

Research Article

Conservation Without Coexistence: Understanding the Paradox of Human–Leopard Relationships around Bannerghatta National Park, India

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ABSTRACT

Understanding community perspectives on large carnivores is essential for designing effective coexistence strategies in human-wildlife conflict zones. This study examines social attitudes toward leopards among 79 residents of five villages bordering Bannerghatta National Park, India. Semi-structured interviews and quantitative analyses examined how experiences of conflict, institutional support, and compensation influence willingness to coexist. While 72% of respondents supported leopard conservation, only 18% felt coexistence, defined as accepting leopards' regular presence near settlements, was feasible, revealing a coexistence paradox of moral support without spatial tolerance. No significant associations emerged between conflict experience, perceived support, or compensation and willingness to coexist. However, gaps between official mitigation advice and community beliefs, along with low satisfaction with institutional responses, highlight opportunities for improved outreach. These findings emphasise that coexistence requires more than tolerance; practical progress depends on context-specific risk mitigation, community-inclusive governance, and culturally grounded education that can rebuild trust and support long-term conservation outcomes.

Keywords: human-wildlife interactions, coexistence, leopard conservation, community perceptions, Bannerghatta, Karnataka

INTRODUCTION

Large carnivores have long occupied a paradoxical position in human societies—celebrated as icons of wilderness yet perceived as threats to human lives and livelihoods. Among them, leopards (*Panthera pardus*) are increasingly at the centre of human–wildlife conflict in human-modified landscapes. In India, where dense human populations overlap extensively with leopard ranges, questions of coexistence are both ecological and cultural imperatives (Athreya et al., 2015; Venkataraman et al., 2021). Globally, conservation science has increasingly focused on the concept of coexistence, encompassing not only the mitigation of conflict but also the dynamic and often adaptive ways in which humans and wildlife share space over time (Carter and Linnell 2016; Jolly and Stronza 2025). Coexistence, in this sense, is not defined by the absence of conflict but by the presence of tolerance, adaptation, and negotiation (Pooley et al. 2021). However, studies across South Asia have shown that social attitudes toward coexistence are influenced by a range of factors, including cultural beliefs, personal experience, economic loss, institutional trust, and media narratives (Inskip et al. 2016; Bhatia et al. 2013; Ghosal and Kjosavik 2015). In many landscapes, particularly those undergoing rapid urban expansion, the boundaries between wilderness and settlement are increasingly blurred, reshaping how rural and peri-urban communities interact with wildlife. The Indian leopard (*Panthera pardus fusca*), while listed as Vulnerable by the IUCN, continues to demonstrate ecological resilience in human-dominated habitats (Stein et al. 2020). Yet this adaptability often brings leopards into conflict with people, especially in peri-urban landscapes like the fringes of Bannerghatta

National Park (BNP) in Karnataka. BNP, situated just south of Bengaluru, India's fifth-largest and third-most populous city, presents a critical case study. Here, fragmented forest corridors are juxtaposed against expanding agrarian and residential settlements, making human-leopard interactions increasingly common (Krishnan et al. 2018; Nagendra et al. 2012).

Leopards are culturally ambiguous figures in Indian society. Historically associated with strength and mysticism, they are today more frequently portrayed in the media as dangerous predators or urban nuisances (Crown and Doubleday 2017; Vikas et al. 2022). This narrative shift may influence public sentiment, especially in communities directly affected by conflict. At the same time, evidence from other regions in southern India, such as Wayanad (Kerala) or the Anamalais (Tamil Nadu), shows that coexistence is possible under certain sociocultural and institutional conditions (Jolly et al., 2022; Sidhu et al., 2017).

This study examines the human-leopard interface around Bannerghatta National Park through the lens of local perceptions and lived experience. Specifically, it examines how rural inhabitants of five villages perceive leopards, the degree to which they support coexistence or conservation, and the role of factors such as support from the forest department, conflict history, and livestock ownership in shaping these attitudes. Recent research highlights that institutional distrust and underlying social conflicts play a significant role in shaping community perceptions of conservation efforts and wildlife management (Fletcher, 2021; Hill, 2021; Lecuyer et al., 2022). Beyond direct impacts, factors such as historical grievances, risk perception, and varying levels of tolerance create complex dynamics in human-wildlife relationships (Hill, 2021; Lecuyer et al., 2022).

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Considering these themes is crucial to understanding the local attitudes and effectively addressing conservation conflict and coexistence in Bannerghatta National Park.

Studies have shown that values, beliefs and attitudes are often shaped by experiences with wildlife and are central to local willingness to accept or tolerate large carnivores (Naha et al., 2018; Bhatia et al., 2018). Experiencing livestock loss or attacks by leopards reduces people's tolerance and decreases their support for coexistence (Naha et al., 2018; Kichloo et al., 2024). This makes it crucial to examine if such patterns persist in areas like Bannerghatta National Park, where human-wildlife interaction is recurrent but the relationship between abstract support for conservation and actual willingness to coexist with leopards remains understudied. While institutional trust and effective intervention by forest departments increase willingness to coexist (Abas et al., 2025; Gupta et al., 2024; Woolaston et al., 2021), the extent and mechanisms of this effect have not been thoroughly investigated in the Bannerghatta context. Empirical and theoretical work in comparable Indian landscapes suggests that personal experience with conflict may reduce support for coexistence, while perceived institutional support, such as from the forest department, may have the opposite effect. (Bhatia et al., 2018; Redpath et al., 2019).

There also appears to be a complex, sometimes contradictory relationship between supporting leopard conservation in principle and embracing coexistence in daily life – a “coexistence paradox” frequently cited in conservation literature. Guided by these documented drivers, this study explores whether witnessing conflict with leopards diminishes local willingness to support coexistence, whether perceived support from the Karnataka Forest Department fosters coexistence and whether

opposition to coexistence aligns with a lack of support for leopard conservation.

Through a mixed-methods analysis of interviews with 79 residents, we investigate how these factors interact within the human-modified landscape of Bannerghatta. This paper aims to fill knowledge gaps by providing an anchored, socially nuanced understanding of conservation conflict, contributing to the growing research on human-wildlife relations in the Global South.

STUDY AREA AND METHODS

This study was conducted around Bannerghatta National Park (BNP), a protected area located approximately 22 km south of Bengaluru, Karnataka, in southern India. BNP spans an area of ~260 km² and forms a critical part of the Eastern Ghats–Western Ghats landscape complex. The landscape is composed of tropical dry deciduous forests, scrubland, and fragmented agricultural and urban patches (Ramachandra and Setturu 2019). BNP supports a diverse assemblage of fauna, including several mesopredators, but the Indian leopard (*Panthera pardus fusca*) is the dominant large carnivore. Although adjacent to Bengaluru, BNP's northern and western boundary is bordered by approximately sixteen rural and peri-urban settlements, many of which experience periodic leopard encounters. Fieldwork was conducted across five villages bordering BNP—Thattaguppe, Byatrayana Doddi, Boothanahalli, Kyaserguppe, and Seep Kere, all characterised by a mixed subsistence economy based on agriculture and livestock (Figure 1). These villages are also sites of recurrent leopard sightings and conflict incidents, as recorded by local forest department records and community reports, which is why they were selected.

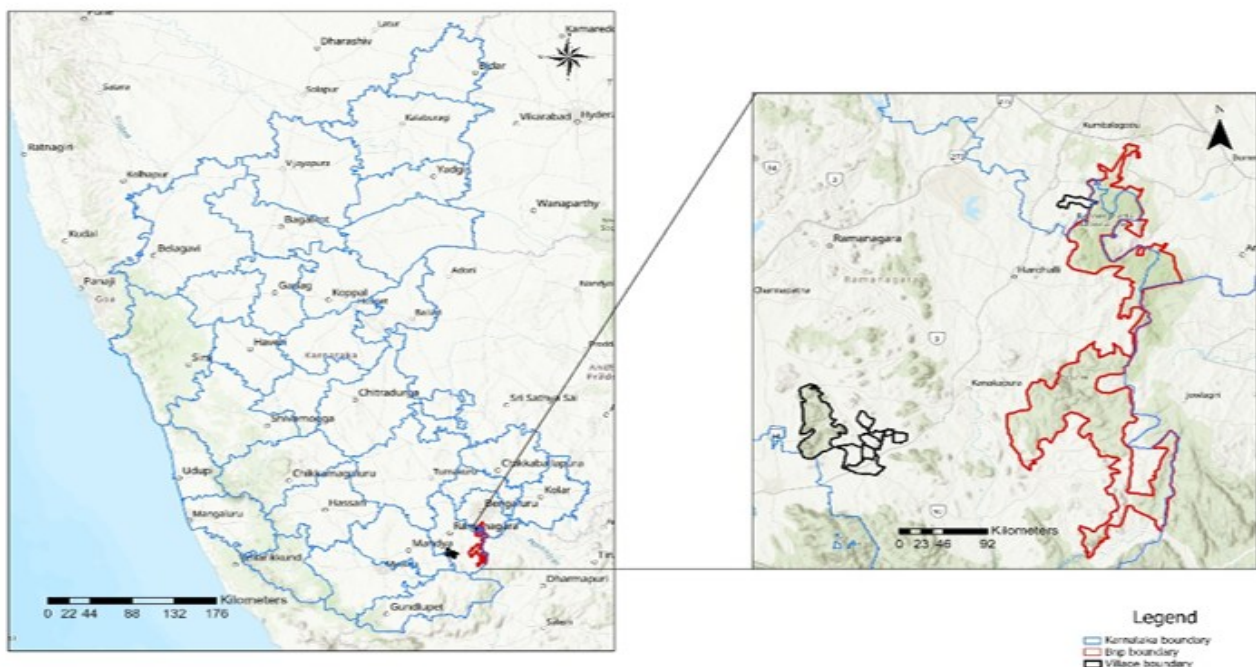


Figure 1. Map showing Bannerghatta National Park and surveyed villages (Thattaguppe, Byatrayana Doddi, Boothanahalli, Kyaserguppe, and Seep Kere), Karnataka, India.

Survey Design and Data Collection

Between December 2022 and April 2023, semi-structured interviews were conducted with adult residents (aged 18 years and above) across five villages adjacent to Bannerghatta National Park. Using a 22-item

questionnaire, data were collected on key thematic areas including livelihood practices and livestock ownership, experiences of leopard sightings and conflict, attitudes toward human–leopard coexistence, perceptions of leopard conservation, and levels of institutional support, particularly regarding assistance and compensation from

the Karnataka Forest Department. The survey instrument included both open-ended and closed-ended questions, allowing for both quantitative analysis and qualitative depth. Villages were purposively selected to capture variation in proximity to the park boundary and the reported frequency of leopard encounters. Within each village, a convenience and voluntary response sampling strategy was employed, as no formal household register or complete census data were available, and due to the sensitivity surrounding human–wildlife conflict, probability sampling was deemed unfeasible. To minimise bias and improve representativeness, respondents were sought from diverse gender groups, livelihood backgrounds and locations at varying distances from the forest edge.

All interviews were conducted in the local language, Kannada, and subsequently translated into English for analysis and interpretation. Interview durations ranged from 4 to 21 minutes, with an average of approximately 6 minutes. Our survey employed a mixed-methods design. Most participants gave brief responses; a few were more expressive, providing additional context beyond the focus of our questions. These instances generally occurred when respondents felt especially invested in the topic or appreciated their concerns being acknowledged. Since most respondents were concise, the average interview lasted approximately 6 minutes. Although the mixed-methods approach was employed, the brevity of most interviews limited the qualitative depth that could be achieved. In total, 79 interviews were completed, comprising 49 male and 30 female respondents. The geographic coordinates of each interview location were recorded using handheld GPS devices to facilitate spatial analysis.

Statistical Analysis

Quantitative data were analysed using R software (version 4.2.2). Prior to analysis, the distribution of continuous variables was assessed using the Shapiro–Wilk test to determine the suitability of parametric or non-parametric approaches. Given the non-normal distribution of key variables, a combination of non-parametric and categorical statistical tests was employed. Wilcoxon rank-sum tests were used to examine the relationship between the number of livestock owned and two outcome variables: (i) whether respondents had experienced conflict with leopards and (ii) their willingness to support human–leopard coexistence. Associations between categorical variables were tested using chi-square (χ^2) tests of independence. These included: (i) the relationship between conflict experience (yes/no) and willingness to support coexistence or conservation, and (ii) the influence of perceived forest department support and compensation on willingness to coexist. To evaluate the consistency of individual attitudes toward coexistence and conservation, a McNemar test was applied. Additionally, a McNemar–Bowker test was used to assess differences between respondents' reported behaviours during leopard encounters and their perceptions of what constituted an appropriate response. To improve clarity and reproducibility, we explicitly defined all variables and linked each statistical test to the relevant hypothesis. Continuous variables included the *number of livestock owned* and *respondents' age*. Ordinal variables included *willingness to support human–leopard coexistence* and *perceived adequacy of forest department support*, both measured on a 3-point scale (low, moderate, high). Categorical variables included *conflict*

experience (yes/no), *perceived compensation sufficiency* (adequate/inadequate), *reported behaviour during leopard encounters* (categorised into three response types), and *perceived appropriate behaviour* (same categories).

RESULTS

Demographic Overview and Leopard Presence

A total of 79 individuals were interviewed across five villages surrounding BNP: Thattaguppe (n=25), Byatrayana Doddi (n=25), Boothanahalli (n=14), Kyaserguppe (n=10), and Seep Kere (n=5) (see *Supplementary Figure S.1*). While 47% of respondents reported leopard presence in their village, only 23% had directly seen a leopard, with most knowledge of presence derived from pugmarks or word of mouth. Among those who had observed leopards, 83% had also witnessed a conflict interaction, such as livestock predation.

Factors Influencing Willingness to Coexist

Contrary to expectations, no statistically significant associations were found between direct conflict experience and willingness to support human–leopard coexistence ($\chi^2 = 0.00$, $df = 1$, $p = 0.99$) or leopard conservation ($\chi^2 = 0.00$, $df = 1$, $p = 0.97$) (see *Supplementary Figure S.2*). A Wilcoxon test comparing number of livestock owned and conflict experience revealed no significant difference ($W = 390$, $p = 0.29$), nor did livestock ownership correlate with willingness to coexist ($W = 681$, $p = 0.76$).

Perceptions of Institutional Support

Perceived support from the Karnataka Forest Department was mixed. Although some respondents reported prompt responses and occasional preventive measures (e.g., sound bombs), others cited delays or lack of compensation. Only 36% of respondents perceived any meaningful support from the department, and even fewer (19%) reported receiving compensation (see *Supplementary Figure S.3*). Nevertheless, neither perceived support ($\chi^2 = 0.35$, $df = 1$, $p = 0.55$) nor compensation ($\chi^2 = 0.69$, $df = 1$, $p = 0.41$) had a significant impact on willingness to coexist.

Coexistence versus Conservation: A Paradox

Despite widespread reluctance to coexist with leopards (36% expressed reluctance), a significantly higher proportion (58%) supported continued leopard conservation (see *Supplementary Figure S.2*). A McNemar test confirmed a statistically significant divergence between these two attitudes ($\chi^2 = 5.11$, $df = 1$, $p < 0.05$), suggesting a complex coexistence paradox in which fear and respect exist.

Education and Response Practices

Respondents' self-reported responses to leopard sightings (e.g., fleeing, making noise, throwing stones) were compared to what they believed to be the "correct" response in that situation (see *Supplementary Figure S.4*). A McNemar–Bowker test revealed no significant difference between actual and perceived appropriate responses ($\chi^2 = 9.33$, $df = 15$, $p = 0.15$). However, discrepancies emerged between personal beliefs and official advice. Most respondents believed in passive withdrawal, while the forest department promoted aggressive deterrents.

Table 1. Village-wise breakdown of the proportion of respondents who answered yes to having witnessed leopard conflict interactions, wanting to support coexistence and leopard conservation, and perceived support and compensation received from the Karnataka State Forest Department. All percentages were rounded to the nearest whole number. Cells are colour coded based on most (green) to least (red) favourable answers.

	Conflict Interactions Witnessed	Support Co-existence	Support Leopard Conservation	Received Support from Forest Department	Compensation Received
Thattaguppe	16%	52%	52%	24%	32%
Byatrayana Doddi	20%	24%	48%	32%	4%
Boothanahalli	14%	29%	64%	50%	21%
Kyaserguppe	40%	50%	80%	50%	20%
Seep Kere	20%	20%	60%	40%	0%

DISCUSSION

This study examined how rural communities living near Bannerghatta National Park perceive leopards, human-leopard conflict, and the potential for coexistence. While coexistence frameworks in conservation often assume that tolerance is shaped by direct experience or institutional support (Treves and Bruskotter 2014; Inskip et al. 2016), our findings complicate these assumptions. For instance, although 72% of respondents expressed support for leopard conservation efforts, only 18% believed that spatial coexistence with leopards, defined as a willingness to accept their regular presence in proximity and the associated risks, was feasible. Most respondents specifically rejected the idea of coexisting with leopards within or near their villages, preferring that leopards remain confined to forest areas. This rejection reflects both a reluctance to tolerate physical proximity and an aversion to the risks inherent in sharing space with a large carnivore. The “coexistence paradox” revealed by the data illustrates a nuanced and emotionally complex relationship between humans and carnivores in peri-urban landscapes. This divergence between support for conservation and spatial coexistence, while seemingly contradictory, reflects the complexity of community perceptions rather than a methodological or logical inconsistency.

Coexistence as Containment, Not Co-adaptation

Most respondents did not view coexistence as desirable or feasible, regardless of whether they had experienced conflict, received support, or owned livestock. Instead, coexistence was often framed as containment: keeping leopards within forest boundaries and humans outside them. Many interviewees explicitly stated, “The Forest Department should take more control and make efforts to keep leopards inside the park,” or “They shouldn’t be let out of the forest for our safety,” emphasising the importance of fencing and clear boundaries between wildlife and human areas. adaptation. This dominant narrative, echoed in remarks about forest boundaries and the need for physical barriers, contradicts definitions of coexistence that emphasise shared space and mutual adaptation (Carter and Linnell 2016). The desire for containment may reflect a growing fear, heightened by media sensationalism (Bhatia et al., 2013; Vikas et al., 2022), as well as a loss of everyday familiarity with wildlife that persists in more forest-embedded or indigenous communities (Jolly et al., 2022).

This boundary-based notion of coexistence, shaped by

physical fencing and social separation, may create psychological distance from wildlife and reflects the influence of peri-urban conservation governance approaches, where management efforts often prioritise risk reduction and spatial separation over integration. Prior research has shown that proximity alone does not lead to tolerance; rather, socialisation, cultural context, and shared ecological understanding play critical roles (Ghosal and Kjosavik 2015; Peterson et al. 2010). In BNP, formal barriers may have protected both humans and leopards in the short term, but they may also erode the very relational fabric needed to sustain long-term coexistence. These findings suggest that successful peri-urban management must strike a balance between immediate safety and efforts to foster meaningful interactions and shared stewardship between communities and wildlife.

Respect Without Proximity

Support for leopard conservation among respondents was only marginally higher for those who had not witnessed conflict compared to those who had. This suggests that a deep-seated moral or cultural respect for wildlife may play a role in sustaining conservation support, even among individuals who have experienced conflict or hold negative perceptions of leopards, rather than support being solely dependent on positive engagement or lack of negative experiences. Several respondents remarked, “Because it keeps people out of the forest and the forest can grow nicely”, and “It’s not good for us, but if it exists in the forest and doesn’t cause us trouble, it’s okay”, highlighting how respect for leopards’ right to exist is often contingent upon maintained distance. Others affirmed, “As long as something is done so they don’t leave the forest” or urged that leopards “stay far away from the area near the forest,” underscoring respect without a desire for proximity. Respondents commonly referenced the forest as the leopards’ “true home” and affirmed their right to exist. These sentiments align with those observed in studies of other Indian contexts, such as Wayanad and Gir, where respect for wildlife is grounded in ethical, spiritual, or place-based narratives (Gogoi et al., 2024; Jolly et al., 2022).

However, such respect may not be sufficient to sustain coexistence. Without concrete institutional trust or meaningful local inclusion, moral support risks becoming a passive stance that enables further alienation. Moreover, conservation support rooted in abstract reverence may diverge from the practical realities of living in close proximity to a dangerous animal.

The challenge, therefore, is not only to preserve respect for leopards but to rebuild relationships grounded in shared space, risk negotiation, and local empowerment.

Institutional Distrust and Shifting Responsibility

Respondents expressed mixed opinions about the Karnataka Forest Department. While some acknowledged attempts at conflict mitigation, most cited delayed responses, ineffective measures, and inadequate compensation. These perceptions may contribute to a broader erosion of trust, reinforcing the view that conservation is top-down and unaccountable. Moreover, respondents frequently located the responsibility for resolving conflict with the department alone, rarely suggesting proactive community-based strategies.

This sense of externalisation may stem from the historical exclusion of local communities from wildlife management and decision-making (Karanth et al. 2002). It also reflects the limitations of compensation schemes that are delayed, partial, or opaque. Recent studies in the Indian context suggest that governance models, such as adaptive co-management, participatory wildlife management, and community forest governance models that actively involve local voices and decision-making power, may help strengthen institutional trust and shared stewardship. As found in other Indian studies, adequate and timely compensation, especially for livestock losses, can increase tolerance and foster coexistence (Gogoi et al. 2024; Loch-Temzelides 2021). However, compensation alone is insufficient if it is not paired with procedural justice and inclusive governance mechanisms that give communities a greater role in shaping strategies for coexistence.

Education as a Reconnection Tool

While most respondents claimed to react to leopards appropriately, a clear mismatch existed between official advice (e.g., making noise, using firecrackers) and local instincts (e.g., silent retreat). This disconnect raises questions about the effectiveness of conservation education, not only as a means to reduce risk but as a platform to facilitate dialogue, address fears, and cultivate ecological literacy.

The example of Sanjay Gandhi National Park (SGNP) in Maharashtra, where sustained outreach helped reduce conflict and build coexistence norms, is especially instructive (Surve et al. 2022). In contrast, BNP lacks comparable programmes. This gap represents both a challenge and an opportunity. By investing in locally grounded, culturally sensitive outreach that frames coexistence as a shared value, the Forest Department and conservation NGOs can begin to bridge the cognitive and emotional divide that currently exists.

Beyond Conflict Metrics

Finally, the results challenge a persistent assumption in human-wildlife conflict literature: that negative experiences drive negative attitudes. In BNP, conflict experience did not significantly influence willingness to coexist. This suggests that attitudes may be shaped less by incidents themselves and more by broader social narratives, institutional context, and cumulative uncertainty. As argued by Pooley et al. (2021), conservation research must move beyond counting conflict events to explore how people make sense of wildlife, risk, and place. Future coexistence interventions in peri-urban India should therefore combine spatial risk mitigation with trust-building, participatory governance and moral

ecological education to address the complex social dynamics underlying tolerance and coexistence.

Way Forward

While this study provides a foundation for understanding human-leopard interactions in peri-urban Karnataka, the research focused on a single protected area and relied on community perceptions from five villages, which restricts the generalizability of the findings to broader landscapes or different sociocultural settings. Sample size and possible biases related to voluntary participation may also affect representativeness. Future research should expand to include additional regions and community types, enabling comparative analyses that explore variability in perceptions, conflict drivers and management strategies.

It is critical for future research to approach coexistence not merely as a form of conflict management but as a dynamic relationship shaped by social context, values and aspirations. It should prioritise participatory and locally adapted approaches to human-leopard coexistence, focusing on sustained community engagement, transparent institutional support and livelihood strategies (Boronyak et al., 2020). Viewing coexistence only through a conflict lens risks missing deeper sources of tolerance and respect, especially when empirical data does not clearly associate negative attitudes with prior conflict exposure. Coexistence should be conceptualised as a dynamic socio-ecological process, one open to change, negotiation and local meaning (Jolly et al., 2025; Kaltenborn et al., 2022). This approach would recognise the value of lived experiences and local knowledge, alongside enabling meaningful dialogue and trust-building strategies tailored to diverse community priorities.

CONCLUSION

This study contributes to the growing literature on the social dimensions of human-wildlife interactions in Asia by examining how rural communities living near Bannerghatta National Park perceive leopards, conflict, and conservation efforts. While analysis revealed no single variable as a clear predictor of willingness to coexist, the findings from the responses reveal a more complex narrative interplay of fear, shaped not only by material losses but also by moral reasoning, institutional trust, and shifting notions and perceptions of space and responsibility. By distinguishing support for conservation from willingness to share space, this study clarifies an often-overlooked dimension of coexistence research in human-dominated landscapes.

A key insight is the theme, identified as a “coexistence paradox,” where respect for leopards exists alongside reluctance to tolerate their proximity. This paradox underscores the need to reframe conservation not merely as conflict mitigation, but as a social negotiation that addresses local concerns, acknowledges community histories, and provides a redefinition of coexistence not merely as conflict avoidance but as an ongoing social negotiation that integrates local beliefs, perceptions of safety, and community histories. Strengthening trust in the Karnataka Forest Department and improving transparency, timelines, and the effectiveness of compensation mechanisms are crucial steps towards enhancing local engagement and tolerance.

Education and awareness initiatives grounded in local knowledge and participatory communication offer promising pathways to bridge the cognitive and

emotional gaps between people and leopards. Such outreach can help reduce fear, correct misconceptions, and nurture long-term coexistence values. Ultimately, ensuring the survival of leopards in peri-urban landscapes, such as Bannerghatta, depends not only on effective ecological management but also on building inclusive, trust-based governance that supports both communities and carnivores. Moving beyond containment, conservation must transform the collective imagination of what it means to live with leopards.

Author contribution statement

AK conceived and designed the study; VV collected the data; KM analysed the data. AK, VV, and KM led the drafting of the manuscript. All authors contributed critical, intellectual content to the drafts and gave final approval of the version to be published.

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Declaration of competing/conflicting interest

The authors declare that they have no competing interests in conducting this research.

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Research ethics approval

All research activities were conducted in accordance with ethical guidelines for human subject research. Ethical approval for the study was obtained through internal review by A Rocha India, and necessary field permissions were secured from the Karnataka State Forest Department. The study protocol was also reviewed under the Bangor University Research Ethics Framework and was found to pose minimal ethical risk. Verbal informed consent was obtained from all participants prior to data collection. No personally identifiable information was recorded, and all responses were anonymised during transcription and subsequent analysis to ensure participant confidentiality.

Data availability

The data from this research are not publicly available due to confidentiality permissions

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