InJAST
Volume 6, Number 1, April 2025
Pages: 7-19

P - ISSN: 2722 - 0133
E - ISSN: 2722 - 0141
DOI: https://doi.org/10.33751/injast.v6i`1.3

Living with Leopard-utopia or possible! Study on perception of local people towards coexistence with Leopard (*Panthera pardus fusca*) in and around the vicinity of the urban areas of Central India

ANIRUDDHA MAJUMDAR[1,*], TANUJ SURYAN[1], BALRAM LODHI[1], ANJANA S. TIRKEY[2], ABHAY KUMAR PATIL[3], RAVINDRA MANI TRIPATHI[1], SHAKTI SHUKLA[1], JASHNDEEP SINGH THAKUR[1], AMIT KUMAR JAISWAL[1], JASTI SAI KRISHNA[4]

[1]State Forest Research Institute, Jabalpur, 482008-Madhya Pradesh, India
[2]Field Director, Panna Tiger Reserve, Madhya Pradesh
[3]Retired PCCF, Madhya Pradesh Forest Department, Bhopal
[4]Amity University, Noida, Delhi NCR

*Corresponding author: *aniruddha.tiger@gmail.com*

Submitted 26 March 2025; Accepted 10 April 2025; Published 26 April 2025

ABSTRACT

Study on people's perception towards human & leopard coexistence in urban landscape was conducted from April 2022 to March 2023 at Jabalpur and Indore, Madhya Pradesh. In total, 73 villages and 2,827 households were surveyed in the urban areas of Jabalpur, whereas 48 villages and 2,255 households were surveyed in the urban areas of Indore through a standard structured questionnaire. The present study revealed a higher frequency of reported leopard encounters in Indore as compared to Jabalpur. Despite similar concerns in both study areas about the threats posed by leopards and the need for conservation, significant differences were found in respondents' willingness to learn about leopards and to coexist with them. Respondents in both Jabalpur and Indore predominantly attributed leopard presence to deforestation and forest land diversion. Despite their fear of living with large carnivores, a majority of participants indicated that they would not harm a leopard if encountered. Respondents from Indore reported higher satisfaction with the forest department's conservation efforts, possibly due to quicker compensation payments as compared to Jabalpur and also because they have exhibits (zoological park) of leopards and other wildlife for common people. During the survey, lack of awareness about conservation of leopard was observed in the periphery of urban landscape. Hence, running conservation awareness programmes with the help of NGOs and civil societies on human-leopard coexistence in both of these study areas may greatly help reduce hatred towards leopard in and around urban areas.

Keywords: *Human-leopard interaction, Indore, Jabalpur, large carnivores, urban ecology*

INTRODUCTION

Interactions between humans and wildlife are a global phenomenon and represent one of the most significant challenges to wildlife conservation (Khorozyan et al., 2015). The expansion of human populations into the habitats of large carnivores has led to substantial habitat loss, affecting both carnivores and their prey species (Mijiddorj et al., 2018; Priatna, 2019; Priatna et al., 2023). Consequently, carnivores often pose real or perceived threats to humans and livestock, leading to human-wildlife conflicts, with livestock depredation being the most common issue (Dhungana et al., 2019; Linnell et al., 2001; Mwakatobe et al., 2013). The increasing encroachment by humans into carnivore habitats has resulted in the depletion of these species' natural ranges (Krishnakumar et al., 2020). As predators require extensive habitats, they frequently enter human-dominated areas to meet their dietary and reproductive needs (Carter &Linnell, 2016; Uduman et al., 2021; Naha et al., 2021). The long-term survival of these species outside protected areas is largely dependent on local attitudes and tolerance towards them (Samantha et al., 2018).

Data on local perceptions of large carnivore interactions in human-dominated areas are scarce (Gebo, Takele, & Shibru, 2022). These perceptions are crucial as they often serve as primary data for understanding carnivore abundance trends and are influenced by cultural beliefs and social pressures within communities (Naughton-Treves & Treves, 2005; Dickman, 2010). Negative attitudes towards carnivores are common, particularly when they prey on livestock, leading to retaliatory actions such as poisoning, habitat destruction, and direct killings (Oli et al., 1994; Lenihan, 1996). In many regions, large carnivores must coexist with humans, necessitating an understanding of people's attitudes towards carnivore conservation. As human populations continue to encroach on protected areas, their role in both conserving and endangering predators becomes increasingly significant. Over the past two decades, awareness of large felids in semi-urban areas has grown, particularly as these animals' home ranges increasingly overlap with densely populated human

landscapes. India, home to a significant diversity of carnivore species, exemplifies this challenge, as these species must share space with a rapidly growing human population (Athreya et al., 2013). Leopards are found across Africa and South Asia, extending northward to Central Asia and eastward to the Amur Valley in Russia (Bailey, 1993; Edgaonkar & Chellam, 1998).The leopard is frequently involved in conflicts across India due to its behavioral adaptability and ability to thrive in a wide range of human habitats (Athreya et al., 2007).

Human-leopard conflicts are a significant management and conservation issue, primarily due to the opposition and intolerance of local communities in human-dominated landscapes (MacLennan et al., 2009). Identifying interface areas where conflicts occur can inform management strategies, but local community support is essential for successful conservation efforts (Pooley et al., 2021). Earlier studies revealed that leopards have attacked and killed people in various regions of India, which further leads to retaliatory killing of leopards by humans (Mishra et al., 2003; Treves & Karanth, 2003; Nyhus & Tilson, 2004; Badola et al., 2021). These conflicts arise from the overlap of human settlements and leopard habitats, with habitat loss, fragmentation, and degradation driving leopards into human areas in search of food and shelter. This often results in attacks on livestock, pets, or humans, triggering fear and retaliation from affected communities. Addressing human-leopard conflicts requires strategies such as improved livestock management, habitat protection, community engagement, and education to promote coexistence (Priatna et al., 2023).

While extensive research has been conducted on leopard ecology, particularly within protected areas, studies on urban leopard ecology remain limited (Jhala et al., 2016; Athreya et al., 2018). Despite being habitat specialists, leopards display a preference for specific landscapes. Substantial leopard populations were identified in both urban landscapes: 23.0 ± 4.8 in Indore and 17.6 ± 5.4 in Jabalpur (Majumder et al., 2024). Understanding local perceptions and tolerance levels towards leopards is crucial for integrating these species into broader areas where protected and human-shared landscapes intersect (Sanderson et al., 2002; Athreya et al., 2013). Conservation efforts must also consider the influence of social science in differentiating the negative impacts of wildlife on people from conflicts related to wildlife management (Redpath et al., 2013). Leopard venturing has been observed regularly in the housing complexes, residential colonies, and university complexes in Jabalpur and Indore, in search of domestic prey (Majumdar et al. 2025). Two writ petitions have been filed in MP High Court in the form of Public Interest Litigation, alleging that the presence of leopards is being noticed around the residential area of Rampur Colony, District Jabalpur (WP No. 492/2020 and WP No. 10703/2020). Though both petitions were disposed of by Hon'ble Madhya Pradesh High Court, it was felt important to have a detailed study of their source sites, the identification of main interaction zones and attitudes of local inhabitants in the urban areas of Jabalpur and Indore to reduce man-leopard interaction amicably. Based on this premise, the present study investigated the attitudes of local communities towards co-existence with leopard and leopard conservation in the urban areas of Jabalpur and Indore. This research provides a critical baseline for future studies and conservation initiatives aimed at mitigating human-leopard interactions in urban areas. Outcome of this study may help to propose conservation implications and practical actions to address these conflicts.

STUDY AREAS

Jabalpur

Jabalpur district, situated centrally in Madhya Pradesh, India, has a diverse geographical and demographic profile. It has a tribal population constituting about 15% of the total population. The district is renowned for its marble deposits, especially around Bhedaghat near the Marble Rocks on the Narmada River, located approximately 13 miles west of Jabalpur. Geographically, Jabalpur is positioned between north latitude 22°49' and 23°07' and east longitude 79°21' and 80°35'. It is bordered by Mandla and Dindori districts to the southeast and east, Seoni district to the south, Narsingpur district to the southwest, and Damoh

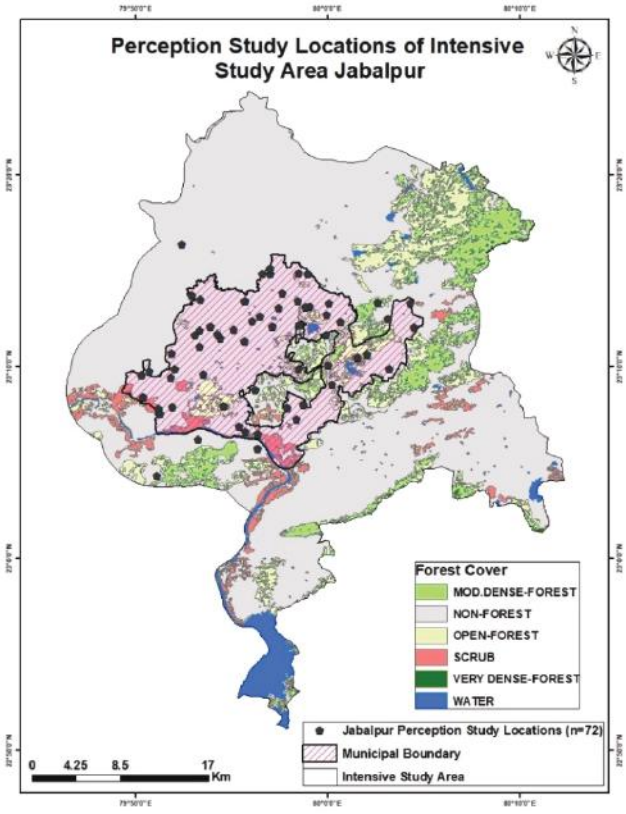

Figure 1. Surveyed area for perception study in Jabalpur.

district to the west. The district covers an area of 5,198 km² and is mapped in Survey of India Top sheets Nos. 55M, 64A, and 55N on a 1:250,000 scale (Figure 1). Jabalpur city, which lies in the Mahakoshal region along the banks of the Narmada River, serves as the judicial capital of Madhya Pradesh. According to the 2011 census, Jabalpur district has a population of 2,460,714.

In Jabalpur, Dumna Nature Park was identified as the primary leopard habitat, along with a sizable unprotected vegetated area near Jabalpur Airport. However, anthropogenic disturbances and developmental projects pose risks to these habitats. Forest patches in the study area could potentially serve as leopard movement corridors, but they face depletion due to various developmental projects. The Jabalpur district has approximately 95,099 hectares of forest cover, which is about 18.30% of the total district area.

Indore

Indore district, located in the heart of the Malwa plateau, spans an area of 3,831 square kilometers. It is situated between latitudes 22°25' and 23°05' N and at longitudes 75°31' and 76°05' E. The district is mapped in Survey of India toposheets Nos. 46M, 46N, and 55B. Geographically, Indore is bordered to the north by Ujjain district, to the south by Khandwa district, to the east by Dewas district, and to the west by Dhar district. The district is administratively divided into four tehsils and four development blocks, encompassing a total of 661 villages. Indore is known for being the industrial capital of the state, with a significant portion of its population engaged in trading and handloom industries (Figure 2). According to the 2011 Census, the total population of Indore district is 3,272,335.

In Indore, the Ralamandal Wildlife Sanctuary provides habitat for leopards, but surrounding areas have experienced fragmentation due to construction and urbanization. Highways, road expansion, industrial development, and agricultural expansion pose threats to identified corridors in the area. The forest of Indore mainly of dry deciduous type and the notify forest area of Indore division is 704.81 sq which is 18.08% of the total geographical area.

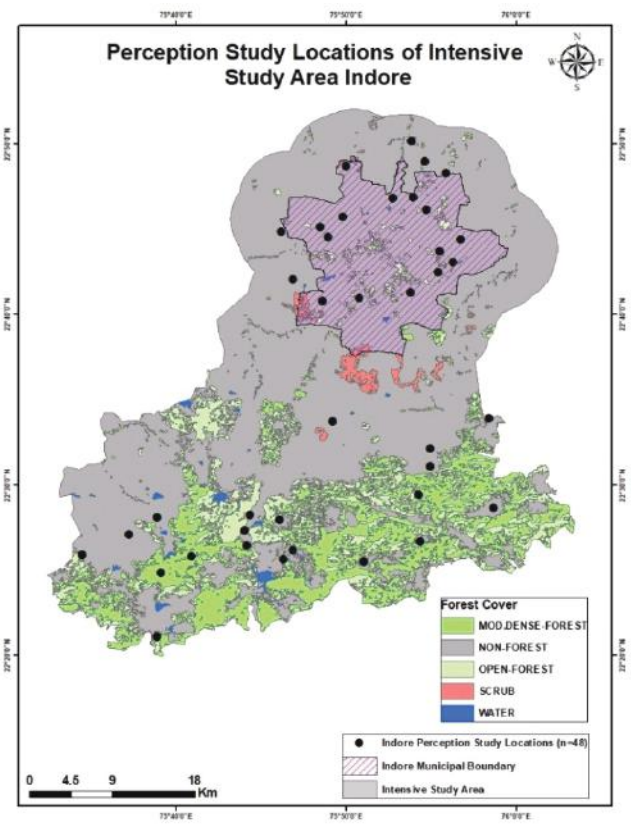

Figure 2. Surveyed area for perception study in Indore.

METHODS

Selection of villages

Present study was conducted to investigate the human perceptions of leopard interactions in the urban areas and also in the villages falling within 10 km of the city boundaries of Jabalpur and Indore, Madhya Pradesh. The study was carried out from April 2022 to March 2023, covering 73 villages with 2,827 households in the Jabalpur study area and 48 villages with 2,255 households in the Indore study area. Participants were selected using simple random sampling from households, irrespective of gender or age. A structured questionnaire was used to assess general awareness of people living with leopards, attitudes toward wildlife, perceptions of ecosystem services, negative interactions, and self-defense measures of local inhabitants, role of forest and other government officials and policymakers. Responses were recorded on a dichotomous (Yes/No) scale. In addition to the said information, age, gender profile, education level, demographic profile and earning sources were also recorded.

Surveyed households

In Jabalpur, the rural area comprises 17,695 households, of which 1,250 (7.06%) were surveyed. The semi-urban area includes 18,364 households, with 856 (4.66%) surveyed, and the urban area includes 15,339 households, with 721 (4.70%) surveyed. Overall, 2,827 (5.50%) households were surveyed out of a total of 51,398 households in Jabalpur district. In Indore, the rural area has 24,151 households, of which 988 (4.09%) were surveyed. The semi-urban area includes 13,463 households, with 756 (5.61%) surveyed, and the urban area includes 9,899 households, with 511 (5.16%) surveyed. In total, 2,255 (4.74%) households were surveyed out of 47,513 households in Indore district.

Statistical evaluation

Data were analyzed using Pearson's chi-square test in SPSS (version 20.0, IBM). A high χ^2 value and a p-value of less than 0.05 were considered statistically significant.

RESULTS

Socio-Demographic Profile of Jabalpur and Indore study area

Age of respondents

In Jabalpur study area, the largest age group among respondents was 28–37 years, with 746 individuals (26.39%), followed by the 18-27 age groups with 681 Individuals (24.09%), the 38-47 age group with 664 Individuals (23.49%), and the 48-57 age groups with 379 individuals (13.41%). Respondents aged over 58 years were relatively lower, with 357 individuals (12.63%) (Figure 3).

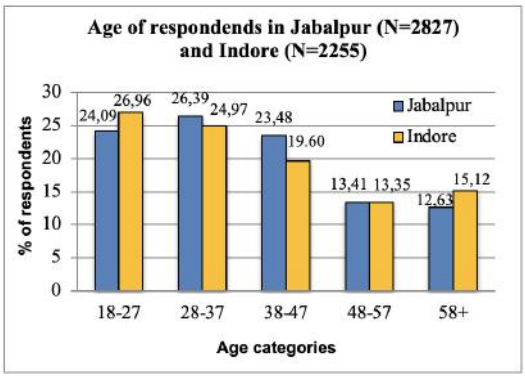

Figure 3. Age categories of surveyed of Respondents in Jabalpur and Indore.

In the Indore study area, the 18-27 age group was the largest, with 608 individuals (26.96%), followed by the 28-37 age group with 563 individuals (24.97%), the 38-47 age group with 442 individuals (19.60%), and those aged over 58 years with 341 individuals (15.12%). The 48-57 age group was the smallest, with 301 individuals (13.35%) (Figure 3).

Gender of respondents

In Jabalpur study area, about 59% (n=1,668) of the respondents were male, while 41% (n=1,159) were female (Figure 4). In the Indore study area, approximately 63.95% (n=1,442) of the respondents were male, and 36.05% (n=813) were female (Figure 5).

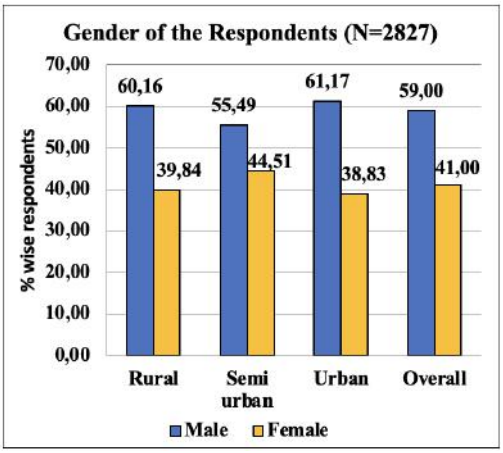

Figure 4. Locality wise gender of the Respondents in Jabalpur.

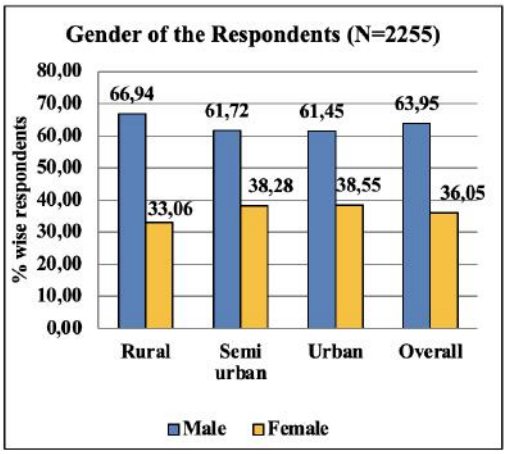

Figure 5. Locality wise gender of the Respondents in Indore.

Locality

In Jabalpur study area, out of total respondents, 1,250 individuals (44.22%), were from rural areas, followed by 856 individuals (30.28%) from semi-urban areas, and 721 individuals (25.50%) from urban areas (Figure 6). Similarly, in the Indore study area, out of total respondents, 1,003 individuals (44.48%), were from rural areas, followed by 744 individuals (32.99%) from semi-urban areas, and 508 individuals (22.53%) from urban areas (Figure 6).

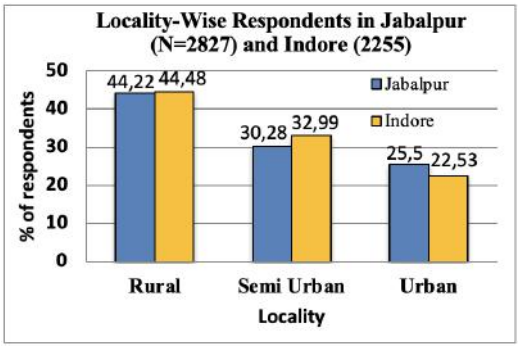

Figure 6. Locality wise respondents in study area in Indore.

Education level of respondents

In Jabalpur study area, the highest percentage of respondents were educated up to the secondary school level (32.68%), followed by 27.31% who were educated up to the graduate level, 24.66% up to the high school level, 7.43% above the postgraduate level, and 7.92% were found to be illiterate. In the Indore study area, most respondents were educated up to the high school level (40.09%), followed by 24.48% up to the graduate level, 19.60% up to the higher secondary school level, 6.43% above the postgraduate level, and 9.40% were illiterate.

General awareness

The survey revealed that in Jabalpur study area, 27.24% of respondents reported having seen a leopard, whereas in Indore study area, the percentage was higher at 53.39%. There was no significant association between locality and leopard sightings in Jabalpur study area (χ^2 = 9.403, df = 2, p = 0.09), with the highest sightings reported in rural areas (29.04%). In Indore study area, a highly significant association was found between locality and leopard sightings (χ^2 = 27.195, df = 2, p = 0.000), with the majority of sightings reported in rural areas (58.44%). The difference in leopard sightings between the two cities was statistically significant (P = 0.0, Z = -19.476). In both Jabalpur and Indore study area, a considerable number of respondents perceived leopards as a threat and a matter of concern in their localities. In Jabalpur study area, 43.79% of respondents expressed this view, while in Indore; the percentage was higher at 52.42%. Regarding necessity of leopard conservation, almost equal percentages of respondents in Jabalpur (91.44%) and Indore (92.51%) believed that conservation was necessary. In Jabalpur (χ^2 = 16.322, df = 2, p = 0.000), locality and the perceived necessity for leopard conservation showed significant differences, with rural respondents (88.56%) more likely to agree on the need for conservation. In Indore, localities did not show a significant relationship with conservation views, though rural respondents (92.05%) still agreed more on the need for conservation. Additionally, a high percentage of respondents expressed a willingness to learn more about leopards, with slightly higher interest in Indore (94.46%) compared to Jabalpur (89.85%). Regarding the reasons behind leopards venturing into localities, more respondents in Indore (94.90%) were willing to understand these reasons compared to Jabalpur (87.41%). However, in both cities, urban respondents reported facing fewer significant problems from leopard sightings, with approximately 90.91% expressing this view. In Jabalpur (χ^2 = 42.462, df = 2, p = 0.000) and Indore (χ^2 = 16.596, df = 2, p = 0.000), locality significantly influenced the willingness to learn more about leopards, with rural respondents in both Jabalpur (91.00%) and Indore (96.06%) showing more interest. There was a significant difference between Jabalpur and Indore in terms of willingness to know the reasons behind leopards venturing into localities (P = 0.0, Z = -9.658). Regarding leopard attacks, 71.34% of respondents in Jabalpur study area believed that leopards mostly attack prey animals, while 15.06% were unsure, and 7.25% believed they attacked children. In Indore study area, 67.49% believed leopards primarily attack prey animals, 25.94% were unsure, and 3.19% believed they attacked children.

Living with leopards

In both Jabalpur and Indore study area, most respondents expressed fear towards leopards only because they are large carnivores and can attack at any time. In Jabalpur study area 83.69% whereas in Indore study area 82.48% was reporting fear from leopard. In Jabalpur (χ^2 = 38.258, df = 2, p = 0.000) and Indore (χ^2 = 26.839, df = 2, p = 0.000), localities and fear of leopards showed significant differences, with respondents in semi-urban areas of Jabalpur (87.03%) and Indore (86.45%) expressing more fear due to the presence of leopards. In terms of gender, in Jabalpur study area, approximately 82.79% of male respondents and 84.99% of female respondents expressed fear towards leopards. In Indore study area, 81.83% of male respondents and 83.64% of female respondents reported the same. When asked about the major problems associated with leopards venturing out of forested areas, 69.5% of respondents in Jabalpur identified deforestation as the major problem, whereas in Indore, 54.15% of respondents cited deforestation and land diversion, followed by 26.39%, who mentioned secret hunting of prey as another important issue (Figure 7). Regarding leopard sightings in their localities, 10.97% of respondents in Jabalpur reported sightings, with a higher proportion among rural respondents. In Indore study area, 17.16% of respondents reported sightings, with a higher proportion among semi-urban respondents. Most respondents in Jabalpur (83.45%) and Indore study area (96.41%) disagreed with the idea that leopards are suitable to live in cities, with significant differences between the two cities (P = 0.0, Z = 16.361). When asked if they were willing to live with leopards in their locality, most respondents in both Jabalpur (80.83%) and Indore study area (96.50%) expressed unwillingness to live as it is a large carnivore. There were significant differences between the two urban areas in this regard (P = 0.0, Z = 18.743). Regarding the fear of leopards, respondents in Jabalpur (78.76%) and Indore study area (82.62%) attributed their fear to the fact that leopards are large carnivores. There were significant differences between the two urban areas in this aspect (P = 0.0003, Z = -3.649). However, a similar proportion of respondents in both of these urban areas (Jabalpur: 74.5%, Indore: 74.6%) stated that they would not harm a leopard if they

encountered one in their locality. Most respondents in Jabalpur (71.35%) and Indore study area (83.19%) agreed with the statement that it is not appropriate to label leopards as dangerous creatures. There were significant differences between the two cities in this perception (P = 0.00, Z = -10.219).

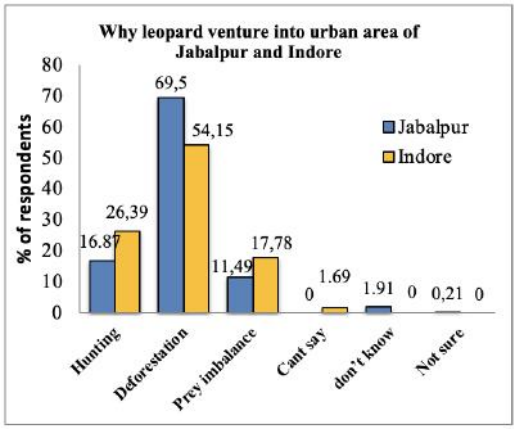

Figure 7. Reason behind Leopard venturing into urban area in Indore.

Attitude towards wildlife

In the survey, 93.10% of respondents in Jabalpur and 96.61% in Indore study area believed that any type of hunting or harming on wild animals should be stopped. Additionally, 82.24% of respondents in Jabalpur and 89.36% in Indore were satisfied with the steps taken by the forest department if any casualties happened by wildlife in both of these urban areas. Most of the local people in Jabalpur (48.89%) believed that leopards primarily reside within forested areas, followed by 38.73% who were unsure about leopard habitat. In Indore, most respondents (61.15%) also selected forest areas as the leopard's primary residence, with 34.77% being unsure. When asked about daily activities affected by leopards, most respondents in both Jabalpur (59.32%) and Indore (55.88%) did not provide a specific response, followed by mentioning that their routine walk is highly affected by the movement of leopard (22.98% and 30.86%, respectively).

Conservation insights

In Jabalpur study area, 29.25% of people believed most of the leopard sightings in their locality occurred during winter, followed by 26.92% during the summer. This perception aligns with secondary data, which also indicated a higher number of leopard sightings in the winter. In Indore, 33.04% of respondents believed leopard sightings mostly happened during the summer, with 29.14% mentioning winter. The study found that most respondents in both cities held an optimistic attitude towards leopard conservation. In Jabalpur study area, 88.22% of households favored leopard conservation, while in Indore study area, 93.79% of respondents expressed support. Significant differences in these attitudes were observed between the two cities (P = 0.0, Z = -10.921). Furthermore, a majority of respondents in Jabalpur (85.85%) and Indore study area (92.50%) expressed willingness to contribute to leopard conservation, with no significant differences between these urban areas (P = 9.33E-15, Z = -7.749).

Ecosystem services

The study revealed that 86.77% respondents in Jabalpur and 94.9% respondents in Indore study area believed an increase in the leopard population in their cities would boost tourism revenue if any safari developed, like Jhalana, Rajasthan. Significant differences were noted between Jabalpur and Indore in this perception (P = 0.0, Z = -10.442). Overall, 69.30% of respondents in Jabalpur and 82% in Indore considered the urban environment unsuitable for leopards (Figure 8 & 9). A significant percentage of respondents in Jabalpur (72.73%) and Indore (69.36%) had a positive attitude towards establishing a sanctuary in their cities (P = 0.009, Z = 2.628) (Figure 10 & 11). Additionally, 79.13% respondents in Jabalpur and 90.20% in Indore believed leopards play a crucial role in maintaining ecological balance, with significant differences between the cities (P = 0.0, Z = -11.217) (Figure 12 & 13). In terms of religious belief and cultural importance, 46.62% of respondents in Jabalpur and

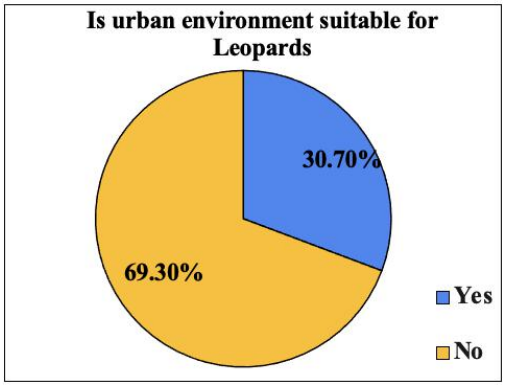

Figure 8. Urban environment suitability in Jabalpur.

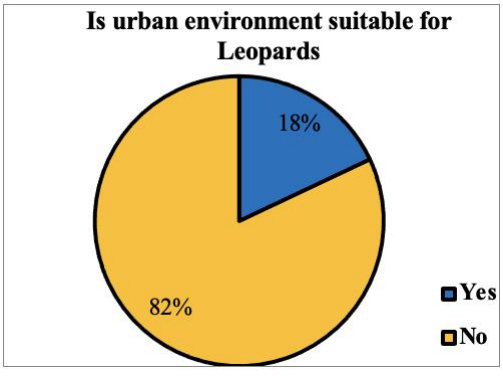

Figure 9. Urban environment suitability in Indore.

28.12% in Indore considered leopards central to their religious beliefs. Significant differences were found between the two study sites (P = 0.0, Z = 13.885). Furthermore, 59.36% of respondents in Jabalpur and 74.28% in Indore believed that the leopards are important in human life, with significant differences were found between the two study sites (P = 0.0, Z = -11.430).

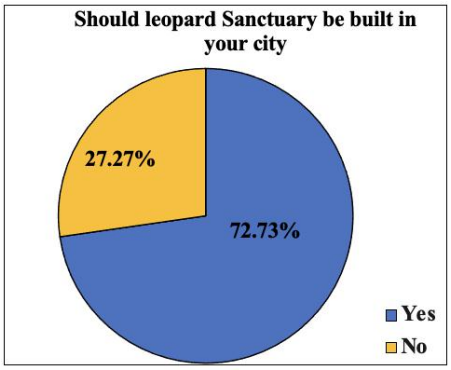

Figure 10. Locality wise respondents in study area in Jabalpur.

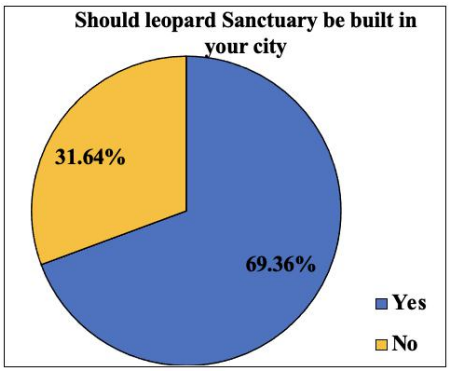

Figure 11. Locality wise respondents in study area in Indore.

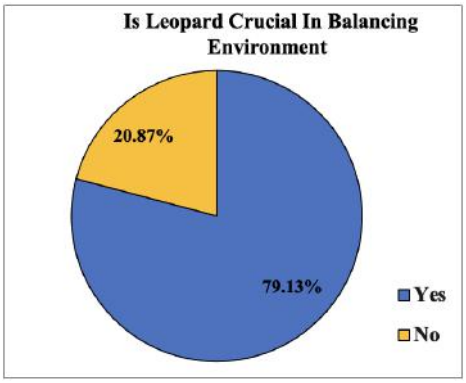

Figure 12. Public perception on leopard's role in environmental Balance in Jabalpur.

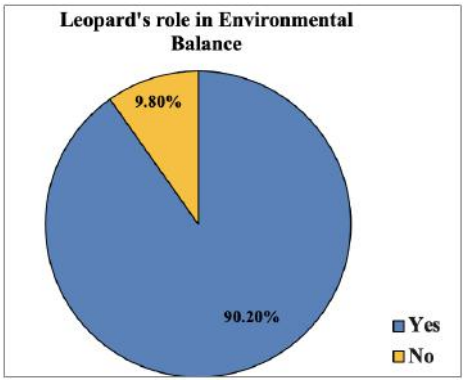

Figure 13. Public perception on leopard's role in environmental Balance in Indore.

Negative interactions

During the household survey, 99.68% of respondents in Jabalpur and 93.09% in Indore study area denied any harm to their livestock by leopards. A smaller percentage of respondents in Jabalpur i.e., 28.72% and a comparatively higher percentage in Indore study area i.e., 44.12% preferred to avoid negative interactions with leopards. There were significant differences between the two study sites in this preference (P = 0.0, Z = -10.127).

Based on the secondary data collected from the Indore Forest Division revealed 955 incidents of cattle depredation by leopards from 2012 to 2021, with the majority targeting cows (83.53%), followed by goats (10.55%) and buffaloes (5.92%) (Figure 14). All three depredation incidents recorded during camera trapping in Indore involved cows. Data from the Jabalpur division, a total of 38 cases of livestock depredation were reported from 2013 to 2021 (Figure 15). The analysis revealed that cows were the most frequently preyed upon by livestock, accounting for 44.74% of the reported cases, followed by goats representing 34.21% of the cases. Buffaloes constituted 13.15% of the cases, and sheep accounted

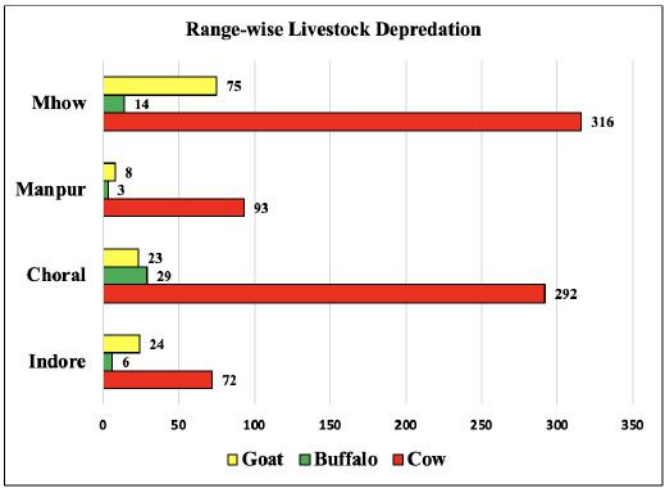

Figure 14. Livestock depredation cases in Indore from 2013-2021.

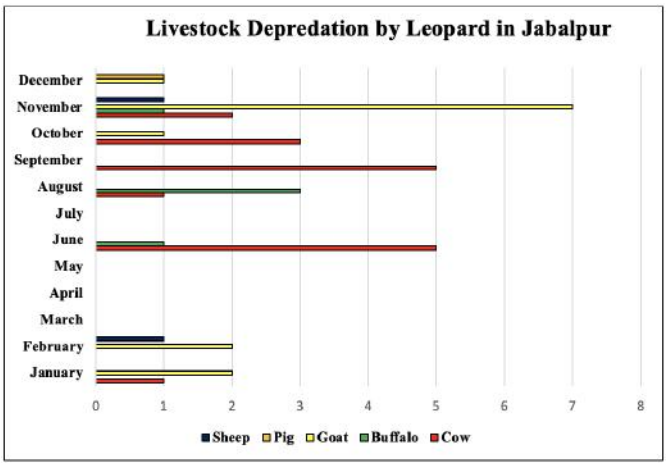

Figure 15. Livestock depredation cases in Jabalpur from 2013-2021.

for 5.26%. The remaining 2.63% involved other types of livestock. These findings, illustrated in Figure 15, offer insights into the distribution pattern of livestock depredation incidents within the Jabalpur division.

Self-defense

In Jabalpur study area, 47.61% of respondents expressed the need for precautions against leopards, with semi-urban residents being more inclined towards taking such measures. In Indore study area, the same percentage of respondents also opted for precautions, but rural residents showed a higher tendency to take precautions against leopards. These differences between the two cities were found to be significant (P = 0.0, Z = 13.235). Regarding specific actions taken for protection, 55.96% of respondents in Jabalpur study area stated they would hide, whereas 33.29% mentioned other protective activities. In Indore study area, 50.47% of respondents stated they would engage in other activities such as using fire, informing rescue teams, or making loud noises to protect themselves, followed by 43.68% who mentioned hiding.

Regarding the installation of cameras or deployment of electronic surveillance systems as a precautionary measure against leopards, 69.26% of respondents in Jabalpur study area expressed the desire for Closed Circuit Television (CCTV) cameras in their localities, whereas in Indore, 84.21% expressed similar desire. The difference between the two study sites in terms of preference for electronic surveillance system installation was significant (P = 0.0, Z = -12.901).

DISCUSSION

Understanding the local perceptions and attitudes towards leopards, particularly in human-dominated landscapes, is crucial for effective biodiversity conservation (Gandiwa, 2012; Merkebu & Yazezew, 2021; Morehouse et al., 2020; Priatna et al., 2023). This study provides a valuable insight into the perceptions and attitudes of residents in Jabalpur and Indore study areas regarding human-leopard coexistence, marking the first investigation of these aspects in urban areas of this state that has highest number of leopards in India as per latest estimation in 2022 (Qureshi et al., 2023).

Seasonal difference

In Jabalpur, the majority of respondents believed that leopard sightings occur primarily during winter, followed by summer. Conversely, in Indore, most respondents thought that sightings predominantly occur in the summer, followed by winter. This seasonal variation in leopard sightings is consistent with previous research (Naha et al., 2020; Tamang et al., 2008), which noted a higher incidence of leopard activity during the dry season. However, this finding contrasts with studies in the Western Ghats, which found greater leopard activity during the rainy season due to increased vegetation cover (Krishnakumar et al., 2020). Naha et al. (2021) further reported that leopards avoid human settlements during the rainy season but are attracted to areas near roads and water sources when human activity is high. These insights highlight the complex relationship between seasonal environmental factors and leopard behavior, emphasizing the need for context-specific conservation strategies.

General awareness

The results of present survey indicated that residents of Indore, where a Zoological Park is present, have more knowledge about leopards and reported a higher likelihood of leopard encounters compared to those in Jabalpur. This finding aligns with previous research showing that local knowledge and experience with wildlife can significantly influence attitudes (Kshettry et al., 2017; Priatna, 2019). In our study, a high proportion of respondents in both Jabalpur and Indore acknowledged the necessity of leopard conservation and expressed interest in understanding the reasons behind leopard sightings in their respective areas. These results are consistent with Rani Megha et al. (2024), who reported a positive local attitude towards leopard conservation in Rajaji Tiger Reserve, Uttarakhand, primarily driven by the aesthetic value of leopards. However, despite the high levels of support for conservation, both urban populations reported minimal issues related to leopard sightings. The majority of respondents in Jabalpur and Indore believed that leopards primarily target the wild prey animals, reflecting a general understanding of leopards' ecological role.

Living with leopards

Fear, often driven by media reports and personal experiences significantly influence attitudes towards large carnivores (Røskaft et al., 2003). In both Jabalpur and Indore, the predominant sentiment is one of the reasons for fear towards leopards, likely due to perceived risks to livestock and human safety. This is supported by previous studies showing that fear of large carnivores often stems from concerns about their potential threats (Lichtenfeld, 2005). Our findings also reveal that men generally hold more positive attitudes towards leopard conservation compared to women, a trend that aligns with other studies highlighting the impact of gender on wildlife perceptions (Teixeira et al., 2021; Mkonyi et al., 2017; Trajçe et al., 2019). Women's greater involvement in forest-based activities may increase their exposure to negative interactions with wildlife. Despite these fears, respondents in both districts showed a willingness to coexist with leopards when associated with tourism and conservation benefits. The consensus on deforestation and prey hunting as primary threats to leopards corroborates findings by Goyal (2007), which identify habitat degradation as a key factor in leopard-human conflicts.

Attitude towards wildlife

Effective carnivore conservation relies on public support for management practices aimed at reducing threats and mitigating conflicts with domestic animals. The survey revealed that a significant majority of respondents in both Jabalpur and Indore oppose hunting of wild animals and expressed satisfaction with the measures taken by the forest department. Notably, respondents in Indore seemed more satisfied, possibly due to the forest department's prompt compensation for livestock losses caused by carnivores as compared to Jabalpur. These findings underscore the importance of aligning conservation strategies with public perceptions and attitudes towards wildlife management, hunting, and illegal wildlife trade (Wilkie & Carpenter, 1999; Heberlein, 2008; Priatna & Monk, 2022).

Attitude towards leopard conservation

In the present study, the majority of respondents demonstrated an optimistic attitude toward leopard conservation and supported the leopard conservation initiatives by Forest Departments. This finding is not consistent with studies in developing countries, where local communities often wish to reduce carnivore populations due to livestock damage (Gandiwa, 2012; Marneweck et al., 2021; Merkebu & Yazezew, 2021; Mkonyi et al., 2017; Tessema et al., 2010). Conversely, in developed countries like Norway, over 84% of people support carnivore conservation, primarily due to compensation for losses, government policies, and conservation education (Hansen et al., 2019; Tilman et al., 2017). Interestingly, while previous research suggested that males generally have more positive attitudes toward conservation than females, possibly due to differences in fear and perceptions of animals (Mkonyi et al., 2017; van der Meer et al., 2020), this study found similar levels of support for conservation among both genders in Jabalpur and Indore. This finding suggest that gender may not be a significant factor in shaping attitudes in these regions. A notable proportion of respondents in Jabalpur and Indore expressed willingness to contribute to leopard conservation. This is in line with Yirga et al. (2011), who highlighted the importance of local attitudes in conservation efforts. The finding that residents in areas without frequent carnivore encounters tend to have more positive attitudes (Szinovatz, 1997) is reflected in the relatively low percentages of respondents in Jabalpur and Indore who preferred leopards only in zoos as compared to open forest. This underscores the need to consider local perceptions of conservation strategies and indicates strong support for leopards remaining in their natural habitats.

Ecosystem services and cultural significance

The study reveals that most respondents in Jabalpur and Indore believed that an increase in the leopard population would boost tourism revenue. These findings align with previous research indicating that positive attitudes toward carnivores are often linked to their potential for tourism revenue (Dickman, Macdonald, & Macdonald, 2011). Moreover, most respondents in Jabalpur and Indore recognize leopards' crucial role in maintaining ecological balance. This understanding contributes to positive attitudes toward leopard conservation (Samantha et al., 2018). The cultural and ecological significance of carnivores, including lynx and gray wolves, has been highlighted in various studies (Bath et al., 2008; Berry et al., 2016), and respondents often mention the spiritual and cultural importance of leopards in the study area. In terms of religious beliefs and cultural importance, a significant percentage of respondents in Jabalpur and Indore consider leopards central to their religious beliefs. Furthermore, majority of respondents in Jabalpur and Indore believed that leopards are important in human life. These findings are consistent with studies that highlight the spiritual and cultural significance of carnivores in various regions (Young et al., 2015; Baynes et al., 2013; Reddy et al., 2013). For example, in Nepal, snow leopards are protected due to Buddhist beliefs, whereas wolves are persecuted due to negative cultural perceptions (Ale, 1998; Mishra, 1997). Additionally, tigers and lions hold cultural significance in the Indian subcontinent, symbolizing the mount of Goddess Durga.

Human-leopard negative Interactions & mitigation measures

Human-wildlife conflicts can have significant financial impacts on local communities, as those living near wild habitats are often among the lowest income categories (Dar et al., 2009; Priatna et al., 2023). In India, increasing human populations, habitat loss, and successful conservation programs have led to rising conflicts between humans and wildlife (Rodgers, 1989; Saberwal et al., 1994). In this study, a substantial percentage of respondents in Jabalpur and Indore expressed concerns about managing encounters with leopards. Additionally, a significant proportion reported lacking safeguards against such encounters.

Most respondents in Jabalpur and Indore reported feeling a sense of danger regarding leopards. This fear is more pronounced among rural respondents and can contribute to negative attitudes toward large carnivores, especially when perceived as threats to livestock or human life (Dickman, 2008; Maddox, 2003; Røskaft et al., 2007). Despite these concerns, most respondents in Jabalpur and Indore denied any harm to their livestock by leopards. A portion of respondents in Jabalpur and a higher percentage in Indore preferred to avoid negative interactions with leopards. This is consistent with previous studies showing that negative attitudes can arise when carnivores prey upon livestock (Oli et al., 1994; Lenihan, 1996).

CONCLUSION AND RECOMMENDATIONS

The study provides valuable insights into the perceptions and preferences of residents in the Jabalpur and Indore study area regarding leopards and human negative interactions. Despite considerable awareness about leopards in both urban areas, respondents generally view them as a threat and are reluctant to coexist with them. To address this issue, it is crucial to initiate awareness drives and programs to enhance understanding of leopards' ecological behavior and the ecosystem services they provide. The prevalent fear of leopards, primarily due to concerns about livestock and human safety, necessitates strengthening Animal Rescue Squads and Forest Department teams to ensure public confidence and improve safety measures for both people and animals. The survey also highlights a strong belief among respondents that secret hunting of wild animals should cease. Overall, respondents expressed satisfaction with the steps taken by the Forest Department, possibly due to prompt compensation for losses caused by large carnivores.

Human-wildlife negative interactions can significantly impact local communities, particularly those with lower incomes. The rising negative interactions in India require addressing factors such as human population growth, habitat loss, and the implementation of successful conservation programs to balance human needs with wildlife conservation. In terms of precautions, respondents in both urban areas expressed the need for preventive measures. Semi-urban residents in Jabalpur showed a higher inclination towards taking precautions, while rural residents in Indore displayed a greater tendency towards precautionary measures. Awareness campaigns should educate people about appropriate responses during direct encounters with leopards. Protective actions mentioned by respondents include hiding, using fire, informing rescue teams, or making loud noises. The installation of electronic surveillance as a precautionary measure was also favored, especially in Indore. These findings emphasize the importance of tailoring conservation strategies and addressing human-leopard negative interactions based on regional differences and preferences. Overall, the survey findings offer valuable insights into designing and implementing effective management strategies for leopard conservation and mitigating human-wildlife interactions in Jabalpur and Indore.

Additionally, interviews with local politicians and policymakers revealed their awareness of leopard behaviour and their willingness to support perception surveys. The findings suggest that local communities may play a crucial role in effective leopard conservation and in promoting coexistence with carnivores, with the support of government officials. Policymakers acknowledged the importance of leopard conservation for maintaining regional biodiversity and stressed the need to manage the leopard population and prevent poaching. The positive response from local politicians and policymakers indicated a growing understanding of leopard conservation's significance. Their support and cooperation are essential for implementing effective conservation strategies and ensuring the long-term survival of leopards in Indore and Jabalpur.

Summarizing, we suggest proper monitoring of boundary walls of institutions, government departments, and housing complexes and period thinning of tree branches crossing the boundaries are also crucial. Regular monitoring of dumping grounds near forest areas is essential to prevent disturbances and potential negative interactions. Regular monitoring of the prey base in larger forest patches and control of feral dogs in the urban landscape is crucial for the long-term sustenance and growth of leopard populations inside the forest area and preventing them from entering the urban area. The creation of an "Urban forest" or locally called 'Nagar Van' could secure the fate of urban leopards in natural habitats- Dumna Nature Park, Thakurtal Nagar Van Udyan and Sangram Sagar areas in Jabalpur, as well as the Ralamandal Wildlife Sanctuary, Devguradia, Choral range and Mhow Cantt area in Indore, should be prioritized for the highest level of protection. Sensitization of night-time movement, especially for

children, is essential in those areas where leopard movements are very frequent. Active surveillance systems can enhance the detection of leopards in the vicinity and reduce the chances of negative interaction with leopards in residential areas. Proper signage and streetlights on roads passing through forest patches are essential to restrict reckless driving and prevent road killings of wildlife, including leopards.

Living with the leopard in urban landscape is not a utopia, it is already proven possible in the other urban landscapes of Central India, especially in Mumbai. It was possible in this city, mostly due to lots of awareness campaign with local inhabitants and various enrichment activities towards leopard conservation. During the survey, lack of awareness on conservation of leopard was observed in the periphery of the urban landscapes as compared to core city areas. The Forest Department can establish a "Tendua Mitra" or "Friends of Leopards" group with the help of local NGOs and Citizens forum or civil societies to sensitize the public about ecology of leopards and foster a positive attitude towards their conservation.

So far as the two Writ Petitioners filed in MP high court are concerned, our study also indicated that local people are not completely against living with leopard. They requested for prompt steps whenever and wherever required to reduce human leopard negative interactions. They also suggested for leopard safari especially in Jabalpur. Regular monitoring of urban leopard and prey population should be carried for long term basis to promote amicable coexistence between human and leopard in the urban areas.

Thus, both the Writ Petitions were based on wrong assumption and misinformation. The present study is clearing the clouds. This is also a major finding or outcome of our study.

ACKNOWLEDGEMENTS

We expressed our sincere gratitude to senior officials of Madhya Pradesh Forest Department, particularly Mr Aseem Shrivastava (HoFF, MP Forest), Mr Subharanjan Sen, Principal Chief Conservator of Forest (Wildlife) and the Chief Wildlife Warden, for financial support and permission to conduct the project work. Special thanks are extended to Mr. Amitabh Agnihotri, (former Director of the State Forest Research Institute (SFRI), Jabalpur), and Mr. Pradeep Vasudeva (PCCF and present Director, SFRI Jabalpur), for their insightful guidance. Mr. Alok Kumar and Mr Jasbeer Singh Chouhan (both former CWLWs, M.P. Forest), Mr Satyanand (Former APCCF Wildlife and retired PCCF Budget) and Dr H S Negi (former APCCF Wildlife) are highly acknowledged for their support towards the "Urban Leopard project". We are thankful to all the officials and staff of both Indore and Jabalpur Forest Divisions for their extended support towards the project team during field data collection, especially, Mr Naresh Pandwa (Former DFO Indore), Mr Krishna K Ninama (SDO Indore) and Mr Gulab Singh Rajput (Forester under Jabalpur Forest Division). A note of gratitude is also extended to the officials of Animal Husbandry Department in Indore and Jabalpur for providing livestock data and to the all-Army officials and other government officials for granting permission during a field survey. This study was financially supported by Madhya Pradesh Forest Department.

Declaration

Authors declare no conflict of interest.

REFERENCES

Athreya A., Pimpale, S., Borkar, A.S., Surve, N., Chakravarty, S., Ghosalkar, M., et al (2018). Monster or gods? Narratives of large cat worship in Western India. *Cat New, 67:23-26*.

Athreya, V. R., Thakur, S. S., Chaudhuri, S., & Belsare, A. V. (2007). Leopards in humandominated areas: a spillover from sustained translocations into nearby forests?. *Journal-Bombay Natural History Society, 104(1): 45*.

Athreya, V., Odden, M., Linnell, J. D., Krishnaswamy, J., & Karanth, U. (2013). Big cats in our backyards: persistence of large carnivores in a human dominated landscape in India. *PloS one, 8(3): e57872*.

Badola, R., Ahmed, T., Gill, A. K., Dobriyal, P., Das, G. C., Badola, S., & Hussain, S. A. (2021). An incentive-based mitigation strategy to encourage coexistence of large mammals and humans along the foothills of Indian Western Himalayas. *Scientific Reports, 11(1): 5235*.

Bailey TN (1993) The African leopard: ecology and behavior of a solitary felid. Columbia University Press, New York

Bailey, T.N., 1993. The African leopard. In The African leopard. Columbia University Press

Carter, N. H., & Linnell, J. D. (2016). Co-adaptation is key to coexisting with large carnivores. *Trends in Ecology & Evolution, 31(8): 575-578*.

Dhungana, R., Lamichhane, B. R., Savini, T., Dhakal, M., Poudel, B. S., & Karki, J. B. (2019). Livestock depredation by leopards around Chitwan national park, Nepal. *Mammalian Biology, 96: 7-13*.

Dickman, A. J. (2010). Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. *Animal conservation, 13(5): 458-466*.

Edgaonkar A, Chellam R (1998) A preliminary study on the ecology of the leopard (*Panthera pardus fusca*) in the Sanjay Gandhi National Park, Maharashtra. RR-98/002. Wildlife Institute of India, Dehra Dun, p 33

Gandiwa, E. (2012). Local knowledge and perceptions of animal population abundances by communities adjacent to the northern Gonarezhou National Park, Zimbabwe. *Tropical Conservation Science, 5(3): 255-269*.

Gebo, B., Takele, S., &Shibru, S. (2022). Perception and attitude of the local people toward carnivore population and conservation in the Faragosa-Fura landscape of the Southern Rift Valley, Ethiopia. *Conservation Science and Practice, 4(7): e12705*.

Graham, K., Beckerman, A. P., &Thirgood, S. (2005). Human–predator–prey conflicts: ecological correlates, prey losses and patterns of management. *Biological conservation, 122(2): 159-171*.

Jhala, Y. V., Qureshi, Q., & Ghosh, P. (2016). Status of the leopard (Panthera pardus) in India. *PlosOne, 11(7), e0159871*. https://doi.org/10.1371/journal.pone.0159871

Khorozyan, I., Ghoddousi, A., Soofi, M., &Waltert, M. (2015). Big cats kill more livestock when wild prey reaches a minimum threshold. *Biological Conservation, 192: 268- 275*.

Krishnakumar, B. M., & Nagarajan, R. (2020). Living with Leopard *Panthera pardus fusca* (Mammalia: Carnivora: Felidae): livestock depredation and community perception in Kalakkad-Mundanthurai Tiger Reserve, southern Western Ghats. *Journal of Threatened Taxa, 12(10):16210-16218*.

Kshettry, A., Vaidyanathan, S., & Athreya, V. (2017). Leopard in a tea-cup: A study of leopard habitat-use and human-leopard interactions in north-eastern India. *PLoS One, 12(5): e0177013*.

Lenihan ML (1996). Public attitudes about wolves: a review of recent investigations. In: The Yellowstone Wolf—A Guide and Sourcebook. Mill Pond Press, Venice, FL, p. 354.

Lichtenfeld LL (2005) Our shared kingdom at risk: human–lion relationships in the 21st century. PhD Dissertation, Yale University, CT

Linnell, J. D., Swenson, J. E., & Anderson, R. (2001, November). Predators and people: conservation of large carnivores is possible at high human densities if management policy is favourable. In Animal conservation forum (Vol. 4, No. 4, pp. 345-349). Cambridge University Press.

Maclennan, S. D., Groom, R. J., Macdonald, D. W., & Frank, L. G. (2009). Evaluation of a compensation scheme to bring about pastoralist tolerance of lions. *Biological Conservation, 142(11): 2419-2427*.

Majumder, A., Suryan, T., Rizvi, T., Mani, R.M., Nag, S. ((2024). Assessment of the population and suitable habitat for a leopard (*Panthera pardus*) in the urban landscapes of Central India. *European Journal of Wildlife Research, 70: 120*. https://doi.org/10.1007/s10344-024-01871-7

Majumder, A., Suryan, T., Rizvi, T., Thakur, J., Tripathi, R.M. and Rokde, A. (2025). Dietary Resource Selection Pattern of Leopard (*Panthera pardus*) and its Conservation Implications in Urban Landscapes of Central India. *Mammal Study, 50(3):1-11*.

Merkebu, S., &Yazezew, D. (2021). Assessment of Human-Wildlife Conflict and the Attitude of Local Communities to Wild Animal Conservation around BorenaSayint National Park, Ethiopia. *International Journal of Ecology, 2021(1): 6619757*.

Mijiddorj, T. N., Alexander, J. S., Samelius, G., Badola, R., Rawat, G. S., & Dutta, S. (2018). Corrigendum to: Livestock depredation by large carnivores in the South Gobi, Mongolia. *Wildlife Research, 45(4): 381-381*.

Mishra, C., Allen, P., McCarthy, T. O. M., Madhusudan, M. D., Bayarjargal, A., & Prins, H. H. (2003). The role of incentive programs in conserving the snow leopard. *Conservation Biology, 17(6): 1512-1520*.

Morehouse, A. T., Hughes, C., Manners, N., Bectell, J., & Bruder, T. (2020). Carnivores and communities: a case study of human-carnivore conflict mitigation in southwestern Alberta. Frontiers in Ecology and Evolution, 8, 2.

Mwakatobe, A., Nyahongo, J., &Røskaft, E. (2013). Livestock depredation by carnivores in the Serengeti ecosystem, Tanzania. *Environment and Natural Resources Research, 3(4): 46*.

Naha, D., Dash, S. K., Kupferman, C., Beasley, J. C., & Sathyakumar, S. (2021). Movement behavior of a solitary large carnivore within a hotspot of human-wildlife conflicts in India. *Scientific Reports, 11(1): 3862*.

Naughton-Treves, L., & Treves, A. (2005). Socio ecological factors shaping local support for Nestlerode, J. A., Engle, V. D., Bourgeois, P., Heitmuller, P. T., Macauley, J. M., &Allen, Y. C. (2009). An integrated approach to assess broad-scale condition of coastal wetlands—the Gulf of Mexico Coastal Wetlands pilot survey. *Environmental monitoring and assessment, 150: 21-29*.

Nichols JD, Thomas L, Conn PB (2009) Inferences about land bird abundance from count data: recent advances and future directions. In: Thomson DL, Cooch EG, Conroy MJ (eds) Modeling demographic processes in marked populations. Springer, New York, pp 201–235

Nyhus, P., & Tilson, R. (2004). Agroforestry, elephants, and tigers: balancing conservation theory and practice in human-dominated landscapes of Southeast Asia. *Agriculture, ecosystems & environment, 104(1): 87-97*.

Oli, M. K., Taylor, K. R., & Rogers, M. E. (1994). Snow leopard *Panthera uncia* predation of livestock: An assessment of local perceptions in the Annapurna Conservation Area, Nepal. *Biological Conservation, 68: 63–68*.

Pooley, S., Bhatia, S., & Vasava, A. (2021). Rethinking the study of human–wildlife coexistence. *Conservation Biology, 35(3), 784-793*.

Priatna, D. 2019. Konservasi Harimau di Bentang Alam Industri. In: A. Prijono, M. Kholis, & L.D. Bahaduri (eds.). AUM! Atlas Harimau Nusantara. Jakarta: KLHK-GEF UNDP. Pp. 162-167.

Priatna, D., Baruah. C., & Sharma, D. K. (2023). Better Management Practices (BMP) towards a Human-Wildlife Co-existence. *Asian Journal of Conservation Biology, 12 (2): 177-178*. https://doi.org/10.53562/ajcb.EN00024

Priatna, D., & Monk, K. A. (2022). The role of the academic community in combating wildlife trafficking. *Indonesian Journal of Applied Environmental Studies, 3(2): 85-91*. 10.33751/injast.v3i2.6302

Qureshi, Q., Jhala, Y. V., Yadav, S. P., Tiwari, V. R., Garawad, R., & Mallick, A. (2024). Status of Leopards in India, 2022. *National Tiger Conservation Authority, Government of India, New Delhi, and Wildlife Institute of India, Dehradun*.

Rani, M., Singh, S. K., Allen, M. L., Pandey, P., & Singh, R. (2024). Measuring people's attitude towards conservation of Leopard *Panthera pardus* (Mammalia: Carnivora) in the foothills of Himalayan region. *Journal of Threatened Taxa, 16(6): 25283-25298*.

Rao, M., Rabinowitz, A., & Khaing, S. T. (2002). Status review of the protected-area system in Myanmar, with recommendations for conservation planning. *Conservation Biology, 16(2): 360-368*.

Redpath, S. M., Young, J., Evely, A., Adams, W. M., Sutherland, W. J., Whitehouse, A., ... & Gutierrez, R. J. (2013). Understanding and managing conservation conflicts. *Trends in ecology & evolution, 28(2):100-109*.

Røskaft, E., Bjerke, T., Kaltenborn, B., Linnell, J. D., & Andersen, R. (2003). Patterns of self-reported fear towards large carnivores among the Norwegian public. *Evolution and human behaviour, 24(3): 184-198*.

Samantha, L. D., Tee, S. L., Kamarudin, N., Lechner, A. M., & Azhar, B. (2020). Assessing habitat requirements of Asian tapir in forestry landscapes: Implications for conservation. *Global Ecology and Conservation, 23, e01137*.

Sanderson, E. W., Redford, K. H., Vedder, A., Coppolillo, P. B., & Ward, S. E. (2002). A conceptual model for conservation planning based on landscape species requirements. *Landscape and urban planning, 58(1): 41-56*.

Teixeira, L., Tisovec-Dufner, K. C., Marin, G. D. L., Marchini, S., Dorresteijn, I., & Pardini, R. (2021). Linking human and ecological components to understand human–wildlife conflicts across landscapes and species. *Conservation Biology, 35(1): 285-296*.

Treves, A., & Karanth, K. U. (2003). Human-carnivore conflict and perspectives on carnivore management worldwide. *Conservation biology, 17(6): 1491-1499*.

Uduman, A., Hagerman, S., Kroc, E., Watson, A., Kittle, A., & Burton, A. C. (2022). Attitudes towards the Sri Lankan leopard *Panthera pardus kotiya* in two rural communities. *Oryx, 56(4): 528-536*.