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Mitigation Techniques to Reduce Human Leopard Conflicts in Jhalana Conservation Reserve and Nahargarh Wildlife Sanctuary

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ABSTRACT

Human-leopard conflicts pose a significant conservation challenge for the Indian leopard (*Panthera pardus fusca*) population in Jhalana Conservation Reserve and Nahargarh Wildlife Sanctuary. This subspecies is listed as Vulnerable on the IUCN Red List due to habitat loss, poaching and conflicts arising from human-leopard interactions. This study aims to explore mitigation techniques to reduce human-leopard conflicts in these two protected areas. The research combines literature review, field observations and stakeholder consultations to identify effective strategies. The findings highlight key factors contributing to conflicts, including habitat encroachment, livestock depredation and fear among local communities. Promising mitigation measures such as habitat restoration, improved livestock management and community awareness programs are discussed.

Keywords: Indian leopard, *Panthera pardus fusca*, human-leopard conflicts, mitigation techniques, Jhalana Conservation Reserve, Nahargarh Wildlife Sanctuary, habitat loss, livestock depredation, community awareness.

1. INTRODUCTION

Indian Leopard

The Indian leopard (*Panthera pardus fusca*) is a leopard subspecies widely distributed in the Indian subcontinent. The species *Panthera pardus* is listed as Vulnerable on the IUCN Red List because populations have declined following habitat loss and fragmentation, poaching for the illegal trade of skins and body parts and persecution due to conflict situations (Srivastava, 2000). In 2014, a national census of leopards around tiger habitats was carried out in India except the northeast. 7,910 individuals were estimated in surveyed areas and a national total of 12,000-14,000 speculated (Bhattacharya, 2015).

Study Area

Nahargarh Wildlife Sanctuary and Jhalana Conservation Reserve, Jaipur, Rajasthan 26.9260° N, 75.8235° E (Degree Decimal). These two forest divisions are considered to be the most leopard-populated regions of the Jaipur Forest Area. Most of the leopard conflicts with humans occur in these two forest divisions as there is ever increasing presence of human settlements close by. The forest vegetation that accounts for 8.19% in Rajasthan is deciduous and has thorny trees, grasses and shrubs. The tree species found are Babool, Dhonk, Amaltas, varied species of Acacia and Khejri, etc.

Numerous species of herbs and plants that have medicinal value are very common here. The forests consist of sandstone and quartzite rocks and the foliage typically symbolizes the sultry dry deciduous and muggy bristle forests. At present, there are approximately 40 leopards in Jhalana Reserve Forest and 15 leopards in Nahargarh Wildlife Sanctuary and according to the forest department there are approx. 75 leopards in Jaipur Forest area besides deer, blue-bull, fox, wolf, sambhar, hyena, jackal and several other species.

Problem Overview

The leopard is an important animal in the ecosystem of Jaipur Forest area. It occupies the highest trophic level. The main problem arising for the survival of the leopards in Jaipur Forest area is the illegal/legal encroachment by humans in the fringe area of the forest due to which this magnificent carnivore has started moving out of the forest and has been sighted frequently in and around the villages of the forest. The intensity of these sightings and encounters has risen over the years and is still increasing. Proper mitigation techniques and conservation guidelines need to be implemented in order to safeguard these magnificent carnivores.

As an animal which has learnt to adapt itself to the fast-changing landscape, it is also the most maligned in the Indian context, bludgeoned to death, poisoned or even burnt alive, by the so-called "civilized society". The animals are hard-pressed from all directions, forcing them to come into conflict with humans. Rise in human settlements around the Jaipur Forest area has increased human interference inside forest area. The mere presence of a leopard in an area does not mean that it has to be removed. Certain monitoring protocols have to be devised in order to mitigate this problem.

Review of Literature

Human disturbances have caused the leopard to wander over very large territories to satisfy their food requirements and they may not remain more than a few days in a given locality (Anwar-Maan and Aleem-Chaudhary, 2000).

The increased evidences of livestock predation and human conflicts indicates depleted natural resources with poor prey base and that urgent conservation measures by reducing habitat degradation & to restore the population of prey species are required (Stein et al., 2016).

Table 1 Recorded leopard sightings in the past years (2011-2017)

Date/Month/Year	Area	Leopard case	Attack	Dead/Alive
29/7/2011	Galta ji	Entered house/ Beaten to death	---	Dead
13/10/2012	Chandwaji	Road Kill	---	Dead
19/9/2013	Amore (Nahargarh Biological Park)	Unknown	---	Dead
7/10/2013	Jamwa Ramgarh	Territorial fight	---	Dead
28/10/2013	Looniawaas	Entered house/Rescued	4 persons mauled	Alive
25/11/2013	Bandh ki Ghati (Amer)	Internal injuries (Brain, Liver, Lung)	---	Dead
22/4/2015	Virat Nagar	Entered village/Beaten to death	3 persons mauled	Dead
6/11/2015	Milaap Nagar	Entered house/Rescued	---	Alive
21/2/2016	Jaisinghpura Khor	Iron Trap by Poachers/Rescued	---	Alive
8/3/2016	Galta forest	Leopard cub entered human settlement/Rescued	---	Alive
15/6/2016	Khole ke Hanuman	Found dead due to starvation	---	Dead
8/7/2016	Jamwa Ramgarh	Electrocuted	---	Dead

21/12/2016	University of Rajasthan, Jaipur	Entered University campus/Rescued	---	Alive
9/1/2017	Daulatpura, Manpura	Entered village/Beaten and Tied to tree by villagers/Rescued	1 boy mauled	Alive
6/3/2017	JLN Marg, Jaipur	Entered public park/residing there/park closed	---	Alive
18/5/2017	Bassi	Entered human settlement/Rescued	---	Alive
09/05/2017	Raisar	Fallen in Well	---	Alive
28/12/2017	Jalsu	Entered human settlement/Rescued	---	Alive
29/12/2017	Jagatpura	Entered human settlement/Rescued	1 Man	Alive
27/02/2018	Galta	Leopard Cub entered human settlement	---	Alive
02/12/2019	Shahpura	From Agriculture Field	---	Alive
19/12/2019	Jaipur City	Entered School and main city	---	Alive
27/02/2020	Amer	From Agriculture Field	---	Alive
30/02/2020	Jagatpura	Entered human settlement/Rescued	---	Alive
01/01/2021	Galta	Leopard Entered human settlement	---	Dead
01/02/2022	Jagatpura	Entered human settlement/Rescued	---	Alive
26/01/2022	Achrol	Near Human Settlement	---	Alive
05/12/2022	Mahindra SEZ	From Agriculture Field	---	Alive

Trashing speculation following the spate of recent incidents of human-leopard conflict which indicated that leopard numbers were on the rise, a study conducted by three wildlife scientists has found that the leopard population, on the contrary, has declined by a whopping 70-80% over the past 100 years. When the interests of human beings and wildlife are at odds, sometimes nobody wins. In rural India, several million people rely on crops and livestock for income. A roaming tiger, leopard, Elephant or pig can pose a threat to their livelihood, not to mention human life. The conflict plays out along the "hard edges", areas where nature reserves end and villages begin (Karanth, 2013).

To avert such conflicts, state wildlife departments must launch awareness drives among local residents about the possible causes of such attacks and the preventive measures to be taken so that losses in terms of livestock, humans as well as leopards can be minimized. Residents should be paid ex-gratia in case of attacks/deaths of humans and loss of livestock at the earliest (Rattan, 2014).

2. MATERIALS AND METHODS

Survey

Data related to human leopard conflict, leopard status near villages, leopard's social behavior around forest area, etc, was collected by means of many questionnaire surveys conducted from September 2021 – December 2021 in the fringe villages of the given forest area.

Scientific and Indigenous Mitigation Techniques

Halogen Light Technique: Villages situated in fringe area of Jaipur Forest have been witnessing regular leopard sightings. These leopards attack livestock after watching them carefully from a safe distance. Due to the absence of proper illumination by lights in

these areas, leopards remain elusive until the attack is carried out. Installation of halogen lights on the roof the houses and livestock sheds facing the boundary and bushy forest area was the first mitigation technique applied.

I-Cow Technique: In this technique the structure of eyes is painted on the rump of cattle which dwell near the forest area. This idea is already present in nature; many animals use such mechanism to defend themselves from the enemy. Animals like Spectacled Cobra (*Naja naja*), Four-eyed butterfish (*Chaetodon capistratus*), Owl Butterfly (*Caligo beltrao*), etc use this technique to confuse their predator.

Metallic Livestock Sheds: To reduce leopard dependency on livestock metal sheds were constructed for cattle in some villages. A guideline was given to villagers how to construct metallic livestock sheds in place of their thatch roofed cages. Earlier the cattle were being kept in temporary sheds which are not very safe during leopard attacks. These domestic animals were very easy for the leopards to kill and eat.

'Cattle bell' technique: Villagers were instructed to tie cattle bells around the necks of few members in a shed every night. This technique was carried out as an alarm for shepherds in case of a leopard attack wherein anxious movement inside the shed would draw the attention of shepherd.

3. RESULTS AND DISCUSSION

Survey

On the basis of a scale prepared, we graded these conflict zones from highest to lowest level of conflict. We conducted surveys and marked waypoints in GPS of the conflict areas. We surveyed 79 villages in fringe areas of these two forests, out of which 18 villages showed rare or no leopard movement, 22 villages are suffering from conflict situations, but 39 villages are in major conflict zones.

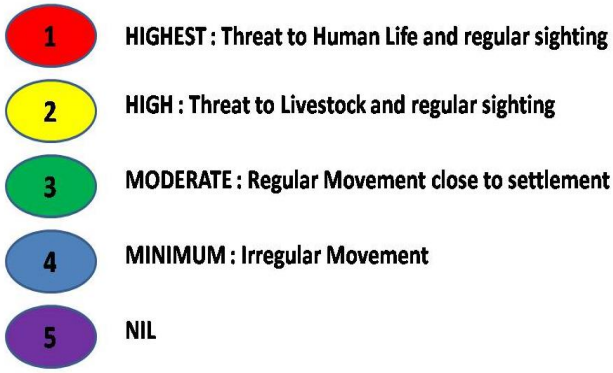

Figure 1 Scale of Human Leopard Conflict zones

Table 2 Number of villages and colonies in identified conflict zones

Zone	Number of Villages and Colonies
Zone 1	08
Zone 2	31
Zone 3	19
Zone 4	03
Zone 5	18

Scientific and Indigenous Mitigation Techniques

Halogen Light Technique

Installation of halogen lights on the roof of houses and livestock sheds facing the boundary and bushy forest area illuminated the hideout spots of leopards during the night time. Leopards have a habit of scanning their territory where they wish to conduct an ambush. In these conflict hotspots, leopards stopped lying in wait for their attack victim around attack-prone houses in forest fringe areas. This technique discouraged leopards to enter the area.

Figure 2 Installed Halogen light on village house roof top

I-Cow Technique

In this technique the structure of painted eyes on the rump of 50% cattle population in fringe communities enabled us to compare the rate of leopard attacks between cattle with and without the I-Cow technique. This novel technique acted like a 'surprise element' for leopards which attack cattle while grazing in forest fringe areas.

Figure 3 "I-Cow technique" on cattle of affected villages

The outcome was that the cattle with eyes painted on their rump were not attacked by leopards. Not a single case of leopard attack has been seen since this technique was implemented. We analyzed the results of the situation before and after this technique were carried out as well as compared the threat level to cattle with and without rumps painted with eyes.

Table 3 'I-Cow' Status in Jhalana and NWLS

	Till 30th December 2016			Till February 2017	
Animal	Adult	Sub-adult/Baby	Total	Mark Still Found	Repeated
Cow	154	123	277	76	201
Buffalo	39	21	60	9	51
Goat	257	54	311	37	274
Sheep	115	32	147	21	126
Donkey	7	1	8	0	8
Total	572	231	803	143	660
			Total "I-Cow"	Total + Repeated	1463

Metallic Livestock Sheds

We encouraged shepherds to build metallic livestock sheds for their animals with the aim of better protection from predation by leopards. A better alternative was construction and installation of wire mesh cages with thorny bushes along the outer surface of the livestock sheds. This technique discouraged leopards to come near the livestock sheds both during the day as well as at night time. These metallic livestock sheds have been very resourceful and have replaced older thatch-roofed and wooden cages in these villages. After making these sheds leopard movement in these villages is now reduced.

Figure 4 Installation of Metallic Livestock Sheds in affected villages

'Cattle bell' technique

Villagers were instructed to tie cattle bells around the necks of few members in a shed every night, so that even if some leopard strayed into the neighborhood at night, these few cattle with bells around their necks would act like an alarm. This was most useful in those houses in which villagers could not afford cemented base for metallic livestock sheds and there were chances for the leopard to dig around the wired mesh and enter the shed. The villagers were instructed to remove the cattle bells every morning before they went for grazing in order to avoid every possible chance for the leopard to follow the cattle bell sound in the forest fringe area while the cattle were grazing.

4. CONCLUSION

This study enabled us to become fully aware of the rampant situation in forest fringe areas. Regular visits to the conflict areas brought out many unknown problems. Mitigation techniques including metallic livestock sheds cages, I-Cow technique, halogen lamps and cattle bell technique have been implemented in conflict hotspots. These mitigation techniques were implemented to reduce the dependency of leopards on livestock. By constructing metallic livestock sheds leopards stopped coming in villages with these sheds because there was no easy food available in those areas.

I-Cow technique was done on about half of the cattle population in forest fringe area. I-Cow technique surprises the predator which gives extra time to the prey to escape. In this way we reduced the attacks inside forest fringe area. Conflict prevention, such

as live monitoring interventions, could also be improved with maps that were developed during the survey that identified vulnerable villages.

Informed consent

Not applicable.

Ethical approval

The Animal ethical guidelines are followed in the study for observation & identification.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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