Status of Common Leopard in Katerniaghat Wildlife Division
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Foreword

This report is an outcome of a comprehensive study of the leopard population and its distribution within the Katerniaghat Wildlife Division (WLD) in Uttar Pradesh, carried out by WWF India, in collaboration with the Uttar Pradesh Forest Department.

The study was conducted to assess the status of leopards within the Protected Area, map the intensity of human leopard conflict and describe various methods of engaging with local communities to mitigate human leopard conflict. The derived information on density, abundance, and spatial use could further provide insights for Protected Area managers and conservationists to design and plan appropriate conflict mitigation strategies. A chronicled highlight of 52 cases of leopards attacking or preying on humans between 2017 and April 2019 in and around the sanctuary, is a critical conservation challenge that has been elaborated upon and stated in the report.

This significant work has been accomplished as a direct result of the dedication and hard work devoted by the officers and field staff of Katerniaghat Wildlife Division, field teams of WWF India, and the guidance of experts on big cats.

Sincere thanks to the officers of Uttar Pradesh Forest Department, institutions, individuals and partners who made this work possible. I hope this report is useful in formulating a conservation action plan that ensures the well-being of local communities and helps conserve this magnificent species.

Mr. Ravi Singh,
Secretary General & CEO,
World Wide Fund for Nature- India (WWF-India).
Foreword

Katerniaghat Wildlife Division is a very significant protected area within the Terai Arc Landscape of Uttar Pradesh. Though it is only about 550.11 km² in area out of which 400.09 sq km is Katerniaghat Wildlife Sanctuary and 150.03 sq km of reserve forest serving its buffer, it still shelters populations of various species of conservation relevance. In fact, this small forest has so many leopards within it, that human-leopard conflict has emerged as one of the main management challenges here.

This informative report reveals that there are many leopards in Katerniaghat Wildlife Division. Many of these leopards occur along forest fringes and seem to frequently use adjacent farmland habitats. As a result, human living in fringe villages are vulnerable to encounters with leopards, sometimes with devastating outcomes.

The Uttar Pradesh Forest department is deeply committed to the conservation of leopards and other wildlife, and to ensuring the well-being of people affected by wildlife. This is a very hard task when especially when wildlife moves beyond forest boundaries. But this also serves as a reminder that wildlife does not recognize administrative boundaries, and have large home range requirements. This report lists some of the measures the Katerniaghat Wildlife Division officials and WWF-India have taken to address local grievances. Much hard work lies ahead to scale-up these initiatives and we will work with all stakeholders to make the landscape safer for humans and leopards.

(Sunil Pandey)
Foreword

I am pleased to script a forward for this first report on leopards in Katerniaghat Wildlife Division. Recurring human-leopard conflict in this forest area has been cause for great worry and deliberation for a number of years. This report scientifically documents and maps the population status of leopards using comprehensive camera trap data, while also highlighting the severity of conflict in villages along the southern boundary.

It is a notable feature that while both tigers and leopards exist in this forest, leopards are commonly associated with conflict and tigers to a much lesser extent. This is unlike other areas of Uttar Pradesh like Pilibhit where conflict usually involves tigers. There is much that we need to understand about the ecology of carnivores and the human wildlife interface, and this work adds to that body of knowledge.

I commend all involved in the preparation of this report and am confident that this information will be used to sharpen our strategies for conflict mitigation.

(Pawan Kumar Sharma)
Acknowledgements

We would like to thank the Chief Wildlife Warden, Uttar Pradesh and Mr. Ravi Singh (SG & CEO, WWF-India) for their encouragement to undertake this survey. We also acknowledge the support of the Field Director of Dudhwa Tiger Reserve, Sh. Sunil Choudhary and the Divisional Forest Officer, Sh. G. P. Singh (Katerniaghat).

We would like to acknowledge Range Officers, Sh. R.K.P. Singh (Katerniaghat & Nishangara), Sh. S P Singh (Murthia & Dharmapur), Sh. Satish K Verma (Sujauli), Sh. Vikas Asthana (Kakraha) and Sh. Khursid Alam (Motipur) who were enthusiastically involved in the camera trapping exercise. We would like to thank Mr. Kandhai Lal and Mr. Arjun Kamdar (Intern) who assisted the team in carrying out field surveys.

We also thank all the foresters, forest guards and watchers who were involved in the camera trapping exercises and have relentlessly working to manage human-leopard conflict situations. We would also like to acknowledge the support provided by field assistants in carrying out this survey.

We thank Dr. Sejal Worah (Programme Director, WWF India), Dr. Dipankar Ghose (Director, Species & Landscapes, WWF India) and Dr. Anil Kumar Singh (Team Leader, TAL, WWF India) for their support and inputs.
Background

Katerniaghat Wildlife Division (WLD is comprised of Katerniaghat WLS and its buffer ~550 km²), a part of Dudhwa Tiger Reserve, is a unique wildlife habitat within the Terai Arc Landscape (TAL) of India. This Protected Area (PA) is well known for the endangered fauna it harbours in remnant grassland-wetland-forest mosaics, including Tigers (*Panthera tigris*), the One-horned rhinoceros (*Rhinoceros unicornis*) and Elephants (*Elephas maximus*). Moreover, Katerniaghat WLD is also home to increasingly rare aquatic species, including the Gangetic dolphin (*Platanista gangetica*), and Gharial (*Gavialis gangeticus*), which is categorized as “critically endangered” in IUCN Red List (www.iucnredlist.org). Diverse avifauna and fish species, including Golden Mahseer (*Tor putitora*), thrive in the Girwa (Karnali) river system that flows through the heart of the division.

The division’s connectivity with Bardia National Park in Nepal (via Khata and Chedia corridors), and productive habitats associated with the Girwa and Kaudiyala river have allowed the persistence of diverse life forms, even though the sanctuary is otherwise narrow, with extensive edges, and subject to significant anthropogenic pressure. The corridors that connect Katerniaghat with expansive and well protected forests in Nepal are also very important, and have enabled the periodic movement of wild elephants, rhinos and tigers between protected areas in India and Nepal, even as other corridors in the region have been degraded (Chanchani et al., 2014a). These species and the ungulate prey of tigers have especially benefited from the presence of cane-brakes, grasslands and swamps in trans-girwa, Sadar and Bichia beats of Katerniaghat and Sujauli ranges, along the flood plains of the Girwa and Kaudiyala - which are truly the lifeline of the sanctuary as they provide both high-quality forage and cover.

Katerniaghat also harbours a sizable leopard population. The leopards of Katerniaghat have been associated with conflict for a number of years – which is perhaps the highest within the Terai Arc Landscape. Between 2017 and April 2019 alone, 52 people were mauled by leopards, resulting in 14 human fatalities. Pervasive conflict has predictably resulted in considerable fear and resentment towards leopards among local communities, and antipathy towards forest managers. Such conflict has also resulted in the occasional killing of carnivores by locals. In this fraught situation, the Forest Department and conservation agencies have constantly persevered to mitigate conflict and reduce risk for affected communities – for example by capturing problem animals, running awareness programs, distributing lights to ward leopards away from forest-edge settlements and compensation programs. Still the problem persists. A comprehensive conflict mitigation strategy that identifies a series of direct and indirect interventions and empowers government agencies and local stakeholders respond swiftly and effectively to contain conflict is the need of the hour. One essential step towards this is to develop an understanding of the area’s leopard population and space use, which this report addresses.

Katerniaghat’s human-leopard conflict problem needs to be understood in the context of the sanctuary’s unique geography. This PA is no more than 4-6 kilometers wide for much of its extent. The matrix surrounding the sanctuary to the south, west and east comprises extensive agricultural land (sugarcane, wheat and paddy cultivation) and numerous villages with high human densities. Farmlands are essentially an extension of wildlife habitats for many mammals, especially when the crops are tall. The farmlands to the north of the sanctuary in Nepal are fallow for several months of the year and there is little sugarcane.
cultivation. Many villages are at the forest edge. Moreover, four Gram-sabha villages and two forest-villages with a combined population of 10,372 (Census of India, 2011) are embedded within the division. Thus, human reach within the forest is high, both because of these settlements and because the forests are accessed by residents of matrix villages. A major arterial road and a railway line passing through the middle of the forest, bifurcating habitat into two narrow patches, and numerous smaller roads provide easy access to the forest. Local dependence on forest resources (primarily firewood and fodder) is also high, and many thousands of cattle are grazed in some grasslands within the division. Wild prey is relatively low in the division (Chanchani et al., 2014b). For these reasons, the likelihood of humans encountering leopards both within the division and around is high.

Given its narrow width and high human pressure, it is remarkable that the sanctuary still harbours populations of large carnivores and herbivores – which can be attributed both to conservation measures and protection, and equally to the willingness of communities to coexist with wildlife in their neighborhoods. However, the long-term persistence of these species rests at least in part on more effective conflict management, principally to significantly reduce encounters between humans and leopards.
Data collection and Analysis

To generate information on wildlife occurrence, particularly large carnivores, and their abundance, 118 camera trap stations were distributed across all 7 ranges of the division. A pair of camera traps (models Cuddeback—Attack, Professional and Color C1) was tethered to trees or poles at each station about 45 cm from the ground, and about 10-15 feet from the center of forest roads and trails. Camera placement was informed by sign surveys along forest roads, trails, river courses and other features which were likely to be used by leopards and tigers. The surveys were carried out over a 58-day period in 2017 (Figure 1).

Leopard images were collated and individuals were identified based on pelage patterns, while also identifying sex. This information was used to build capture history matrices that included information on the spatial coordinates of capture locations and survey occasion for each independent capture event.

**Details on Leopard Monitoring exercise in Katerniaghat WLD (2017):**
Sampling Period: 24th April – 20th June 2017
Area surveyed: 550km2
Camera stations: 118
Proportion of camera stations that photo-captured leopard: 42%
Total trap nights: 5,097
Average inter-trap (meters): 1087

Figure 1 Camera stations (in blue color) and 15 km state-space region within which home range centers of leopards in the sampled population are distributed. The yellow points (1000 m spacing) represent potential leopard activity centers within available habitat areas. The Gramsabhas boundaries are approximate.
Data Analysis

Population density and abundance were computed using spatially explicit capture recapture analysis using package `secr` (version 2.9.5) in R (Efford et al., 2015; Venables & Smith, 2003). Spatial capture recapture estimates demographic parameters by using information on the spatial locations of animal captures to model the movement of individual animals around their home range centers, and coupling this information with a model that describes the distribution of animals within the sampling frame. We defined state space that included all habitat within a 15 km area around the camera trap array. This is a large enough area to ensure inclusion of home range centers of all animals that were exposed to camera traps. The state space was defined by 777 points, 1 km apart. Non-habitat areas were masked out, and density was estimated over this entire area, following Borchers & Efford (2008). We then estimated abundance (number of individuals) within the administrative boundary of Katerniaghat WLD (Efford & Fewster, 2013).

Summary of animal captures

- 29 Adults (~2+ years, post-dispersal animals)
- 23 Adults with recaptures
  - Male: 16 animals with multiple captures; 2 animals with a single capture
  - Female: 10 animals with multiple captures; 1 animal with a single capture
  - Sex unknown: 3 animals with multiple captures; 3 animals with a single capture
- 3 Cubs/juveniles/sub adult
Results: demographic estimates and space-use patterns

The camera trap survey yielded 493 images of 29 adult leopards (likely > 2 years, post-dispersal) and 10 cubs/juveniles/sub-adults (<2 years old, pre-dispersal individuals), based on right-flank images. 79% of adults were captured in >2 occasions during the camera trapping exercise.

The estimated density of leopards/100 sq. km ($\hat{D}_{2017}$) was 5.79 (95% CI 4.0-8.39). The estimated abundance ($\hat{N}$) within Katerniaghat WLD administrative boundary was 33.2 (95% CI 30.5-40.7). Estimates of detection parameters, $g_0$ and $\sigma$ for the 2017 survey were 0.66 (SE 0.12) and 4238 m (SE 321.0), respectively. $Go$ is the baseline encounter probability, or the probability of ‘capturing’ a leopard if cameras were placed exactly at its activity center. $\sigma$ is the scale parameters that describes a leopard’s movement around its home range center, described by a bivariate normal distribution.

Adult male to adult female sex ratio was 1:0.62 during this survey. While sex could not be attributed to three individuals based on available images, these estimates suggest that the population was male-biased during the survey period.

The highest number of leopards was photo-captured in Nishangara range (11), followed by Katerniaghat range (10), Dharmapur range (8) and Sujauli range (6) (Figure 2). In Murthia and Motipur range, four leopards were photo-captured. Of all animals photo-captured, 10 adults were known to range in two or more ranges. There was thus a west-east gradient in leopard density, with fewer leopards in the eastern ranges, where the forests are also narrower.

Table 3 –Estimates from spatially explicit capture recapture analysis. $\hat{N}$ is the number of individuals within Katerniaghat WLD, and Density ($\hat{D}$) is number of leopards/100 km$^2$.

<table>
<thead>
<tr>
<th>Year</th>
<th>Camera stations</th>
<th>Trap nights</th>
<th>$\hat{N}$ (SE)</th>
<th>$\hat{N}$ (95% CI)</th>
<th>$\hat{D}$ (SE)</th>
<th>$\hat{D}$ (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>118</td>
<td>5,097</td>
<td>33.2 (2.36)</td>
<td>30.5-40.7</td>
<td>5.79 (1.10)</td>
<td>4.0-8.39</td>
</tr>
</tbody>
</table>

Density ($\hat{D}$) was computed for the entire state space including some areas beyond the division’s boundaries where leopard home range centers could be, and abundance ($\hat{N}$) was computed for the division boundary only.
Human-Leopard Interface

Of 52 leopard attacks on humans between 2017 and April 2019, 27% resulted in human fatalities. 24 gram sabhas located along the southern boundary of Katerniaghat WLD were affected during this period (see figure 2). There was reoccurring conflict in Madhwapur (5 incidents), Chahalwa (4), Gangapur (4), Semrighatai (4), Amritpur (3), Jhala (3), Harkhapur (3), Bajhpur Bankati (3) and Sujauli (3). Other 15 gram sabhas were associated with 1-2 conflict cases. Various gram sabhas including Gangapur, Amritpur, Jhala (situated to the east of Sujauli range) are emerging as conflict hot-spots. These three gram sabhas cumulatively had 10 conflict cases.

Unlike attacks by tigers which typically occur in areas with dense cover, 38% of the conflict with leopards occurred when the victim was either inside or adjacent to a home. Another 40% of the conflict was recorded in agricultural fields, and 11% of attacks were on people who were defecating in farmlands (a common practice in rural areas as homes generally do not have toilets or their use is minimal). The remaining cases were reported from forests, along village roads and other places. 55% of the affected people were less than 18 years in age and 57% of victims were male.

Although a large number of conflict incidents were at dawn, dusk and during the night, a few incidents occurred in broad daylight as well, for example those in Matehi, Chafaria, Kathoutiya and Semrimalmala.

Key conservation actions undertaken (2017-March 2019)

Rescue operations:

Between May 2018 and June 2019, leopards were successfully captured and rescued on 12 occasions in Katerniaghat WLD. One leopard on average was rescued per month by the forest staffs of Dudhwa Tiger Reserve (DTR). In 8 incidents, leopards were captured with the use of cages, while in order to rescue 2 others, methods of chemical immobilization were involved. A leopard, spotted atop a tree in Girgitti village surrounded by a mob, was given a safe passage to the forest. Furthermore, a leopard cub was found in a sugarcane field of Laltupurwa village, which was rescued and rehabilitated in the Lucknow Zoo.

Except two leopards, others were released into their natural habitat in Dudhwa-Katerniaghat forest complex. Most of these rescue operations were carried-out during the monsoon and winter seasons. The rescue operations hinted at problem rising as the cover availability increases in sugarcane farmlands and harvesting period approaches. It is further evident that female leopards give birth to their litters in sugarcane fields during the winter season and use these farmlands to raise their cubs.

Figure 1- Map showing leopard rescue instances in and around Katerniaghat WLD.
An intensive awareness program themed as ‘Leopard Safety Month’, was launched, where villages surrounding Katerniaghat were involved in order to sensitise the local communities on leopard conservation. Furthermore, an initiative was undertaken to spread awareness amongst the locals by sending messages on the phone under the ‘Leopard Suraksha Express’ program. It proved to be an effective method for information gathering and gaining public support and it also helped in avoidance of human leopard conflict.

**Community support**

150 solar street lights were installed in 15 conflict prone villages which lacked means of electricity or street lighting. Installation of these solar lights were aimed to benefit local communities by increasing visibility during night hours, and reducing the chances of encounter with carnivores.

*Ex-gratia* support was provided to 32 families in the case of human mortality or injuries. This was to help with immediate costs, and provide some relief to affected families until the Government compensation reached them.

**Establishing the identity and tracking movement of the conflict-prone leopard using camera traps**

In order to identify the animal responsible for attacks and to track its movement in farmlands within the conflict area, the state forest department and WWF-India personnel carefully tracked pugmarks and selected sites to deploy camera traps. Camera stations were deployed in and around conflict location thereby covering several villages, namely Sujauli, Telianpurwa, Amritpur, Harkapur, Semrimalmala and Nibiapur.

**Sensitization program**

Various activities for raising awareness were launched in and around the conflict villages. Awareness building program is an effective tool to reduce conflict by bringing in a behavioral change in people. Reasons such as lack of knowledge on dos and don’ts of living around leopards, and reckless behavior
in a conflict scenario is what makes humans more vulnerable to large carnivore attacks, that are sometimes fatal.

Meetings were organized in conflict-affected villages and issues around conflict were discussed. This served as a trust-building activity with local villagers, and provided an opportunity to dispel some hostile notions towards wildlife conservation.

Pamphlets and posters were used by WWF-India, wherein pamphlets describing the important points to be considered during a conflict situation were distributed in villages to raise awareness, while posters were put up at common junctions and important locations throughout the conflict villages.

**Key recommendations for management**

1. Detailed analysis and studies are required to develop a more detailed understanding of the status of leopards in the protected area's forests and adjacent farmlands with respect to habitat use, diet, population dynamics and spatial use. At least three individual leopards were photo-captured on camera traps deployed in farmlands (a small agricultural area spanning a few square kilometers) during a rescue operation in the year 2018. Understanding the abundance of leopards in these farmlands, the extent to which they're used, and the drivers of farmland-use need to be considered when planning conflict mitigation measures.

2. To develop an understanding on the status of prey and its recovery, use of farmlands by wild prey, and the relevance of domestic animals in the diet of a leopard.

3. Devise habitat management strategies to promote the recovery of wild prey populations within Katerniaghat WLD.

4. Develop a comprehensive plan to minimize human-leopard interactions, drastically reduce risks to humans, and for the rehabilitation of conflict animals.

5. Scale-up the community engagement efforts and mobilize Quick Response Teams to monitor leopards in the vicinity of villages and forewarn the local communities.
Literature Cited


Camera Trap Images of Leopards from Katerniaghat WLD

L1 RIGHT FLANK

5/9/2012 1:04 AM

L2 RIGHT FLANK

5/27/2017 2:09 AM

L3 LEFT FLANK

5/12/2017 2:11 AM

L1 LEFT FLANK

5/9/2012 1:05 AM

L2 LEFT FLANK

5/27/2017 1:06 PM

L3 RIGHT FLANK

5/12/2017 3:59 AM