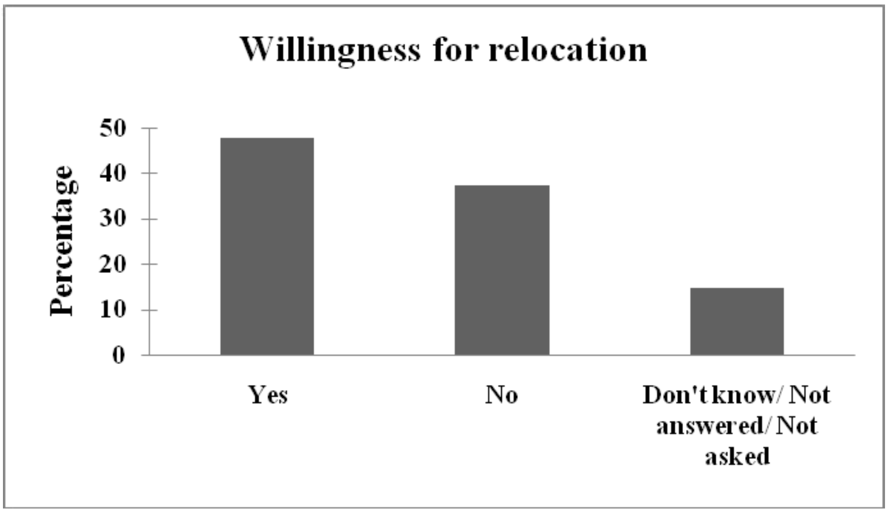
5.6: Percentage of respondents providing information about different types of meat consumed in the village (n=210)



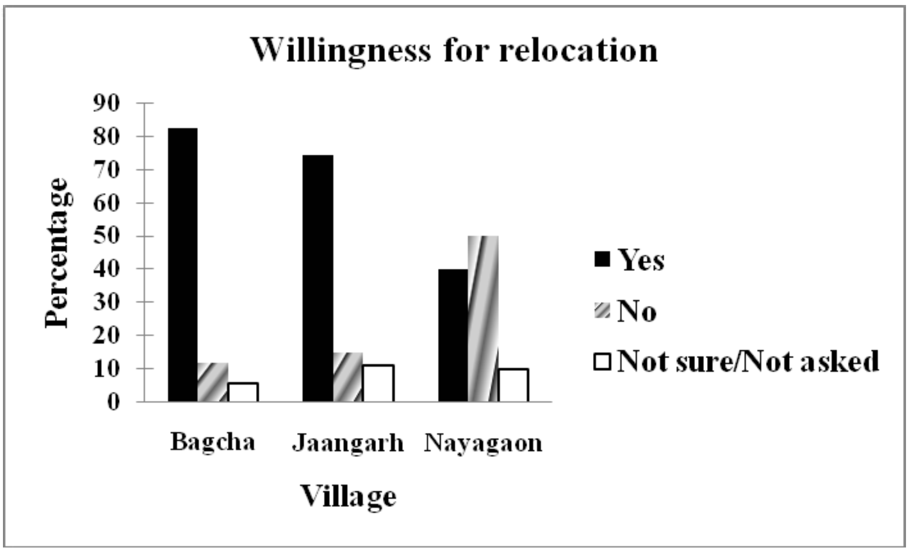
Appendix 6:

Willingness to relocate

6.1: Percentage of interviewees responding about willingness to relocate (n=270)



6.2: Percentage of respondents providing information about willingness to relocate in the three villages identified for relocation (Bagcha (n=17), Jaangarh (n= 27), Nayagaon (n=10))



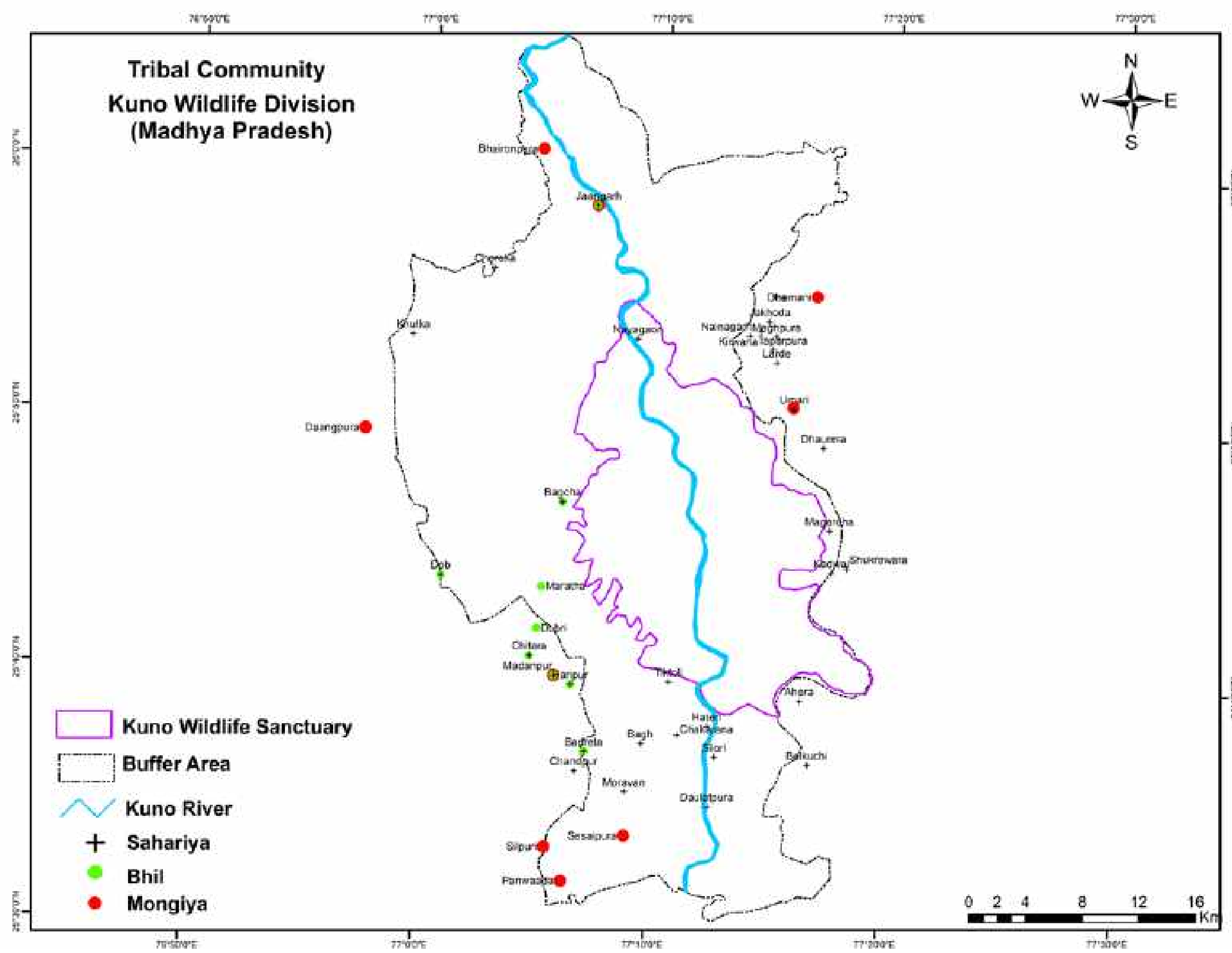
Appendix 7: Tribal communities in Kuno Wildlife Division

7.1: Details of Mogiya tribe in and around Kuno Wildlife Division

S. no.	Village	No. of families	No. of individuals	Livelihood				No. of families owning guns
				Agriculture	Livestock	Dailywage	Job	
1	Jaangarh	14	70	14				3
2	Umarikalan	34	132	31		2	1	4
3	Dangpura	2	5			2		1
4	Silpura	3	10			3		1
5	Dhawani	10	74	2		8		1
6	Sesaipura	6	31	1	5			1
7	Panwada	5	20	1	4(L+ Dw)	*		1
8	Madanpura	4	19	1		3		1
9	Bhaironpura	14	66	14				2
		92	427					15

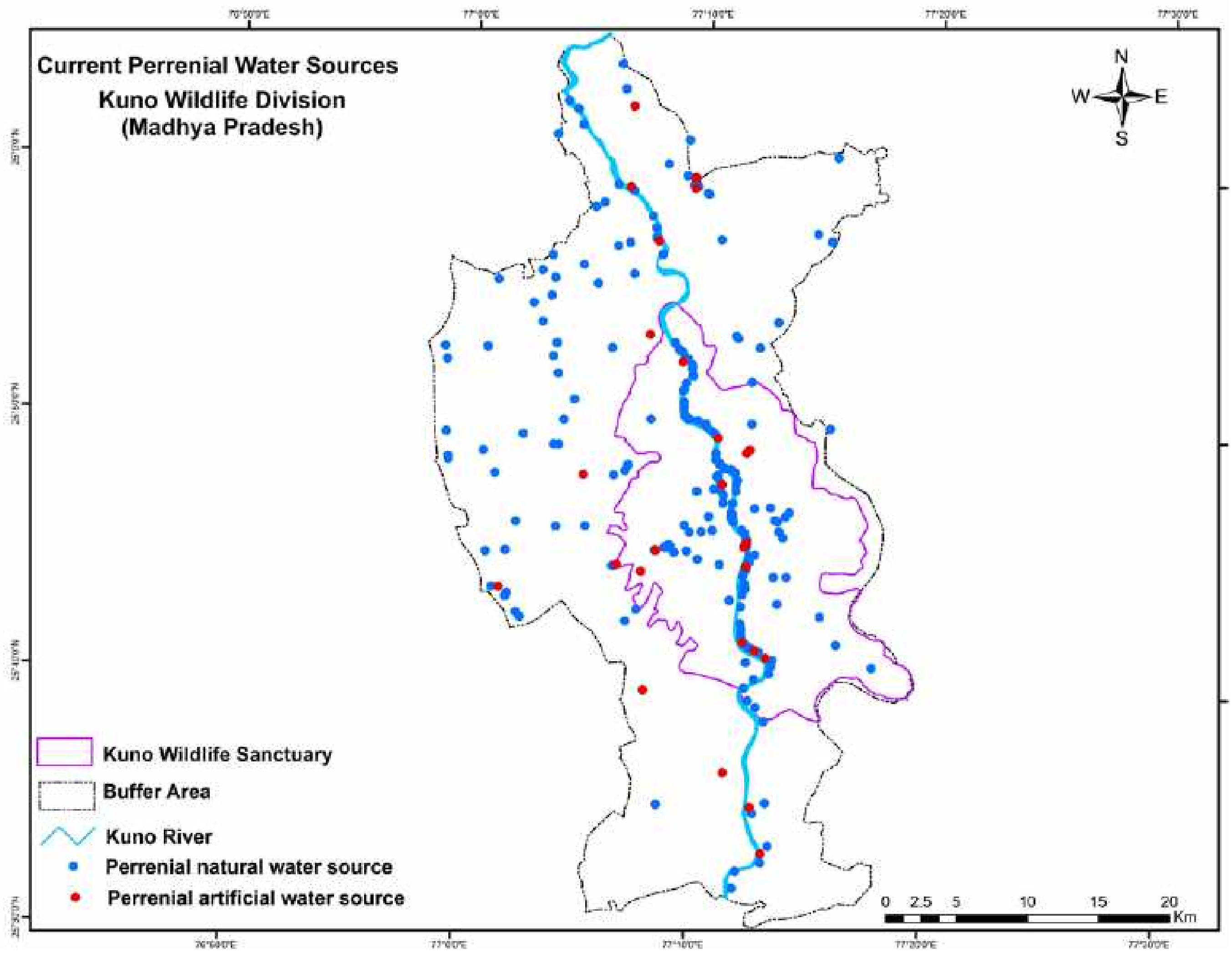
L-Livestock, Dw- Daily wage

7.2: Presence of tribal communities in Kuno Wildlife Division



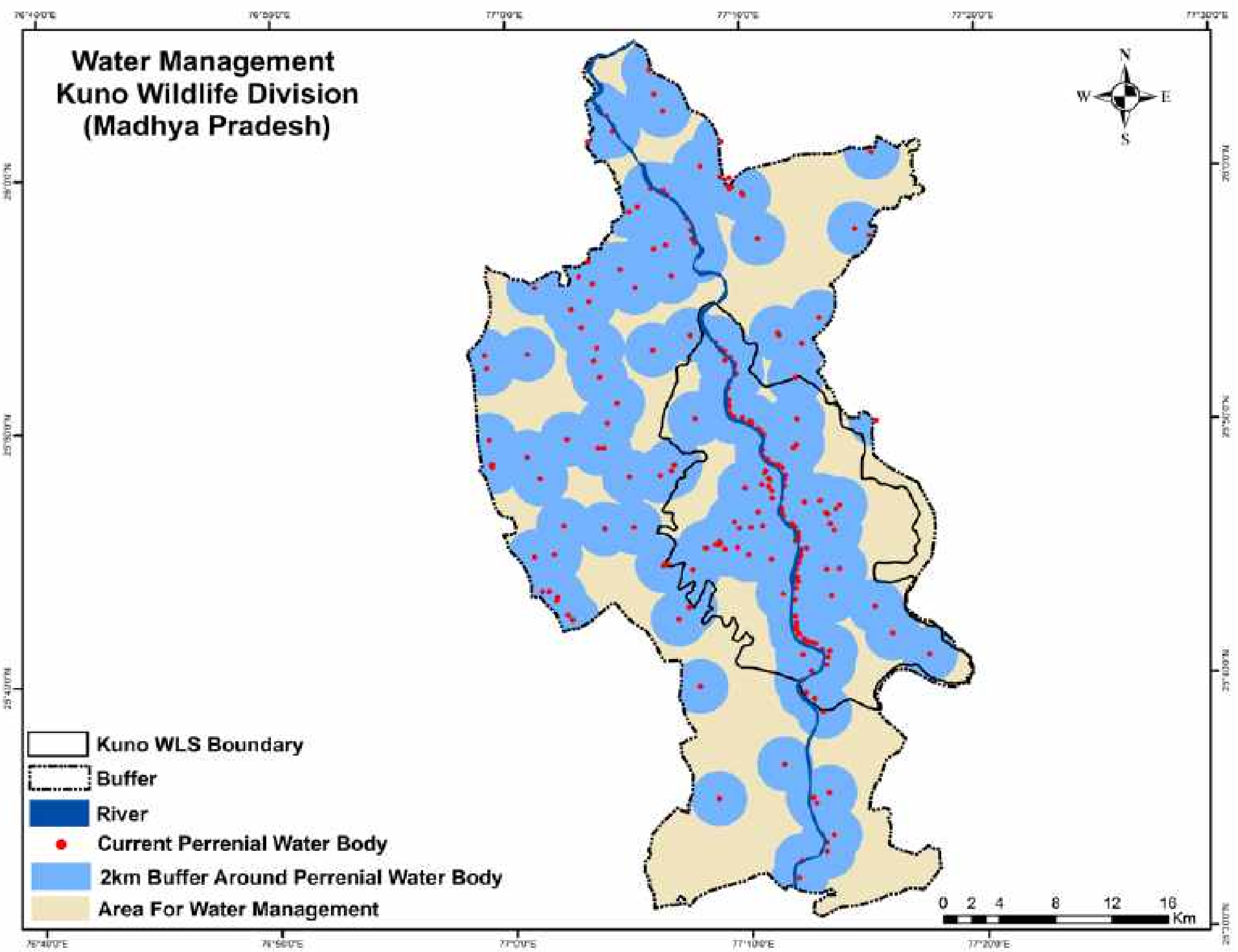
Appendix 8:

Locations of perennial water bodies in Kuno Wildlife Division



Appendix 9:

Areas for water management in Kuno Wildlife Division



Appendix 10:

Staff structure in Kuno Wildlife Division

OFFICE OF THE D.F.O. KUNO WILDLIFE DIVISION, SHEOPUR					
CADREWISE INFORMATION REGARDING NUMBER OF SANCTIONED POSTS, POSTED & VACANT POSTS IN KUNO WILDLIFE DIVISION, SHEOPUR					
S.NO.	**POST**	**NO. OF SANCTIONED POSTS**	**NO. OF POSTED PERSONNEL**	**NO. OF VACANT POSTS**	
1	***2***	***3***	***4***	***5***	
				Field	**Office**
1	D.F.O.	1	1	0	0
2	A.C.F.	3	3	0	0
3	**FOREST RANGE OFFICER**	10	9	**1**	0
4	DY. RANGER	5	5	0	0
5	**FORESTER & FIELD ASSISTANT**	30	25	**5**	0
7	**FOREST GUARD**	144	102	**42**	0
8	DRAFTSMAN	1	1	0	0
9	HEAD CLERK	1	1	0	0
10	ACCOUNTANT	3	1	0	2
11	L.D.C.	9	6	0	3
12	**DRIVER**	3	2	0	1
13	PEON, ORDERLY ETC.	8	2	0	6
	TOTAL :-	**218**	**158**	**48**	**12**

Appendix 11:

Wildlife Institute of India Research Team

Bipin C.M. - Research Biologist

Anirudh G. Vasava - Research Biologist

Ridhima Solanki - Research Biologist

Arti Singh –Research Sociologist

Appendix 4

Draft

Action Plan for the Reintroduction of the Cheetah (*Acinonyx jubatus*) in Shahgarh Landscape, Rajasthan

Cheetah Task Force
Rajasthan Forest Department
Wildlife Institute of India
2011

Action Plan for the Reintroduction of the Cheetah (*Acinonyx jubatus*) in Shahgarh Landscape Rajasthan

Background

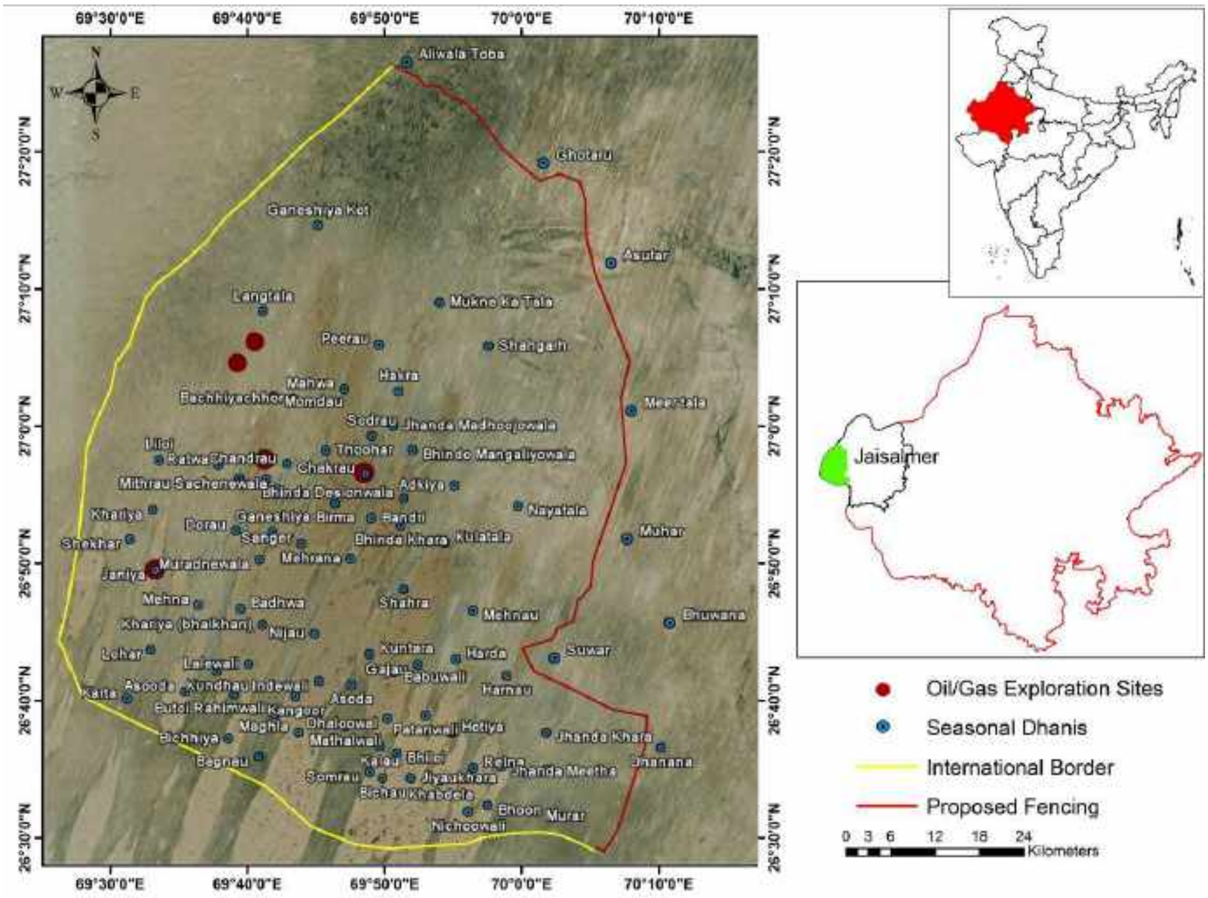
Cheetah (*Acinonyx jubatus venaticus*), which has been an integral part of the Indian heritage, folklore and culture since times immemorial, went extinct in India by the middle of the twentieth century. This loss has been attributed, apart from overhunting of the species and its prey, to the loss of its primary habitat, the arid and semi arid grasslands to their conversion into agriculture. This is the only recorded extinction of a large mammal in India, in historical times, as the country has been able to save all other major species, despite exploding human population and consequent pressure on natural resources. The country has been able to preserve several critical ecosystems in the name of iconic flagship species such as the tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*), gharial (*Gavialis gangeticus*), the great one-horned rhinoceros (*Rhinoceros unicornis*), amongst others that inhabit such habitats. However, the grassland and scrub-thorn forest ecosystems have been declining as they are generally considered a wasteland by the public and a *blank* by forest departments. As nearly all the productive grasslands have been converted into croplands, the principal prey of the cheetah in these habitats, the blackbuck (*Antilope cervicapra*), is also living a very precarious life due to its conflict with the agrarian communities.

The Government of India (GoI) started contemplating the reintroduction of the cheetah, as a means of reviving and preserving the remaining grasslands and dry forest systems of India, in 2009, when a meeting of national and international experts was called at Gajner, Rajasthan, on September 9th and 10th to discuss the prospects. The participants supported the idea wholeheartedly and proposed a nationwide assessment of potential reintroduction sites. The task of carrying out this assessment was entrusted to the Wildlife Institute of India (WII) and the Wildlife Trust of India (WTI). A rapid assessment of ten potential sites was carried out, encompassing the states of Rajasthan, Madhya Pradesh (MP), Gujarat, Chattisgarh and Uttar Pradesh, in terms of the size and quality of the available habitat, prey base, scope of future development etc. and recommended that three sites, Shahgarh landscape in Rajasthan, Kuno-Palpur and Nauradehi Wildlife Sanctuaries in MP, as the most promising ones (Ranjitsinh & Jhala, 2010). Shahgarh landscape in Rajasthan is the largest potential cheetah habitat (4683 km^2) available in the country.The Nauradehi Sanctuary has adequate prey base but has 52 villages in it, nearly 15 of which will need immediate relocation, involving large investments and other inputs. The Kuno Wildlife Sanctuary (WLS) in north western MP has been adjudged as ready in most respects for immediate reintroduction of cheetah, as it has adequate prey base, and virtually no human population within it and a relatively low human population in the adjoining forests, which are fairly open. The GoI constituted the Cheetah Task Force (CTF) under the chairmanship of Dr. M.K. Ranjitsinh to steer and facilitate the process of reintroduction, on 1st September, 2010.

Consequent to the decision to start the process in Shahgarh landscape, the Wildlife Institute of India carried out a fresh assessment of the status of the prey base in the proposed area, in the monsoon of 2011 and found it to be nearly 3 animals per sq km. (**Annexure I**).

The southern Shahgarh Grasslands (27° 18’ to 26° 47’ N and 69° 37’ to 69° 29’ E) cover an area of over 4000 km^2 and is located in Jaisalmer district of western Rajasthan (fig. 1). These grasslands lie in the Desert- Thar (zone 3A) bio-geographic zone of India (Rodgers *et al.* 2002) and form the eastern limit of the Persio- Arabian desert that extends from the great Sahara desert eastwards (Rahmani, 1997). The area falls in the sand dune covered, true desert zone or *marusthali* of the Thar Desert.

Figure 1: Shahgarh Landscape in Jaisalmer District of Rajasthan



This region is situated close to the international border of India and Pakistan. Major portion of this landscape is under the control of Border Security Force (BSF) and the Indian Army. The international boundary is demarcated by a fence that is impregnable to most animals and people. The total proposed area of the Shahgarh landscape is about 4683 km^2. However, similar habitat albeit with lower prey and high potential for human conflict, exists contiguously for another 12,000 km^2 (Ranjitsinh & Jhala, 2010).

The area experiences high variation in diurnal and seasonal temperatures. Summer temperatures during the day can exceed 45° C, while night temperatures can be as low as 20° C. Winters are cold with temperatures often going down to -2° C (Sharma & Mehra 2009). Rainfall is erratic and ranges from 100-200 mm (Water resources department, Rajasthan). According to F.Blasco’s main climatic regions of South east Asia, the Shahgarh landscape is located mainly in Arid 4 class (10-11 dry months).

The scarcity of water, shifting soil, desiccating winds in summer, very poor rainfall and extremes of temperature inhibit plant growth. The vegetation of the area is classified as Northern Tropical Thorn Forest (6B) - Subdivision Desert thorn forest type (C_1) (Champion &

Seth, 1968). Most of the flowering plants found in this xerophytic habitat are shrubs and wild grasses which do not survive for more than few months after the rains. The main variety of trees are *Acacia nilotica* (Babul), *Acacia Senegal* (Kumta), *Azadiracta indica* (Neem), *Capparis decidua* (Kair), *Prosopis cinereria (Khejri), Salvadora oleoides* (Mitha jhal) and *Salvadora persica* (Khari Jhal), *Tacomella undulate* (Rohira), *Zizyphus mauritiana* (Ber) and *Gmelina arborea*.The shrubs of the area include *Aerna tomentosa* (Bhui), *Calotropis procera* (Safed Ak), *Calligonum polygonoides* (Phog), *Euphorbia tirucalli* (Thohar), *Leptadenia pyrotechnica* (Khimp),*Sweda fructose* (Jagg) and *Tephrosia spp*.
The scanty rainfall helps a variety grass to come up. Some of the important grasses of the area are *Panicum frumentaceum, Lasiurus sindicus* (Sewan), *Cenchrus catharticus* (Bharut), *Chloris roxburglina* (Morant), *Cynodon dactylon* (Doob), *Pennisetum cenchroides* (Dhaman), *Cyperus longus* (Motha) and *Haloxylon salicornium* (Lana).

The western most part of Jaisalmer district has a special significance for wildlife. The area may be poor in its mammalian diversity but houses rich & diverse wildlife which include birds, reptiles and many arthropoda. The wild ungulates currently found in this area are chinkara (*Gazella bennetii*), nilgai (*Boselaphus tragocamelus*), and wild pig (*Sus scrofa*). Chinkara can survive on very low quantities of water or can meet its water requirements from the vegetation it forages upon (Dookia & Goyal 2004). Carnivores include the desert fox (*Vulpes vulpes pusilla*) and desert cat (*Felis silvestris libyca*). Feral dogs are also common and are responsible for chinkara and livestock depredation. During the field survey, sightings of Indian crested porcupine (*Hystrix Indica*), Indian hedgehog (*Paraechinus micropus*), and Indian hare (*Lepus nigricollis*) were encountered.

Presence of Vipers and many non-venomous snakes are reported from the region. During the study period the desert monitor (*Varanus griseus*), spiny-tailed lizard (*Saara hardwickii*), fringe toed lizard (*Acanthodactylus cantoris*), and Pakistan ribbon snake (*Psammophis leithii*) were commonly sighted. A species of Rajasthan toad headed lizard (*Phrynocephalus laungwalaensis*), that has been identified as a separate genus (1992) is found in this area.
The birds observed during the survey were Sind woodpecker (*Dendrocopos assimilis*), painted sandgrouse (*Pterocles indicus*), blue cheeked bee eater (*Merops superciliosus*) Eurasian roller (*Coracias garrulus*), laggar falcon (*Falco jugger*), peregrine falcon (*Falco peregrinus*), short toed snake eagle (*Circaetus gallicus*), tawny eagle (*Aquila rapax*), steppe eagle (*Aquila nipalensis*), Egyptian vulture (*Neophron percnopterus*), white- backed vulture (*Gyps africanus*), Eurasian griffon (*Gyps fulvus*) and red headed vulture (*Sarcogyps calvus*).

Mainly Sindhi and Marwari speaking Muslims are the predominant communities in the area and are nomadic. The main source of livelihood for the local community is pastoralism. Most of the population of the people reside in the rural areas and are distributed in varying densities.Scarcity of water makes life difficult in this region and thus few nomadic settlements exist in this area. Location of a settlement depends a lot on the availability of water and pasture for livestock. Most of these settlements are small, comprising of a cluster of 7-8 thatch houses which are seasonally occupied by nomadic Muslim communities and at times depending on permanent drinking water availability are sedentary for a long time. The human population density in this area is 1 person/ km^2 (Census of India, 2001).

Few of the Hindu communities found in the area mostly utilize the land for the grazing purpose of their livestock. Most of the communities were traditionally engaged in trade across the border with Sind. However, since the partition of the two countries they depend entirely on pastoralism to generate revenue. Goat, sheep, camel and donkey are owned in large numbers (Table 1). Over-grazing leading to grassland degradation in the region resulting in starvation appears to be a common cause for livestock mortality. Locals also rear cattle, though in small numbers. Alternate sources of livelihood and public facilities like schools and hospitals do not exist. There are a very few permanent settlements. Small hamlets called '*dhanis*' are seasonally occupied by 5-8 households. There are close to 80 such '*dhanis*' in the 4683 km^2 area. During times of tension between the two neighboring countries, local communities are not permitted to reside in most parts of this region, especially within 10 km from the border.

Table 1: Livestock Population in Shahgarh Landscape

Species	**Population**
Goat	57536
Sheep	10071
Cattle	4564
Donkey	1231
Camel	2053

(Livestock census, 2007)

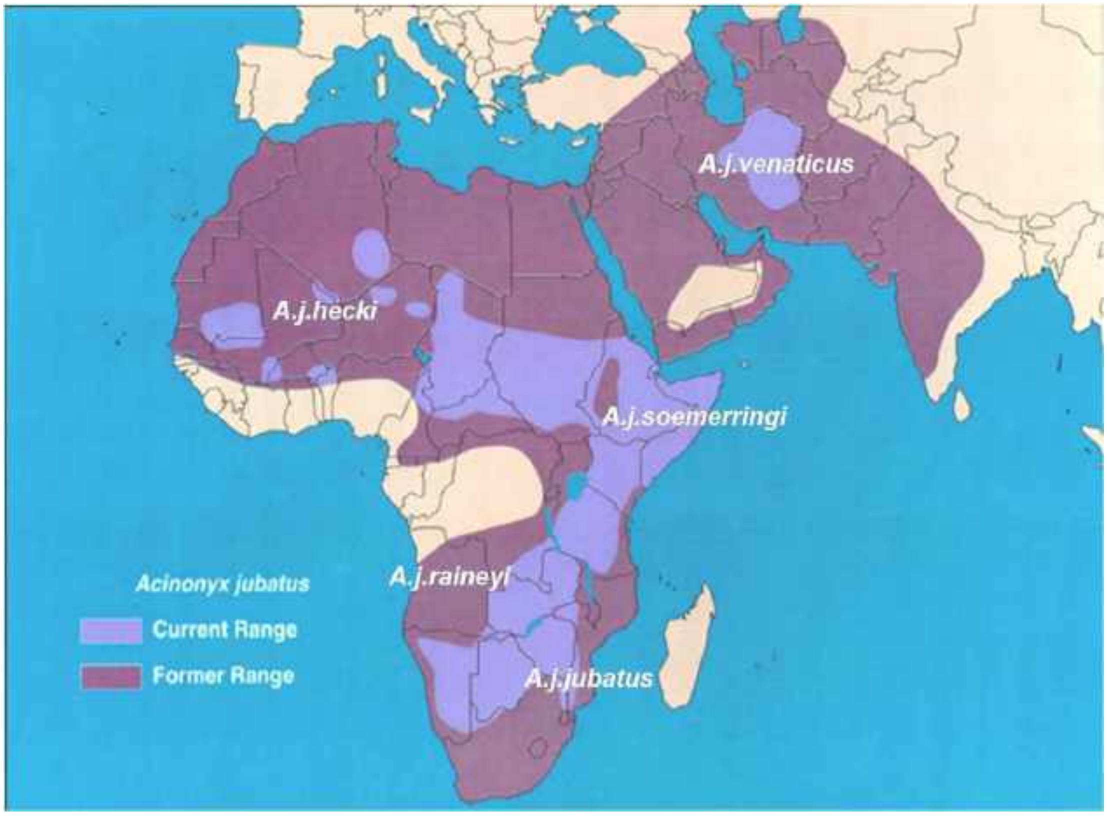
Besides the major hold of defence forces in the area, Ministry of Petroleum and Natural Gas has activities of interest in the same. The ministry has allotted the area to Focus Energy Limited, Oil and Natural Gas Corporation Limited (ONGC), Oil India Limited (OIL) and Gas Authority of India Limited (GAIL). Focus Energy limited has been allotted 4026.16 km^2 area in Shahgarh landscape, and is currently carrying out exploration and extraction operations for natural gas in many places across the proposed area. Presently the company generates 70 lakh cubic feet of gas per day (Battle on the Border, The Times of India, Aug 23, 2011).

Research into cheetah biology and ecology has greatly increased our understanding of the fastest land animal and education programmes for schools, the farming and pastoralist communities help change public attitudes to allow predator and humans to co-exist (Cheetah Conservation Fund). The local communities should be made aware of the fact that cheetah is one carnivore whose conflict with humans and livestock reports throughout the world has been minimal. There is no record of a cheetah ever having killed a human in the wild (IFAW *et a*l., 2011). In Namibia, research shows that cheetahs were only responsible for 3% of livestock losses to predators (Marker, 2002). The co-existence of the locals with the wildlife will play a crucial role in making a larger landscape available for the cheetah as well as better management of wildlife too.

Origin of Sourced Cheetah

The Asiatic Cheetah being extinct from its earlier distribution in India (Divyabhanusinh, 2006) is now only known to occur with certainty in Iran (IUCN Red List of Threatened Species, 2011). The census population of cheetahs in Iran is estimated at 60-100 (Hunter et al., 2007).

Fig.2: Historical and Current Distribution of the Cheetah



Approximately 10000 cheetahs live in the African continent, but the largest population of about 4000 is found in Namibia, followed by South Africa. It is natural to believe that the founder stock for Indian reintroduction programme should, preferably, be sourced from Iran, rather than from Africa, as the former are genetically closer to the extinct Indian cheetah (Charruau *et al*, 2011). However, Iran does not have the capacity to spare any animals for the Indian reintroduction programme as they do not have even a single animal for their own captive breeding programme (pers.comm.Jhala with Vice President of Iran). Moreover, at least till recently, cheetahs were believed to have very limited genetic diversity and all cheetahs, including the Iranian stock, were considered to have segregated in very recent times. Recent studies (Charruau *et al*, 2011) have demonstrated more genetic variations within cheetah lineages. In any case, the question of genetics would have been more relevant if there was any risk of mixing lineages with a different resident population. As there are no existing cheetah populations in India, this question does not arise.

This issue was thoroughly debated by the CTF and a conclusion reached that India will source cheetah from Southern Africa (Namibia and South Africa), which can provide India substantial numbers of suitable cheetah for several years. Cheetahs from Southern Africa have the maximum genetic diversity observed among extant cheetah lineages which is an important attribute for a founding population stock. Also the Southern African cheetah are found to be ancestral to all the other cheetah lineages including those found in Iran and should therefore be ideal (for reasons stated above) for the Indian reintroduction programme.

Compliance with IUCN Guidelines

The project is fully compliant with 'IUCN/SSC Guidelines for Re-introductions'. The guidelines define re-introduction 'as an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct'. The proposal is fully in conformity with this definition. As per the guidelines, there can be one or multiple objectives for re-introduction; this proposal conforms to the following objectives stated in the guidelines to enhance the long-term survival of a species; to maintain and/or restore natural biodiversity. The reintroduction of the cheetah will restore the role of this top order carnivore in the ecosystem and subsequently restore the balance that such carnivores bestow on ecosystemic and community functions (Smith & Bangs, 2009).The proposal also meets another recognized objective, viz. 'to provide long-term economic benefits to the local and/or national economy' to some extent. The guidelines recommend a multidisciplinary approach and prefer wild stock as the founder population. The IUCN guidelines also recommend that 'where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these'. The proposal is fully compliant with this aspect since the entire area would be fenced and well patrolled. Significant improvements in the protection infrastructure of Shahgarh landscape are also proposed in the project. Other elements of the guidelines, related to selection of the stock, legal requirements, policies of the relevant governments etc. shall be complied with as and when required. IUCN was a participant in the Gajner meeting where the project was conceived.

Mortality and Supplementation of Cheetahs

Even successful reintroduction projects go through a series of ups and downs and one of the factors that we have to reckon with is the mortality of cheetahs before release and after release. There can be deaths from accidents, diseases, intraspecific fights etc. before release. After release, the mortality can occur due to injury from hunting of prey, poisoning, poaching, road hits, as well as from other predators (especially to cheetah cubs). Not all deaths after release should be a cause of worry. Mortality of reintroduced cheetah is expected in spite of all the efforts taken to minimize risks. Appropriate awareness campaigns need to be conducted prior to the commencement of the project, so that all the stakeholders, public and officials are aware of this eventuality and some cheetah deaths should not put the project in bad light or consider it a failure. Supplementation of initial founders may be needed annually or once in five years for managing the demographic and genetic composition of the reintroduced population.

Project Goal and Objectives

The project aims to establish a free-ranging breeding population of cheetahs in the Shahgarh landscape. The carrying capacity of Shahgarh landscape was estimated to be 15 cheetahs (Ranjitsinh & Jhala, 2010). The two to three established populations of cheetah in

India are proposed to be managed as a meta-population with occassional “immigrants” brought in from Southern Afica, as and when needed (Ranjitsinh & Jhala, 2010). Within this larger goal, the project will strive to achieve the following objectives:

a. Establish and maintain a population of cheetah within the Shahgarh Bulge so that the species adequately performs its role as top predator in this arid biome.

b. Provide adequate security to local flora and fauna and ecosystem processes.

c. Revive and maintain the grassland and scrub forest systems existing in the landscape in an optimum productive state and thereby evolve management techniques and practices for better conservation of these habitats.

d. Build the capacity of the Forest Department of Rajasthan in the field of habitat and prey management, especially grasslands, in view of the emerging needs and in handling of the cheetah itself.

e. Build the capacity of the Rajasthan Forest Department (RFD) in mass translocation of herbivores, particularly blackbuck and nilgai, in view of the emerging need for protection of crops and scientific management of wildlife populations.

f. Conserve and enhance the faunal diversity of the desert biome especially the threatened species, such as the endemic white browed bushchat (*Saxicola microrhynchus)* and houbara bustard (*Chlamydotis undulata*) and provide a future safe haven for even more endangered species such as the caracal (*Caracal caracal schmitzi*) and great Indian bustard (*Ardeotis nigriceps*).

g. Generate benefits for the local people through the development of wildlife tourism and ancillary activities.

Action Plan

The process of reintroduction is proposed as follows:

1. **Procuring the area for the reintroduction of cheetah:** Persuade the Government of Rajasthan to permit the use of 4683 km^2 area in the Shahgarh landscape for the reintroduction of cheetah. The area will be managed with conservation as one of the primary objectives. The international border along the south and west of the proposed area is already fenced and the rest of the area will be cordoned off with chain link fence.

2. **Dialogue with the Ministry of Petroleum and Natural Gas:** Convince the Ministry of Petroleum and Natural Gas that reintroduction of cheetah will not compromise with the exploration and extraction of natural gas and petroleum. The area does not need to be declared as National Park or Wildlife Sanctuary for reintroducing the cheetah, therefore legal sanctions against oil/ natural gas exploration/ extraction will not be imposed. The area is large and oil/ natural gas extraction from the region if done with

safeguards would not be detrimental to the conservation objectives of the region. The cheetah poses no threat to the oil and natural gas company workers.

3. **Dialogue with the defence services**: Cheetah reintroduction will not in anyway compromise with national security. A dialogue will be held with the defence services to ensure that their activities within the region are not compromised. Security activities could be planned in a manner to have minimal impact on the conservation values at the region.Since the region is close to the international border, the management and jurisdiction of the area should be a joint effort between the BSF, stake holders and the project management authorities.

4. **Outreach activities**: Raise political awareness, opinion and education regarding the ecological and economic benefits from the reintroduction of the cheetah among the local communities of the region. Forest Department of the Government of Rajasthan and suitable NGOs will be involved for this undertaking. Educational/ awareness campaigns will be undertaken in schools and dhanis to enhance the understanding of the local communities regarding the role and importance of the cheetah in ecosystem functions. Appropriate changes in lifestyle eg. Livestock husbandry, will be suggested to minimise conflicts with the cheetah and local communities.

5. **Voluntary resettlement of the pastoralist communities:** To enhance the carrying capacity of the area and to reduce human wildlife conflict, it is very crucial that this area is made totally free of livestock. This could be achieved by compensating the nomadic pastoralists that periodically use this area from the 80 'dhanis' situated in the landscape. About 800 families seasonally reside in this area. It is important that the local communities are more than adequately compensated and provided alternatives for livelihood or pasture lands. Perennial water sources will also be made available to these relocated communities outside of the cheetah reintroduction area and provision to use pasture land for their livestock ensured by local administration.

6. **Alignment of the chain link fence in the area:** A chain link fence will be erected for a total length of 130 km in the area (International boundary- Aliwala Toba- Ghotaru-Asu Tar- Mir ki Tala- Muhar- Suwar- Dhanana- International boundary). The fence will be running roughly west to east and north to south (fig.1 and Appendix 3). The fencing will be done in a manner that it minimizes the economic loss of the local communities, while it serves to keep the cheetah within the enclosed area and the livestock out of the area. Entry and exit points will be manned 24×7 so as to ensure that the value of the fence is not compromised. The best option fence alignment will be decided in consultation with BSF, Government of Rajasthan and local communties, keeping in mind the biological requirements of the cheetah.

7. **Construction and maintenance of the fence:** The height of the chain link fence will be 2.5 m above ground and 0.5m below ground. The construction and maintenance of the fence will be outsourced to the Public Works Department (PWD) of the Government of Rajasthan.

8. **Patrolling of the fence:** The patrolling of the chain link fence after it is constructed will be entrusted to the local Forest Department of the Government of Rajasthan.

Field staff required for the patrolling will be recruited based on the requirement. As far as possible, the staff will be recruited from the local villages.

9. **Develop perennial water holes**: Since the water table is relatively high (30-50 ft) in the region, to increase habitat utilization by wildlife, perennial waterholes spaced throughout the landscape have to be developed. While creating these waterholes it has to be ensured that the distance between the water holes is within 5-8 km. These water holes will be created in a way as to minimise loss of water due to evaporation.

10. **Water harvesting:** In the areas where perennial water holes are to be developed, possibilities of windmill and solar power technology for water extraction will be explored. Since the area has high potential for harnessing both wind and solar energy, it will be prudent to utilize the above mentioned technologies for harvesting water.

11. **Habitat management:** As part of habitat management, forage tree species like *Acacia* spp., *Zizyphus* spp. and *Prosopis cineraria* will be planted near the water sources to increase the carrying capacity of prey. This will also help in increase of areas with more shade and shelters from sand storms.

12. **Building shades**: Construction of artificial shades for the carnivores for protection from sun and sand storms. The sites for building these shades will be selected in areas where there is shortage of tree cover and will be spread out across the landscape.

13. **Translocation of prey**: Prey species like blackbuck and nilgai will be translocated into the reintroduction site to augment the prey base once perennial water sources are identified. For this purpose, a fully equipped mass animal capture unit will be created. Possibility of a Public Private Partnership (PPP) in animal capture will also be explored.

14. **Compensation:** Working with the local administration in identifying the families that have stake/ rights within the enclosed landscape to provide an appropriate compensation package that serves as an incentive for voluntary resettlement. Since majority of the people in the proposed area do not own land but seasonally graze their livestock on public lands with the approval of BSF and are often displaced during times of tension between India and Pakistan, the cost of compensation for relocation may not be too high. An appropriate compensation package will need to be worked out similar to that for Project Tiger areas, but in consultation with the local administration since the situation in Shahgarh landscape is unique, with large majority of the local population not having land ownership but only grazing rights.

15. **Scheme for eco-development**: Eco-development schemes will be implemented outside the reintroduction site for resettled communities to enhance their livelihood options. Revenues generated from tourism and ancillary activities should be shared with the local communities and they should be actively associated in the development of ecotourism right from the start so that they develop an economic stake in the endeavor.

16. **Control of feral dogs and vaccination campaign for domestic dogs:** Adequate steps will be taken to control feral dogs by capture or elimination. A vaccination campaign throughout the BSF camps and villages for Rabies, Canine distemper and Parvovirus will be undertaken.

17. **Creating housing enclosures and veterinary facilities**: Housing enclosures for the soft release of cheetahs will be constructed near the release sites. The size of these enclosures will be 100 ha area with a 2.5 m high chain link fence. A veterinary unit will be created with the help of Government of Rajasthan to manage the released animals in case of straying, injury, conflict etc.

18. Government of India (GoI), Ministry of Environment and Forests (MoEF) and the Cheetah Task Force (CTF) shall take the initiative to create a formal framework for collaboration between the GoI and Governments of Namibia and/or South Africa, through the Ministry of External Affairs (MEA), in order to facilitate the collaboration of the agencies/individuals participating in the project. Scope for using any existing agreements for collaboration between the countries shall be explored by MoEF/ CTF/MEA.

19. MoEF shall issue an initial import permit for minimum 10 cheetahs on the recommendation of CTF from Namibia and/or South Africa, under the CITES regulations. The Cheetah Conservation Fund (CCF) in Namibia and And Beyond (AB), a safari and wildlife management company in South Africa, have indicated their willingness to donate the founder stock during preliminary discussions. MoEF/ CTF shall also liaise with other relevant agencies/departments of GoI to facilitate the import of the animals. Member Secretary-CTF/MOEF/MEA shall send the import permits, and other necessary documentations if any, to the agencies supplying the animals, as soon as possible, under intimation to the GoI and the high commissioners of India and Namibia/South Africa.

20. The chosen donor organizations and suppliers in Nambia and South Africa, in cooperation with the concerned Indian High commissioners, shall procure the necessary export permits from their respective government agencies. They shall make the arrangements for shipping the animals to India through an airline to be designated by CTF.

21. A cohort of upto 8-10 cheetahs that are ideal (young age group that is genetically diverse, behaviourally sound- eg. not overly imprinted to humans, capable of hunting wild prey and socially tolerant of each other) for reintroduction shall be imported from Namibia or South Africa, as a founder stock during the first year. An existing coalition of wild males shall be selected while the selected females shall also be known to each other as far as possible. The animals' lineage and condition shall be checked in the host country, to ensure that they are not from an excessively inbred stock and in the ideal age group, so as to conform to the needs of a founding population.

22. The selection of animals suitable for release will be the responsibilities of the chosen donors/experts in Namibia and South Africa and will be verified by CTF/WII.

23. The selected animals shall be collected from different locations, as the case may be, and prepared for transportation, after necessary vaccinations and health checks etc, as per international protocols, and the animals shall be delivered to the designated airlines. A veterinarian from the donor agency and if need be, one representative

from India (RFD /CTF) shall accompany the shipment, along with necessary supplies and equipment.

24. Natural prey within the enclosure will ensure that cheetah become accustomed to hunting Indian prey species before their release.

25. These animals shall be released into the main enclosures, after a short stay in a smaller enclosure (1-2 ha) for the purposes of inspection.

26. The cheetahs shall be radio collared and soft released from the main enclosure after an appropriate period (2-6 weeks). Their movements shall be monitored daily by the local staff, assisted by a team of researchers from WII. If any animal tends to get into undesirable environment, it will be brought back into the reintroduction site. Darting will be done if absolutely essential, by qualified trained personnel.

27. To manouver, approach and capture cheetah, we propose to try out camels besides Four Wheel Drive (4WD) vehicles. Two trained camels will be stationed at three to four different well spaced and strategically located sites. This placement is essential since camels would be able to operate within a range of 15km radius and then these camels could be used to track and approach them. The camels would also be useful for purposes of patrolling and monitoring the fence.

28. An international experienced cheetah expert shall stay at the project site, from before the arrival of the cheetah upto about two months after the release of the females from the enclosure, to advise and assist the authorities in coping with any unwarranted situations, to care for the cheetah in captivity, opine on their readiness and that of the habitat for the release and to help monitor the animals after their release. He/ She will also train the local staff.

29. Genetic management of the reintroduced population is proposed by substituting the male coalition by a different coalition after F1 generation sired by the first male coalition is over 1.5 years of age. Females will be supplemented as required in consultation with CTF and technical advisors.

30. Expecting approximately 5% growth rate in the released population, incorporating natural mortality, births and annual supplementation, the released population should reach carrying capacity level in a few years.

31. Availability of prey base shall be assessed each year by the WII biologists to be attached to the project and supplementation of prey will be decided on the basis of this annual assessment.

32. All new posts in the field, which have been advocated as essential and those found necessary by the state government, foreign experts and CTF, would be created and filled by the state government within 3-6 months. Here again, recruitment should be as far as possible from the local communities, In this regard experience of Nagarjunasagar-Srisailam Tiger Reserve could be taken into account where efforts are being taken to work with and employ the local Chenchu tribals to protect forest.
33. Representatives from the core group of the reintroduction team shall be sent on a study tour of cheetah reintroduction sites/programmes in Africa. The action plan for reintroduction may be finalised/ modified on the basis of the learning from this study tour. The composition of the team (inclusive of RFD, BSF, WII Scientists and research fellows) would be decided by the CTF.

34. A project implementation team consisting of The Chief Conservator of Forests, in charge of the project, Divisional Forest Officer, assistant conservator (s), range officer (s), deputy rangers, foresters and to the extent possible the forest guards shall be selected on the basis of their interest, commitment and capabilities and shall be posted for a minimum period of at least 3 years and if possible upto 5 years**.** Representative of BSF and local NGO must be included in the project implementation team. The senior members of the team, including the project biologist and veterinarian, would be sent on a training tour to selected cheetah reintroduction sites in Africa as early as possible. The composition of the team would be decided by the CTF. The training shall be conducted in batches. The senior members who would be trained abroad would train the junior staff. The entire staff working for the cheetah reintroduction project shall be paid a 'Project Allowance' at par with the allowance paid to the staff working for Project Tiger.

35. A team of two well-known cheetah experts shall be created to advise the project planning and implementation. Ms. Laurie Marker of CCF and Mr. Les Carlisle from And Beyond, South Africa, have shown interest in advising the project. Both of these have vast experience in cheetah conservation and management. The services and help of their organisations as advisors and contributors to the project may be obtained by CTF, who would then also negotiate the terms of their involvement. Other experts will be coopted as and when required. The reintroduction of the cheetah offers unique opportunity to understand the role of top predators in ecosystems. Research in all aspects of system recovery and interactions including ecology of the reintroduced cheetah should be addressed by WII.

36. Sustainable and conservative tourism subservient to the conservation needs of the reintroduction site and of the project shall be encouraged so that jobs and business opportunities for the local people can be created and the project and Shahgarh landscape get adequate public support. An attempt to generate revenues through brand building, marketing, sponsorships, merchandising shall be made, through private partnerships, but in complete consonance with the conservation activities and prerequisites. In the 1st phase of the plan, a site specific tourism policy will be developed and implemented through appropriate Government mechanisms without compromising on security issues and only after the concerned defence agencies are on board.

37. Local NGOs, district administration and people's representatives shall be briefed regularly about the value of the project to the local ecology and economy and their support shall be earnestly solicited. One or more reputable local NGOs, active in the rural development and conservation fields in the area, shall be encouraged and supported to develop and implement a suitable strategy for the project and for the welfare of the local commmunities, in order to improve its interface with the local stakeholders and to improve their quality of life.

38. There are no known or historically recorded attacks by cheetah on humans. Cheetah may predate small livestock like sheep and goats. A mechanism will be developed that will ensure that all livestock predated by cheetah will be compensated at market rates in a timely fashion so as to reduce any hostility from local communities living around the reintroduction site.

Project Duration

This is proposed to be an ongoing activity after reintroduction, without an 'end-of-project' situation in sight in the foreseeable future. However, the first phase of the project is devised, for the sake of convenience alone, for a period of **five years.**

Project Costs

Approximate cost of the project is estimated to be Rs. 114 crore. Broad estimates of cost for Phase-I (first 5 years) of the project are given in **Appendix 6.** Detailed estimates shall be prepared after the project is formally approved, as proposed here. Actual expenses will vary from year to year, based on adaptive annual action plans that will be prepared, based on the progress of previous years.

Financing the Project

The entire cost of relocation, habitat management/restoration, sourcing and tranportation of cheetah, fence, enclosure and housing/veterinary facility construction, monitoring and research cost, additional staff allowance, protection (equipment and logistics) shall be borne by the GoI. The State government shall provide the staff salaries and general management of the proposed area. The funding from Central government will be based on the framework and guidelines of the Project Tiger scheme of GOI.

Revenues

There is potential for earning significant revenues from the project from filming, photodocumentation, merchandising, sponsorship and tourism on a competitive basis. This income shall be spent on the management of the reintroduction site as well as for assisting the local communities. A proactive approach to market the project as a brand shall be adopted to promote conservation as an economic activity, after fully ensuring that it in no way hampers the conservation interest and priorities of the project and of the reintroduction site.

Development of Tourism

The project can generate significant tourist interest which will create new opportunities for employment and businesses for the local people, besides generating revenues for the government. Therefore, proper emphasis on sustainable ecotourism in the region would be given, which will give priority to the local people in employment and which will be subservient to the long term conservation interests of the project and of the area, The State Government will prepare a five to ten year site specific tourism policy (which will address the land-use and development of the surrounding areas as well). It will be documented separately apart from action plan for the reintroduction of cheetah in Shahgarh, which would be approved by CTF. A documentation and filming policy guidelines will be drafted. Separate guidelines for news channels and for profession process documentation will be listed. These activities will be planned in consultation with defence agencies like BSF and the Army. In no case will national security issues be compromised.

Annual Review

The progress of the project shall be reviewed every year by a committee appointed by GoI and nominated by CTF, consisting of experts, and decision makers from the state and central governments and the WII.

Tentative Time Line

Task	2012										2013		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	DEC	JAN	JUN	DEC
Procuring the Area													
Dialogue with the Ministry of Petroleum and Natural Gas													
Dialogue with the Defence Services													
Project Preparation by WII and RFD, in Consultation with the CTF													
Project Approval by the GoI													
Disbursement of Funds to State													
Study Tour of Planning Team													
Training/ Study Tour of Implementation Team													
Creation of Infrastructure													
Fencing of Inner Boundary													
Training of Staff by CCF Ranger													
Import of Cheetahs													
Release of Cheetahs into the Wild													
Preparation of Tourism Plan													
Recruitement of Staff													
Translocation of Prey													
Relocation of Settlements (Dhanis)													
Vaccination of Dogs													

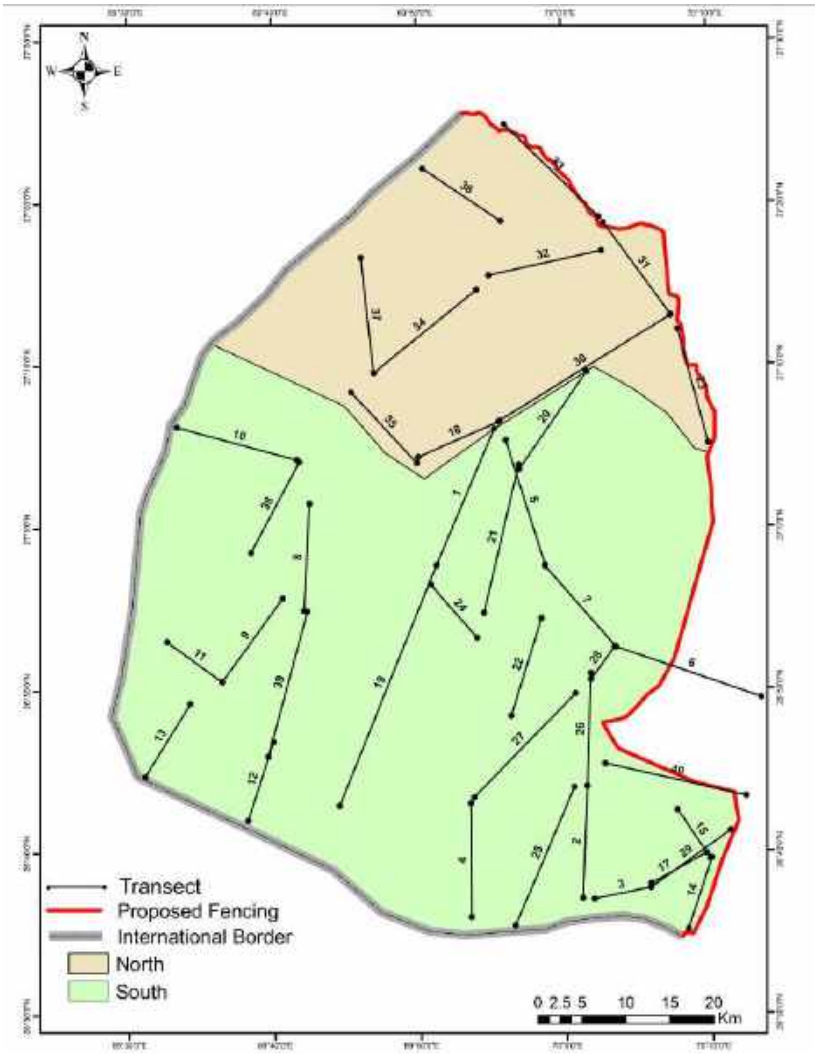
Annexure I

Survey to Assess Prey Base, Socio-Economic Status, Perceptions and Attitudes of Local People towards Wildlife

Prey Base Estimation-

The survey was conducted in the area during the months of July and August 2011.The sampling protocol designed for monitoring tigers, co-predators, prey and their habitat (Jhala *et al.,* 2009) was used for this survey. To estimate population density of prey, vehicle transect sampling method was used (Buckland *et al*. 2001). A total of **40 transects** were sampled with the length varying from 7.69 km to 30 km (Mean=16.11). Along with the start and end locations, track log of the transects were recorded using GARMIN© 72 GPS unit. Perpendicular sighting distance to the prey was measured using a laser range finder (Bushnell pro 800).

Fig 3: The 40 Transects Sampled in Shahgarh Landscape



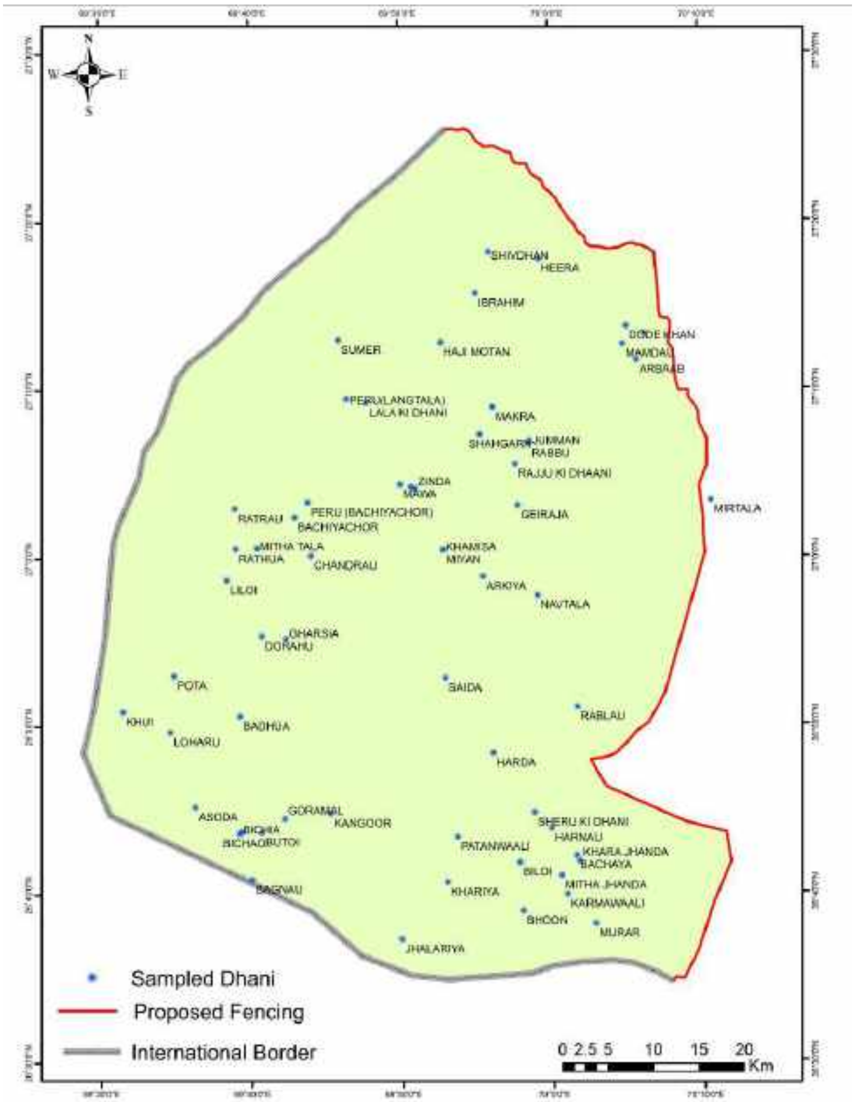
Socio-Economic Survey to Assess Perceptions and Attitudes of the Local People towards Wildlife-

A questionnaire was used for the survey to assess the attitudes and perceptions of the people living in and around the proposed area towards wildlife and forests. The questionnaire was divided into five sections.

1) Demographic variables. 2) Household characteristics. 3) Livelihood and interactions with wildlife. 4) Facilities available. 5) Dependency on forest and knowledge about wildlife.

We conducted interviews in a total of 65 households belonging to the 62 dhanis present in the area, amounting to 77.5% of the settlements in the proposed area (80 dhanis are reported in the area). Some of the settlements were deserted. Respondents were randomly selected. About 4-10% of the households in all the dhanis were interviewed. All the respondents were above 18 years of age. The survey was conducted during the months of July and August 2011.

Fig 4: The 62 Dhanis (settlements) Sampled in Shahgarh Landscape



Analysis

Prey Base Density Estimation-

Vehicle transect data was analysed using the software DISTANCE 6.0. The total sampling effort is **648.16 km for 40 transects** across the landscape.
To calculate densities, prey was categorized into three types

Categories of prey:
1) All prey species: Chinkara, goat, sheep, donkey and cattle
2) Domestic Livestock: Goat, sheep, donkey and cattle
3) Chinkara

Socio-Economic Survey-

A survey of the demographic variables, household characteristics and facilities available was used to calculate the monetary status of the households in the area. The perception and attitude towards wildlife were assessed by the responses to the questionnaire. The responses to bushmeat consumption, possession of traps and weapons, livestock depredation and the prevention measures employed were used to assess the threat to wildlife by the communities. The responses to guarding measures for the livestock taken by the locals help to identify the conflict areas and thus develop a management strategy accordingly.
Responses to the presence of wildlife in the surrounding area were done to assess the knowledge of the locals about wildlife. They were asked to describe the animal (like appearance, group size, height etc.).

Results:

a) Prey Density Estimates;

The density of all prey species in the proposed area is **40.72/ km^2 ± 5.26.** The density of domestic livestock is **43.26/ km^2 ± 7.13. Chinkara** density is the proposed area is **2.71/ km^2 ± 0.42.** In the northern part of the proposed area, Chinkara density is **1.2/ km^2 ± 0.44** whereas in the southern part it is **3.26/ km^2 ± 0.5.** The summary of the prey density model parameters are shown in Appendix I and the detection function curves are shown in Appendix 2.

b) Socio-Economic Survey;

In Shahgarh landscape, most of the settlements were small comprising of one household to a maximum of 60 households (major settlements were six). Household size ranged from 2 to a maximum of 60 members (mean=12.5). Apart from two interviews with the people of Hindu community, rest all the respondents were Muslims whose prime occupation is livestock rearing. The respondents from Hindu community have temporary settlements in the area of interest. Majority of the respondents were males (58) and rest women respondents (7).The age class distribution of the sampled population is shown in fig. 5.

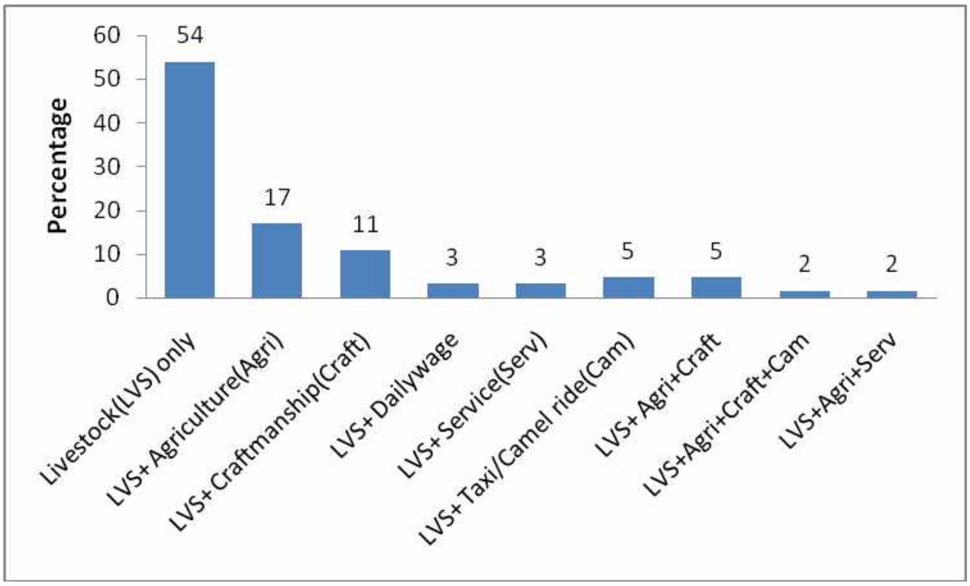
Fig 5: Age Class of the Respondents in Shahgarh Landscape (n=65)

Only 4.6% of the sampled population has had some kind of formal education (maximum being class 8th). All the households have kutcha house, since the nomadic tribes keep on

moving to different areas in search of water and pasture. None of the settlements had electricity connection. Of the interviewed households, 78 % of the dhanis had solar power and rest 22% had no form of electricity.

Livelihood- More than half of the responses were for livestock rearing as the only means of livelihood (54%) and the rest (46%) had additional occupation besides livestock rearing. The distribution of source of livelihood of the respondents is shown in fig.6.

Fig 6: Livelihood of the Respondents in Shahgarh Landscape (n=65)

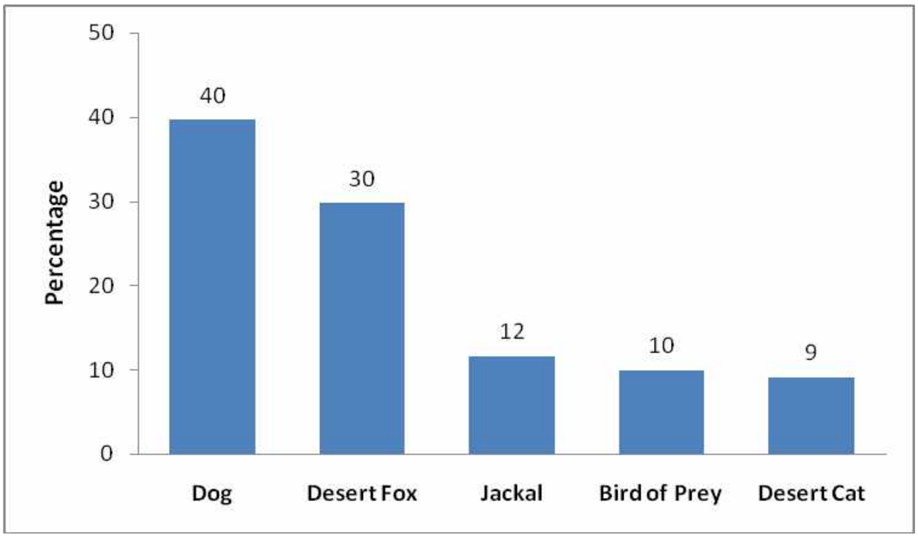


The major livestock asset of the households is sheep and goat. Donkeys were mostly left unattended in the surrounding areas and used as and when required. Camels are used for transportation. Based on the survey, as per the livestock density index the goat density was the highest (42.26/ 10 km^2), followed by sheep (18.01/ 10 km^2), cattle (1.36/ 10 km^2), camel (1.31/ 10 km^2) and donkey (1.07/ 10 km^2).

The average possession of the sheep and goat for the 65 households was calculated as 387.4 animals based on the responses. The average livestock (sheep, goat, cattle, camel, donkey and poultry) possession of the household was calculated as 414.4 animals. The average monetary value of the livestock for the household was calculated (cost of sheep and goat- Rs 3000, camel- Rs 40,000, cattle- Rs 10,000, and poultry- Rs. 500) as Rs 14.8 lakhs, with the range being minimum of Rs 1.3 lakhs to a maximum of Rs 69 lakhs.

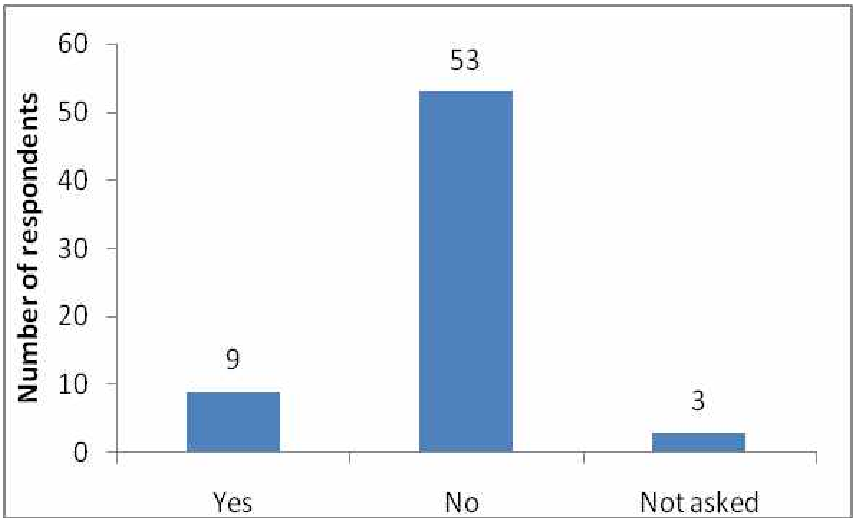
Livestock Depredation: According to the respondents, livestock depredation is prevalent in the area with 51% answering in affirmative. The species mainly responsible for this as stated by the respondents is the dog (40%). The local Muslim communities do not keep dogs as pets; however they did mention that the dogs either come from the BSF camps or from across the border. The other species responsible for livestock killing are desert fox (30%), jackal (12%), birds of prey (10%) and desert cat (9%) (fig.7).

Fig 7: Species Responsible for Livestock Losses According to Respondents



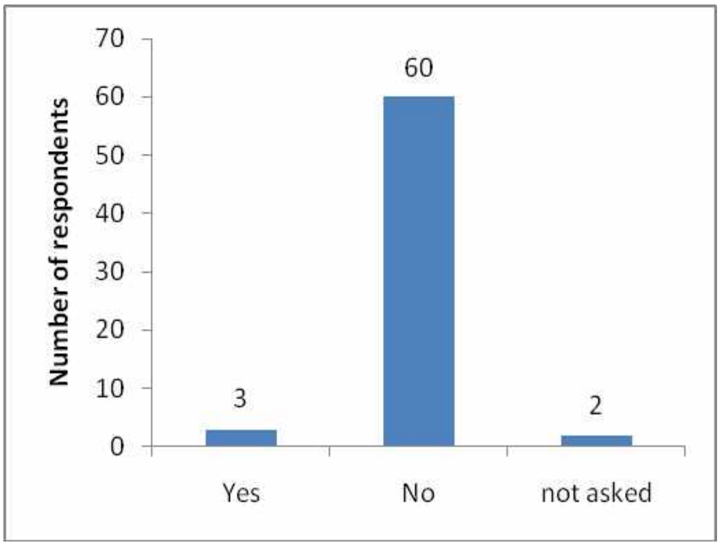
Traps- In the survey, only 14.5% of the respondents gave positive reply to presence of trapping or snaring in the dhanis. The dhanis where instances of trapping were reported are Liloi ki dhani, Mitha tala, Kui ki dhani, Ahmed khan ki dhani, Zhinda ki dhani and Mawa ki dhani. The number of respondents providing information about people in the village trapping or snaring wild animals is shown in fig. 8.

Fig 8: Respondents Providing Information about People in the Dhani Trapping or Snaring Wild Animals (n=65)



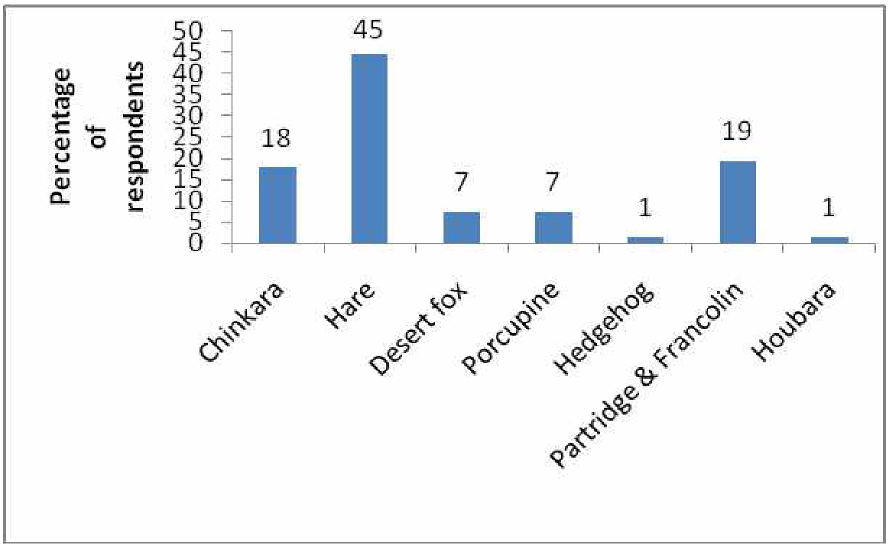
Possession of Weapons- Out of the total samples, only 4.7% gave positive reply to the question on presence of weapons. The dhanis where people possess guns are Shivdhan Singh ki dhani, Rabbu ki dhani and Khariya. The number of respondents reporting about the presence of guns in the dhanis is shown in fig. 9.

Fig 9: Respondents Reporting about the Presence of Guns in the Dhani (n=65)



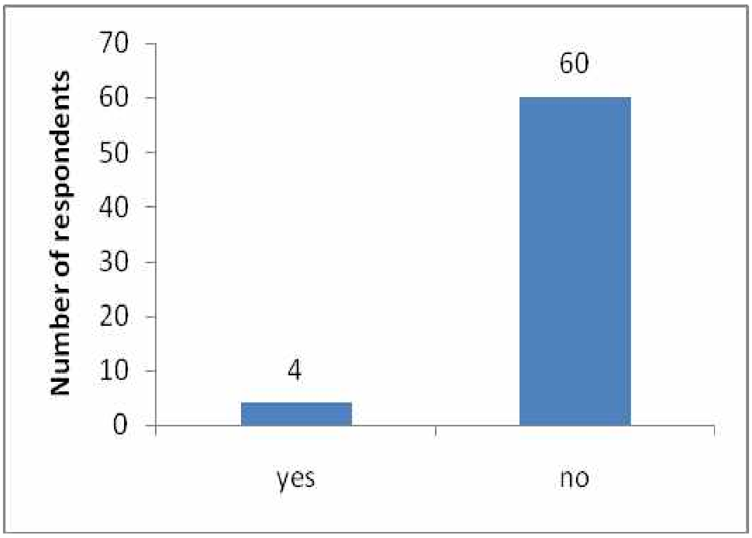
Bushmeat Consumption- There was a 100% positive response for consumption of meat. Of this 50% (i.e. 32 responses) were of domestic meat consumption only and rest 50% for Domestic and Bushmeat combined. Bushmeat consumption is quite rampant in the area according to the responts. The responses for the different types of bushmeat consumed according to interviewees are shown in fig. 10.

Fig 10: Percentage of Respondents Providing Information about Different Types of Bushmeat Consumption in the Dhanis (n=33)



Willingness to Relocate: In the 65 dhanis sampled, maximum responses were negative for willingness to relocate. Of the total sample, 93.75 % said No to relocation. Only 6.25 % answered in affirmative.The number of responses for the question for willingness to relocate is shown in fig.11.

Fig 11: Responses for Willingness to Relocate (n=64)



Literature Cited:

- Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L. (2001). Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York.
- Blasco, F., Bellan, M.F. & Aizpuru, M.(1996). A vegetation map of tropical continental Asia at scale 1:5 million. Journal of Vegetation Science. 7: 623-634.
- Champion, H.G. and Seth, S.K. (1968). A revised survey of the forest types of India, Manager of publications, Government of India, New Delhi.
- Charruau, P., Fernandes, C., Orozco-Terwengel, P., Peters, J., Hunter, L., Ziaie, H., Jourabchian, A. Jowkar, H., Schaller, G., Ostrowski, S., Vercammen, P., Grange, T., Schlotterer, C., Kotze, A., Geigl, E. M., Walzer, C. & Burger, P. A. (2011). Phylogeography, genetic structure and population divergence time of cheetahs in Africa and Asia: evidence for long-term geographic isolates. Molecular Ecology, 20: 706-724. doi:10.1111/j.1365-294X.2010.04986.x
- Cheetah Conservation Fund- http://www.cheetah.org/
- Divyabhanusinh (2006). The End of a trail- The cheetah in India. 3rd ed., Oxford Publishing House.
- Hunter, L., H. Jowkar, H. Ziaie, G. Schaller, G. Balme, C. Walzer, S. Ostrowski, P. Zahler, N. Schaurre, and K. Kashiri. (2007). Conserving the Asiatic cheetah in Iran: Launching the first radio-telemetry study. Cat News 46:8-11.
- Jhala, Y.V., Quereshi, Q., Gopal, R. and Amin, R. (2009). Field Guide: Monitoring tigers, co-predators, prey and their habitats. Third ed. Technical Publication of National Tiger Conservation Authority, New Delhi and the Wildlife Institute of India, Dehradun.
- Jowkar, H., Hunter, L., Ziaie, H., Marker, L., Breitenmoser-Wursten, C. & Durant, S. (2008). *Acinonyx jubatus ssp. venaticus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2
- International Fund for Animal Welfare (IFAW), Panthera, IUCN/SSC Canid Specialist Group, IUCN/SSC Cat Specialist Group, and Wildlife Conservation Society.(2011). A report: The fading call of the wild - A status update on 15 species of disappearing wild cats & canids.
- Marker, L. (2002). Aspects of Namibian Cheetah (*Acinonyx jubatus*) Biology, Ecology and Conservation Strategies. PhD. Thesis, Department of Zoology, University of Oxford.

- Ranjitsinh, M. K. & Jhala, Y. V. (2010) Assessing the potential for reintroducing the cheetah in India. Wildlife Trust of India, Noida, & Wildlife Institute of India, Dehradun, TR2010/001.
- Rajasthan District Gazetteers, Jaisalmer (1973).
- Rodger, W.A., Panwar, H.S. and Mathur, V.B (2002).Wildlife Protected Area network in India: A reiew (Executive summary). Wildlife Institute of India, Dehradun.
- Sharma, K.K. and Mehra, S.P. (2009). The Thar of Rajasthan (India): Ecology and Conservation of a desert ecosystem. In Faunal Ecology and Conservation of the Great Indian Desert.Sivaperuman, C., Baqri, Q.H., Ramaswamy, G. and Naseema, M. (eds.).Springer-Verlag, Berlin, Heidelberg.
- Smith, D. W. & Bangs, E. E. (2009). Reintroduction of wolves to Yellowstone National Park: History, values and ecosystem restoration. Pages 92-125 in Hayward, M.W & Somers, M.J. (Eds.) Reintroduction of top-order predators. ZSL & Blackwell Publishing Ltd. West Sussex U.K.

Appendix I

Summary of Prey Species Abundance Estimation Model Parameters in DISTANCE

Category	All prey Species	Domestic livestock	Chinkara	Chinkara (North)	Chinkara (South)	Chinkara (pooled data of 2010-2011)
Number of spatial replicates	40	40	40	10	30	55
Number of observations (n)	1008	738	265	31	234	302
Effort (L) km	648.16	648.16	648.16	171.86	476.74	798.16
Density (D_i) / km^2 ± Standard Error (S.E)	**40.72 ± 5.26**	**43.26 ± 7.13**	**2.71 ± 0.42**	**1.2 ± 0.44**	**3.26 ± 0.5**	**2.64± 0.38**
D_i Coefficient of Variation (% CV)	12.91	16.48	15.59	36.51	15.21	14.41
Group Density(D_s) / km^2 ± S.E	**7.78 ± 0.93**	**6.07 ± 0.93**	**2.15 ± 0.33**	**0.95 ± 0.35**	**2.58 ± 0.39**	**1.96± 0.27**
D_s Coefficient of Variation (% CV)	11.97	15.38	15.39	36.43	15	14.10
Probability of Detection (p)	0.25	0.21	0.32	0.32	0.32	0.32
Goodness of Fit (Chi-p)	0.88	0.91	0.9	0.9	0.9	0.90
Effective Strip Width (ESW) m	99.9	93.77	94.94	94.94	94.94	96.38
Group Encounter rate (n/L)	1.56	1.14	0.41	0.18	0.49	0.37
AIC Value	3935	2390.2	753.9	753.9	753.9	858.2
Model	Hazard rate	Half normal	Half normal	Half normal	Half normal	Half Normal
Model adjustment term	Simple polynomial	Cosine	Cosine	Cosine	Cosine	Cosine

Categories of prey:

All prey species: Chinkara, goat, sheep, donkey and cattle

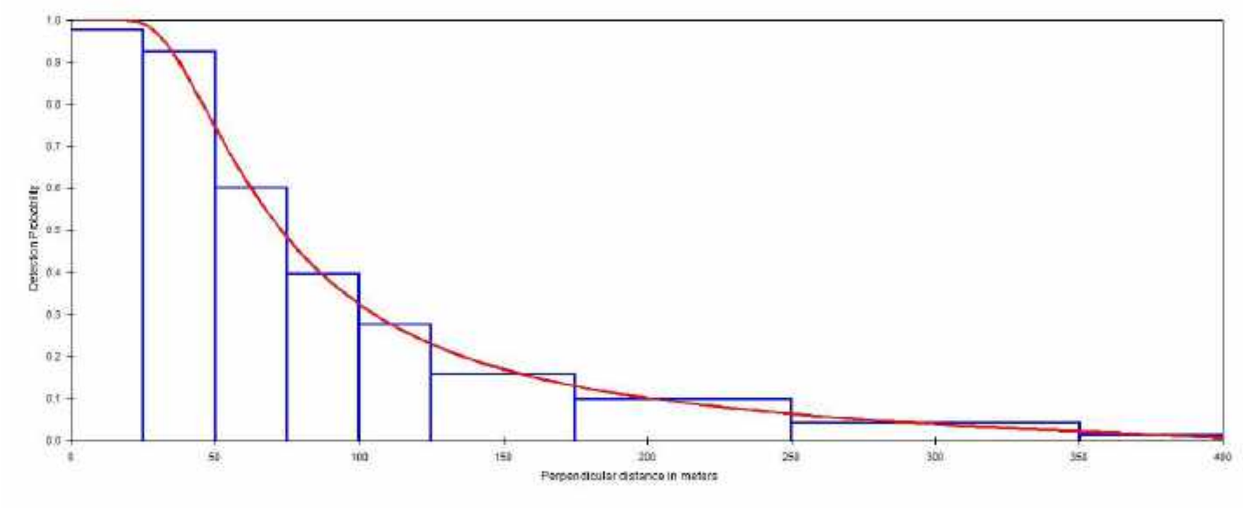
Domestic Livestock: Goat, sheep, donkey and cattle

Appendix 2

Detection Function Curves for Prey Species Abundance Estimation

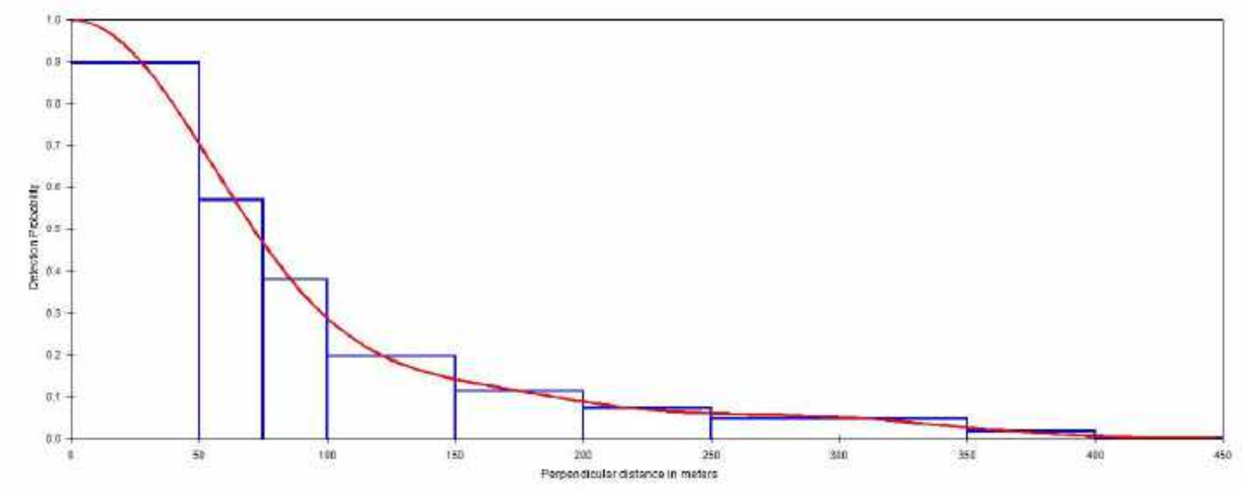
2.1: All prey species- Chinkara, goat, sheep, donkey and cattle

Model- Hazard rate with Simple polynomial adjustment term (Chi- square value=0.88, p=0.25)



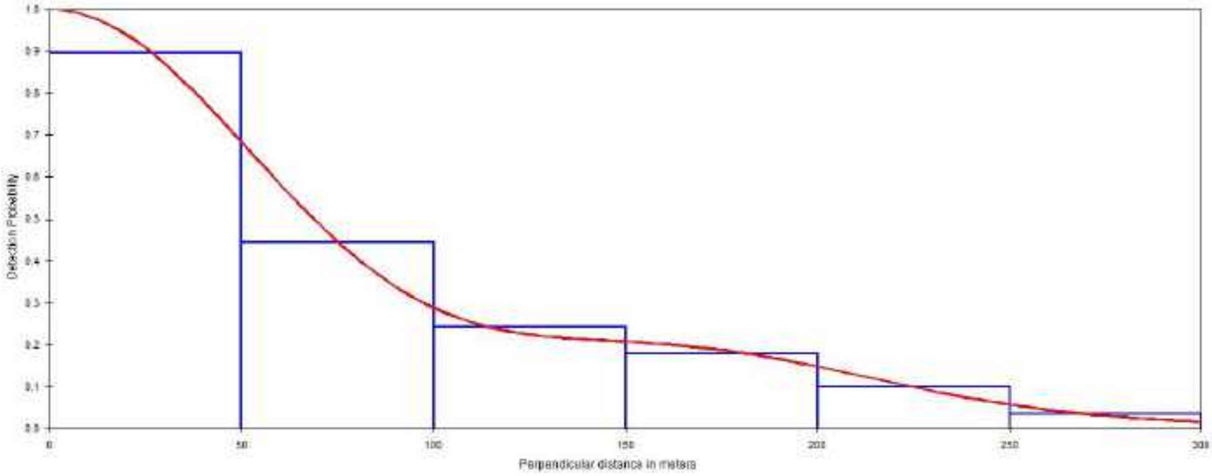
2.2: Domestic Livestock- Goat, sheep, donkey and cattle

Model- Half normal with Cosine adjustment term (p=0.2)



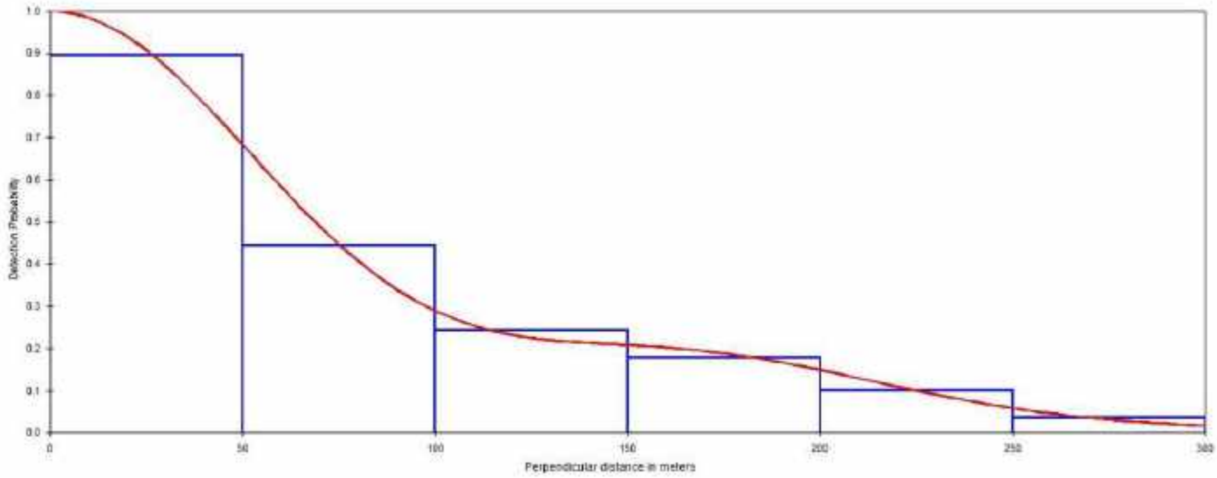
2.3: Chinkara

Model- Half normal with Cosine adjustment term (Chi- square value=0.9, p=0.32)



2.4: Chinkara: North and South

Model- Half normal with Cosine adjustment term (Chi- square value=0.9, p=0.32)



Appendix 3:

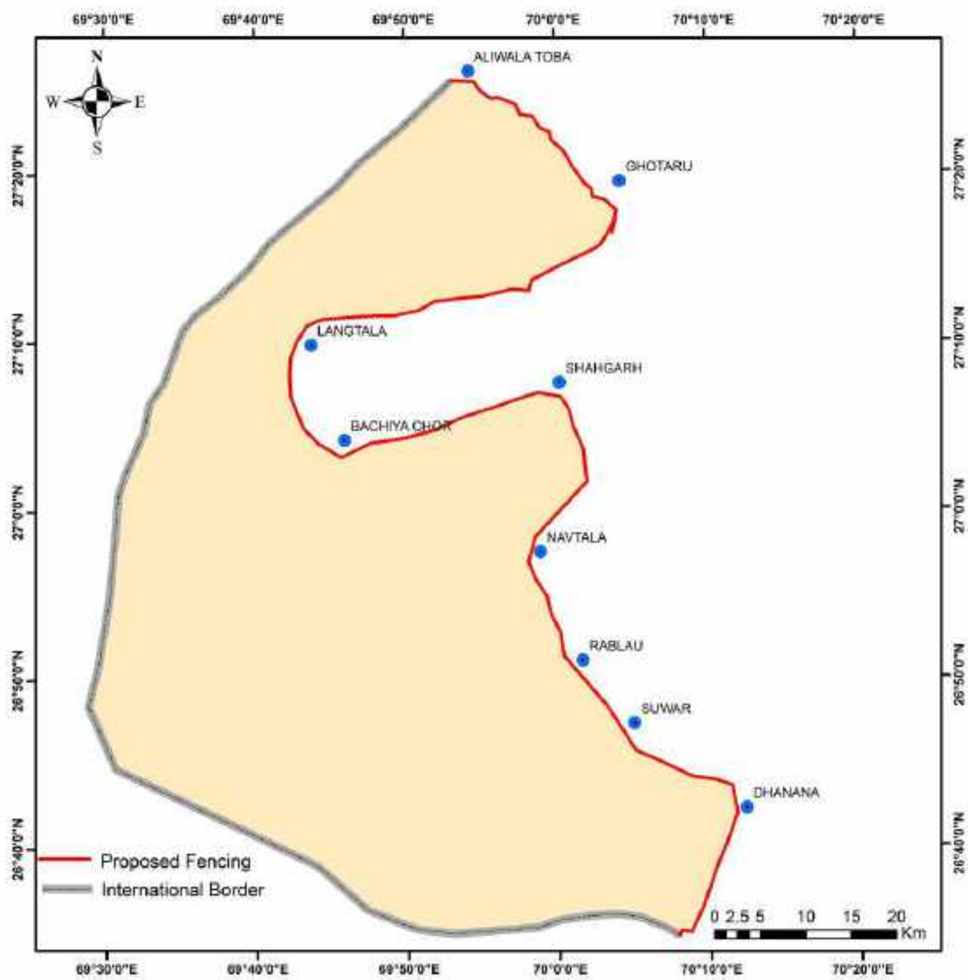
Alternative Alignment of the Chain Link Fence:

3.1) Alignment 1

Area: 3580 km^2

Length of the chain link fence: 185 km

International boundary- Aliwala Toba- Ghotaru- Langtala- Bachiya Chor- Shahgarh- Navtala- Rablau- Suwar- Dhanana- International boundary

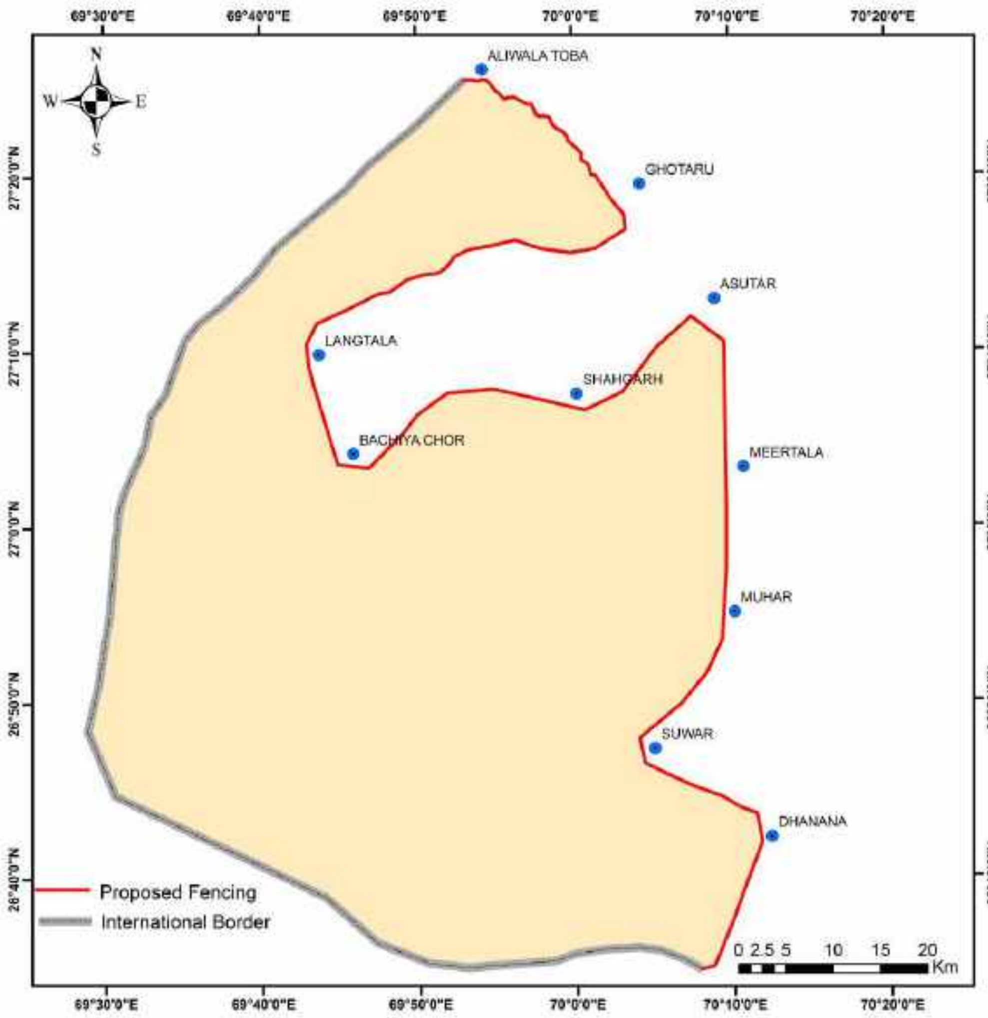


3.2) Alignment 2

Area: 4096.25 km^2

Length of the chain link fence: 206 km

International boundary- Aliwala Toba- Ghotaru- Langtala- Bachiya Chor- Shahgarh- Asu Tar- Meertala- Muhar- Suwar- Dhanana- International boundary

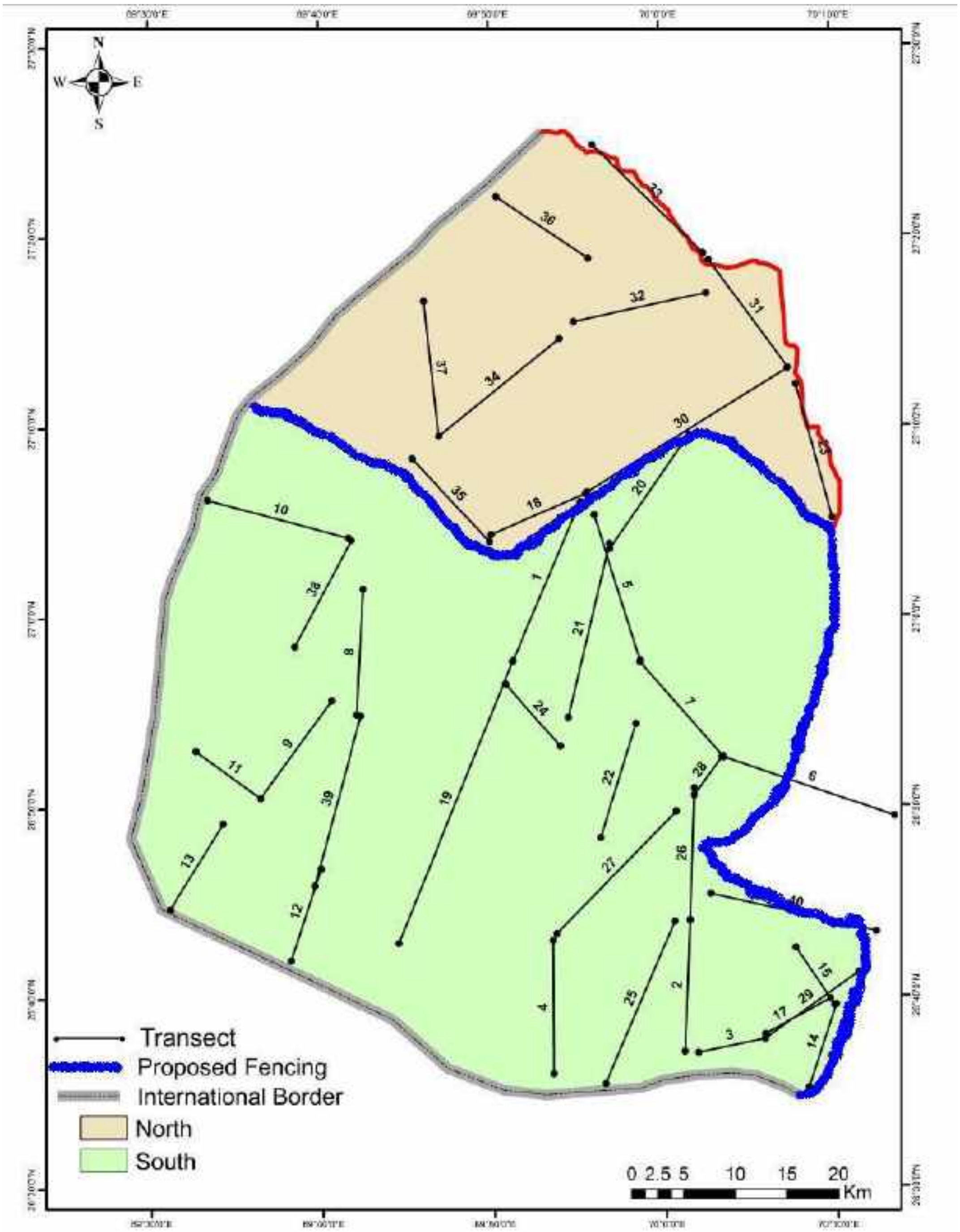


3.3) **Alignment 3**

Area of the southern part of the proposed site: 3442.46 km^2

Length of the fence for the southern part: 140 km

International boundary- Liloi- Bachiya Chor- Shahgarh- Meertala- Muhar- Suwar- Dhanana-International boundary



Appendix 4: Human and Livestock Population in Shahgarh Landscape

No	Village Name	Area (ha)	No. of House holds	Human Population (2001)	Livestock Population (2007)				
					Sheep	Goat	Cattle	Donkey	Camel
1	Ghotaru	67439	31	250	107	945	130	0	24
2	Ganeshiya Khot	28497	5	22	0	0	0	0	0
3	Langtala	12711	38	267	1539	2860	92	0	141
4	Peerau	2755	11	45	0	0	0	0	0
5	Hakra	1848	4	20	0	0	0	0	0
6	Jhanda Madhoojwala	1173	2	13	0	0	0	0	0
7	Bhinda Mangaliyowala	3606	3	13	0	0	0	0	0
8	Sodrau	1825	0	0	0	0	0	0	0
9	Mahwa	5852	8	53	0	0	0	0	0
10	Thoohar	5615	0	0	0	0	0	0	0
11	Bachhiya Chhor	3105	9	37	39	380	0	0	7
12	Momdau	4066	3	20	0	0	0	0	0
13	Ratrau	19152	11	85	484	1958	105	0	53
14	Ratwa	415	6	31	229	928	35	0	13
15	Liloi	7544	14	101	273	1891	118	0	40
16	Khariya	8781	6	47	940	616	34	0	38
17	Dorau	4347	8	45	116	316	43	8	14
18	Meethatala	1684	7	34	394	1465	74	0	65
19	Mithrau Mochiyonwala	1183	2	9	0	0	0	0	0
20	Chandrau	600	9	44	133	550	18	0	22
21	Mithrau Sachenewala	253	0	0	0	0	0	0	0
22	Ganeshiya	1959	4	25	334	1009	355	36	102
23	Sanger	6028	3	25	0	0	0	0	0
24	Birma	2375	7	48	84	394	157	10	25
25	Chakrau	2344	0	0	0	0	0	0	0
26	Bandri	2171	0	0	0	0	0	0	0
27	Bhinda Deslonwala	2954	0	0	933	1571	334	39	114
28	Adkiya	5964	23	112	855	1762	656	76	164
29	Geraja	10835	8	46	274	895	193	0	52
30	Shahra	10024	8	48	459	1518	329	25	89
31	Mehrana	4407	3	20	338	1817	125	22	80
32	Nijau	10094	2	17	0	215	25	11	7
33	Badhwa	2992	8	43	0	98	25	3	7
34	Muradenwala	692	0	0	181	616	154	23	25
35	Mehna	7421	2	13	30	166	20	5	11

Contd.....

Contd.....

No	Village Name	Area (ha)	No. of House holds	Human Population (2001)	Livestock Population (2007)				
					Sheep	Goat	Cattle	Donkey	Camel
37	Shekar	3659	1	15	0	0	0	0	0
38	Jamrau	1731	2	48	0	0	0	0	0
39	Khui Fatoonjnwali @ Khadoojanwali	4132	7	59	614	2688	92	0	176
40	Jasiya	1911	0	0	0	0	0	0	0
41	Karta	3708	8	151	0	0	0	0	0
42	Lohar	4563	8	44	128	948	183	19	35
43	Asooda	3674	0	0	0	0	0	0	0
44	Mukne ka tala	7588	13	89	343	2034	58	0	23
45	Nawatala	16583	56	260	133	1356	155	82	67
46	Suwar	11441	25	181	302	1901	121	72	52
47	Rabhlau Fakironwala	7113	44	255	364	1694	204	113	89
48	Rabhlau Rajaronwala	6533	4	19	0	0	0	0	0
49	Mehnau	3777	13	64	0	502	16	24	27
50	Kula tala	3703	5	22	10	160	13	8	8
51	Bhinda khara	321	2	15	0	0	0	0	0
52	Khariya (Baikhan)	3738	2	30	0	0	0	0	0
53	Tharoi	1780	1	17	0	0	0	0	0
54	Bichhiya	2878	6	63	0	43	4	2	1
55	Buranwali	1975	1	2	30	50	9	3	2
56	Kundhau	1246	1	5	0	0	0	0	0
57	Lalewali	819	1	7	0	52	6	2	3
58	Butoi Jeevanwali	1320	4	27	0	150	15	4	6
59	Butoi Rahimwali	797	4	12	0	124	11	6	4
60	Bagnau	1572	0	0	0	0	0	0	0
61	Basna	5633	7	72	0	218	34	0	6
62	Maghla	2130	6	32	30	422	17	0	18
63	Kangoor	2589	2	12	0	62	8	2	3
64	Edewali	978	2	7	0	70	10	3	4
65	Asoda	1567	7	44	0	185	22	6	9
66	Kuntara	2817	7	48	0	135	12	5	6
67	Babuwali	2361	2	6	0	0	0	0	0
68	Gajau	1777	2	13	0	40	0	4	1
69	Patanwali	3982	5	24	0	1781	48	58	33
70	Dhaloowal	1233	0	0	0	155	11	9	5

Contd.....

Contd.....

No	Village Name	Area (ha)	No. of House holds	Human Population (2001)	Livestock Population (2007)				
					Sheep	Goat	Cattle	Donkey	Camel
71	Mandhalwali	4582	2	7	0	50	6	4	2
72	Mithikhui	2559	0	0	0	0	0	0	0
73	Biryaree	1299	0	0	17	263	9	4	6
74	Akanwali	443	0	0	0	0	0	0	0
75	Jhalariya	2408	15	129	0	3755	81	102	70
76	Kiradwali	2716	2	60	0	0	0	0	0
77	Jiyaukhara	3498	5	21	0	104	0	2	1
78	Bichau	651	4	22	0	0	0	0	0
79	Somrau	516	1	1	0	0	0	0	0
80	Kalau	730	4	24	110	757	16	23	14
81	Bhiloi	707	2	10	0	461	11	10	14
82	Hotiya	1409	0	0	0	0	0	0	0
83	Harda	6159	11	37	0	292	14	12	11
84	Harnau	5556	19	91	55	4433	69	114	67
85	Jhanda khara	6619	10	30	0	1831	38	20	27
86	Jhanda meetha	538	4	17	51	1819	42	57	0
87	Ralna	3504	1	35	0	1339	35	34	23
88	Khabdela	2424	9	56	0	822	20	24	15
89	Mungel	1449	2	28	0	0	0	0	0
90	Soma	1466	1	8	0	0	0	0	0
91	Nichoowali	1451	1	18	0	0	0	0	0
92	Bhoon	1103	2	21	0	803	15	22	13
93	Murar	6509	17	163	104	2299	76	81	69
94	Karam wala	3999	16	120	0	1445	42	42	25
	Total	**439225**	**625**	**4098**	**10071**	**57536**	**4564**	**1231**	**2053**

Appendix 5:

Wildlife Institute of India Research Team

Bipin C.M. - Research Biologist

Anirudhkumar Vasava - Research Biologist

Anant Pande - Research Biologist

Ridhima Solanki - Research Biologist

Arti Singh - Research Sociologist

Appendix 6: **Project Cost Estimates**

Item	Unit	No.	Unit Cost (Rs. Lacs)	Year I	Year II	Year III	Year IV	Year V	Total Cost	Remarks
Expenses in Source Country										
Transportation cages	No.	10	0.25	2.50					2.50	
Misc. Costs: Permits, Local Transportation, Vaccination, Health check ups etc.	No.	10	0.25	2.50					2.50	
Cost of Cheetahs	No.	10	1.00	10.0					10.00	May be donated.
Sub-Total Expense in Source Country										**15.00**
International Transportation of Animals	LS			20.0					20.00	
Local Transportation from Airport to Shahgarh Including Handling charges.	No.	10	0.50	5.00					5.00	
Holding Fence	LS			50.00					50.00	
Staff Costs										
Biologist-1	PA		5.00	5.00	5.00	5.00	5.00	5.00	25.00	The same biologist and the vet. must stay with the project for its entire duration. The costs are averaged for the entire period and include all staff related expenses including salaries, allowances etc.

Veterinarian-1	PA		5.00	5.00	5.00	5.00	5.00	5.00	25.00	
Asstt. Veterinarian-1	PA		2.50	2.50	2.50	2.50	2.50	2.50	12.50	
Office Assistant-1	PA		1.20	1.20	1.20	1.20	1.20	1.20	6.00	
Watchmen-2	PA		0.60	1.20	1.20	1.20	1.20	1.20	6.00	
Drivers-10	PA		1.20	12.00	12.00	12.00	12.00	12.00	60.00	
Vehicles, Equipment and Supplies									0.00	
Field Vehicles-4WD Scorpios	No.	2	12.00	24.00					24.00	
Field Vehicles-4WD Bolleros	No	2	8.00	16.00					16.00	
Animal Capture and Mass Transportation Vehicles: 2	No.	2	30.00	30.00	30.00				60.00	Animal Transport vehicles shall have to be suitably modified to meet the specialized requirements of the project.
4WD Recovery Vehicle for Animal Capture	No.	2	8.00	8.00	8.00				16.00	
Multipurpose Vehicles (Truck & Tractor)	No.	2	8.00	8.00	8.00				16.00	
Misc. Capture Equipment and Tools Winches, and Implements	LS		10.00	10.00	10.00	10.00	10.00	10.00	50.00	
Operational Costs of Animal Capture (Labour, POL, misc.)	No.	5000	0.01	10.00	15.00	15.00	15.00	10.00	65.00	
Veterinary Equipment Computers and Consumables.	LS		10.00	10.00	10.00	10.00	10.00	10.00	50.00	
Monitoring (By WII)										
Vehicles-2	No.	**1**	8.00	8.00					8.00	

Radio Collars and Accessories	No.	15	2.00	15.00	15.00				30.00	
Researchers: 2	PA	2	2.00	4.00	4.00	4.00	4.00	4.00	20.00	
Field Assistants-4	PA	4	1.00	4.00	4.00	4.00	4.00	4.00	20.00	
Drivers-1	PA	1	1.00	1.00	1.00	1.00			3.00	
Operational Costs (POL and Other Field Consumables)	LS			4.00	4.00	4.00	4.00	4.00	20.00	
Computers, Stationary, GPS, Binoculars, Equipment, etc.	LS			2.00	1.00	1.00	1.00	1.00	6.00	
Travel (including International) and Other Misc. Costs	LS			4.00	4.00	1.50	1.50	1.50	12.50	
Sub-Total Monitoring (WII)										**119.50**
Publicity and PR	LS			10.00	5.00	5.00	5.00	5.00	30.00	
Maintenance of Vehicles	LS			20.00	20.00	20.00	20.00	20.00	100.00	
Misc. and Unforeseen Costs	LS			10.00	10.00	10.00	10.00	10.00	50.00	
Travel Costs (including International Travel)	LS			10.00	10.00	10.00	5.00	5.00	40.00	
Capture, restraint and Tranquilisation, Equipment, Drugs, Other Consumables	LS			10.00	5.00	5.00	5.00	5.00	30.00	
Support to Local People (Ecodevelopment)	LS			50.00	50.00	50.00	50.00	50.00	250.00	
Strengthening of Protection Infrastructure										
Construction of Patrolling Camps	No.	8	5.00	5.00	20.00	15.00			40.00	
Solar Lights in Patrolling Camps	No.	100	0.25		6.25	6.25	6.25	6.25	25.00	
PDAs and GPSs	No.	100	0.25		6.25	6.25	6.25	6.25	25.00	
Wireless Equipment	No.	50	0.25	2.50	2.50	2.50	2.50	2.50	12.50	
Internet Cost	LS			10.00					10.00	

Camels	No.	2	0.40	8.00					8.00	
Camel Maintainance	LS			1.00	1.00	1.00	1.00	1.00	5.00	
Ex-Servicemen/Labourers for Patrolling	No.	50	0.70	35.00	35.00	35.00	35.00	35.00	175.00	
Import of 6 cheetah	LS					10.00	10.00		20.00	
Relocation of 80 Settlements (Dhanis)	Families	800	10.00	4000.00	4000.00				8000.00	
Consultancy	LS		20.00	20.00	20.00	20.00	20.00	20.00	100.00	
Project Allowance for Staff	Persons	200	0.25	10.00	60.00	60.00	60.00	60.00	250.00	
Merchandising and Marketing	LS			5.00	5.00	5.00	5.00	5.00	25.00	
Boundary Fencing Along Villages	Km	130	12.00	780.00	780.00				1560.00	
Livestock Predation Compensation	LS	50	0.02	1.00	1.00	1.00	1.00	1.00	5.00	Considering 1 sheep/goat killed per week
Unforeseen Contingencies	LS			6.00	18.00	18.00	18.00	18.00	78.00	
Grand Total.				**5268.40**	**5195.90**	**357.40**	**336.40**	**321.40**	**11479.50**	

Appendix 5

Action Plan for the Reintroduction of the Cheetah (*Acinonyx jubatus*) in Nauradehi Wildlife Sanctuary Madhya Pradesh

Cheetah Task Force
Madhya Pradesh Forest Department
Wildlife Institute of India

2012

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Action Plan for the Reintroduction of the Cheetah (*Acinonyx jubatus*) in Nauradehi Wildlife Sanctuary, Madhya Pradesh

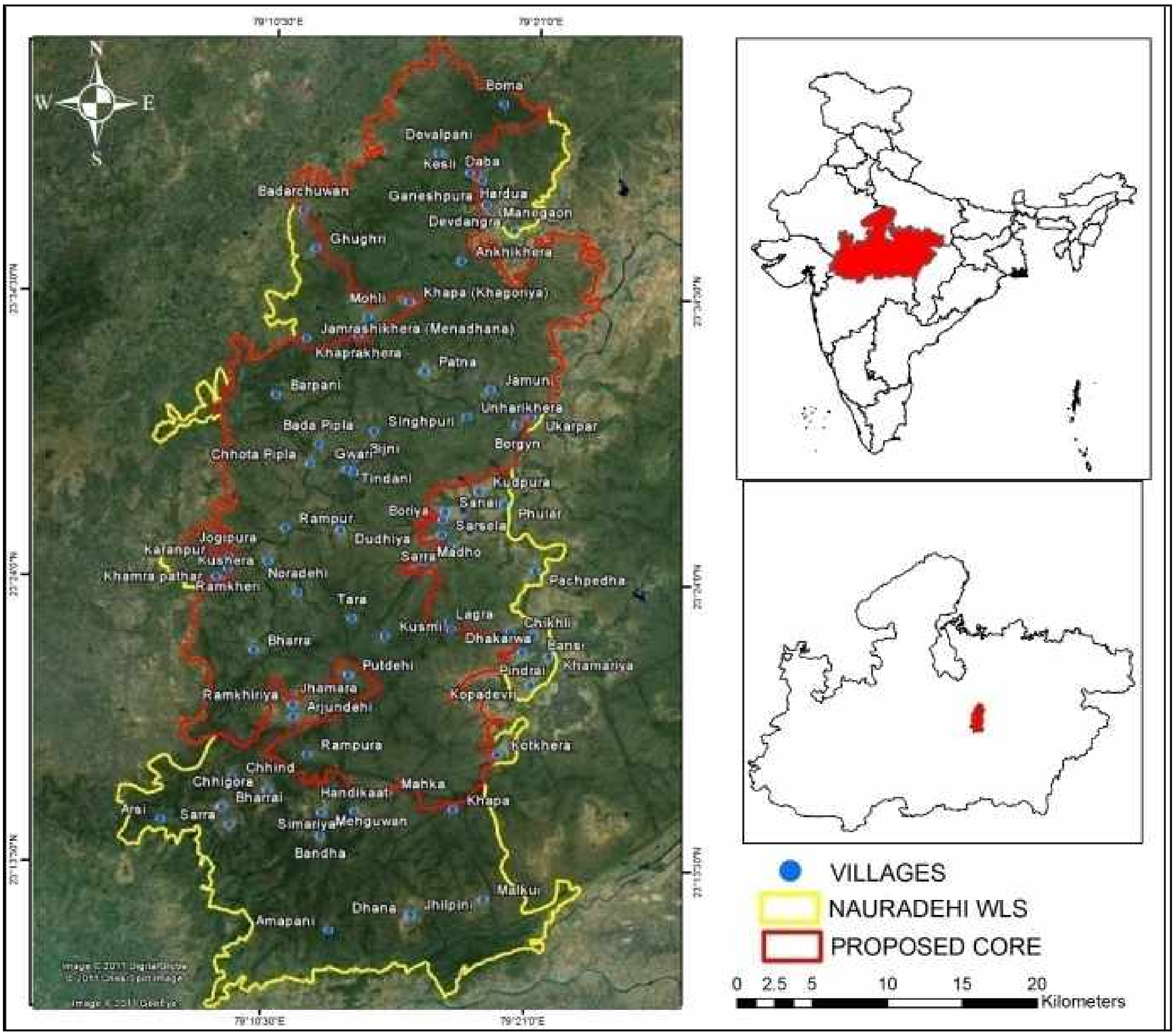
BACKGROUND

Cheetah (*Acinonyx jubatus venaticus*), which has been an integral part of the Indian heritage, folklore and culture since times immemorial, went extinct in India by the middle of the twentieth century. This loss has been attributed, apart from overhunting of the species and its prey, to the loss of its primary habitat, the arid and semi-arid grasslands to their conversion into agriculture. This is the only recorded extinction of a large mammal in India, in historical times, as the country has been able to save all other major species, despite exploding human population and consequent pressure on natural resources. The country has been able to preserve several critical ecosystems in the name of iconic flagship species such as the tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*), gharial (*Gavialis gangeticus*), great one-horned rhinoceros (*Rhinoceros unicornis*), amongst others that inhabit such habitats. However, the grassland and thorn-scrub forest ecosystems have been declining as they are generally considered a wasteland by the public and a *blank* by forest departments. As nearly all the productive grasslands have been converted into croplands, the principal prey of the cheetah in these habitats, the blackbuck (*Antilope cervicapra*), is also living a very precarious life due to its conflict with the agrarian communities.

The Government of India (GoI) started contemplating the reintroduction of the cheetah, as a means of reviving and preserving the remaining grasslands and dry forest systems of India, in 2009, when a meeting of national and international experts was called at Gajner, Rajasthan, on September 9th and 10th to discuss the prospects. The participants supported the idea wholeheartedly and proposed a nationwide assessment of potential reintroduction sites. The task of carrying out this assessment was entrusted to the Wildlife Institute of India (WII) and the Wildlife Trust of India (WTI). A rapid assessment of ten potential sites was carried out, encompassing the states of Rajasthan, Madhya Pradesh (MP), Gujarat, Chattisgarh and Uttar Pradesh, in terms of the size and quality of the available habitat, prey base, scope of future development etc. and recommended that three sites, Kuno-Palpur Wildlife Sanctuary and Nauradehi Wildlife Sanctuary in MP and Shahgarh landscape in Rajasthan, as the most promising ones (Ranjitsinh & Jhala 2010). Although the Shahgarh landscape in Rajasthan is the largest potential cheetah habitat available in the country, it has no legal protection under the Wildlife (Protection) Act, 1972. The Kuno-Palpur Wildlife Sanctuary (WLS) in north-western MP has been adjudged as ready in most respects for immediate reintroduction of cheetah, as it has adequate prey base, and virtually no human population within it and a relatively low human population in the adjoining forests, which are fairly open. The Nauradehi WLS has adequate prey base but has 69 villages inside, out of which 21 villages and 3 settlements will need immediate relocation, involving large investments and other inputs. The GoI constituted the Cheetah Task Force (CTF) under the chairmanship of Dr. M.K. Ranjitsinh to steer and facilitate the process of reintroduction, on 1st September, 2010. Consequent to the decision to start the process in Nauradehi WLS, the Wildlife Institute of India carried out a fresh assessment of the status of the prey base in the proposed area, in the winter of 2011 and found it to be nearly 22- 36 animals/ km^2. (**Annexure I**).

The Nauradehi WLS (23° 05' to 23° 43' N and 79° 05' to 79° 25' E) is one of the largest Sanctuaries in India (Fig. 1). It covers an area of 1197.04 km^2 and is located in three districts of Sagar, Damoh and Narsinghpur in Madhya Pradesh (Shukla 2007). Two perennial rivers Bearma and Bamner flow through the Protected Area. Major part of the Sanctuary lies on a plateau, rising gently from the north which terminates into low hill ranges and drops steeply into the Narmada valley in the south and is part of the upper Vindhyan range. Nauradehi WLS is classified under Deccan peninsula (zone 6A) biogeographic zone (Rodgers *et al*. 2002). The Sanctuary is patchily connected to Veerangana Durgawati WLS towards the east in Damoh district which extends upto Bandhavgarh Tiger Reserve and towards the west as a thin strip of forest in Bareli Tehsil of Raisen district. The area of this forested habitat is about 5500km^2 (Shukla 2007).

Fig. 1: Nauradehi Wildlife Sanctuary



The average maximum temperature is 40°C during summer with May being the hottest month and the average minimum winter temperature is reported as 12°C in January (Shukla 2007). Monsoon sets in during July and extends up to October. The annual average rainfall ranges from 914 to 1522 mm.
The vegetation of the area is classified as southern tropical dry deciduous forest (type 5A) (Champion & Seth 1968). A large part of the Sanctuary mainly comprises of open woodlands with grasses (Fig. 2). The dominant tree species are *Tectona grandis*, *Terminalia tomentosa, Lagerstroemia parviflora, Diospyros melanoxylon, Madhuca indica, Chloroxylon sweitenia, Phyllanthus emblica* and *Aegle marmelos.* Some of the grass species include *Eragrostis tenella*, *Themeda quadrivalvis*, *Heteropogon contortus* and *Cynodon dactylon*.

Fig. 2: Open woodlands in Nauradehi WLS

The wild ungulates found in this area are nilgai (*Boselaphus tragocamelus*), spotted deer or chital (*Axis axis*), sambar (*Rusa unicolor*), barking deer or Northern red muntjac (*Muntiacus vaginalis*), chinkara (*Gazella bennettii*), blackbuck (*Antilope cervicapra*), four-horned antelope or chowsinga (*Tetracerus quadricornis*) and wild pig (*Sus scrofa*). Two species of primates, rhesus macaque (*Macaca mulatta*) and southern plains gray langur (*Semnopethicus dussumieri*) are present in the Sanctuary.

Tigers are occasionally reported from the area, the last being in August 2011 when a female tiger was found dead inside Mohli range of the Sanctuary. The last reports of leopard (*Panthera pardus*) dates back to early 2000 and the present status of the leopard in the park are unknown. The other carnivores found in the area include sloth bear (*Melursus ursinus*), Indian wolf (*Canis lupus pallipes*), wild dog or dhole (*Cuon alpinus*), striped hyena (*Hyaena hyaena*), golden jackal (*Canis aureus*), Indian fox (*Vulpes bengalensis*), jungle cat (*Felis chaus*), desert cat (*Felis silvestris ornata*), honey badger (*Mellivora capensis*), ruddy mongoose (*Herpestes smithii*), Indian grey mongoose (*Herpestes edwardsii*) and small Asian mongoose (*Herpestes javanicus*). Among reptiles, mugger (*Crocodylus palustris*), Indian python (*Python molurus molurus*), Common Indian monitor (*Varanus bengalensis*) are some of the species found in the Sanctuary.

About 129 species of birds are found in the Sanctuary which include the common woodshrike (*Tephrodornis pondicerianus*), crested bunting (*Melophus lathami*), spotted treecreeper (*Salporniss pilonotus*), common iora (*Aegithina tiphia*), yellow-crowned woodpecker (*Dendrocopos mahrattensis*), stork-billed kingfisher (*Pelargopsis capensis*), Indian peafowl (*Pavo cristatus*) , lesser adjutant (*Leptoptilos javanicus*), Sarus crane (*Grus antigone*), brown fish owl (*Ketupa zeylonensis*), white-eyed buzzard (*Butastur teesa*), crested serpent eagle (*Spilornis cheela*), changeable hawk-eagle (*Nisaetus cirrhatus*), Egyptian vulture (*Neophron percnopterus*), white-rumped vulture (*Gyps bengalensis*) and Red-headed Vulture (*Sarcogyps calvus*) (Shukla 2007).

The predominant communities residing in the villages present inside the Sanctuary are the Gond tribe and the Yadavs. Agriculture is the main source of livelihood for these communities although Yadavs are also traditional pastoralists. Gwaliya, Lodhi, Chaudhary and Harijan are the other communities living in the Sanctuary. Most of the people are living below poverty line and are dependent on the forest resources. The Protected Area is under a lot of pressure in terms of livestock grazing, fuelwood collection and illegal timber extraction by the outsiders. Two important roads traverse the forest area, Sagar to Jabalpur via Mohli and Tendukheda to Deori which, along with National Highway no. 12 (southern boundary of the park) cause a lot of disturbance to the wildlife movement inside the Sanctuary.

Research into cheetah biology and ecology has greatly increased our understanding of the fastest land animal and education programs for schools and the farming & pastoralist communities help change public attitudes to allow predator and humans to co-exist (Cheetah Conservation Fund). The local communities should be made aware of the fact that cheetah is one carnivore whose conflict with humans and livestock reports throughout the world has been minimal. There is no record of a cheetah ever having killed a human in the wild (IFAW *et al*. 2011). In Namibia, research shows that cheetahs were responsible for only 3% of livestock losses to predators (Marker 2002). The co-existence of the locals with the wildlife will play a crucial role in making a larger landscape available for the cheetah as well as better management of wildlife too.

Large Carnivores

The prospects of promoting tiger and leopard occupancy within the landscape will not be compromised in any way with the reintroduction of cheetah. These large carnivores have been sympatric in historical times (Divyabhanusinh 2006), and the restorative inputs in Nauradehi will make the habitat suitable for such efforts in the future. The only caveat for such an effort is that cheetah population needs to have been established before encouraging other large carnivores, since cheetah are the least dominant amongst these large carnivores and would not be able to establish in high density tiger/ leopard habitats due to direct competition. Currently, Indian wolf is the dominant predator of Nauradehi WLS sustaining itself mainly on the livestock of the villages in the sanctuary. The management efforts taken to protect the area for cheetah would also immensely benefit this locally threatened species in the long run. Cheetah being the least dominant of these carnivores would sometimes be killed by these carnivores, but that would be a natural process and management by appropriate supplementation and recruitment from the reintroduced population would compensate these.

Nauradehi WLS and the surrounding forests was historically tiger country. This landscape was contiguous with Bandhavgarh Tiger Reserve and still retains habitat connectivity (Jhala *et al*. 2011). Habitat management with restorative inputs and protection should assist in developing this corridor connectivity between these two important landscapes further, thus resuming the objective of tiger conservation as well and facilitate the metapopulation structure between Bandhavgarh Tiger Reserve and Nauradehi WLS.

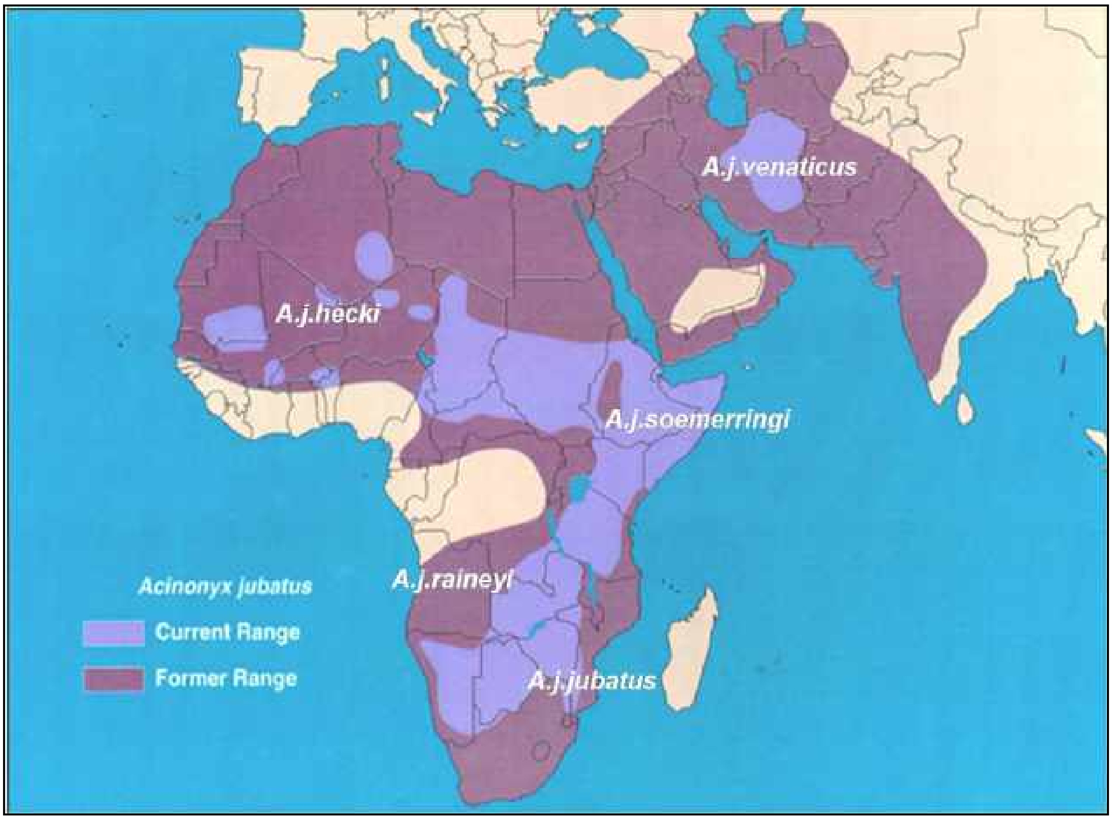
A buffer zone management strategy for Nauradehi WLS needs to be developed in line with the National Project Tiger areas landscape management plan guidelines. These guidelines emphasise incentives and enhancement of livelihood of resident communities, compensation for livestock kills, mitigation of human-wildlife conflicts and curtailment of high impact developmental activities.

Tigers have been resident here and may return with the improvement of habitat, prey base and protection. The present status of leopards in the Sanctuary is unknown. It is necessary to clarify that all these predators can co-exist, if adequate prey base and other resources are available. As tigers and leopards live compatibly in Indian forests, cheetah and leopards are found together in Africa. All the species have co-existed in India for several thousand years before the explosion in human population disrupted this equilibrium. All these species are adapted to share the same habitat and have carved their distinct ecological niches. There will be occasional conflicts and just as tigers sometimes kill leopards, an occasional cheetah too may be killed by these carnivores. But such deaths due to interspecific conflict or non-target poaching will not jeopardize the reintroduction project once cheetah populations are established.

Origin of Sourced Cheetah

The Asiatic Cheetah being extinct from its earlier distribution in India (Divyabhanusinh 2006) is now only known to occur with certainty in Iran (Jowkar *et al*. 2011) (Fig. 3).The census population of cheetahs in Iran is estimated at 60-100 (Hunter *et al*. 2007).

Fig.3: Historical and current distribution of the cheetah



Approximately 10000 cheetahs live in the African continent, of which the largest population of about 4000 is found in Namibia, primarily on commercial farm lands (Marker 2002) and an estimated 2000 to 3000 in Botswana followed by South Africa (Durant *et al*. 2008). It is natural to believe that the founder stock for Indian reintroduction programme should, preferably, be sourced from Iran, rather than from Africa, as the former are genetically closer to the extinct Indian subspecies of Asiatic Cheetah (Charruau *et al*. 2011). However, Iran does not have the capacity to spare any animals for the Indian reintroduction programme as they do not have even a single animal for their own captive breeding programme (pers. comm. Jhala with the Vice President of Iran). Moreover, at least till recently, cheetahs were believed to have very limited genetic diversity and all cheetahs, including the Iranian stock, were considered to have segregated in very recent times. Recent studies (Charruau *et al*. 2011) have demonstrated more genetic variations within cheetah lineages. In any case, the question of genetics would have been more relevant if there was any risk of mixing lineages with a different resident population. As there are no existing cheetah populations in India, this risk is automatically obviated.

This issue was thoroughly debated by the CTF and a conclusion was reached that India will source cheetah from Southern Africa (Namibia and South Africa), which can provide India substantial numbers of suitable cheetah for several years. Cheetahs from Southern Africa have the maximum genetic diversity observed among extant cheetah lineages which is an important attribute for a founding population stock. Besides, Charruau *et al.* (2011) suggests that the Southern African cheetah (*Acinonyx jubatus jubatus*) were the ancestral stock from which all the modern day cheetah lineages arose and these cheetah populations are genetically the most diverse.

Compliance with IUCN Guidelines

IUCN was a participant in the Gajner meeting where the project was conceived. The project is entirely compliant with 'IUCN/SSC Guidelines for Re-introductions' (IUCN 1998). The proposal is fully in conformity with the definition of re-introduction provided in the guidelines 'as an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct'. As per the guidelines, there can be one or multiple objectives for re-introduction; this proposal conforms to the following objectives stated in the guidelines to enhance the long-term survival of a species; to maintain and/or restore natural biodiversity. The reintroduction of the cheetah will restore the role of this top order carnivore in the ecosystem and subsequently restore the balance that such carnivores bestow on ecosystemic and community functions (Smith & Bangs 2009).

The proposal also meets another recognized objective viz. 'to provide long-term economic benefits to the local and/or national economy' to some extent. The guidelines recommend a multidisciplinary approach and prefer wild stock as the founder population. The IUCN guidelines also recommend that 'where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these'. Significant improvements in the protection, infrastructure and relocation of villages in the proposed core area of Nauradehi WLS are proposed in the project. Other elements of the guidelines, related to selection of the stock, legal requirements, policies of the relevant governments etc. shall be complied with as and when required.

Mortality and Supplementation of Cheetahs

Even successful reintroduction projects go through a series of ups and downs and one of the factors that we have to reckon with is the mortality of cheetahs before and after release. There can be deaths from accidents, diseases, intraspecific fights etc. before release. After release, the mortality can occur due to injury from hunting of prey, poisoning, poaching, road hits, as well as from other predators (especially to cheetah cubs). Not all deaths after release should be a cause of worry. Mortality of reintroduced cheetah is expected in spite of all the efforts taken to minimize risks. Appropriate awareness campaigns need to be conducted prior to the commencement of the project, so that all the stakeholders, public and officials are aware of this eventuality and some cheetah deaths should not put the project in bad light or consider it a failure. Supplementation of initial founders may be needed annually or once in five years for managing the demographic and genetic composition of the reintroduced population.

Project Goal and Objectives

The project aims to establish a free-ranging breeding population of cheetahs in Nauradehi WLS. The carrying capacity of Nauradehi WLS was estimated to be 26 cheetahs (Ranjitsinh & Jhala 2010). The two to three established populations of cheetah in India are proposed to be managed as a meta-population with occasional "immigrants" brought in from Southern

Africa, as and when needed (Ranjitsinh & Jhala 2010). Within this larger goal, the project will strive to achieve the following objectives:

a. Establish and maintain a population of cheetah in Nauradehi WLS so that the species adequately performs its role as top predator in this biome.

b. Provide adequate security to local flora and fauna and ecosystem processes.

c. Revive and maintain the grassland and open forest systems existing in the PA in an optimum productive state and thereby evolve management techniques and practices for better conservation of these habitats.

d. Build the capacity of the MP Forest Department in the field of habitat and prey management, especially grasslands, in view of the emerging needs and in handling of the cheetah itself.

e. Build the capacity of the MP Forest Department (MPFD) in mass translocation of herbivores, particularly blackbuck, nilgai and spotted deer, in view of the emerging need for protection of crops and scientific management of wildlife populations.

f. Conserve and enhance the faunal diversity, especially the threatened species, such as the chowsinga and blackbuck, and provide a future safe haven for even more endangered species such as the Indian wolf.

g. Generate benefits for the local people through the development of wildlife tourism and ancillary activities.

h. Develop the capacities of the local communities to co-exist with wild animals, particularly large carnivores.

Action Plan

The process of reintroduction is proposed as follows:

1. Government of India (GoI), Ministry of Environment and Forests (MoEF) and the Cheetah Task Force (CTF) shall take the initiative to create a formal framework for collaboration between the GoI and Governments of Namibia and/or South Africa, through the Ministry of External Affairs (MEA), in order to facilitate the collaboration of the agencies/individuals participating in the project. Scope for using any existing agreements for collaboration between the countries shall be explored by MoEF/ CTF/MEA.

2. MoEF shall issue an initial import permit for minimum 20 cheetahs on the recommendation of CTF from Namibia and/or South Africa, under the CITES regulations. The Cheetah Conservation Fund (CCF) in Namibia and And Beyond (AB), a safari and wildlife management company in South Africa, have indicated their willingness to donate the founder stock during preliminary discussions. MoEF/ CTF shall also liaise with other relevant agencies/departments of GoI to facilitate the import of the animals. Member Secretary-CTF/MOEF/MEA shall send the import

permits, and other necessary documentations if any, to the agencies supplying the animals, as soon as possible, under intimation to the GoI and the high commissioners of India and Namibia/South Africa.

3. The chosen donor organizations and suppliers in Namibia and South Africa, in cooperation with the concerned Indian High commissioners, shall procure the necessary export permits from their respective government agencies. They shall make the arrangements for shipping the animals to India through an airline to be designated by CTF.

4. A cohort of upto10-12 cheetahs that are ideal (young age group that is genetically diverse, behaviourally sound- e.g. not overly imprinted to humans, capable of hunting wild prey and socially tolerant of each other) for reintroduction shall be imported from Namibia or South Africa, as a founder stock during the first year. An existing coalition of wild males shall be selected while the selected females shall also be known to each other as far as possible. The animals' lineage and condition shall be checked in the host country, to ensure that they are not from an excessively inbred stock and in the ideal age group, so as to conform to the needs of a founding population.

5. The selection of animals suitable for release will be the responsibilities of the chosen donors/experts in Namibia and South Africa and will be verified by CTF/WII.

6. The selected animals shall be collected from different locations, as the case may be, and prepared for transportation, after necessary vaccinations and health checks etc, as per international protocols, and the animals shall be delivered to the designated airlines. A veterinarian from the donor agency and if need be, one representative from India (MPFD /CTF) shall accompany the shipment, along with necessary supplies and equipment.

7. The animals shall be housed in fenced enclosure of size 150 sq. km. The enclosures should not have any corners and should be rounded. Males and females shall be kept in separate but adjoining compartments so that they are able to know each other before release. The location of the enclosure will be chosen such that the cheetahs can see for some distance to understand the environment and the presence of prey, before release. The height of the fence will be about 2.5 meters, and a line or two of power fence shall have to be fitted at the top to discourage any attempts by leopards to enter the enclosure. Adequate water and shade in the enclosure will be suitably augmented as needed. In case the project envisages holding a breeding population within the enclosure, the existing fenced enclosure can be extended.

8. Natural prey within the enclosure will ensure that cheetah become accustomed to hunting Indian prey species before their release.

9. These animals shall be released into the main enclosures, after a short stay in a smaller enclosure (1-2 ha) for the purposes of inspection.

10. The males shall be radio collared and soft released from the main enclosure after an appropriate period (2-6 weeks). They are expected to establish a coalition territory after exploring and investigating the available habitat, but would tend to return to the enclosure to meet the females. The presence of females in the main enclosure shall ensure that the males do not wander too far away, after their exploration instinct is satiated. Their movements shall be monitored 24 hours a day by the local staff, assisted by a team of researchers from WII. If any animal tends to get into undesirable environment, it will be brought back into the Sanctuary. Darting will be done if absolutely essential, by qualified trained personnel.

11. The females shall be released, after radio collaring, 1-4 weeks after the males, depending upon the state of the males' comfort in the new environment. The females shall be monitored and kept under observation through radio telemetry, as in the case of males described above.

12. To manoeuver, approach and capture cheetah, we propose to try out horses besides Four-wheel Drive (4WD) vehicles. Two trained horses will be stationed at three to four different well spaced and strategically located sites. This placement is essential since horses would be able to operate within a range of 15km radius and then these horses could be effectively used to track and approach the cheetahs. The horses would also be useful for purposes of patrolling.

13. An experienced international cheetah expert shall stay at the project site, from before the arrival of the cheetah upto about two months after the release of the females from the enclosure, to advise and assist the authorities in coping with any unwarranted situations, to care for the cheetah in captivity, opine on their readiness and that of the habitat for the release and to help monitor the animals after their release. He/ She will also train the local staff.

14. Genetic management of the reintroduced population is proposed by substituting the male coalition by a different coalition after F1 generation sired by the first male coalition is over 1.5 years of age. Females will be supplemented as required in consultation with CTF and technical advisors.

15. Expecting approximately 5% growth rate in the released population, incorporating natural mortality, births and annual supplementation, the released population should reach carrying capacity level in a few years.

16. Boundaries of the potential cheetah habitat, abutting on human habitation shall be secured through proper fencing if needed, in consultation with the affected people, to minimise conflict, poaching and straying of released cheetahs into human habitat.

17. The release site has adequate prey base to support the cheetah, along with other existing predators such as leopards, wolves, jackals, hyenas, and occasional tigers. However, the rather sudden increase in the predator population in the area may lead to some unexpected effects on certain prey species. The response of the prey species to the increased predation shall be monitored through WII researchers to understand the new dynamics. However, prey availability in the Sanctuary shall also be augmented through translocation of substantial number of blackbuck and nilgai from the crop fields of adjoining districts. A fully equipped animal capture unit will be created under the project for this purpose. Possibility of public private partnership (PPP) in animal capture shall also be explored and expertise from Namibia and South Africa or elsewhere, to India for the group capture and translocation of animals such as nilgai and blackbuck, would be arranged by the CTF with the concurrence of WII and the Government of MP.

18. Availability of prey base shall be assessed each year by the WII biologists to be attached to the project and supplementation of prey will be decided on the basis of this annual assessment.

19. A veterinary unit will be created under the project by the Government of MP, to care for the breeding stock within the breeding enclosure as well as to manage the released animals, in cases of straying, injury, conflict etc.

20. All new posts in the field, which have been advocated as essential and those found necessary by the state government, foreign experts and CTF, would be created and filled by the state government within 3-6 months. Here again, recruitment should be as far as possible from the local communities. In this regard experience of Nagarjunasagar-Srisailam Tiger Reserve could be taken into account where efforts are being taken to work with and employ the local Chenchu tribals to protect the forest.

21. Representatives from the core group of the reintroduction team shall be sent on a study tour of cheetah reintroduction sites/ programmes in Africa. The action plan for reintroduction may be finalised/ modified on the basis of the learning from this study tour. The composition of the team (inclusive of MPFD, WII Scientists and research fellows) would be decided by the CTF.

22. A project implementation team consisting of The Chief Conservator of Forests, in charge of the project, Divisional Forest Officer, Assistant Conservator(s), Range Officer(s), Deputy Range Officers, Foresters and to the extent possible the Forest Guards shall be selected on the basis of their interest, commitment and capabilities and shall be posted for a minimum period of at least 3 years and if possible upto 5 years**.** Representative of a local NGO must be included in the project implementation team. The senior members of the team, including the project biologist and veterinarian, would be sent on a training tour to selected cheetah reintroduction sites

in Africa as early as possible. The composition of the team would be decided by the CTF. The training shall be conducted in batches. The senior members who would be trained abroad would train the junior staff. The entire staff working for the cheetah reintroduction project shall be paid a 'Project Allowance' at par with the allowance paid to the staff working for Project Tiger.

23. A team of two well-known cheetah experts shall be created to advise the project planning and implementation. Ms. Laurie Marker of CCF and Mr. Les Carlisle from And Beyond, South Africa, have shown interest in advising the project. Both of them have vast experience in cheetah conservation and management. The services and help of their organisations as advisors and contributors to the project may be obtained by CTF, who would then also negotiate the terms of their involvement. Other experts will be co-opted as and when required. The reintroduction of the cheetah offers unique opportunity to understand the role of top predators in ecosystems. Research in all aspects of system recovery and interactions including ecology of the reintroduced cheetah should be addressed by WII.

24. To enhance the carrying capacity of the area and to reduce human wildlife conflict, about 700 km^2 area is proposed as the core zone (Fig. 1). It is very crucial that this core area is made totally inviolate. This could be achieved by compensating the people from the 21 villages and 3 settlements situated in the proposed core of the Sanctuary. The relocation will be done according to the National Tiger Conservation Authority (NTCA) norms, if people are willing. About 1600 families reside in this area (Appendix 6). It is important that the local communities are more than adequately compensated and provided alternatives for livelihood.

25. A decision to fence a large part of the reserve so as to hold a breeding population of cheetah as a source for further supplementation of the reintroduced population shall be taken only after a consensus on the issue is reached and if in the first attempt of reintroducing free ranging cheetah, an unacceptable proportion strays out of the PA. Suitable fence shall be erected on the Sanctuary boundary wherever it abuts sensitive areas for e.g. High human population, high intensity agriculture etc. The length of the boundary fence would be determined by experts of the MPFD and of the WII.

26. Raise political awareness, opinion and education regarding the ecological and economic benefits from the reintroduction of the cheetah among the local communities of the region. Forest Department of the Government of MP and suitable NGOs will be involved for this undertaking. Educational/ awareness campaigns will be undertaken in schools and villages to enhance the understanding of the local communities regarding the role and importance of the cheetah in ecosystem functions. Appropriate changes in lifestyle e.g. livestock husbandry, will be suggested to minimise conflicts between cheetah and local communities. Local communities shall be incentivized and sensitized to co-exist with wildlife, particularly predators, through proper training and communication programmes. Suitable NGOs will be involved in this task.

27. There are no known or historically recorded attacks by cheetah on humans, however, they may predate on small livestock like sheep and goats. A mechanism will be developed that will ensure that all livestock predated by cheetah will be compensated at market rates in a timely fashion so as to reduce any hostility from local communities living around the reintroduction site.

28. All dogs in the surrounding villages shall be vaccinated against rabies periodically, to prevent the contagion from reaching the cheetah and to prevent infection of the local human population. Persons bitten by dogs or jackals would be inoculated against rabies.

29. Sustainable and conservative tourism subservient to the conservation needs of the reintroduction site and of the project shall be encouraged so that jobs and business opportunities for the local people can be created and the project and Nauradehi WLS get adequate public support. An attempt to generate revenues through brand building, marketing, sponsorships, merchandising shall be made, through private partnerships, but in complete consonance with the conservation activities and prerequisites. In the 1st phase of the plan, a site specific tourism policy will be developed and implemented through appropriate Government mechanisms.

30. Local NGOs, district administration and people's representatives shall be briefed regularly about the value of the project to the local ecology and economy and their support shall be earnestly solicited. One or more reputable local NGOs, active in the rural development and conservation fields in the area, shall be encouraged and supported to develop and implement a suitable strategy for the project and for the welfare of the local communities, in order to improve its interface with the local stakeholders and to improve their quality of life.

31. Eco-development schemes will be implemented outside the reintroduction site for resettled communities to enhance their livelihood options. Revenues generated from tourism and ancillary activities should be shared with the local communities and they should be actively associated in the development of ecotourism right from the start so that they develop an economic stake in the endeavour.

Project Duration

This is proposed to be an ongoing activity after reintroduction, without an 'end-of-project' situation in sight in the foreseeable future. However, the first phase of the project is devised, for the sake of convenience alone, for a period of **five years.**

Project Costs

Approximate cost of the project is estimated to be **Rs.224 crores**. Broad estimates of cost for Phase-I (first 5 years) of the project are given in **Annexure II.** Detailed estimates shall be prepared after the project is formally approved, as proposed here. Actual expenses will vary from year to year, based on adaptive annual action plans that will be prepared, based on the progress of previous years.

Financing the Project

The entire cost of relocation, habitat management/restoration, sourcing and transportation of cheetah, fence, enclosure and housing/veterinary facility construction, monitoring and research cost, additional staff allowance, protection (equipment and logistics) shall be borne by the GoI. The State government shall provide the staff salaries and general management of the proposed area. The funding from Central government will be based on the framework and guidelines of the Project Tiger scheme of GOI.

Revenues

There is potential for earning significant revenues from the project from filming, photo documentation, merchandising, sponsorship and tourism on a competitive basis. This income shall be spent on the management of the reintroduction site as well as for assisting the local communities. A proactive approach to market the project as a brand shall be adopted to promote conservation as an economic activity, after fully ensuring that it in no way hampers the conservation interest and priorities of the project and of the reintroduction site.

Development of Tourism

The project can generate significant tourist interest which will create new opportunities for employment and businesses for the local people, besides generating revenues for the government. Therefore, proper emphasis on sustainable ecotourism in the region would be given, which will give priority to the local people in employment and which will be subservient to the long term conservation interests of the project and of the Sanctuary. The State Government will prepare a five to ten year site specific tourism policy (which will address the land-use and development of the surrounding areas as well). It will be documented separately apart from action plan for the reintroduction of cheetah in Nauradehi WLS, which would be approved by CTF. A documentation and filming policy guidelines will be drafted. Separate guidelines for news channels and for profession process documentation will be listed.

Annual Review

The progress of the project shall be reviewed every year by a committee appointed by GoI and nominated by CTF, consisting of experts, and decision makers from the state and central governments and the WII.

Tentative Time Line

Task	2012		2013					2014						2015	
	NOV	DEC	JAN	FEB	MAR	SEP	NOV	JAN	FEB	MAR	APR	MAY	DEC	MAR	DEC
Project Preparation by WII and MPFD, in Consultation with the CTF	X														
Project Approval by the GoI		X													
Disbursement of Funds to State		X													
Study Tour of Planning Team			X												
Training/ Study Tour of Implementation Team			X	X											
Relocation of Villages					X	X	X	X	X	X	X	X	X	X	
Creation of Infrastructure						X	X								
Training of Staff by CCF Ranger							X	X							
Import of Cheetahs								X							
Release of Male Cheetahs into the Wild									X						
Release of Female Cheetahs into the Wild										X	X				
Preparation of Tourism Plan									X						
Recruitment of Staff					X	X	X								
Translocation of Prey								X	X						
Fencing of Village Boundaries															X
Vaccination of Dogs													X	X	

Annexure I

Survey to Assess Prey Base, Human Disturbance Levels, Socio-Economic Status, Attitudes and Perceptions of Local People towards Wildlife

Prey Base Estimation and Human Disturbance Levels

The sampling protocol designed for monitoring tigers, co-predators, prey and their habitat (Jhala *et al.* 2009) was used for this survey. The sampling was done in the 700 km^2 proposed core area of Nauradehi WLS.

a) Prey Base Estimation:

The survey was conducted in the Sanctuary during the months of November and December 2011. To estimate population density of prey, distance sampling on systematic line transect method was used (Buckland *et al*. 2001). Fixed line transects of length ranging from 2- 3 km distributed across Nauradehi WLS were walked. A total of **49 transects** were sampled (Fig.4). Start and end locations of transects were recorded using GARMIN© 72 GPS unit. Sighting distance to the prey was measured using a laser range finder (Bushnell pro 800). All the angles were measured with a compass. The total sampling effort was **110.25 km.**

Pellet and Dung Plots:

At every 400m on the transect line and perpendicular to the transect line a 20m × 2m strip transect was laid. The entire plot was scanned for pellets and dung of all the prey species and identified to the species level. The pellets and dung pats were counted and the quantity was recorded. Pellet counts numbering less than 50 were noted as actual count, whereas for counts greater than 50 pellets were categorised as A: 50-100, B: 101- 200 and C: >200 (Jhala *et al*. 2009). All together, 247 plots were sampled.

b) Measure of Human Disturbance Levels:

A circular plot of 15m radius was laid at every 400m on the transect line. Human disturbance indicators such as wood cutting, lopping, grass/ bamboo cutting, direct and indirect signs of human and livestock presence were documented. For wood cutting and lopping, the actual count of trees with these signs in the plot was recorded. A total of 247 plots in the Sanctuary were sampled.

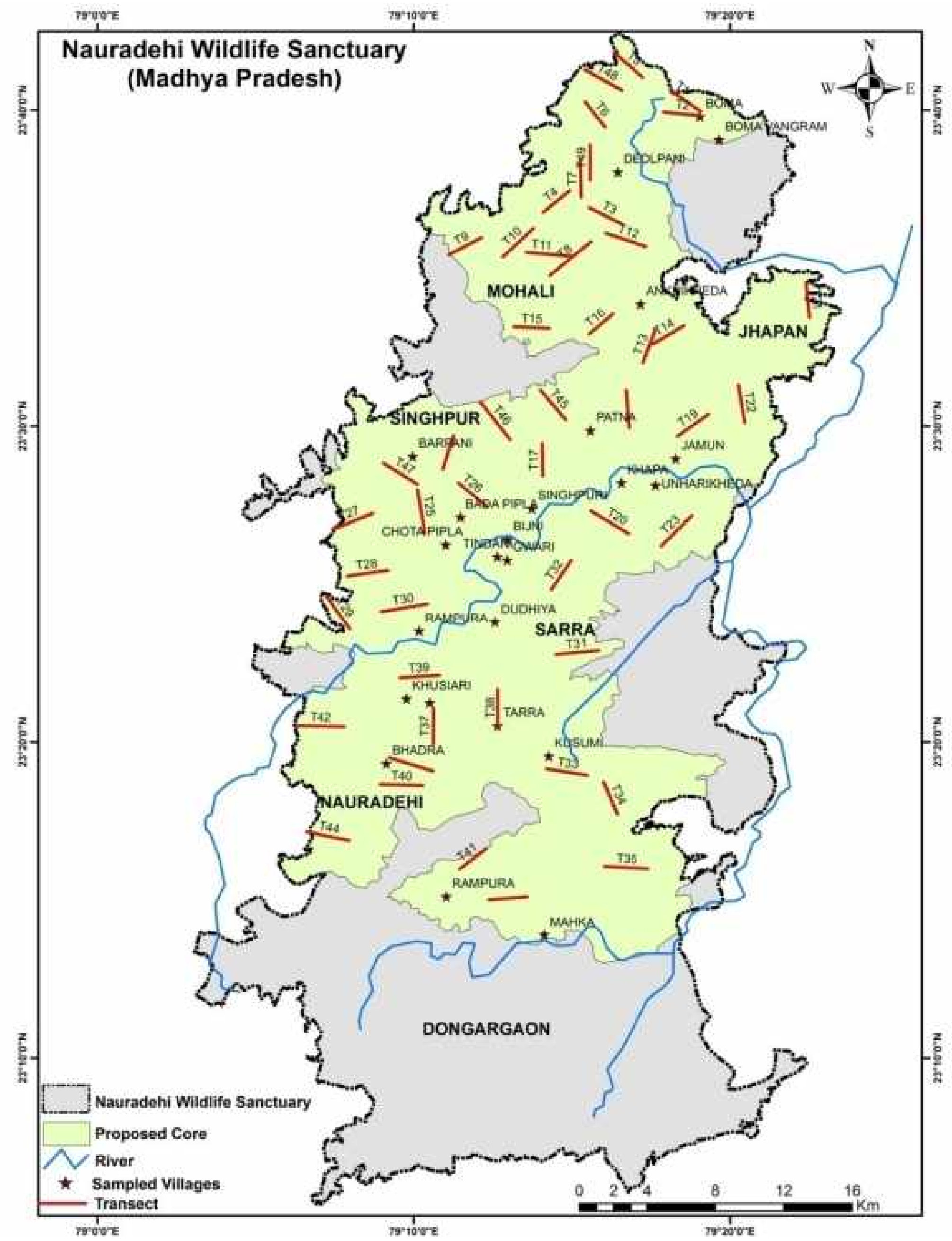
c) Survey to Assess Socio-Economic Status, Attitudes and Perceptions of the Local People towards Wildlife:

A questionnaire was used for the survey to assess the socio- economic status, attitudes and perceptions of the people living inside the proposed core area of the Sanctuary towards wildlife and forests. The questionnaire was divided into five sections as follows:

1) Demographic variables.
2) Household characteristics.

3) Livelihood and interactions with wildlife.
4) Facilities available.
5) Dependency on forest and knowledge about wildlife.

Fig. 4: The 49 transect lines sampled to measure prey base and human disturbance levels along with the 21 villages and 3 settlements surveyed to asses socio-economic status, attitudes and perceptions of local people towards wildlife in the proposed core area of Nauradehi WLS.



Interviews were conducted in a total of 52 households belonging to 21villages and 3 settlements present inside the proposed core area of the Sanctuary (Fig. 4). Respondents were randomly selected and only after obtaining their consent the interview was conducted. About 4-10% of the households in all the villages were interviewed. All the respondents were above 18 years of age. The survey was conducted during the months of November and December 2011.

Analysis

a) Prey Base Density Estimation:

Line transect data was analysed using the software DISTANCE 6.0 (Thomas *et al*. 2009).
To calculate densities, prey was categorized into six types
Categories of prey:

1) All prey: Nilgai, sambar, chinkara, wild pig, langur, rhesus macaque, peafowl and domestic cattle.
2) All prey excluding primates: Nilgai, chinkara, sambar, wild pig, peafowl and domestic cattle
3) Wild prey: Nilgai, chinkara, sambar, wild pig, langur, rhesus macaque and peafowl.
4) Wild ungulates: Nilgai, chinkara, sambar and wild pig.
5) Cheetah prey: Nilgai, chinkara, sambar, wild pig and peafowl.
6) Chinkara pooled: Chinkara sightings from 2010 and 2011 pooled together.

Prey Pellet/ Dung Density Estimation:

Based on the number of pellets and dung encountered for each prey species in the sampled strip transect, pellet/ dung densities were calculated. For observations where actual counts were not available, mid-point value for each category was used for calculating density. The density of pellets/ dung per hectare was computed.

b) Human Disturbance:

To quantify the intensity of disturbance, the number of trees cut and lopped in the circular plot were categorised into four types- low (1-2 trees cut / lopped), medium (3-5 trees cut / lopped), high (6-10 trees cut / lopped) and very high (>10 trees cut / lopped).The intensity was mapped to identify areas of disturbance.
To quantify the intensity of overall human disturbance in the proposed core area, weights were assigned for each of the disturbance types as follows:
Cut & lopped trees-
1-2 trees- **1**
3-5 trees- **2**
6-10 trees- **3**
>10 trees- **4**
People/ livestock seen- **2**
Indirect signs of people/livestock presence- **1**
Presence of grass cutting- **1**

Based on the total scores with the assigned weights, the overall intensity of disturbance was categorised into four classes- Very high (score: >9), high (score: 5-8), medium (score: 3&4) and low (score :< 3). The intensity of overall disturbance in the proposed core area was mapped.

c) Socio-Economic Status, Attitudes and Perceptions of Local People towards Wildlife:

The responses to the questionnaire about the demographic variables, household characteristics and facilities available were used to assess the socio-economic status of the local people in the area. The perception and attitude towards wildlife were evaluated by the responses about bushmeat consumption, trapping, possession of weapons, crop and livestock depredation and the preventive measures employed were used to assess the threat to wildlife by the communities. The responses about preventive measures taken by the locals against crop and livestock depredation also help to identify the conflict areas and thus develop a management strategy accordingly.

Results

a) Prey Density Estimates:

The density of all prey species in the proposed core area of Nauradehi WLS is **43.35/ km^2 ± 9.16**.The density of all prey species excluding primates is **24.87/km^2 ± 6.52**.The density of wild prey species is **29.02/km^2 ± 7.24**.The density of wild ungulate species is **8.5/km^2 ± 2.05**. The density of cheetah prey species is **8.58/km^2 ± 1.99**. Chinkara pooled (2010 & 2011) density in the proposed area is **1.34/km^2 ± 0.35**.
Nilgai is the most common ungulate followed by chinkara, sambar and wildpig. Chital was not sighted during transect walks. Chowsingha and blackbuck is reported from the area but was not encountered during sampling. The summary of the prey density model parameters are shown in Appendix 1 and the detection function curves are shown in Appendix 2.

Pellet Density:

The pellet density of all wild herbivores is **10774/ha ± 1472**. Nilgai pellets accounted for more than half **(51%)** of the pellets observed, whereas chital and chinkara accounted for **35%** of the pellets seen. Nilgai pellets had the highest density **(6005/ha ± 1027)** followed by chinkara **(3416/ha ± 766)**, cattle **(798/ha ± 52)** and chital **(755/ha ± 211)** (Appendix 3). Cattle dung was encountered in majority **(83%)** of the plots, which suggests that the pressure of livestock grazing is very high inside the Sanctuary.

b) Human Disturbance:

In almost all the plots **(98%)**, signs of anthropogenic disturbances such as lopping or wood cutting or grass cutting or presence of human/ livestock were found (Appendix 4.1), implying that the area is heavily disturbed (Fig.5). Signs of woodcutting were observed in 211 plots **(85%)** (Fig.6) (Appendix 4.2). Signs of tree lopping were seen in 164 plots **(66%)**, (Appendix

4.3) and grass cutting in 1 plot (Table 1) (Figs. 7 & 8). Evidences of presence of human/ livestock were detected in 196 plots **(79%)** (Fig.9). People were encountered in 16 plots and livestock was seen in 34 plots (Figs. 10 & 11).

Table 1: Intensity of human disturbance in the proposed core area of Nauradehi WLS

Human Disturbance	**Number of Plots**				**Total**
	Very High	High	Medium	Low	
Wood Cutting	**10**	**44**	74	83	211
Lopping	**5**	**21**	51	87	164
Grass/ Bamboo Cutting	**-**	**-**	-	1	1
Overall Disturbance	**8**	**73**	104	57	242

Fig. 5: Plots with presence of human disturbances in the proposed core area of Nauradehi WLS

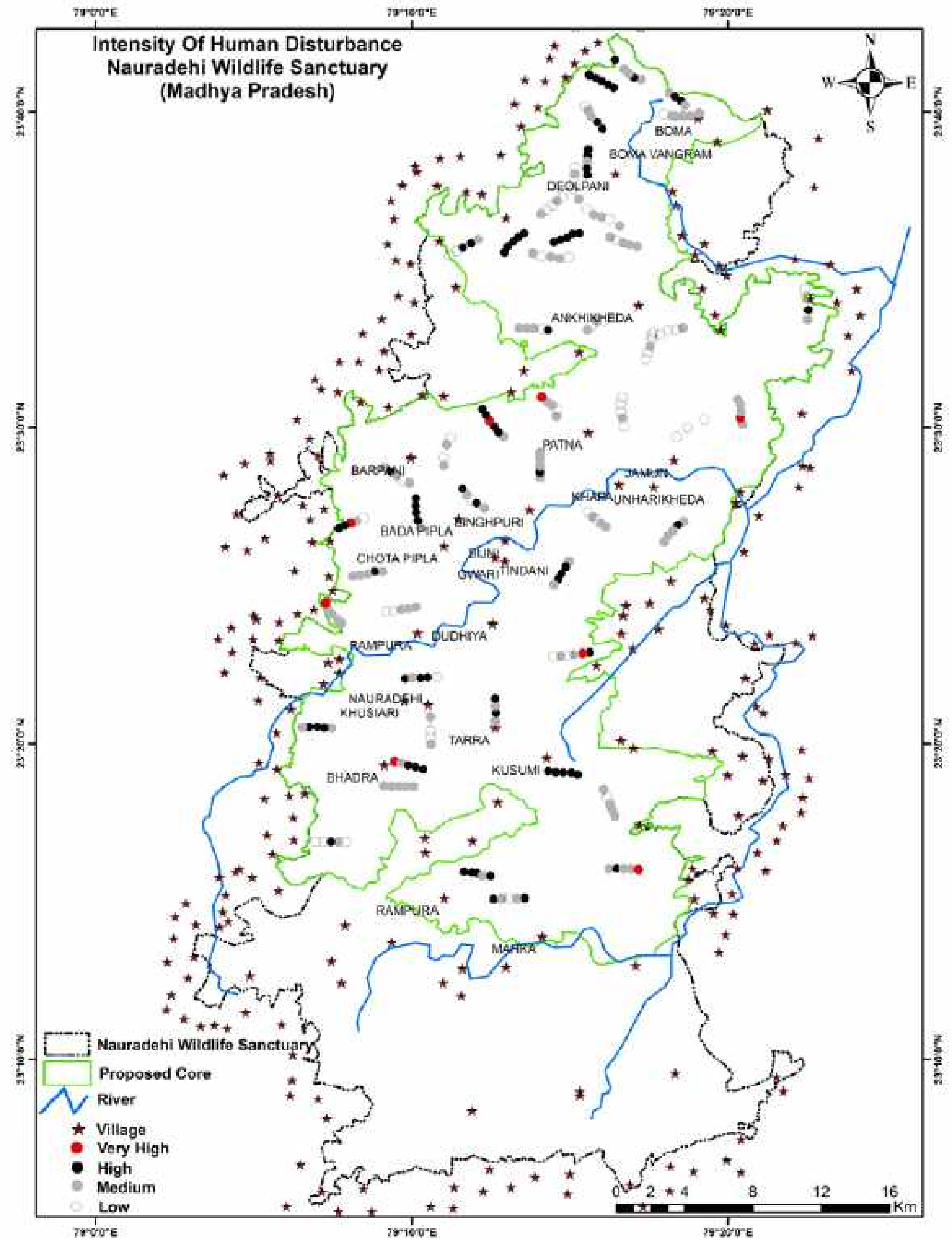


Fig. 6: Plots with presence of woodcutting in the proposed core area of Nauradehi WLS

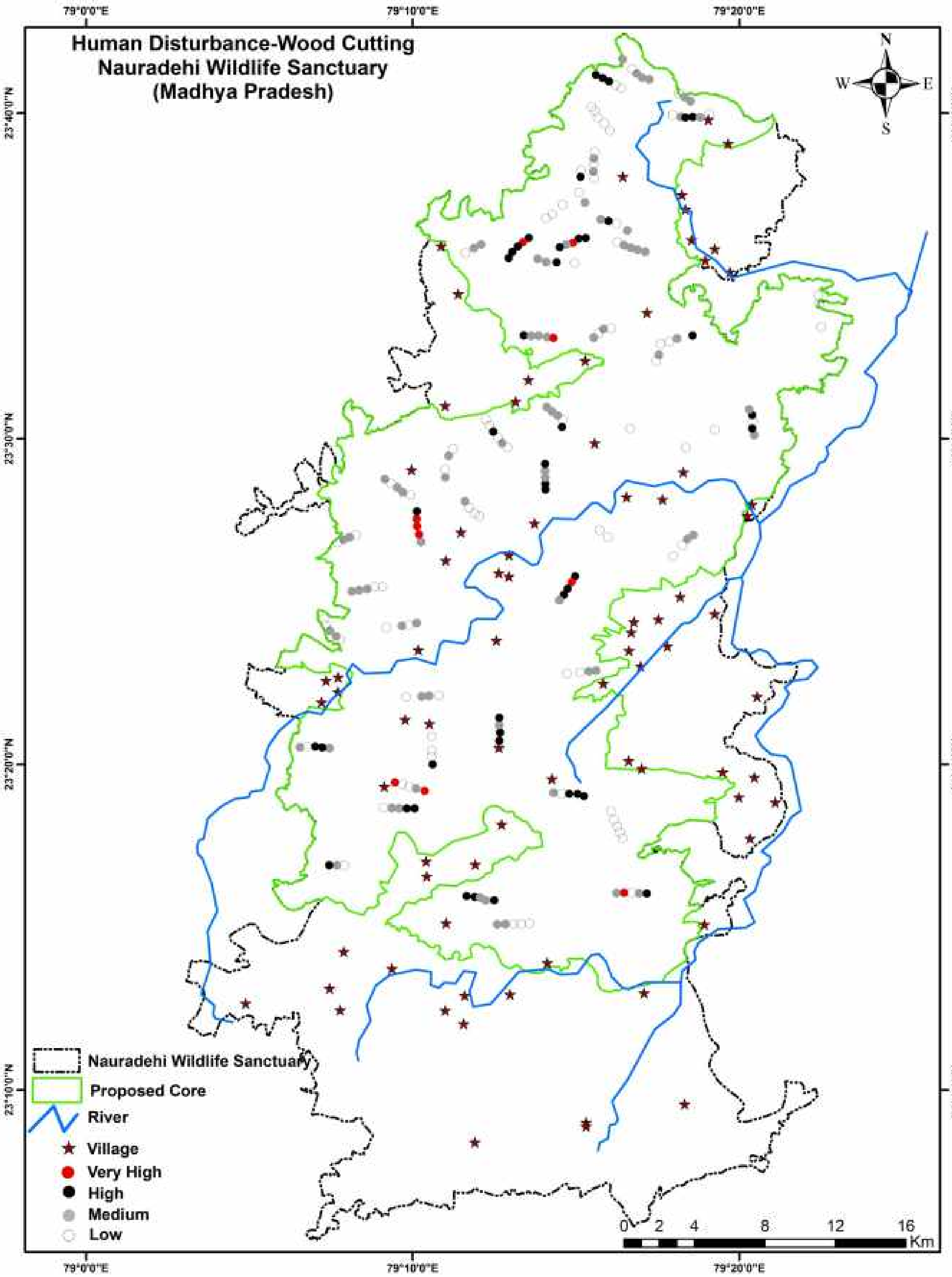


Fig. 7: Plots with presence of tree lopping in the proposed core area of Nauradehi WLS

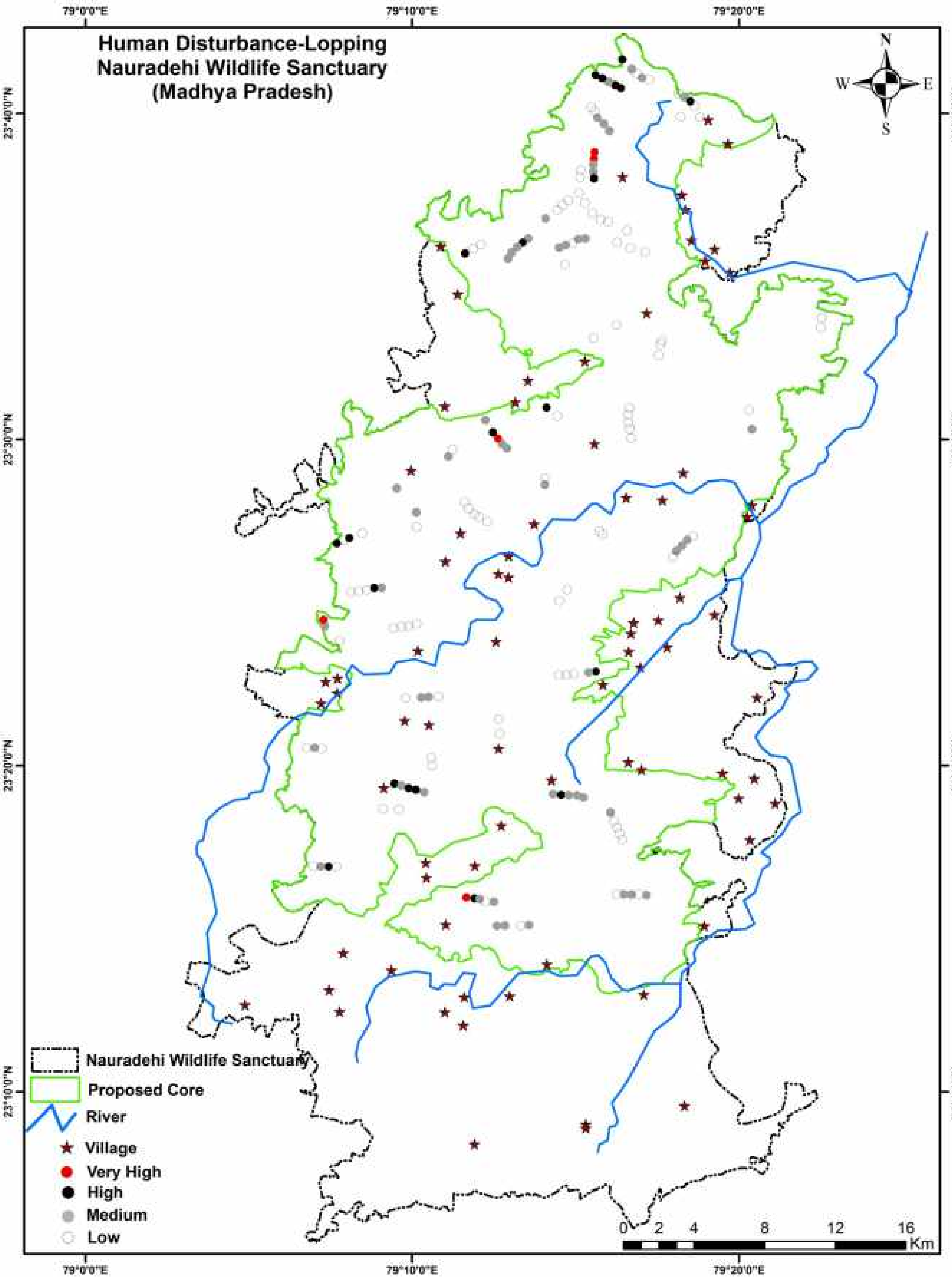


Fig. 8: Plots with presence of grass cutting in the proposed core area of Nauradehi WLS

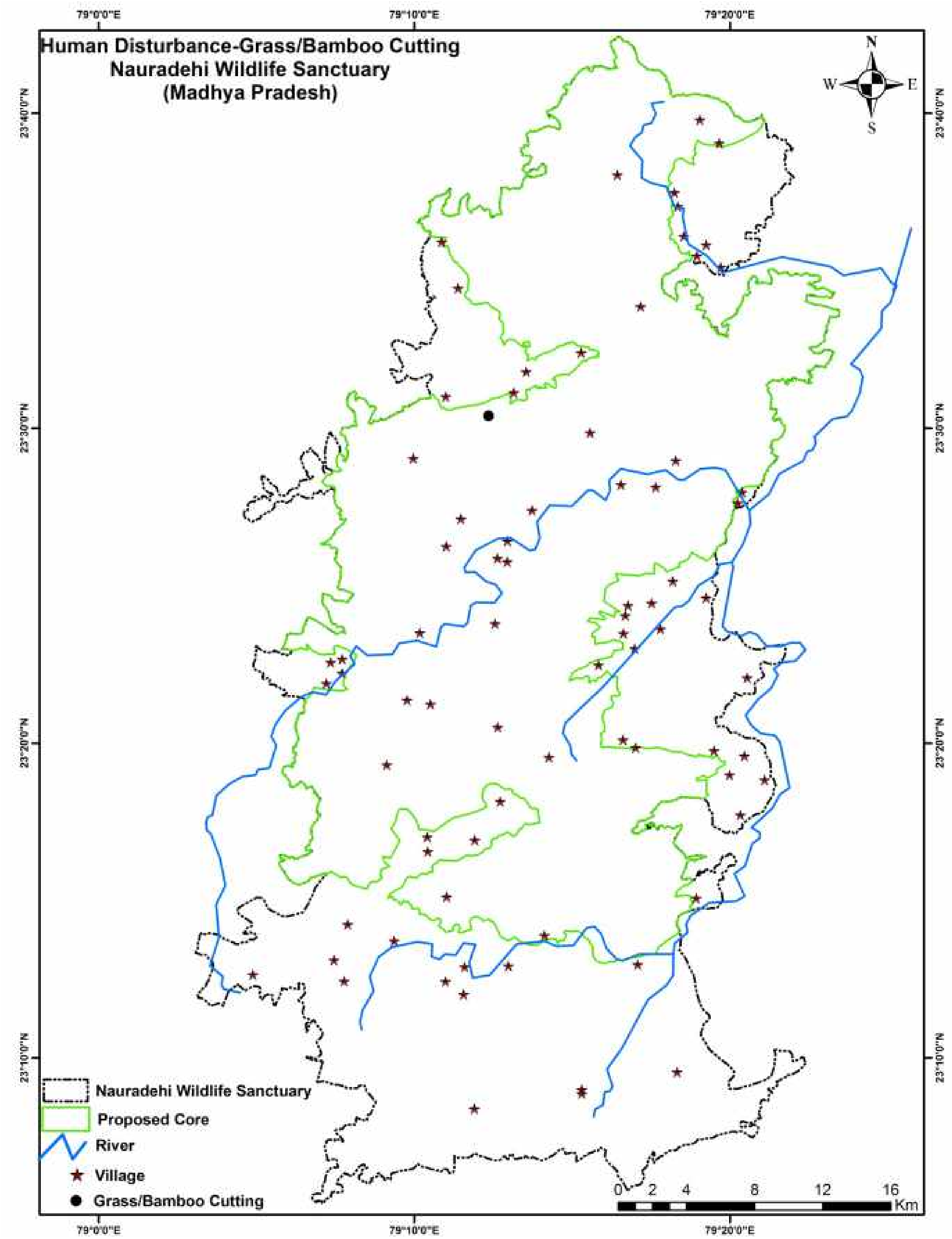


Fig. 9: Plots with presence of human/ livestock trail in the proposed core area of Nauradehi WLS

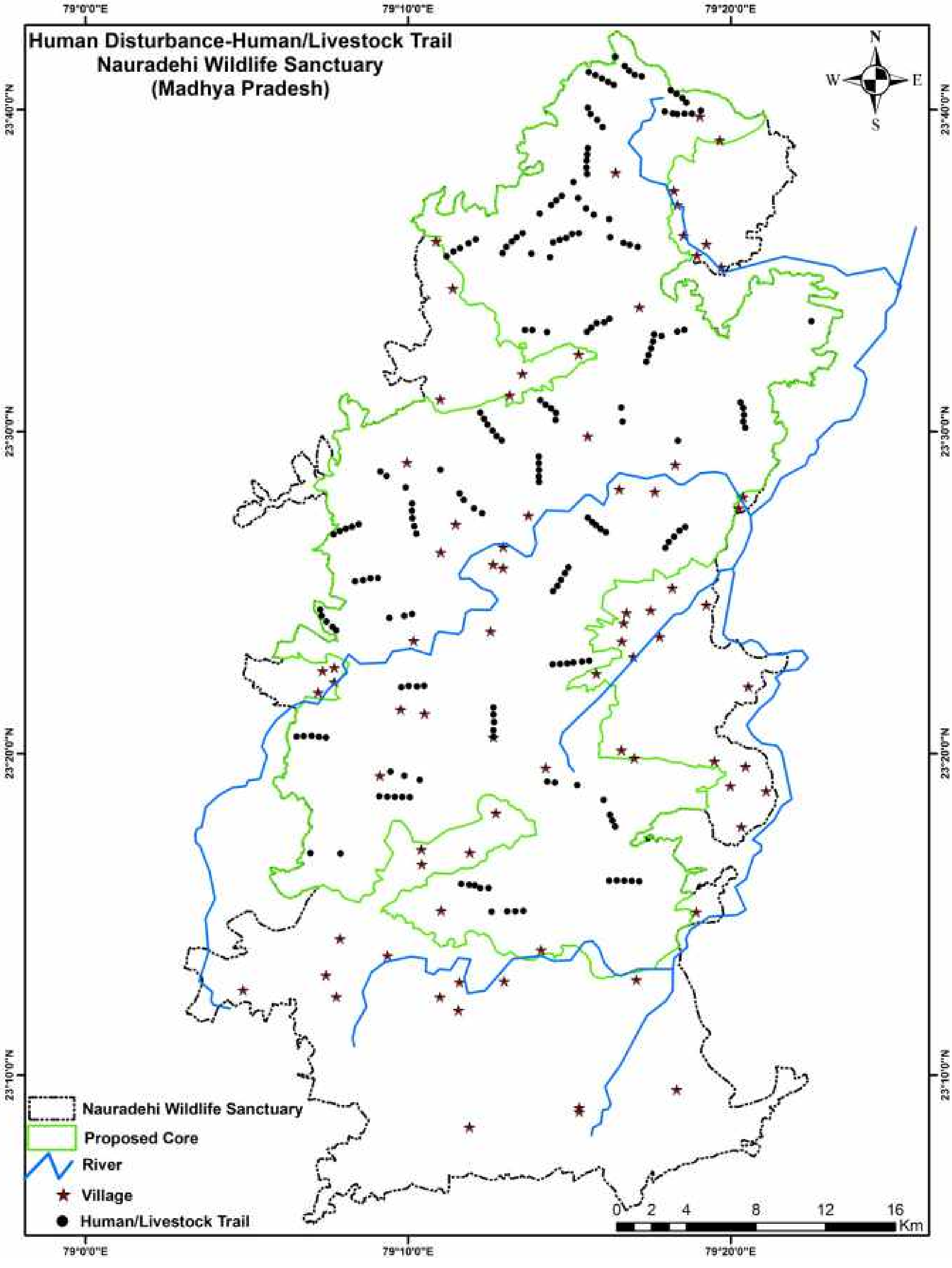


Fig. 10: Plots where people were seen in the proposed core area of Nauradehi WLS

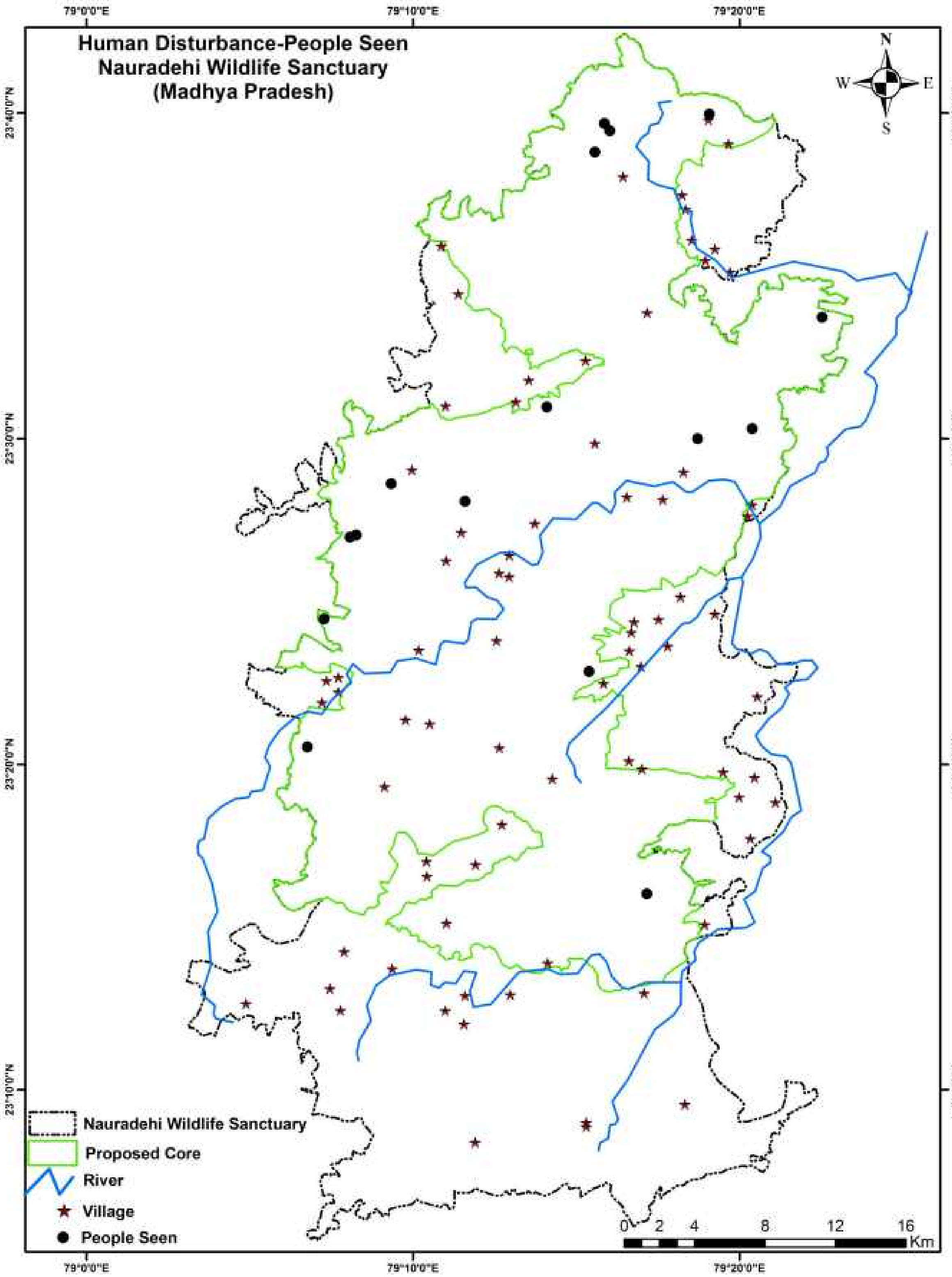
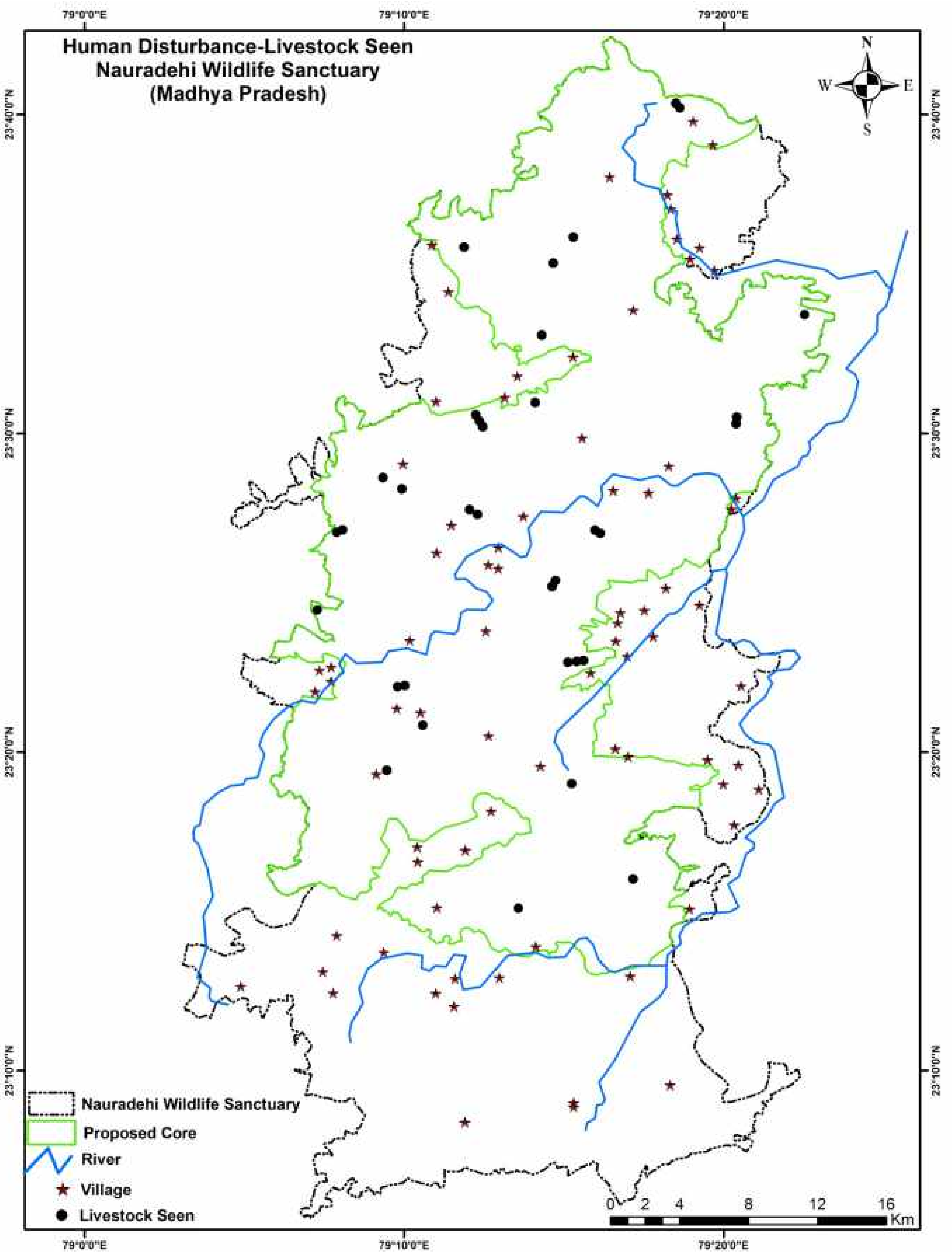


Fig. 11: Plots where livestock were seen in the proposed core area of Nauradehi WLS



c) Socio-Economic Status:

In the surveyed villages, the number of households varied from 11 to a maximum of 178 (major villages are six). Among the 52 respondents, 50 were males and 2 were females with nearly half of them (48%) in the age group of 21-38 years. The age class distribution of the sampled population is shown in Appendix 5.1. People of both Hindu and Muslim communities reside in the area. The predominant castes are the Gond tribe and the Yadavs. The other castes who inhabit the area are Gwaliya, Lodhi, Basudev, Choudhary, and Harijan. Gwaliya belong to the Muslim community and reside only in two villages, Pipla and Kushiyari.

Majority of the surveyed population (88%) owned semi-*pucca* house and the rest reside in *kutcha* house. The average size of the family is 7.5 people, with a minimum of two members in a family to a maximum of 17 people in a family. Many of the interviewees (87%) reported that their families have lived in their respective villages for more than 3 generations.

Nearly half of the surveyed population (44%) is illiterate. Only four respondents were Matriculation pass and two respondents are pursuing higher education. Majority (77%) of the sampled populace had children in the family enrolled in school. 19 out of the surveyed 21 villages and 3 settlements have at least a primary school situated in the village.

Only two villages, Patna and Barpani had electricity connection, although a good number (69%) among the surveyed population used solar powered lights in their house provided by the local administration. Almost half of the respondents (48%) owned mobile phone. Most of the interviewees (77%) used bicycle as their mode of transportation.

For drinking purpose, more than half (62%) of the respondents used water from the hand-pump, whereas the rest of them sourced it from open well (19%) and river/stream (12%). Only two respondents owned open well. The villages where respondents were solely dependent on river/stream for drinking water were Jamun, Unharikheda, Kusumi, Tindani and Khapa. For cooking purposes, all the respondents used wood collected from the forest. More than half of the respondents (56%) also used dried dung cakes apart from firewood for this purpose. People consume meat in all the surveyed villages, as stated by the respondents (94%).The types of meat eaten are chicken (81%), fish (79%), bushmeat (48%) and goat (17%), (Appendix 5.9).

Livelihood:

The main livelihood of the people in this area is agriculture. Almost all (94%) the respondents are agriculturists with additional source of income from either daily wages or pastoralism or Non-Timber Forest Produce (NTFP) collection or government service. The distribution of source of livelihood of the respondents is shown in **Appendix 5.2**.
Most (90%) of the interviewees own arable land and the land size varied from 0.5 to 13 acres (mean=4.6 acres). Agriculturists irrigate their land from river/ stream (41%), open well (20%), open well and river/ stream (16%) and pond/lake (4%), whereas 8% are solely dependent on rain water. Majority of the agriculturists (88%) use chemical fertilizers and nearly half of them (45%) use tractor to till their fields. The chief crops grown in the area are

rice, wheat, maize, Bengal gram, soya bean, pigeon pea and black gram. More than half of the agriculturists interviewed (55%) sold their produce in the market.

Nearly everyone (98%) among the surveyed populace owned livestock. The livestock primarily consisted of cattle, buffalo and goat. The average possession of livestock per family was 8 animals, based on the responses. More than half (55%) of the respondents who owned livestock sold dairy products such as milk, ghee, buttermilk and *khoya*, whereas a small proportion (14%) of them also sold livestock.

Majority of the respondents (77%) have no knowledge of making crafts. 22% were adept at making cots, *beedis*, ploughs, mud tiles, and wooden tools. Only a small percentage (4%) of these craftsmen sold their products. A significant proportion (77%) of the interviewees collect NTFP such as bel fruits, mahua flowers and fruits, tendu leaves, amla fruits, and gum from *Sterculia urens.* These products are either purchased by local agents or by the forest department. Many of the respondents (73%) also work as labourers for daily wages apart from their primary occupation. They travel to places as far away as Gujarat, Delhi and Chandigarh for work.

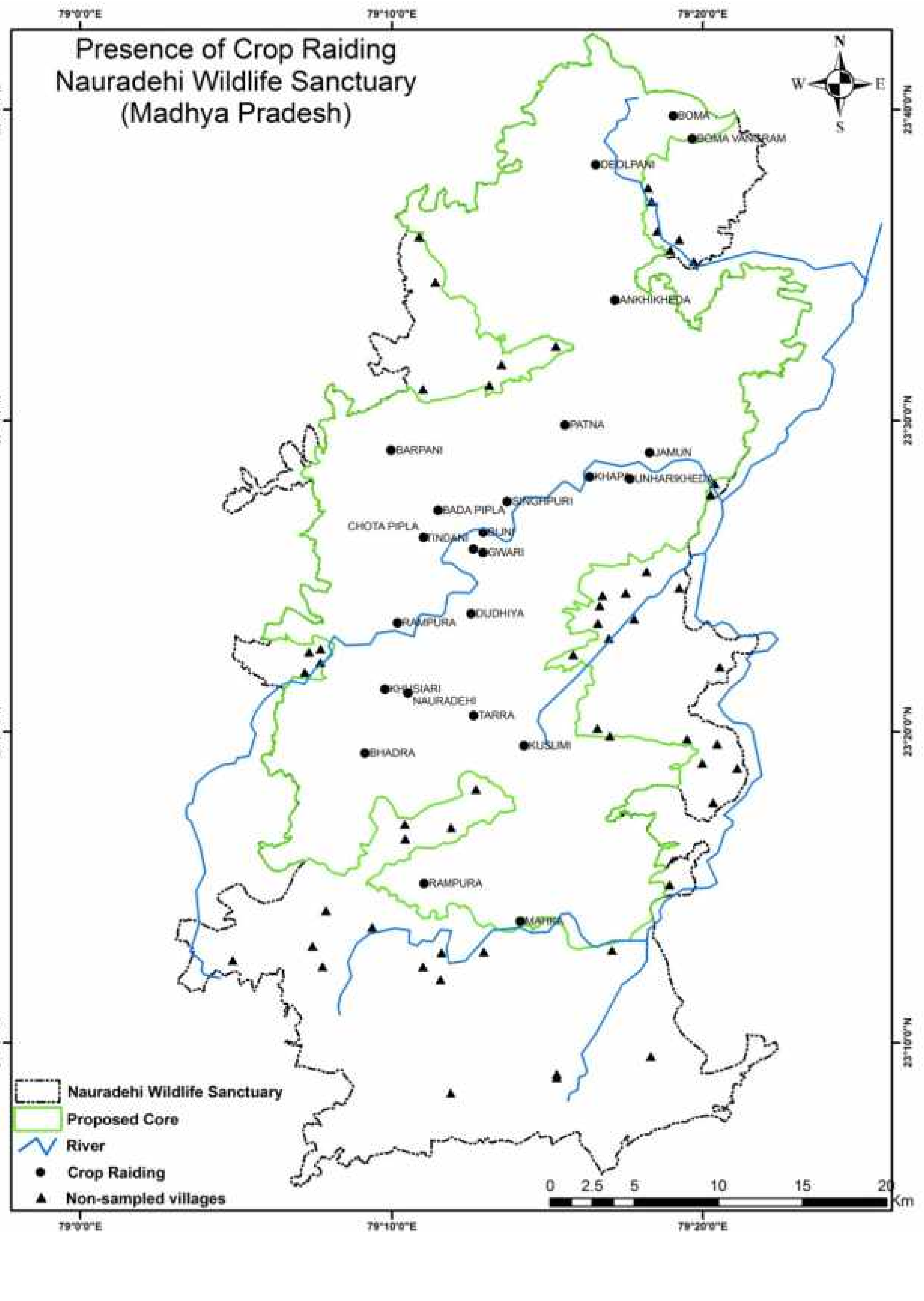
Perception and attitude towards wildlife;

Conflict with wildlife- The responses for crop depredation, livestock depredation, trapping/ snaring, presence of weapons and bushmeat consumption are quantified as follows,

Crop Depredation- Crop damage by wild animals is quite rampant in the area. Majority (98%) of the agriculturists answered in affirmative for the problem of crop raiding (Appendix 5.3). Crop depredation is prevalent in all the surveyed villages (Fig.12). According to the respondents, the species chiefly responsible for crop raiding were wild pig (94%) followed by chital (67%) and nilgai (67%).The other species responsible were sambar, gray langur, rhesus macaque, chinkara, Indian hare and jackal (Appendix 5.4).

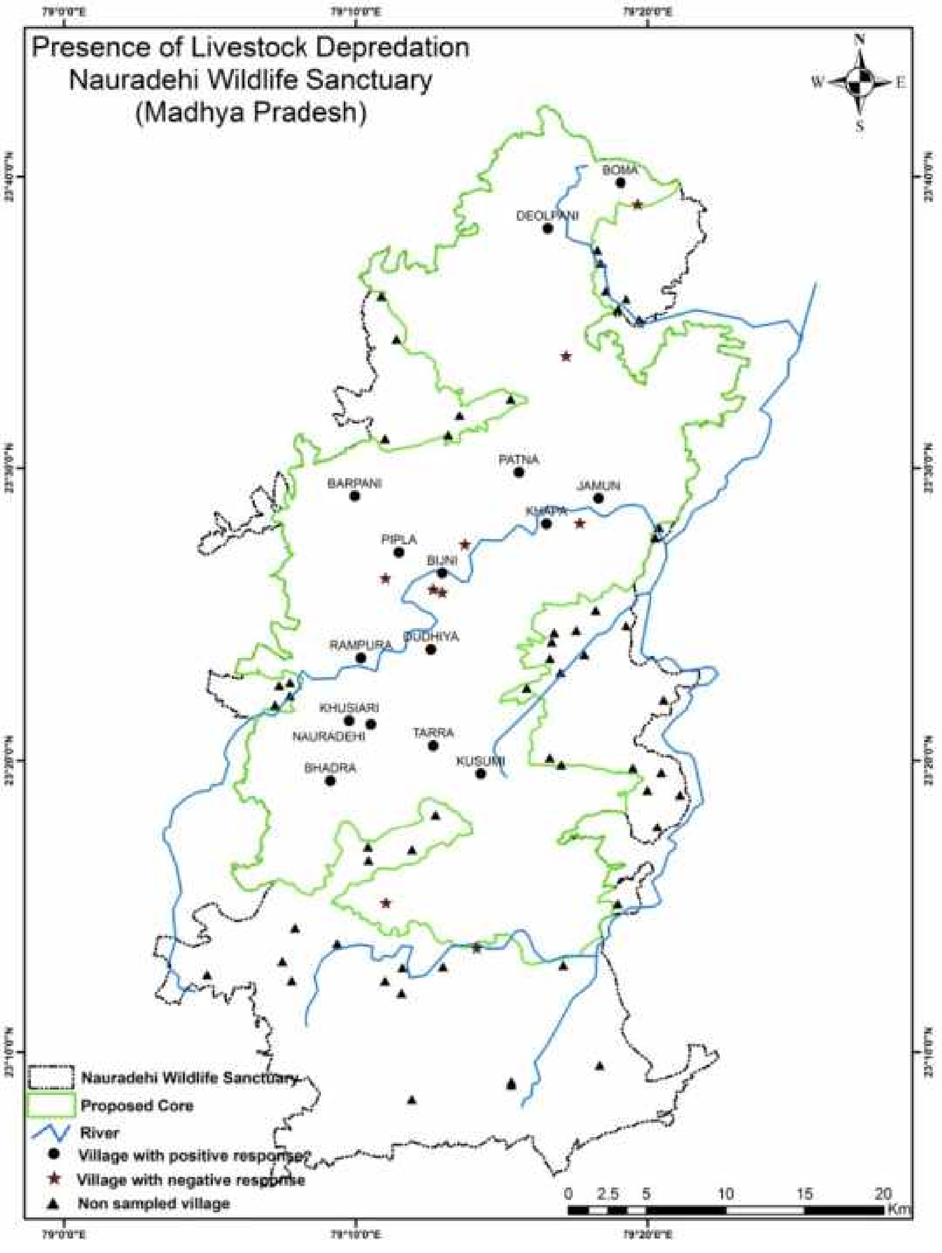
All the respondents who faced crop raiding issues took measures to control them. To reduce crop depredation, all the respondents stated that a person from the family would guard their fields day and night. The other methods included using dogs, scarecrows, fencing to protect crops as well as using traps and snares to catch problem animals. In Bijni village, country-made explosives were used to scare away crop raiding animals.

Fig. 12: Surveyed villages in the proposed core area of Nauradehi WLS with presence of crop raiding by wild animals according to respondents



Livestock Depredation- In the survey, nearly half (47%) of the livestock owners reported losing livestock to carnivores (Appendix 5.5). Mostly cows (92%) were preyed upon (Appendix 5.6). 14% of the livestock lost were cattle calves. According to respondents, most of the attacks on livestock were by wolves (54%). The other carnivores responsible for livestock depredation were tiger, wild dog, crocodile, sloth bear and leopard (Appendix 5.7). This was reported in 16 villages (Fig.13).

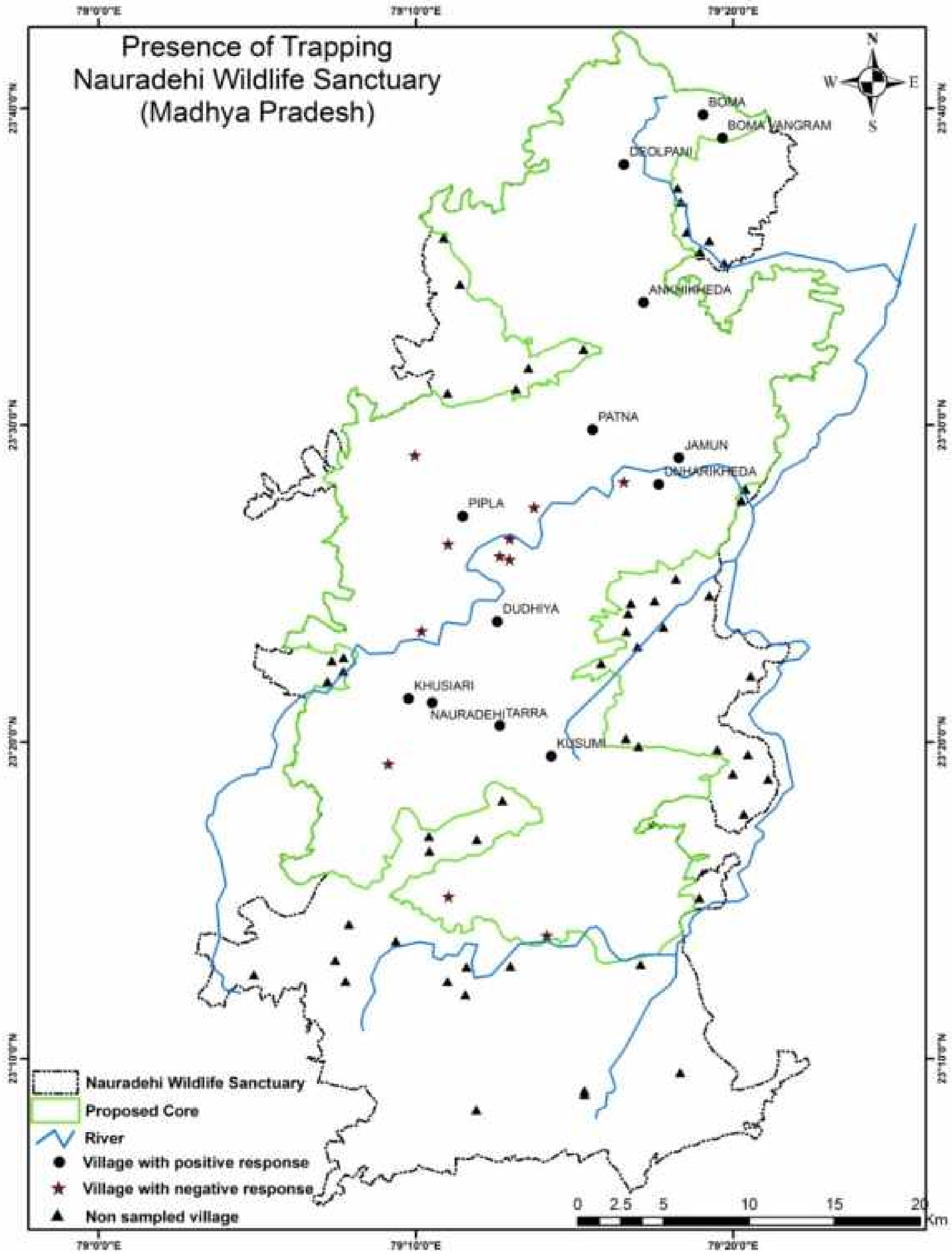
Fig. 13: Surveyed villages in the proposed core area of Nauradehi WLS where respondents have lost livestock to carnivores



Many of the livestock owners (71%) answered that neither they nor people in the village took any measures to control livestock depredation. However, a small proportion of the respondents (22%) do employ methods such as self- guarding, fencing and using dogs for guarding. In Boma village, people occasionally trap or snare the problem animals.

All the livestock owners house their animals in their yards. The livestock is housed in roofed wooden enclosures. Dogs are used for guarding (39%). Majority (75%) of the livestock owners mentioned that the animals are usually let off in the morning for grazing in the forest without a herder accompanying them.

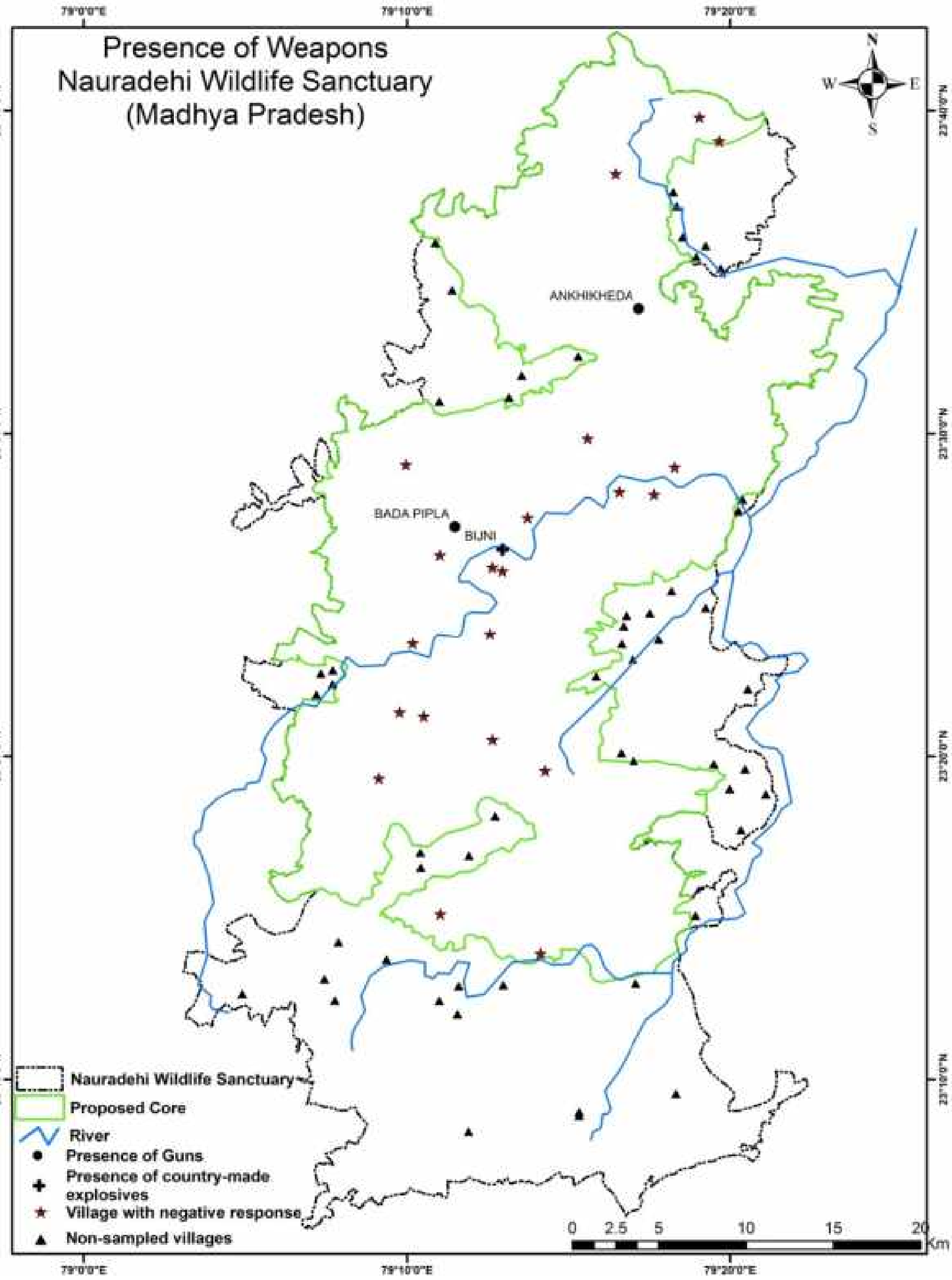
Fig. 14: Surveyed villages in the proposed core area of Nauradehi WLS where people trap/ snare wild animals according to respondents



Trapping/ Snaring- As a measure to control crop damage or livestock depredation or for bush meat, 40% of the respondents reported that either them or the people in the village trapped or snared wild animals (Appendix 5.8). According to the interviewees, presence of trapping or snaring is reported in 14 villages (Fig.14). A few of the respondents also mentioned that people of the nomadic Nat caste come to the area and trap wild animals.

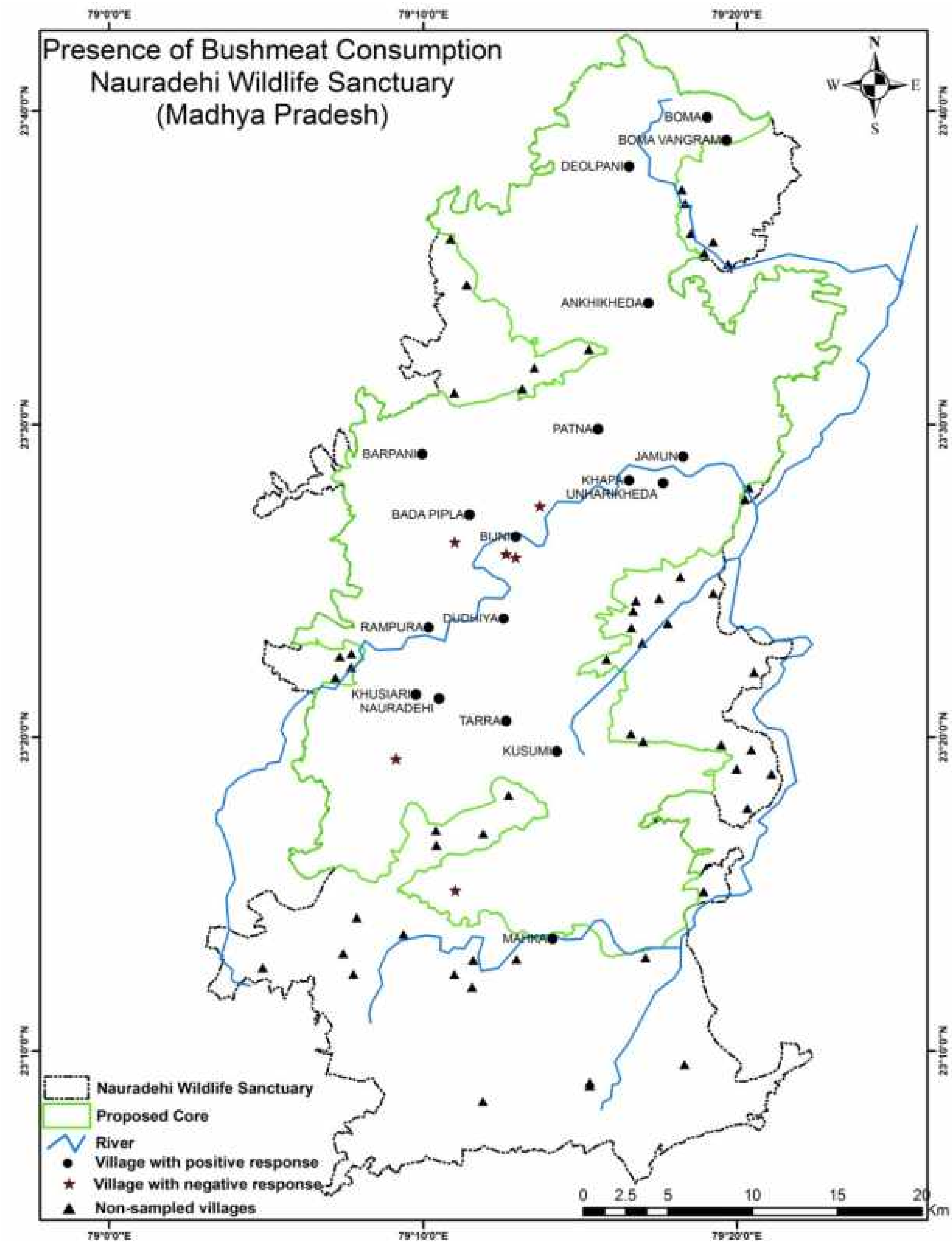
Presence of weapons- According to respondents, people in two villages- Ankhikheda and Pipla owned guns. As a measure to deter wild animals from crop raiding in Bijni village, people used country-made explosives (Fig.15).

Fig. 15: Surveyed villages in the proposed core area of Nauradehi WLS where people own weapons according to respondents



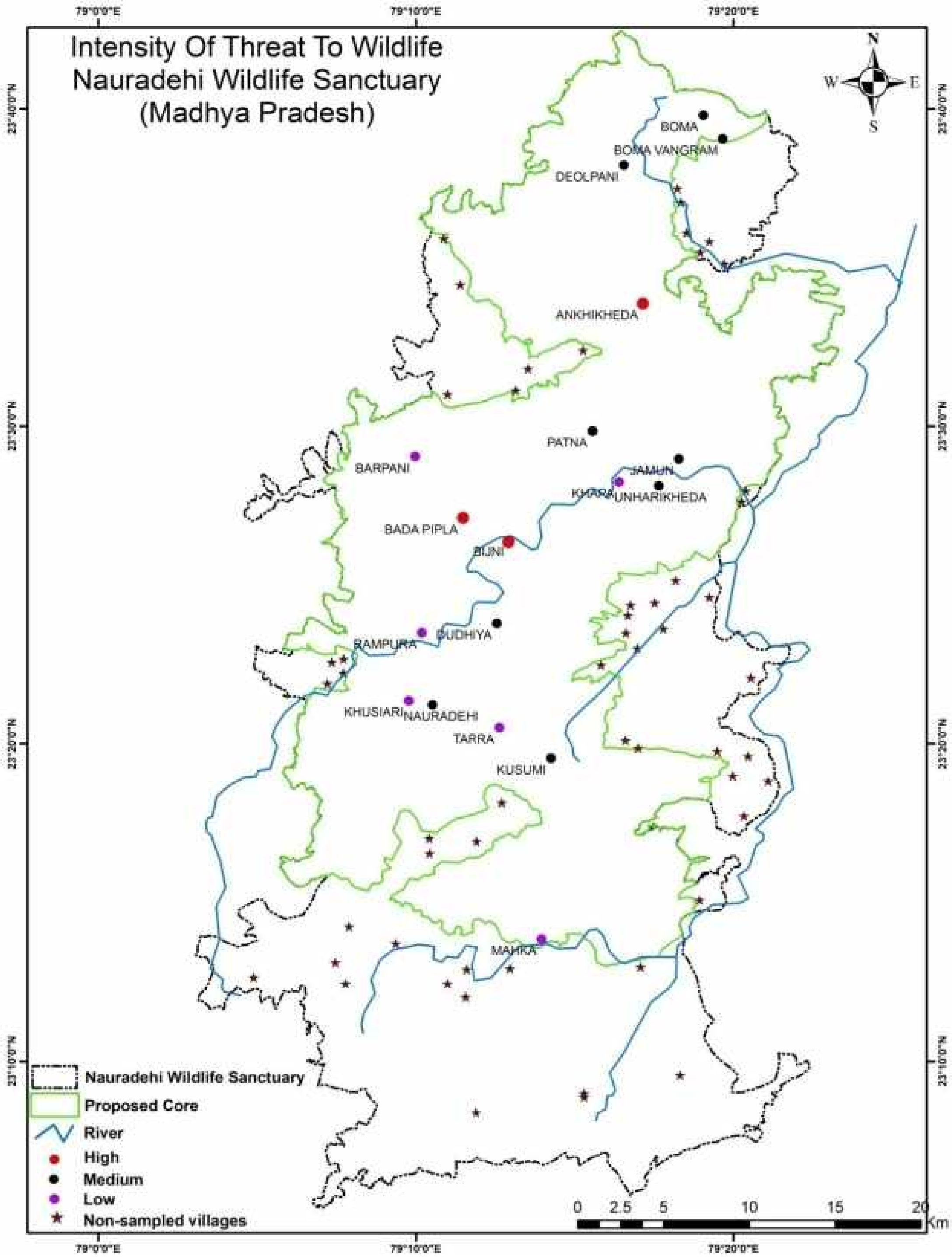
Bushmeat consumption- Nearly half the respondents (48%) reported that either they or people in the village eat bushmeat (Appendix 5.10). The respondents who answered in affirmative belonged to18 villages out of the sampled 24 settlements (Fig.16).According to the respondents, the types of bushmeat consumed are wild pig (68%), hare (40%), chital (32%), francolin (32%), sambar, quail, chinkara and peafowl (Appendix 5.11).

Fig. 16: Surveyed villages in the proposed core area of Nauradehi WLS where people consume bushmeat according to respondents



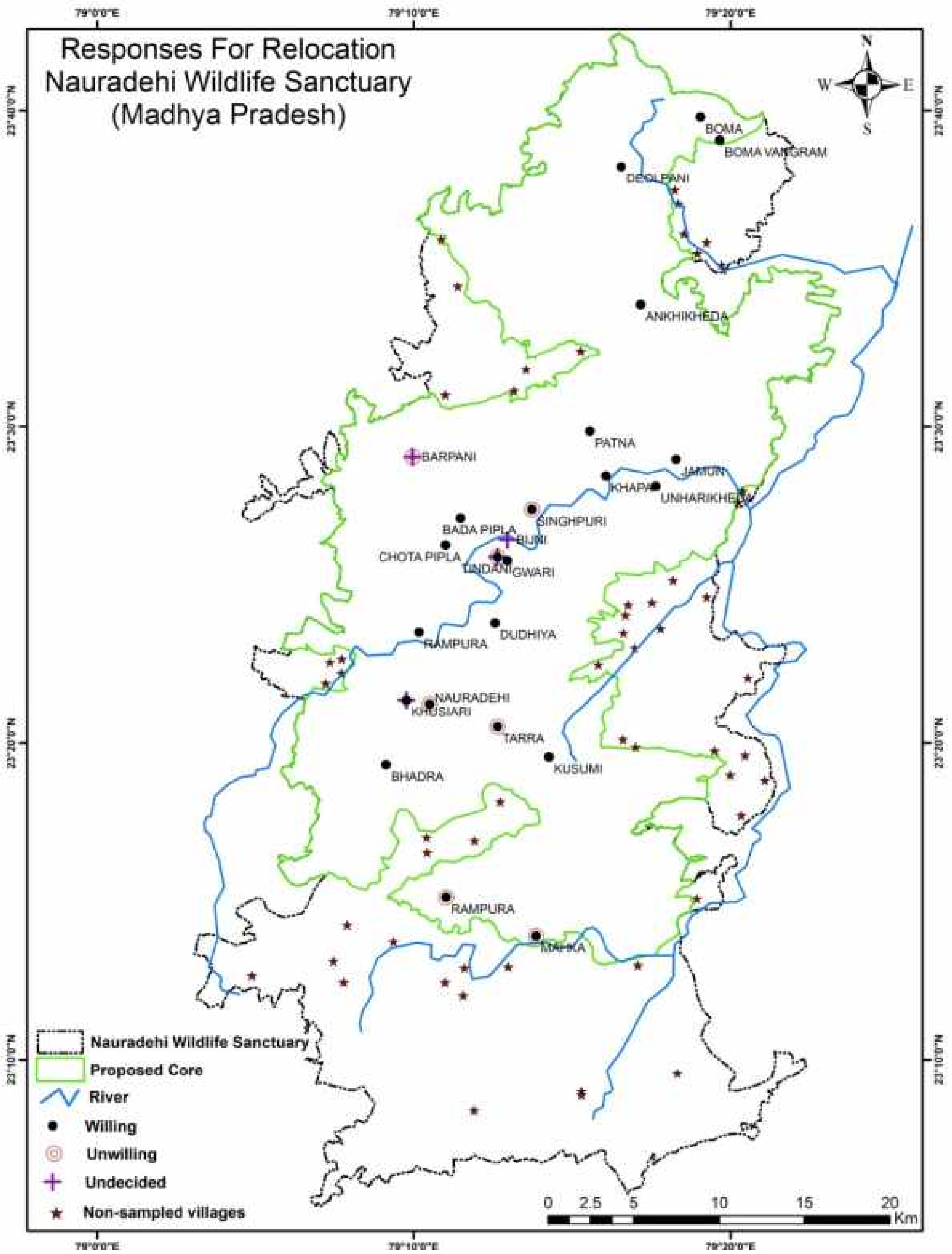
Based on the responses for presence of weapons, affirmative consumption of bushmeat and occurrence of snaring and trapping, threat perception was computed as low, medium and high (Fig.17). According to the respondents in three villages- Pipla, Ankhikheda and Bijni, people possess weapons, trap wild animals and consume bushmeat.

Fig. 17: Surveyed villages which were perceived as threat to park management due to their habit of poaching wildlife for subsistence consumption



Willingness to Relocate- For want of better facilities, job opportunities and livelihood options, majority (75%) of the respondents were willing to relocate. Of the total sample, only a small proportion (13%) answered in negative, whereas the rest of them (10%) were unsure about relocation (Appendix 5.12).

Fig. 18: Willingness for relocation in the villages surveyed in the proposed core area of Nauradehi WLS



Literature Cited

- Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L. (2001). Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York.
- Champion, H.G. and Seth, S.K. (1968). A revised survey of the forest types of India, Manager of publications, Government of India, New Delhi.
- Charruau, P., Fernandes, C., Orozco-Terwengel, P., Peters, J., Hunter, L., Ziaie, H., Jourabchian, A. Jowkar, H., Schaller, G., Ostrowski, S., Vercammen, P., Grange, T., Schlotterer, C., Kotze, A., Geigl, E. M., Walzer, C. and Burger, P. A. (2011). Phylogeography, genetic structure and population divergence time of cheetahs in Africa and Asia: evidence for long-term geographic isolates. Molecular Ecology, 20: 706-724. doi:10.1111/j.1365-294X.2010.04986.x
- Cheetah Conservation Fund- http://www.cheetah.org/
- Divyabhanusinh (2006). The End of a trail- The cheetah in India. 3rd ed., Oxford Publishing House.
- Durant, S., Marker, L., Purchase, N., Belbachir, F., Hunter, L., Packer, C., Breitenmoser- Wursten, C., Sogbohossou, E. andBauer, H. (2008). *Acinonyx jubatus* In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2<www.iucnredlist. org>
- Hunter, L., Jowkar, H. Ziaie, H., Schaller, G., Balme, G., Walzer, C., Ostrowski,S., Zahler,P., Schaurre,N. and Kashiri.K. (2007).Conserving the Asiatic cheetah in Iran: Launching the first radio-telemetry study. Cat News 46:8-11.
- International Fund for Animal Welfare (IFAW), Panthera, IUCN/SSC Canid Specialist Group, IUCN/SSC Cat Specialist Group and Wildlife Conservation Society (2011). A report: The fading call of the wild - A status update on 15 species of disappearing wild cats and canids.
- IUCN (1998). Guidelines for Re-introductions. Prepared by the IUCN/SSC Re-introduction Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. 10 pp
- Jhala, Y.V., Quereshi, Q., Gopal, R. and Amin, R. (2009). Field Guide: Monitoring tigers, co-predators, prey and their habitats. Third ed. Technical Publication of National Tiger Conservation Authority, New Delhi and the Wildlife Institute of India, Dehradun.

- Jhala, Y.V., Quereshi, Q., Gopal, R. and Sinha, P.R. (2011) Status of the tigers, co-predators and prey in India, 2010. National Tiger Conservation Authority, Govt. of India and Wildlife Institute of India, Dehradun. TR 2011/003 pp-302.
- Jowkar, H., Hunter, L., Ziaie, H., Marker, L., Breitenmoser-Wursten, C. and Durant, S. (2008). *Acinonyx jubatus ssp. venaticus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2.<www.iucnredlist.org>
- Marker, L. (2002). Aspects of cheetah (*Acinonyx jubatus*) biology, ecology and conservation strategies on Namibian farmlands. PhD. Thesis, Department of Zoology, University of Oxford.
- Ranjitsinh, M. K. And Jhala, Y. V. (2010). Assessing the potential for reintroducing the cheetah in India. Wildlife Trust of India, Noida and Wildlife Institute of India, Dehradun, TR2010/001.
- Rodgers, W.A., Panwar, H.S. and Mathur, V.B. (2002). Wildlife Protected Area network in India: A review (Executive summary). Wildlife Institute of India, Dehradun.
- Shukla, A. (2007). Management plan for Noradehi Sanctuary: For the period 2007-08 to 2016-17, Forest Department, Government of Madhya Pradesh.
- Smith, D. W. and Bangs, E. E. (2009) Reintroduction of wolves to Yellowstone National Park: History, values and ecosystem restoration. Pages 92-125 in Hayward, M.W and Somers, M.J. (Eds.) Reintroduction of top-order predators. ZSL and Blackwell Publishing Ltd. West Sussex U.K.

Appendix 1

Summary of Prey Species Abundance Estimation Model Parameters in DISTANCE

Category	**All Prey**	**All Prey excluding primates**	**Wild Prey**	**Wild Ungulates**	**Cheetah Prey**	**Chinkara (pooled data of 2010-2011)**
Number of spatial replicates	49	49	49	49	49	85
Number of observations (n)	93	64	77	43	45	24
Effort (L) km	110.25	110.25	110.25	110.25	110.25	208.65
Density (D_i) / km^2 ± Standard Error (S.E)	**43.35± 9.16**	**24.87± 6.52**	**29.02± 7.24**	**8.5± 2.05**	**8.58± 1.99**	**1.34± 0.35**
D_i Coefficient of Variation (% CV)	21.12	26.21	24.96	24.13	23.28	25.79
Group Density(D_s)/km^2 ± S.E	7.89± 1.3	5.46± 0.83	7.09± 1.54	4.75± 1.06	4.89± 1.05	0.77± 0.18
D_s Coefficient of Variation (% CV)	16.48	15.2	21.69	22.38	21.51	23.32
Probability of Detection (p)	0.42	0.44	0.27	0.34	0.33	0.54
Goodness of Fit (Chi-p)	0.91	0.98	0.93	0.9	0.94	0.93
Effective Strip Width (ESW) m	53.45	52.76	49.23	41.08	41.77	75.16
Group Encounter rate (n/L)	0.84	0.58	0.7	0.39	0.41	0.12
AIC value	256.18	217.56	200.92	133.68	146.37	64.56
Model	Uniform	Hazard	Hazard rate	Half normal	Half normal	Uniform
Model adjustment term	Cosine	Cosine	Cosine	Cosine	Cosine	Cosine

Categories of prey-

All prey: Nilgai, sambar, chinkara, wild pig, langur, rhesus macaque, peafowl and domestic cattle.

All prey excluding primates: Nilgai, chinkara, sambar, wild pig, peafowl and domestic cattle

Wild prey: Nilgai, chinkara, sambar, wild pig, langur, rhesus macaque and peafowl.

Wild ungulates: Nilgai, chinkara, sambar and wild pig.

Cheetah prey: Nilgai, chinkara, sambar, wild pig and peafowl.

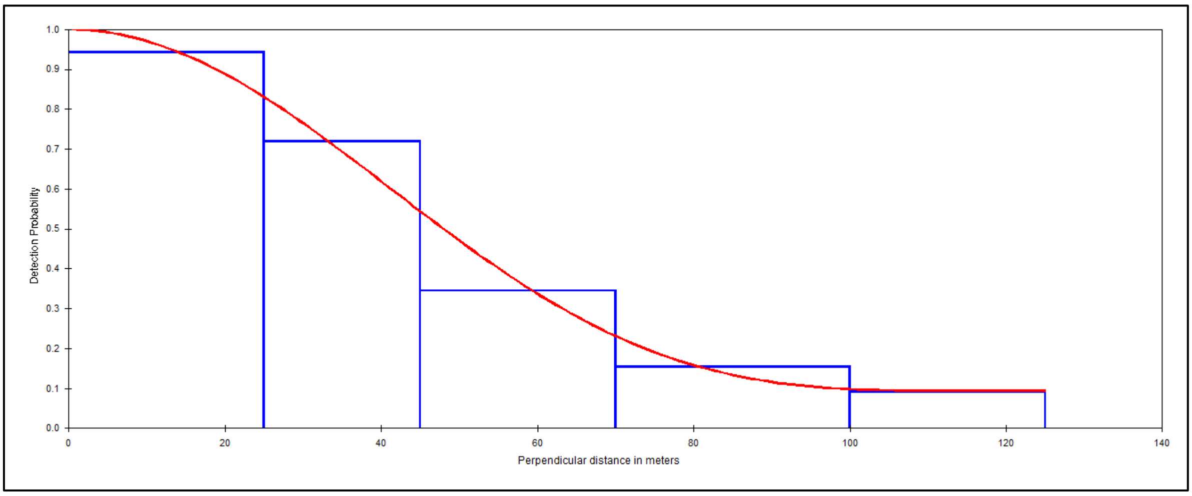
Chinkara pooled: Chinkara sightings from 2010 and 2011 pooled together.

Appendix 2

Detection Function Curves for Prey Species Abundance Estimation

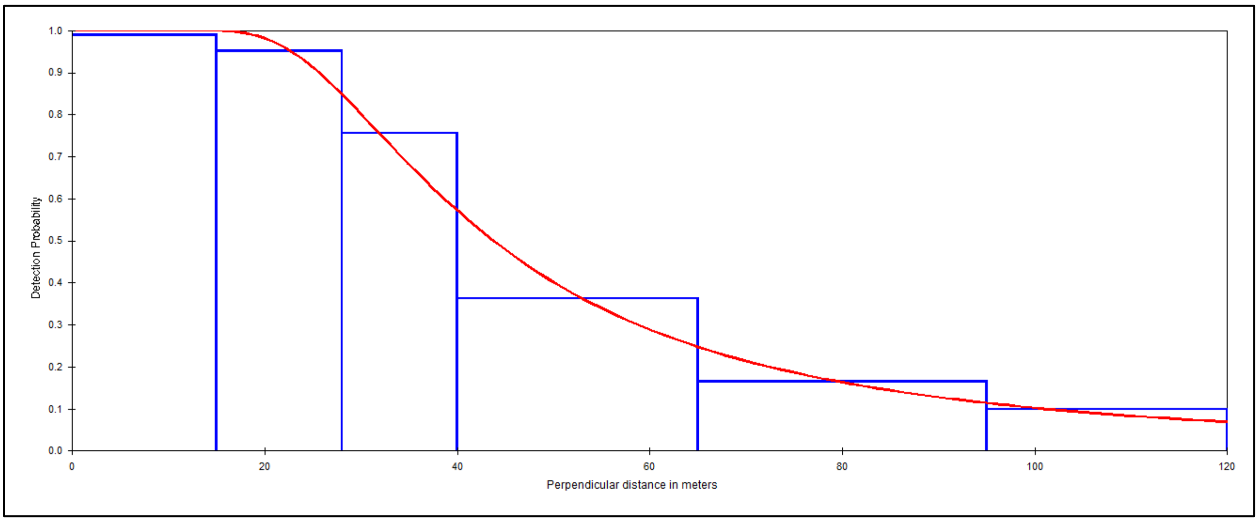
2.1: All prey : Nilgai, sambar, chinkara, wild pig, langur, rhesus macaque, peafowl and domestic cattle.

Model: Uniform with cosine adjustment term (χ^2- p = 0.91, p= 0.42)

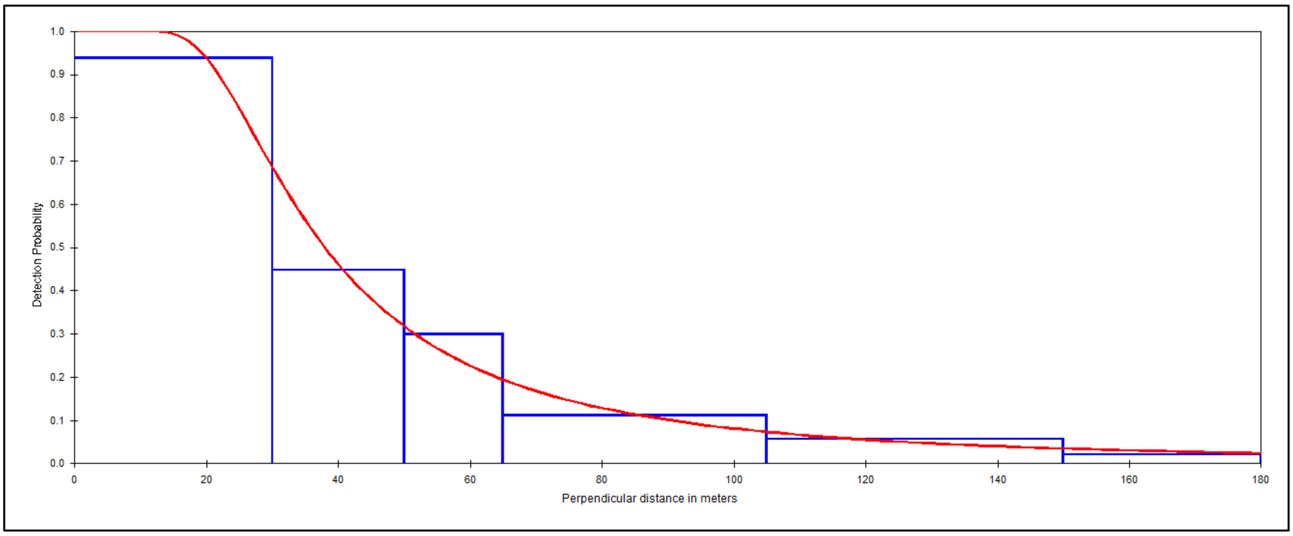


2.2: All prey excluding primates: Nilgai, chinkara, sambar, wild pig, peafowl and domestic cattle

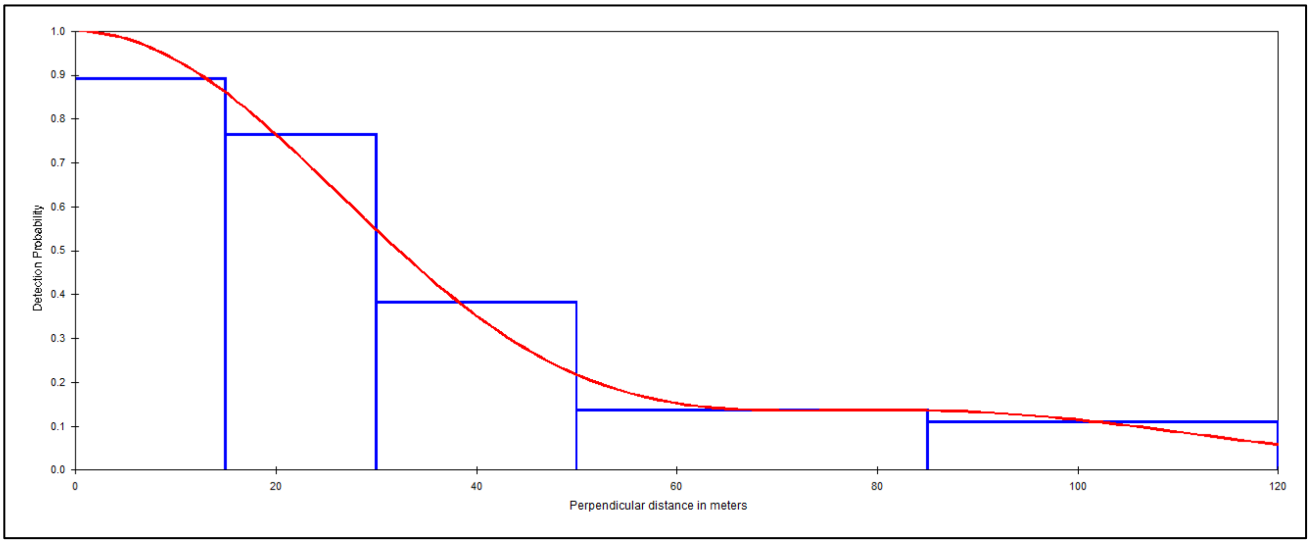
Model: Hazard rate with cosine adjustment (χ^2- p = 0.98, p= 0.44)



2.3: Wild prey: Nilgai, chinkara, sambar, wild pig, langur, rhesus macaque and peafowl.
Model: Hazard rate with cosine adjustment (χ^2- p = 0.93, p= 0.27)

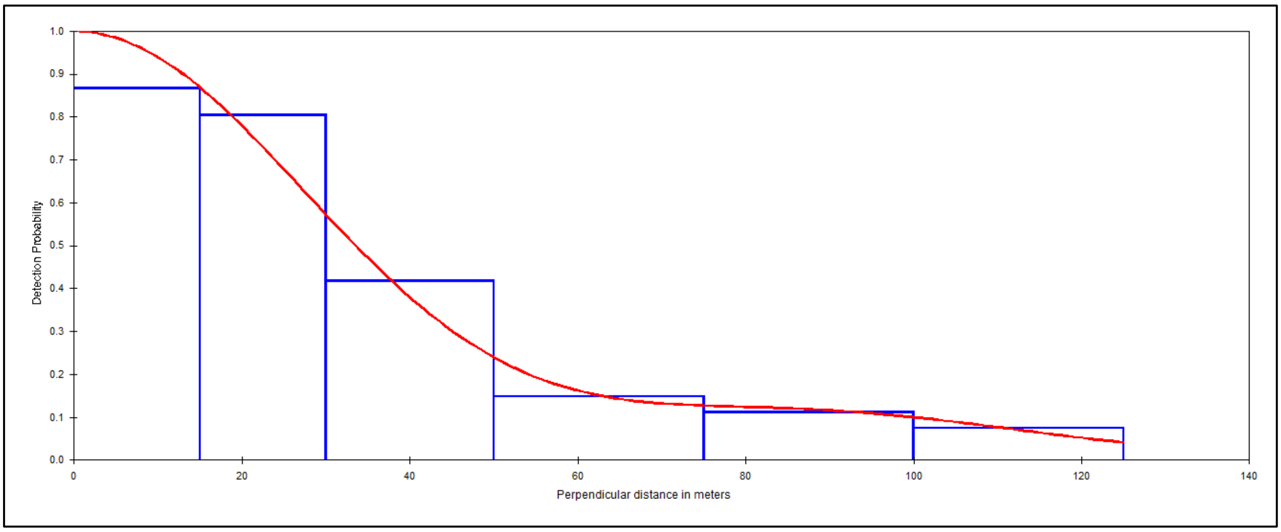


2.4: Wild ungulates: Nilgai, chinkara, sambar and wild pig.
Model: Half normal with cosine adjustment. (χ^2- p =0.9 , p=0.34)



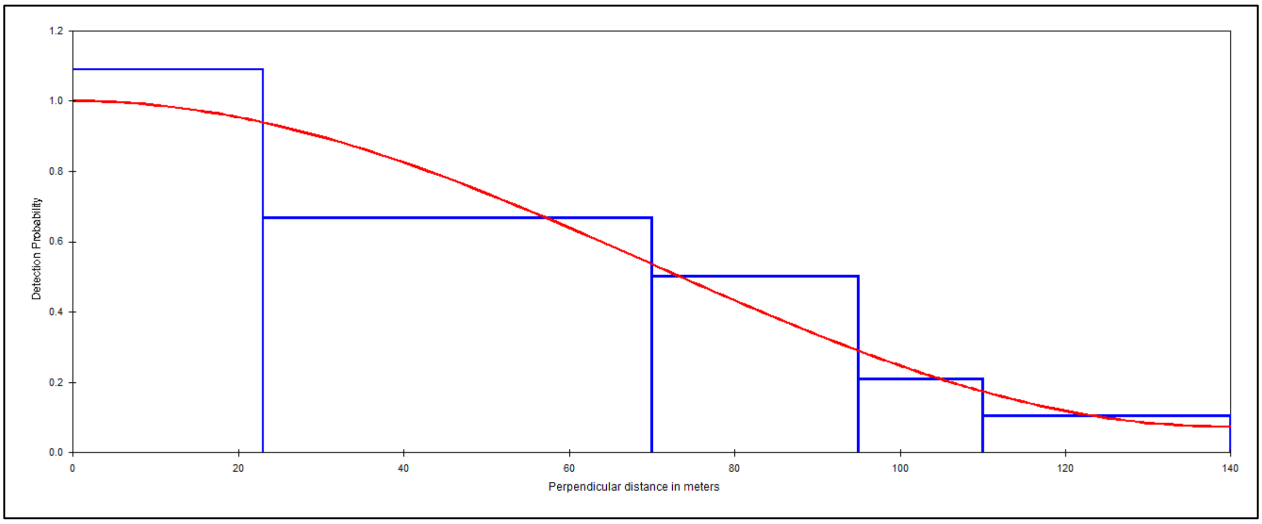
2.5: Cheetah prey: Nilgai, chinkara, sambar, wild pig and peafowl.

Model: Half normal with cosine adjustment. (χ^2- p = 0.94, p= 0.33)



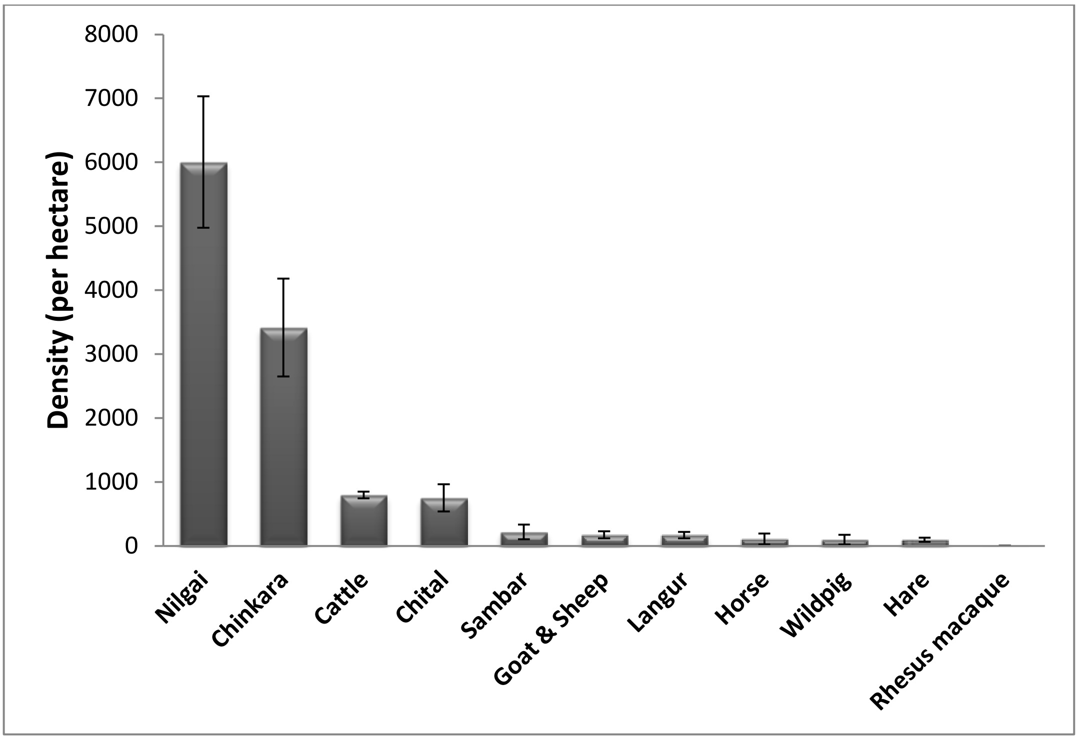
2.6: Chinkara pooled: Chinkara sightings from 2010 and 2011 pooled together.

Model: Half normal with cosine adjustment. (χ^2- p = 0.93, p= 0.54)



Appendix 3

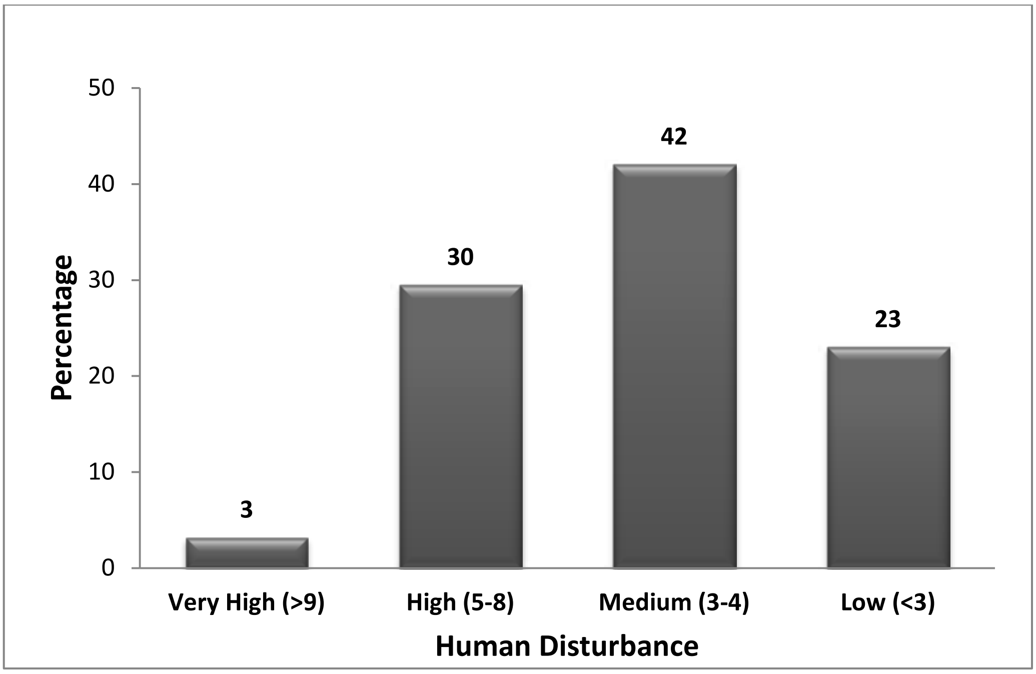
Prey Pellet/ Dung Density in the proposed core area of Nauradehi WLS



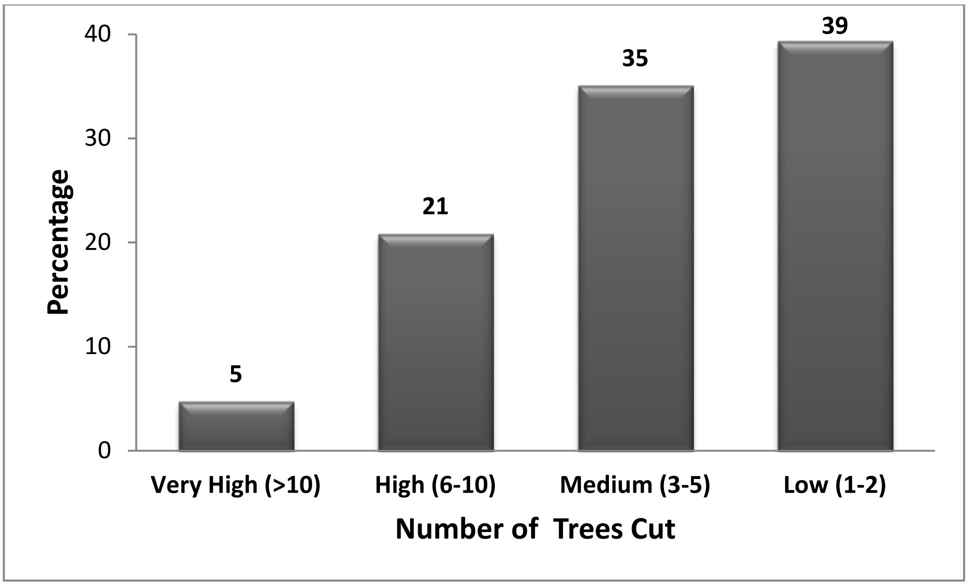
Appendix 4

Intensity of Human Disturbance in the proposed core area of Nauradehi WLS

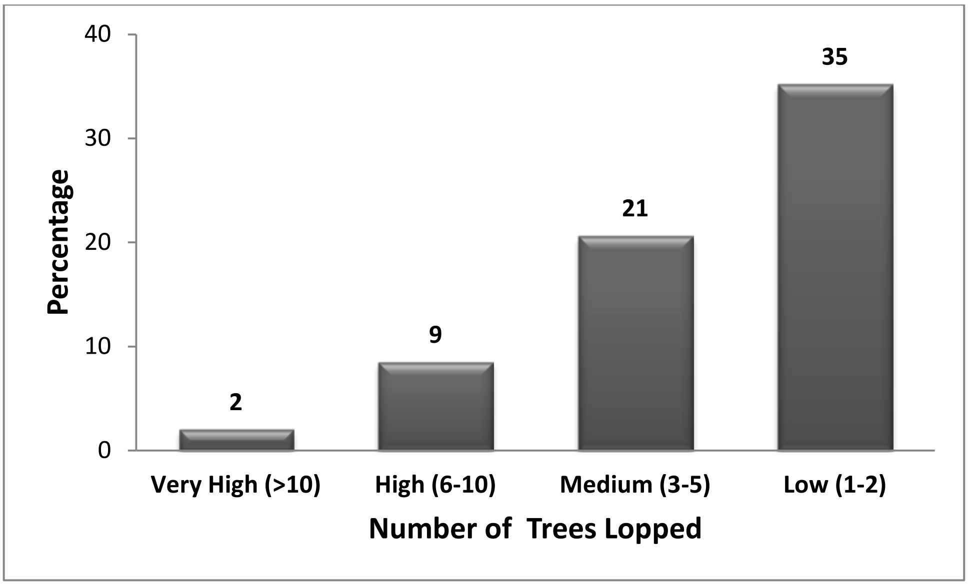
4.1: Intensity of overall human disturbance in the proposed core area of Nauradehi WLS



4.2: Intensity of woodcutting in the proposed core area of Nauradehi WLS



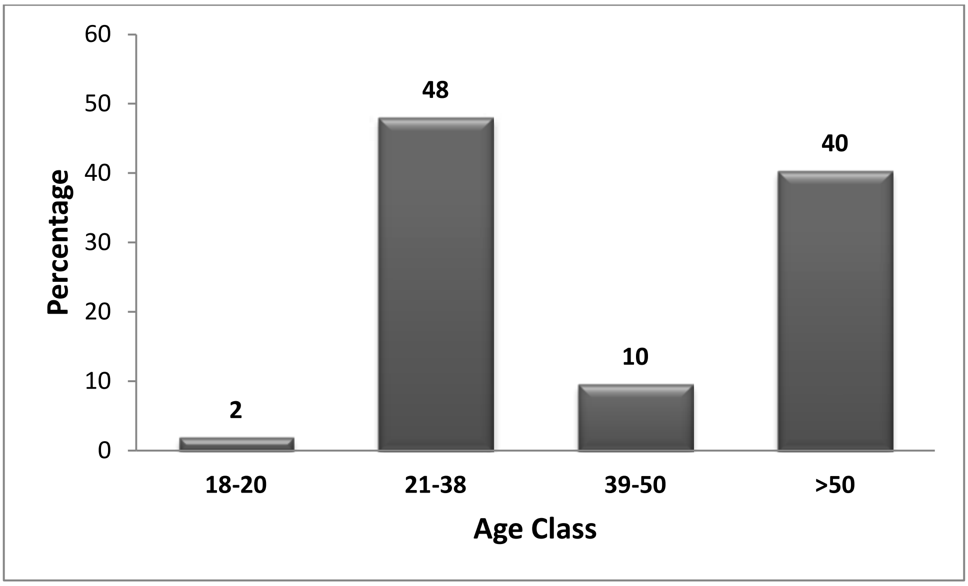
4.3: Intensity of tree lopping in the proposed core area of Nauradehi WLS



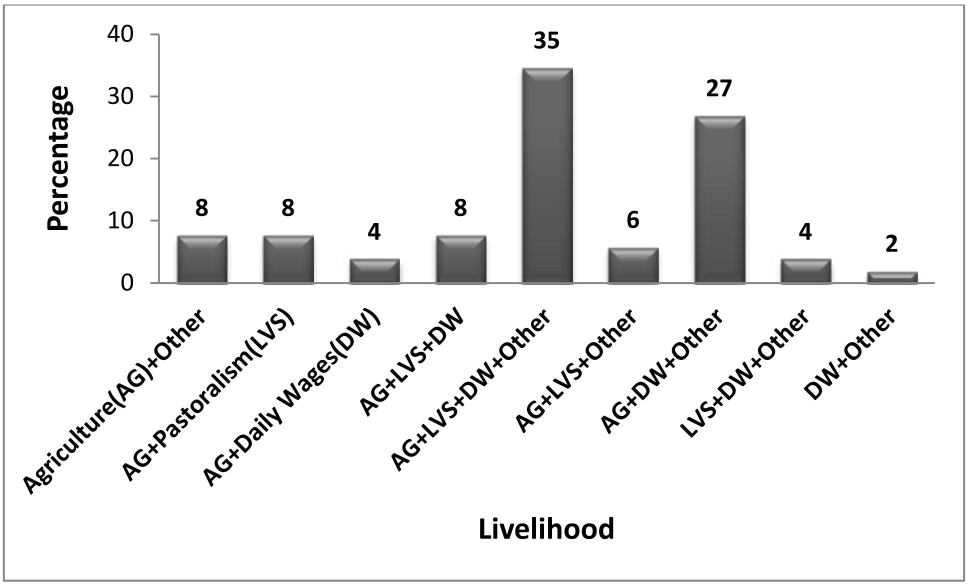
Appendix 5

Socio-economic status, attitudes and perceptions of local people towards wildlife

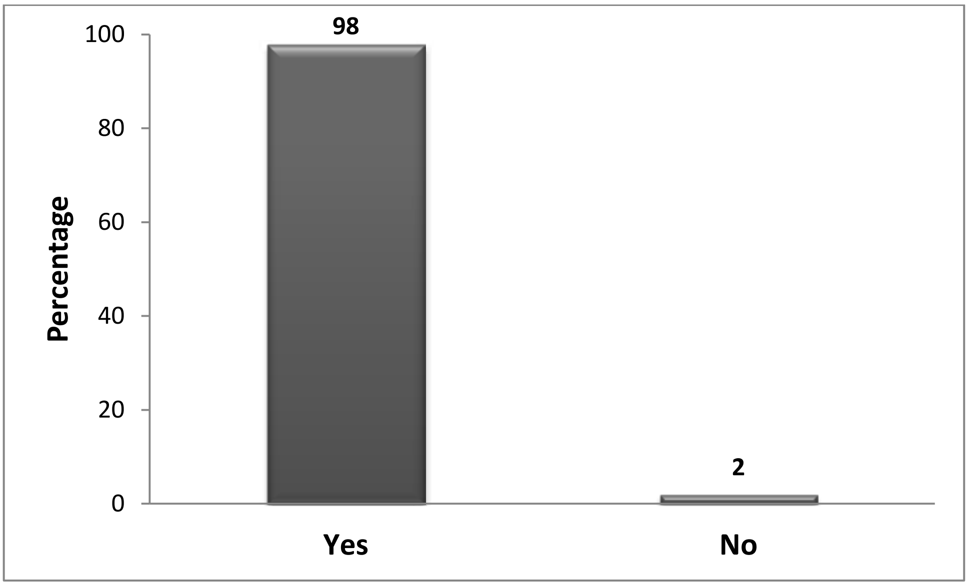
5.1: Age class of the respondents in the villages inside the proposed core area of Nauradehi WLS (n=52)



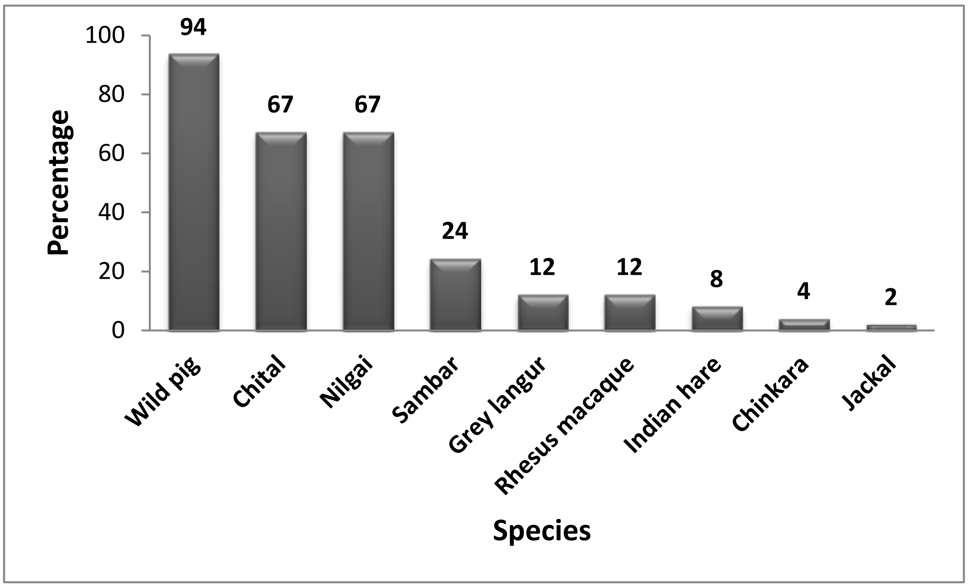
5.2: Livelihood of the respondents in the villages inside the proposed core area of Nauradehi WLS (n=52)



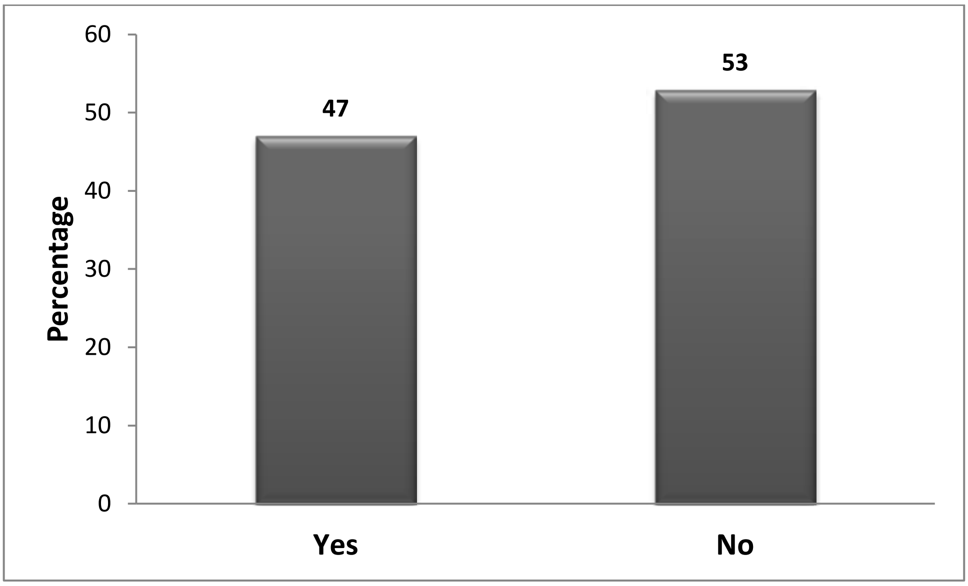
5.3: Percentage of respondents providing information about presence of crop depredation (n=49)



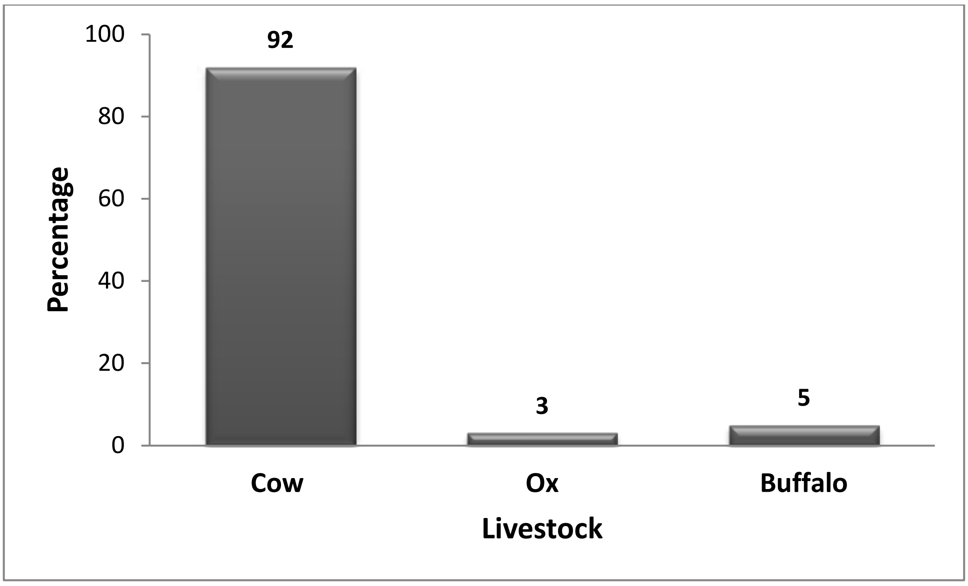
5.4: Percentage of respondents providing information about wild animals responsible for crop damage (n=49)



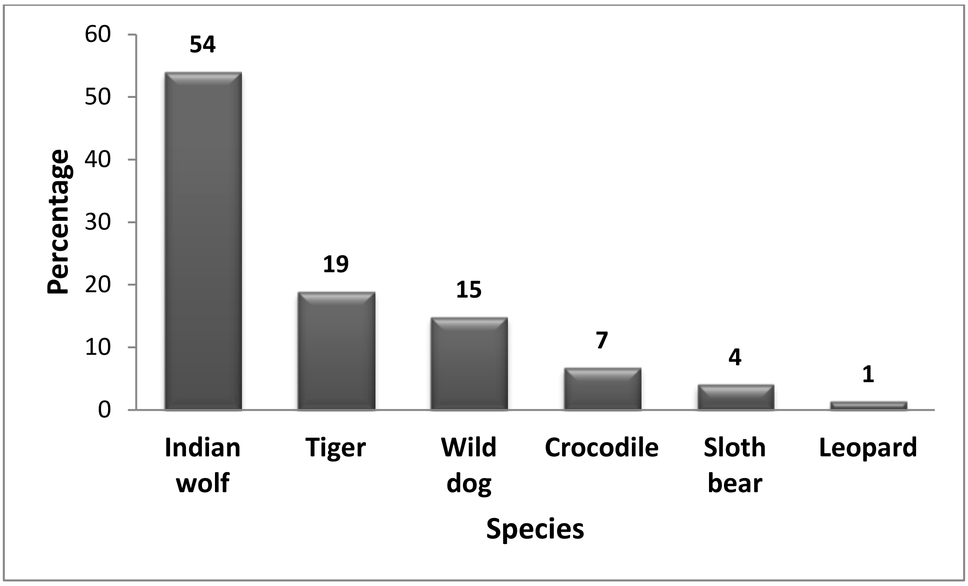
5.5: Percentage of respondents providing information about presence of livestock depredation (n=51)



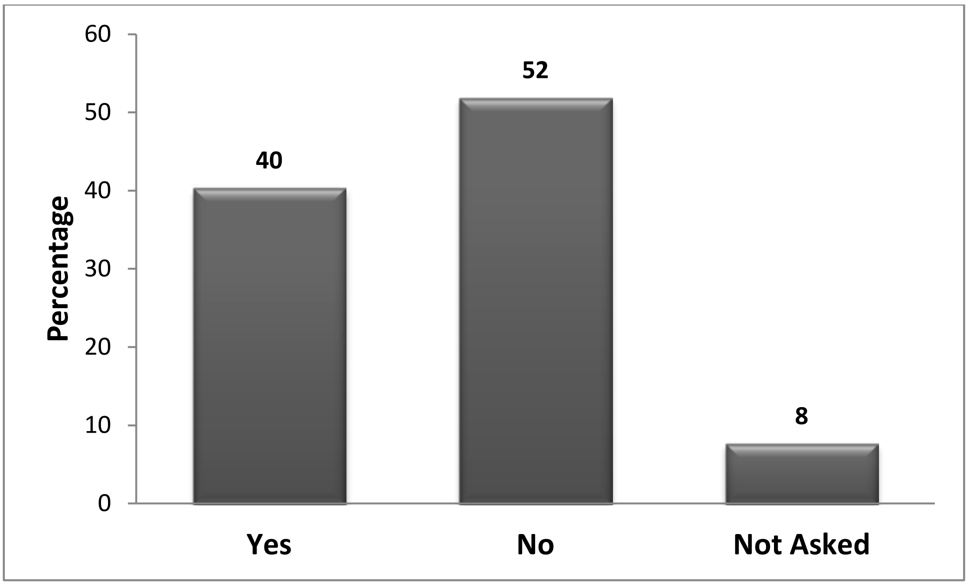
5.6: Percentage of respondents providing information about the type of livestock lost to carnivores (n=51)



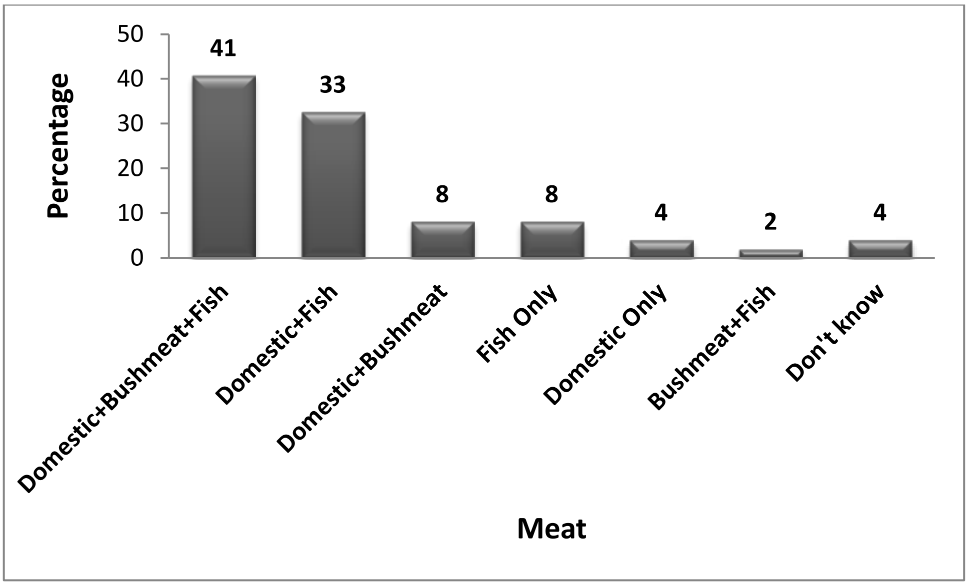
5.7: Percentage of respondents providing information about carnivores responsible for livestock losses (n=51)



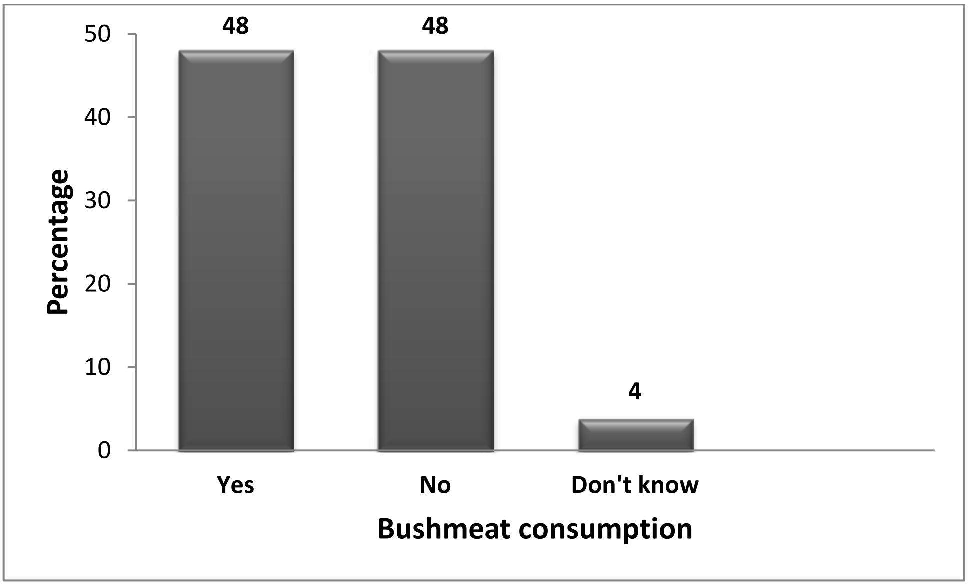
5.8: Percentage of respondents providing information about people in the village trapping or snaring wild animals (n=52)



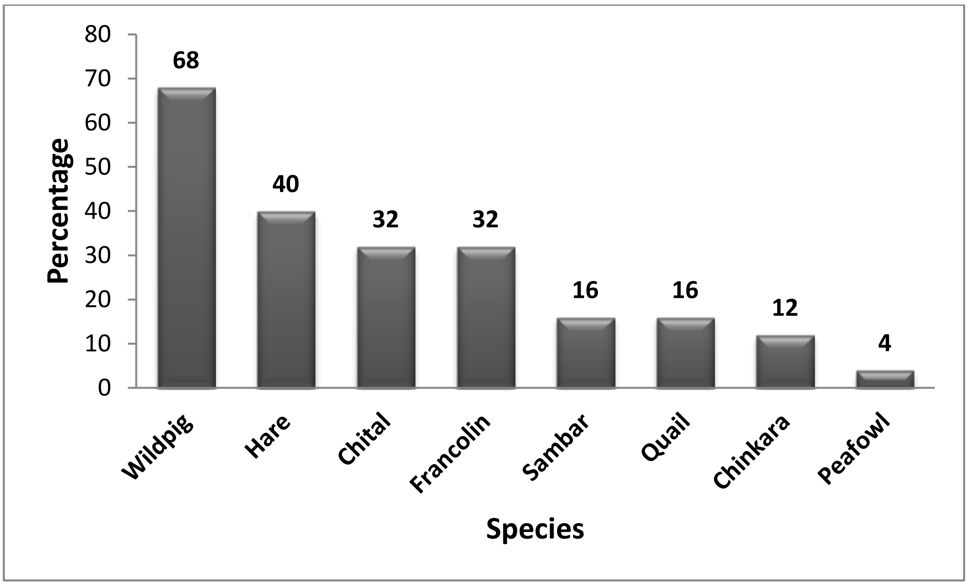
5.9: Percentage of respondents providing information about types of meat consumed (n=49)



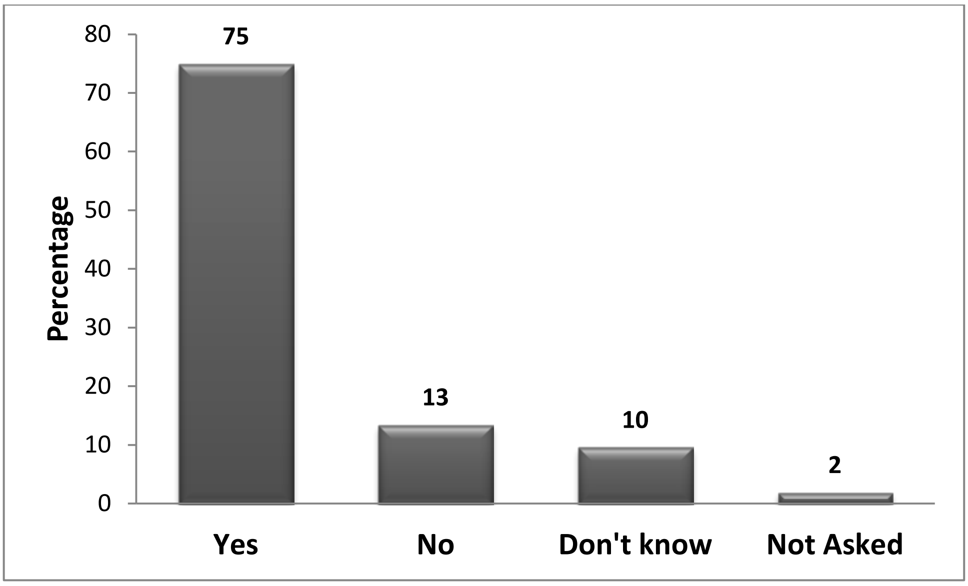
5.10: Percentage of respondents providing information about the presence of bushmeat consumption (n=52)



5.11: Percentage of respondents providing information about different types of bushmeat consumed (n=26)



5.12: Percentage of interviewees responding about willingness to relocate (n=52)



Appendix 6

Human and Livestock Population in the villages inside the proposed core area of Nauradehi WLS

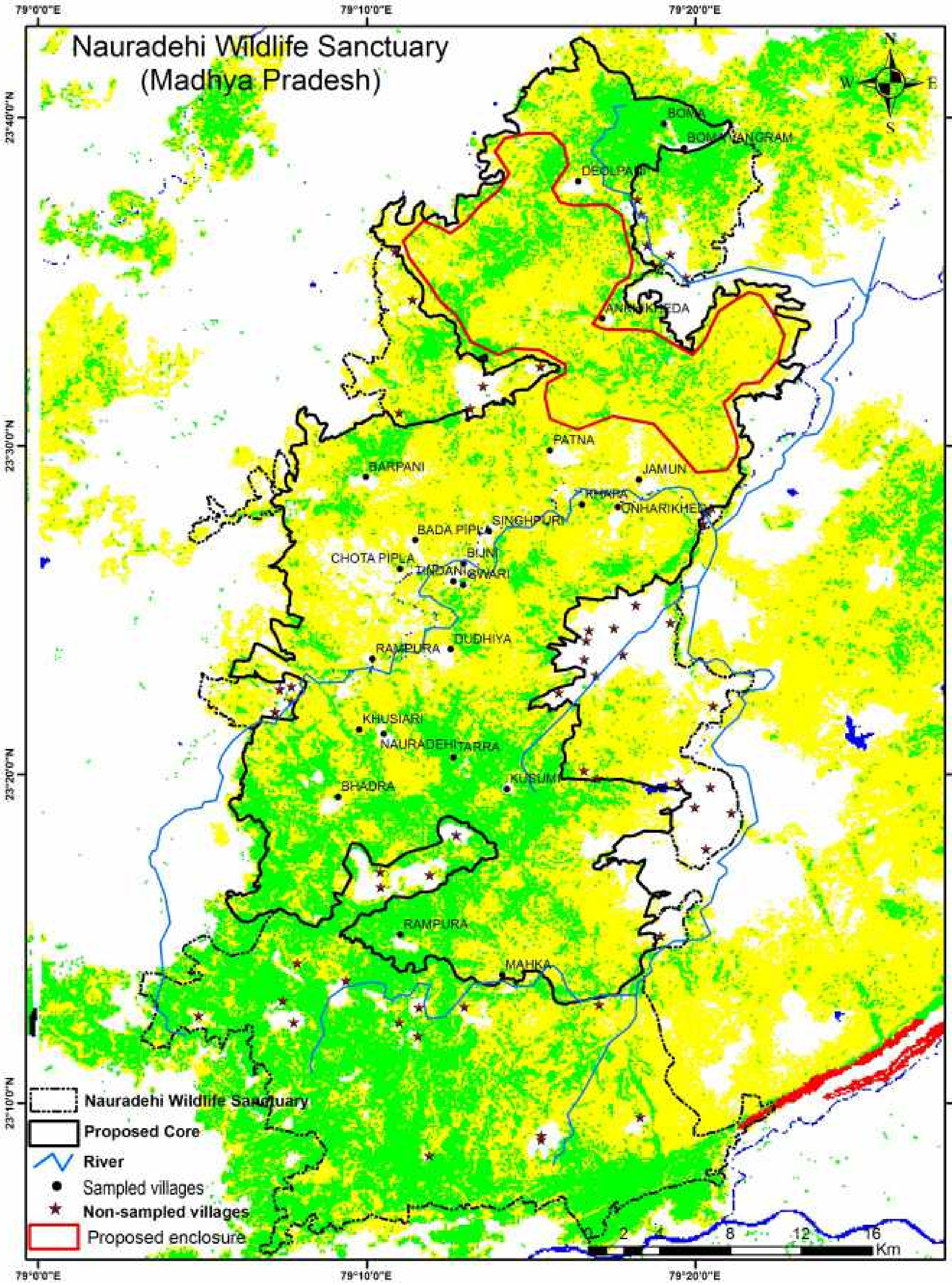
No.	Village	Range	No. of House-holds	Human Population (2001)	Livestock Population (2010)
1	Ankhikheda	Mohli	73	367	160
2	Boma (Forest) *	Mohli	52	192	50
3	Boma (Revenue)	Mohli	23	88	100
4	Devalpani	Mohli	56	322	140
5	Patna	Mohli	178	667	480
6	Barpani	Singhpur	154	321	274
7	Bijni	Singhpur	25	109	195
8	Chota Pipla*	Singhpur	NA	NA	NA
9	Pipla	Singhpur	171	656	566
10	Rampura	Singhpur	48	244	332
11	Jamun	Jhapan	75	298	299
12	Khapa*	Jhapan	11	52	62
13	Unarikheda	Jhapan	90	564	256
14	Dudhiya	Sarra	151	383	485
15	Gwari*	Sarra	NA	NA	NA
16	Kusmi	Sarra	32	116	455
17	Mahka	Sarra	42	236	244
18	Tarra	Sarra	46	173	336
19	Tindani	Sarra	101	364	399
20	Singhpuri	Sarra	42	158	294
21	Rampura	Sarra	NA	NA	NA
22	Bhadra	Nauradehi	69	322	139
23	Kusiyari	Nauradehi	24	61	115
24	Nauradehi	Nauradehi	35	85	274
Total			**1498**	**5778**	**5655**

*--- Settlement (Source: Madhya Pradesh Forest Department)

NA- Not Available

Appendix 7

Fig. 19 Proposed enclosure for holding imported cheetah for soft-release.



Appendix 8

Wildlife Institute of India Research Team

Bipin C.M. - Research Biologist

Anant Pande- Research Biologist

Anirudhkumar Vasava - Research Biologist

Ridhima Solanki - Research Biologist

Annexure II **Project Cost Estimates**

Item	Unit	No.	Unit Cost (Rs. Lacs)	Year I	Year II	Year III	Year IV	Year V	Total Cost	Remarks
Expenses in Source Country										
Transportation Cages	No.	10	0.25	2.50					2.50	
Miscellaneous Costs: Permits, Local Transportation, Vaccination, Health Check- Ups etc.	No.	10	0.25	2.50					2.50	
Cost of Cheetahs	No.	10	1.00	10.0					10.00	May be donated.
Sub-Total Expense in Source Country										**15.00**
International Transportation of Animals	LS			20.0					20.00	
Local Transportation from Airport to Nauradehi including Handling Charges.	No.	10	0.50	5.00					5.00	
Holding Fence	LS	1		3850.00					3850.00	One fences of size 150 sq.km. will be constructed with the requisite compartments for males, females and prey animals. The height of the fence will be 2.5m. Two lines of electric fence shall be installed on top.

Item	Unit	No.	Unit Cost (Rs. Lacs)	Year I	Year II	Year III	Year IV	Year V	Total Cost	Remarks
Staff Costs										
Biologist-1	PA		5.00	5.00	5.00	5.00	5.00	5.00	25.00	The same biologist and the vet. must stay with the project for its entire duration. The costs are averaged for the entire period and include all staff related expenses including salaries, allowances etc.
Veterinarian-1	PA		5.00	5.00	5.00	5.00	5.00	5.00	25.00	
Asstt. Veterinarian-1	PA		2.50	2.50	2.50	2.50	2.50	2.50	12.50	
Office Assistant-1	PA		1.20	1.20	1.20	1.20	1.20	1.20	6.00	
Watchmen-2	PA		0.60	1.20	1.20	1.20	1.20	1.20	6.00	
Drivers-10	PA		1.20	12.00	12.00	12.00	12.00	12.00	60.00	
Plumber cum Electrician	PA		1.20	1.20	1.20	1.20	1.20	1.20	6.00	
Vehicles, Equipment and Supplies										
Field Vehicles-4WD Scorpios	No.	2	12.00	24.00					24.00	
Field Vehicles-4WD Boleros	No	2	8.00	16.00					16.00	
Animal Capture and Mass Transportation Vehicles: 2	No.	2	30.00	30.00	30.00				60.00	Animal transport vehicles shall have to be suitably modified to meet the specialized requirements of the project.
4WD Recovery Vehicle for Animal Capture	No.	2	8.00	8.00	8.00				16.00	
Multipurpose Vehicles (Truck & Tractor)	No.	2	8.00	8.00	8.00				16.00	

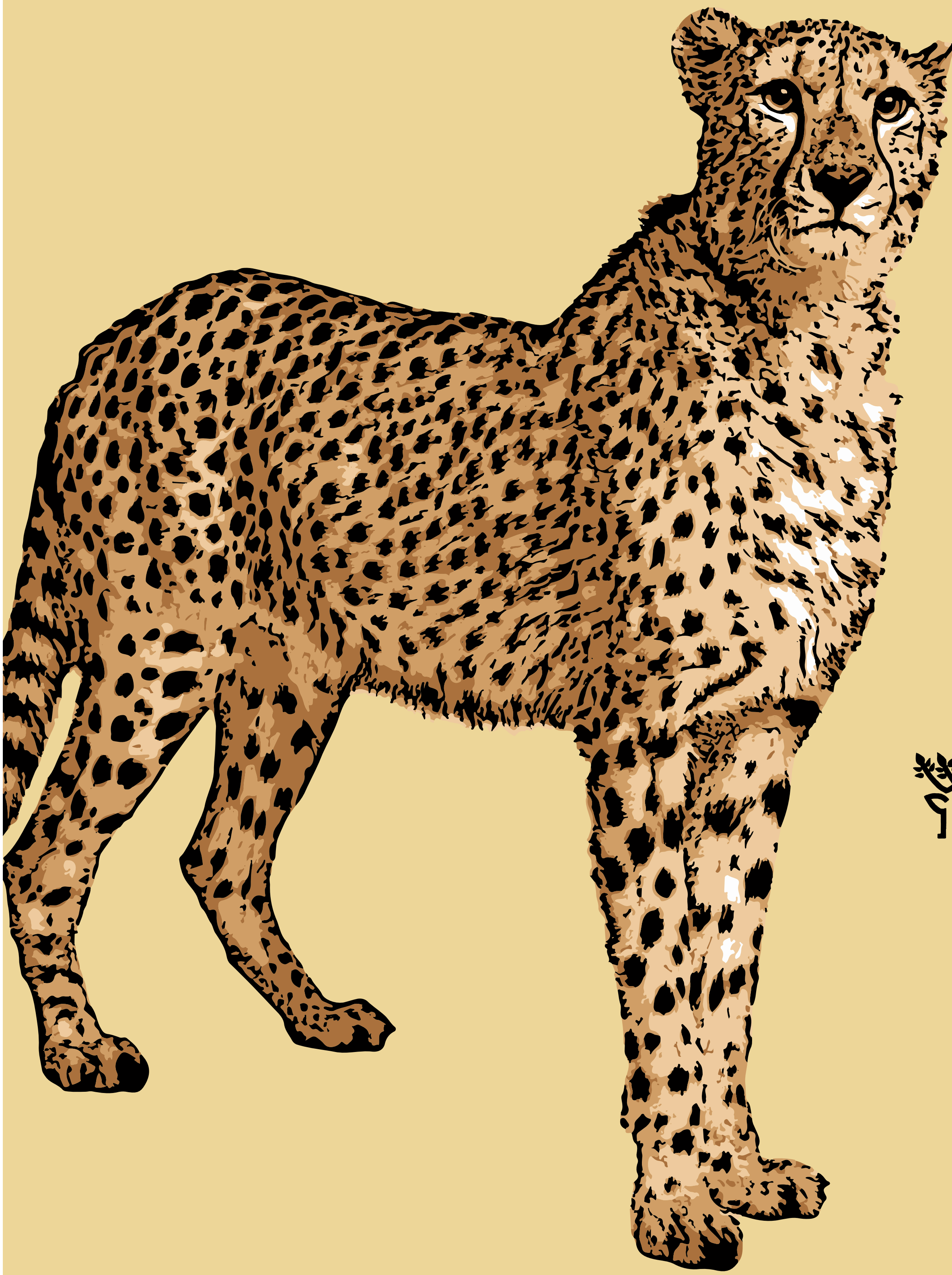
Item	Unit	No.	Unit Cost (Rs. Lacs)	Year I	Year II	Year III	Year IV	Year V	Total Cost	Remarks
Vehicles, Equipment and Supplies										
Misc. Capture Equipment and Tools, Winches, and Implements	LS		10.00	10.00	10.00	10.00	10.00	10.00	50.00	
Operational Costs of Animal Capture (Labour, POL, Misc.)	No.	5000	0.01	10.00	15.00	15.00	15.00	10.00	65.00	
Veterinary Equipment Computers and Consumables.	LS		10.00	10.00	10.00	10.00	10.00	10.00	50.00	
Monitoring (By WII)										
Vehicles-2	No.	2	8.00	16.00					16.00	
Radio Collars and Accessories	No.	15	2.00	15.00	15.00				30.00	
Researchers – 4	PA	4	2.00	8.00	8.00	8.00	8.00	8.00	40.00	
Field Assistants - 6	PA	6	1.00	6.00	6.00	6.00	6.00	6.00	30.00	
Drivers-1	PA	2	1.00	2.00	2.00	2.00			6.00	
Operational Costs (POL and Other Field Consumables)	LS			4.00	4.00	4.00	4.00	4.00	20.00	
Computers, Stationary, GPS, Binoculars, Equipment, etc.	LS			2.00	1.00	1.00	1.00	1.00	6.00	
Travel (including International) and Other Misc. Costs	LS			4.00	4.00	1.50	1.50	1.50	12.50	
Sub-Total Monitoring (WII)										**160.50**
Publicity and PR	LS			10.00	5.00	5.00	5.00	5.00	30.00	
Maintenance of Vehicles	LS			20.00	20.00	20.00	20.00	20.00	100.00	
Misc. and Unforeseen Costs	LS			10.00	10.00	10.00	10.00	10.00	50.00	

Item	Unit	No.	Unit Cost (Rs. Lacs)	Year I	Year II	Year III	Year IV	Year V	Total Cost	Remarks
Travel Costs (including International Travel)	LS			10.00	10.00	10.00	5.00	5.00	40.00	
Capture, Restraint and Tranquilisation, Equipment, Drugs, Other Consumables	LS			10.00	5.00	5.00	5.00	5.00	30.00	
Support to Local People (Ecodevelopment)	LS			50.00	50.00	50.00	50.00	50.00	250.00	
Strengthening of Protection Infrastructure										
Construction of Patrolling Camp	No.	8	5.00	5.00	20.00	15.00			40.00	
Construction of Range Assistant Quarter	No.	2	8.00		8.00	8.00			16.00	
Construction of Range Office	No.	2	8.00		8.00	8.00			16.00	
Solar Light in Patrolling Camps	No.	100	0.25		6.25	6.25	6.25	6.25	25.00	
PDA and GPS	No.	100	0.25		6.25	6.25	6.25	6.25	25.00	
Wireless Equipment	No.	50	0.25	2.50	2.50	2.50	2.50	2.50	12.50	
Internet Cost	LS			10.00					10.00	
Horse	No.	10	0.8	5.60	2.40				8.00	
Horse Maintenance	LS		0.25	1.75	2.50	2.50	2.50	2.50	11.75	
Camera traps	N0.	100	0.06	6.00					6.00	
Ex-Servicemen/Labourers for Patrolling	No.	50	0.70	35.00	35.00	35.00	35.00	35.00	175.00	
Import of 6 Cheetahs	LS					10.00	10.00		20.00	
Relocation of 21 Villages and 3 Settlements	Family	1600	10.00	6000.00	6000.00	2000.00	2000.00		16000.00	
Consultancy	LS		20.00	20.00	20.00	20.00	20.00	20.00	100.00	

Item	Unit	No.	Unit Cost (Rs. Lacs)	Year I	Year II	Year III	Year IV	Year V	Total Cost	Remarks
Project Allowance for Staff	Person	200	0.25	10.00	60.00	60.00	60.00	60.00	250.00	
Merchandising and Marketing	LS			5.00	5.00	5.00	5.00	5.00	25.00	
Boundary Fencing Along Villages	Km	50	12.00		300.00	300.00			600.00	
Livestock Predation Compensation	LS	50	0.02	1.00	1.00	1.00	1.00	1.00	5.00	Considering 1 sheep/goat killed per week
Unforeseen Contingencies	LS			6.00	18.00	18.00	18.00	18.00	78.00	
Grand Total.				**6558.95**	**6744**	**2683.10**	**2345.10**	**330.10**	**22411.25**	

Action Plan for Introduction of Cheetah in India

(With Emphasis on the First Release Site- Kuno National Park)



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