

## Global scenario on human-big cats interactions and coexistence patterns- a critical review

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**Citation:** Suryan, T., Raghav, G., Majumdar, A. and Tripathi, R. M. (2023). Global scenario on human-big cats interactions and coexistence patterns- a critical review. *Journal of Animal Diversity*, 5 (1): 92–107. <http://dx.doi.org/10.61186/JAD.5.1.92>

### Abstract

The big cats are of paramount importance for the sustenance of ecosystems and their interaction with humans is critical for their conservation. Coexistence and tolerance of the people involved will be crucial in the conservation of these cats in the growing human-dominated landscapes. The literature review on humans and big cats' conflicts and their coexistence indicates socio-economic factors are the main driving forces in shaping human attitudes toward these cats. In contrast to the mainstream view, conflict frequency does not directly affect the tolerance capacity of stakeholders; instead, coalitions of many factors like livelihood status, religious and cultural beliefs and government intervention are involved. The review provides an evaluation of the prevalent mitigation measures and other principles that govern human-big cats conflict and sheds light on the potential of coexistence as a pro-conservation strategy.

Received: 11 August 2022

Accepted: 17 March 2023

Published online: 31 March 2023

**Key words:** Big cat, conflict, Felidae, human-wildlife interactions, predator, species

### Introduction

The beguiling big cats are the apex species that play a pivotal role in the sustenance of the biological communities globally. Being at the apex of the food chain, they modulate the prey population and thus safeguard the ecosystems from collapsing (Holland et al., 2018). Consequently, the conservation of these species and their habitat becomes imperative. With the precipitous growth of the human population with the current population of more than 8 billion, the direct human interaction with these big cats is inexorable (source-un.org). Human-big cat interaction is any encounter between humans and these big cats; which can be positive with no distress caused to either side or negative wherein it results in adverse impacts on human social, economic or cultural life or on the conservation of the concerned felid population (Nyhus, 2016). With the

dwindling forest area and intrusive human settlements, human-big cat conflict poses a major challenge to the conservation of these big cats. There are manifold reasons behind the human-wildlife conflict and if narrowed down to the big cats, a protein-rich diet and large territorial propensity are the primary causes as they interfere with the needs of the humans too (Treves and Karanth, 2003). Agro-pastoral land expansion, incessant deforestation and fragmentation of forest cover (big cat's habitat loss), foraging livestock and negligent livestock managing strategies are some of the other reasons contributing to human-big cat conflict (Sharma et al., 2020).

Livestock depredation and tendency to attack on humans is the most prominent factor in negative human-big cat interactions (Chauhan 2011) which also directly impacts their conservation strategies and public attitude towards them (Goodrich 2010) (Table 1).

It might lend an opportunity to poachers to easily target and poach them (Johnson et al. 2006) with the assistance of the local people (Karanth and Gopal, 2005; Kawanishi et al., 2010). Big cats are most commonly found to attack humans accidentally or in a form of defence and to protect their offspring (McDougal, 1987; Gurung et al., 2008; Goodrich et al., 2010). A large number of incidences have been linked with big cats that are injured, sick or malnourished may become man-eaters as they are unable to hunt their natural prey. Shepherd (2020) has extensively reviewed this aspect of human-big cat interaction and highlights that the term ‘man-eater’ applies to an animal which has attacked a human in the past (Brain 1981; Löe and Röskaft, 2004) and develops the habit of devouring human flesh by predation (Corbett, 1944; 1949). Also, depletion, absence or removal of natural prey leads predators to seek out new food sources (Corbett, 1944; 1954; Athreya, 2012). Nonetheless, even if they are uncommon, attacks on people still happen frequently. Asia is one of the main continents where big cats attack humans. The primary offender is the tiger, whose populations regularly intersect with densely populated areas of humans (Nepal and Weber, 1995b; Sukumar, 1991). Attacks by lions on humans are reported in Africa (Yamazaki and Bwalya, 1999), Kenya (Patterson, 1907; Sillero-Zubiri and Laurenson 2001), Tanzania where humans are found to be part of their natural prey base (Peterhans and Gnoske, 2001; Patterson et al. 2003 and Baldus 2006) and Gir National Park, India (Saberwal et al., 1994). Instances of leopard attacking and killing humans inside (Kala and Kothari, 2013; Kumar et al., 2015; Sidhu et al., 2017; Zehra et al., 2022) and outside (Nabi et al., 2009; Athreya et al., 2014; Govind and Jayson, 2021) the protected areas have been widely documented. Jaguar attacks on humans are generally rare but they are often fatal when provoked by hunters (Neto et al., 2011; Iserson and Francis, 2015; Jędrzejewski et al., 2017). In North America, Mountain lion attacks on humans are regularly reported (Leavitt, 2003; Sweanor et al., 2007; Lewis, 2012) and fatality are surprisingly higher in adults as compared to children (Larabee et al., 2010) (Table 1). No documented record of Cheetah or Snow Leopard ever killing a human could be found.

The big cats are designed to prey on ungulates in a wild setting but due to habitat loss and competition between wild prey and livestock, depredation on domesticated ungulates has become an instinctive tendency of the big cats (Treves and Karanth, 2003). There are multitudinous factors and their interplay which govern the behavioural patterns of these big cats.

Mountain lions (*Puma concolor*) are one of the elusive cats and the human conflicts decline with an increase in human density as they tend to avoid people (van Bommel et al., 2020). The conflicts mostly peak in the intermediate human population in an urban setting as observed in the case of Mountain lions in Canada (van Bommel et al., 2020) and leopards in India (Athreya et al., 2013).

The prey selection is determined by the body-size ratio where large cats like tiger (*Panthera tigris*) prefers large-sized livestock whereas leopard (*Panthera pardus*)

prefer small-sized livestock (Bargali and Ahmed, 2018). Majumdar et al. (2013) reported that the observed difference in prey choice as per their body size as a strategy adopted by large carnivores to partition prey resources, thus increasing the potential to avoid intra-guild competition. Intriguingly, in Tibetan plateau, snow leopard (*Panthera uncia*) tends to choose wild prey, i.e., bharal over livestock despite the latter being thirteen times more common as bharals, restricting them to rugged elevation and thus less conflict. The understanding of the prey niche and the human-land use relation results in lesser negative conflicts (Xiao et al., 2022).

Cheetahs in the Botswana exhibited slightly smaller home ranges in human-dominated areas, favoured game farms rather than cattle farms, and commonly avoided humans (Van der Weyde et al., 2017).

Jaguar (*Panthera onca*) home range depends on the natural habitat cover and biomass. Their spatial needs decrease with increases in ecosystem productivity and forest cover but being less flexible than other big cats like cheetah when it comes to habitat, they are more vulnerable in modified landscapes (Thompson et al., 2021). Tigers in close proximity to human-dominated landscape have shown temporal and spatial modifications to coexist with humans, as in Nepal, where tigers stay low during the day when human activity is at its peak (Carter et al., 2012).

Similar pattern is observed in lion (*Panthera leo*) with more activity at twilight or night-time in accord with their natural instinct to surprise their prey (Oriol-Cotterill et al., 2015). In Africa, local farmers have created isolated areas around water reserves for leopards with enough prey nearby to impede attacks on their cattle (Constant et al., 2015). An intricate study of human behavioural patterns with socio-demography will provide a deeper insight into the psychology towards these flagship species and its inclusion in the formulation of mitigation measures will result in more efficient species-specific management strategies.

#### Status and distribution of big cats

Big cats inhabit diverse natural environments from tropical rainforests of Amazon and South America to Savana in Africa. These graceful cats also perpetuate in the snowy boreal forests of north-eastern Russia and the marshy mangrove swamp habitat of Sundarbans in Asia (Seidensticker, 1986). In accord with the IUCN Red List, the largest big cat in America, the jaguar (*Panthera onca*) is categorized as ‘Near Threatened’ with a global population of <180,000 (Jędrzejewski et al., 2018); the tiger (*Panthera tigris*), stands at ‘Endangered’ with a global population of merely 3,726–5,578 individuals (IUCN); lions (*Panthera leo*) is given the status of ‘Vulnerable’ with 23,000–39,000 individuals (iucnredlist.org); leopard (*Panthera pardus*) is the most widely distributed big cat from Africa to Asia owing to their phenomenal adaptive disposition and is categorized as ‘Near Threatened’. Thus, integrated mitigation strategies are required to combat the augmented human-carnivore conflict so as to conserve these feline species.

**Table 1:** Synoptic table representing documented incidences of big attacks on humans globally.

Sl. No.	Species	Scientific name	Year	Deaths reported	Injuries reported	Place	References
1	Jaguar	<i>Panthera onca</i>	2008–2017	3	1	Brazil	Paula et al. (2008); Neto et al. (2011); Marchini et al. (2017)
2	Jaguar	<i>Panthera onca</i>	2015	0	1	Guyana	Iserson and Francis (2015)
3	Jaguar	<i>Panthera onca</i>	2009–2015	4	18	Venezuela	Jędrzejewski et al. (2017)
4	Leopard	<i>Panthera pardus</i>	1990–2014	18	14	Anamalai Tiger Reserve, India	Sidhu et al. (2017)
5	Leopard	<i>Panthera pardus</i>	1996–2003	1	9	Binsar Wildlife Sanctuary, Uttarakhand, India	Kala and Kothari (2013)
6	Leopard	<i>Panthera pardus</i>	2004–2007	19	16	Kashmir, India	Nabi et al. (2009)
7	Leopard	<i>Panthera pardus</i>	2009–2021	2	5	Kerala-Tamil Nadu Border, India	Govind and Jayson (2021)
8	Leopard	<i>Panthera pardus</i>	2001–2003	18	33	Maharashtra, India	Athreya et al. (2014)
9	Leopard	<i>Panthera pardus</i>	1988–2007	162	NA	Himalayas, India	Sathyakumar et al. (2016)
10	Leopard	<i>Panthera pardus</i>	2005–2011	NA*	29	Tadoba-Andheri Tiger Reserve, India	Dhanwatey et al. (2013)
11	Leopard	<i>Panthera pardus</i>	1993–2003	NA	78	Maharashtra, India	Athreya and Belsare (2004)
12	Lion	<i>Panthera leo</i>	NA	NA	3	Gambella, Ethiopia	Gebresenbet et al. (2018)
13	Lion	<i>Panthera leo</i>	1997–1991	28	193	Gir, India	Saberwal et al. (1994)
14	Lion	<i>Panthera leo</i>	2002–2004	35	10	Tanzania	Baldus et al. (2006)
15	Lion	<i>Panthera leo</i>	1990–2007	NA	1000+	Tanzania	Packer et al. (2010); Kushnir et al. (2014)
16	Lion	<i>Panthera leo</i>	End of 19th century	100+	NA	Tsavo, Uganda	Patterson (1898–1899)
17	Lion	<i>Panthera leo</i>	2004	35	NA	Tsavo, Uganda	Patterson (2004)
18	Tiger	<i>Panthera tigris</i>	1860–2006	7833	NA	Sunderban, India and Bangladesh	Barlow (2009)
19	Tiger	<i>Panthera tigris</i>	2005–2011	4	9	Ranthambhore, India	Singh et al. (2015)
20	Tiger	<i>Panthera tigris</i>	1978–1997	146	30	Sumatra, Indonesia	Nugraha and Sugardjito (2009)
21	Tiger	<i>Panthera tigris</i>	2000–2004	7	NA	Sumatra, Indonesia	Nugraha and Sugardjito (2009)
22	Tiger	<i>Panthera tigris</i>	2007–2014	54	22	Chitwan, Nepal	Dhungana et al. (2017)
23	Tiger	<i>Panthera tigris</i>	1979–2006	88	NA	Chitwan, Nepal	Gurung et al. (2008)
24	Tiger	<i>Panthera tigris</i>	2001–2013	76	4	Sunderban, India	Naha et al. (2015)
25	Tiger	<i>Panthera tigris</i>	1990–2009	822	NA	Uttar Pradesh, Uttarakhand, Rajasthan, Madhya Pradesh, Orissa and West Bengal, (India)	Chauhan et al. (2011)
26	Tiger	<i>Panthera tigris</i>	2000–2009	2	19	Russia	Goodrich et al. (2010)
27	Tiger	<i>Panthera tigris</i>	2005–2011	NA	103	Tadoba-Andheri Tiger Reserve, India	Dhanwatey et al. (2013)
28	Tiger	<i>Panthera tigris</i>	2001–2011	11	194	Bandhavgarh Tiger Reserve, India	Chouksey et al. (2018)
29	Mountain Lion	<i>Puma concolor</i>	1950–2009	15	141	USA	Larabee et al. (2010)
30	Mountain Lion	<i>Puma concolor</i>	1890–1997	NA	10	California, USA	Mansfield and Charlton (1998)
31	Mountain Lion	<i>Puma concolor</i>	1891–1997	12	50	British Columbia, USA	Kadesky et al. (1998)
32	Mountain Lion	<i>Puma concolor</i>	1991–2012	NA	95	USA and Canada	Leavitt (2003); Sweanor and Logan (2010); Rumbelow (2017)
33	Mountain Lion	<i>Puma concolor</i>	24 January, 2007	0	1	California, USA	Hazani et al. (2008)

\*NA= Not available

NB-It is important to note that some numbers maybe redundant as certain authors have reported the same cases in the overlapping time periods.

### The trajectory of mitigation measures

Through the years, global governments in cooperation with the local communities have adopted several mitigation measures to tackle human-big cat conflict (Treves et al., 2013; Chatterjee et al., 2017). The timeworn strategy of population management, eradication (wherein the problem animals are

immediately killed) has been proved ineffective as it led to many big cats' teetering on the brink of extinction. Big cat capture and translocation incorporates monitoring and controlling of the problem animal and it resulted in the rise of tolerance among the local communities with respect to carnivores as it satisfied their self-determination

factor. Albeit, regulation is cost-effective but it lacks scientific monitoring and target selectivity (Treves and Karanth, 2003). Of late, translocation is the frequently resorted mitigation measure but it is a temporary and counterproductive strategy as the problem is not solved (Stepkovitch et al., 2022). The mortality rate increases as the transplanted individuals may face competition from territorial conspecifics in the new location (Athreya et al., 2010). The public acceptance and the possibility of a new entrant in the vacant territory add to the frailty of translocation as a mitigation measure. Non-lethal deterrence, guard animals and barrier systems are a few other steps undertaken by the local communities to shield themselves from conflicts with big cats. Schemes like monetary compensation, involvement of locals in ecotourism and conservation initiatives and conduction of educational and rapport-building workshops have contributed to establishing a certain tolerance level among the people and incited the will to co-exist with these charismatic cats (Mishra et al., 2003). Punitive actions taken by governments worldwide include lethal controls like the legal hunting down of a big cat which is not a convention followed in India (Athreya et al., 2013). Study by Khorozyan et al. (2015) had suggested that livestock predation by big cats can be reliably determined and predicted by biomass of wild prey species. Predation rates significantly increase when prey biomass decreases below certain minimum thresholds. Study by Patterson et al. (2004) showed that lion attacks on livestock are predictable based on seasonal rains and the resulting dispersion or concentration of prey animals. The rebuilding and conservation of the forests bearing a diverse prey base must be considered as fundamentally important to incline toward the protection status of big cats (Khan et al., 2020). The ensuing mitigation measures are crucial to the conservation of these big cats as coexistence is the only plausible future taking into consideration the rapid urbanization rate and ever-growing dependence on forest resources.

### **Co-existence and human perception worldwide**

Co-existence is the phenomenon centred on the interrelation of humans and wildlife wherein sustainability by means of co-adapting, and determining the persistence of wildlife in harmony with humans. Strategic institutions, scientific monitoring and stringent execution in conjunction with public tolerance are cardinal for coexistence, especially in an urban setting. Many local communities have been thriving along with the big cats. In India, local communities exhibit exemplary tolerance towards the big cats from time immemorial (Athreya et al., 2019), and community tolerance can vary, even within a single country (Gebresenbet et al., 2018). Religious, cultural, ecological as well as economic factors are accountable for this forbearance (Banerjee et al., 2013).

For decades, the big cats have been labelled as the perpetrators rather than being seen as the victim of these human-big cat conflicts. Media has a pivotal role in shaping the perspective of the people. A decade ago, the terms ‘mauled,’ ‘beast’, ‘mutilated’ etc were predominately used to report conflicts. However, a shift in the descriptive language and referring to them as the ‘victim’ of anthropogenic intervention has brought about sensitization in the people and an inclination to be instrumental in the conservation of the big cats (Hathaway et al., 2017). In India, the religious and cultural beliefs revere these cats as deities as in the case of Hinduism where people worship tigers. The Maldharis of Gir associate coexistence with lions as their regal heritage (Meena et al., 2021). Sometimes these beliefs foster a negative attitude towards the big cats wherein cultural reliance is towards the livestock as in the case of South Africa. The young and informed generation is more conversant with the need to conserve these and is willing to be supportive of the same whereas the old people still stick to their primeval beliefs against these beautiful creatures (Kleiven et al., 2004). People with only single means of earning a livelihood are mostly at odds with the big cats as they are the most exposed to the repercussions of depredation. Incentives and educational-based schemes have seemed to increase the tolerance of people with respect to the big cats (Manfredo et al., 1998). People agreed on extreme retaliatory measures i.e., killing of the animal in case of human attacks but the most were found to be tolerant otherwise in case of neutral interactions, pet-killing and property damage (Karanth et al., 2013).

As previously mentioned, the big cats are essential to the perpetuation of biological communities. As the alpha carnivores, they keep prey population in check, which is indispensable for preserving floral diversity. Many other threatened species live in these big cats’ and benefit from the shared landscape. Their conservation also sustains economies, generating revenue from the forest resources to supporting local tourism. Protecting these big cats, hand-in-hand protects the cultural heritage of indigenous people and goes a long way in their conservation. They are the very essence of nature and need to be conserved. With the growing urbanization, it is inevitable for them to coexist with humans and thrive. This review evaluates the inclusion and importance of human-dominated landscapes in addition to protected areas for the conservation of these majestic creatures.

### **Material and Methods**

The structured literature review framework was followed to delineate a systematic review and bring the research goals to fruition. Due to the increasing human population and spatial demands in the recent years, big cats have been venturing into urban areas as a result of habitat loss. Of late, scientists have



been researching over the coexistence of the two as a conservation strategy and so the focus was primarily on the last two decades. The SCOPUS database was used to retrieve the required literature and analyse the number of research papers/publications from the year 2000 to 2022. In addition, evaluation of publications on the focal big cats, namely, lion, tiger, leopard, snow leopard, jaguar, mountain lion and cheetah within the same time range concerning human-felid conflict and their coexistence was done with the assistance of SCOPUS. The search results amounted to around 164 documents, out of which, 139 articles were utilized to assess the literature published on big cats in the last two decades (Appendix); 25 articles were discarded due to inaccessibility and missing out on the focus of the study. The screening was based on the abstract of the searched documents. The keywords used for the search were 'conflict,' 'big cats,' 'perception' and 'coexistence' with respect to the aforementioned big cats. The SCOPUS database and Google Scholar were used to find the relevant literature for review.

## Results

### Published literature with respect to individual big cats

Owing to their large areal requirements, big cats have been venturing into the neighbouring human-dominated landscape or urban area often resulting in human-felid conflict. Of late, more emphasis is being given to the coexistence of humans and these big cats. In accordance with the research on conflict and coexistence, leopards have been studied the most (23% of research documents), followed by lions (22%), tiger with (16.8%), mountain lion with 12.1% of publications; jaguar (9.8%), cheetah (8.7%), and snow leopards (7.5%) (Fig. 1).

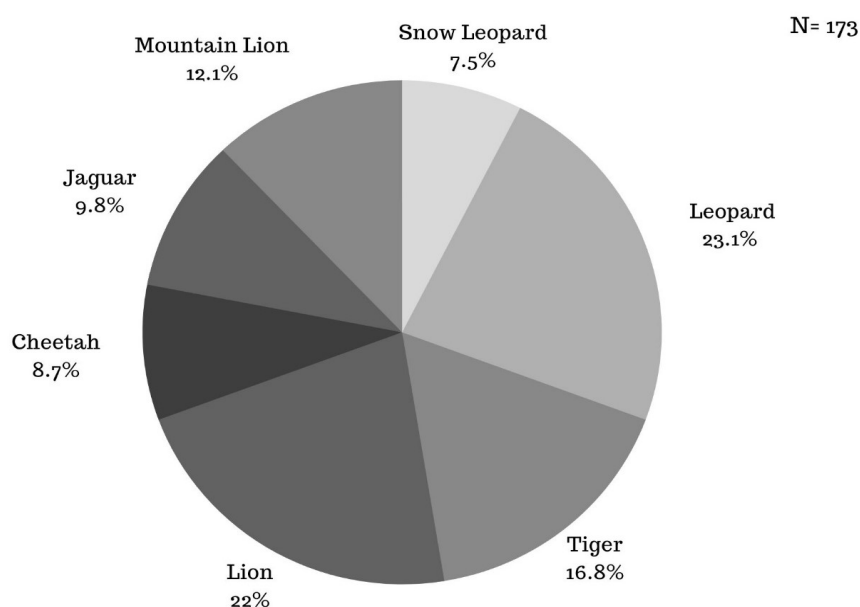
### Published literature over the last two decades (2000–2022)

The documents in the past two decades were primarily focused upon, and were further divided into the range of four years. This was done to see if there is any specific trend being followed in reference to conflict and coexistence as the discussion thread in wildlife research.

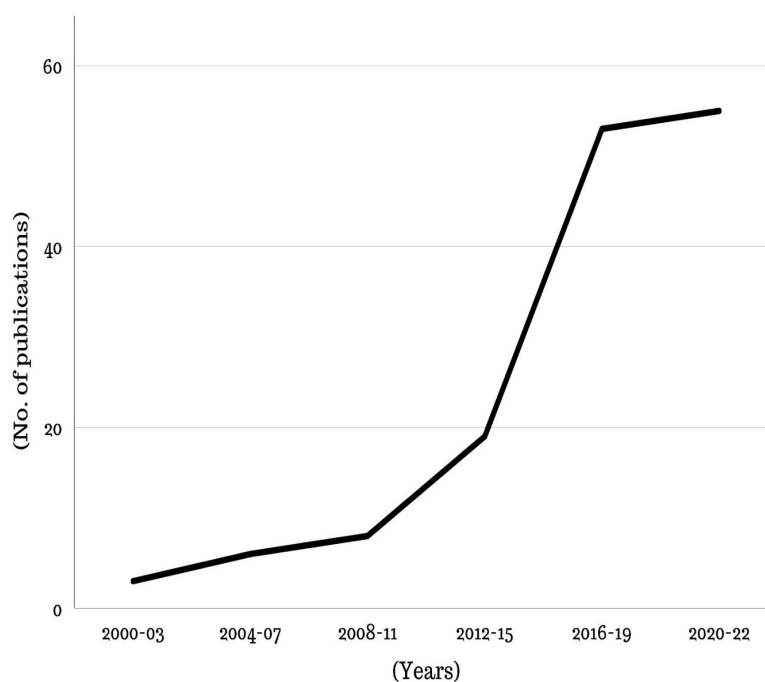
Interestingly, it was observed that there has been an expansion in the research field about the same over the years with a distinct hike from 2015 to 2019. This implies that the inclusion of the human dimension in wildlife conservation is gaining pivotal importance as one of the most sustainable approaches (Fig 2).

### Coexistence and its determinants

The attitude of people is fundamentally based on a subject approach to form an opinion about these felids (Dickman et al., 2013), while perception is more of a logical opinion supported by reasoning (Bowditch et al., 2007); (Fort et al., 2018). Human attitude and perception are of vital importance to sustain these cats in a human-dominated landscape. The local perception mainly incorporates social-demographic factors (age, gender, occupation etc.), and cognitive factors (Caruso et al., 2021) besides other determinants. In some parts of the world, humans have been coexisting with the big cats for a considerable span of time, for instance, in South America, jaguars and humans thrive in a shared landscape aided by government policies (Marchini et al., 2015); Asiatic lions and local communities in the unprotected areas outside Gir, India where 22% of the lion population home ranges lie upon human-dominated landscape (Banerjee et al., 2013). There are multiple aspects that play a role behind this fascinating conservation model that are discussed below.



**Figure 1:** Comparison of published literature with respect to individual big cats.



**Figure 2:** Comparison of number of publications on perception study in respect to time.

### Age

People are of varying opinions with respect to respondent age as a factor. The younger generation was found to be more tolerant and informed towards the big cats as compared to older people who still hang on to fear and dismissive attitudes when the big cats are concerned. On the other hand, the middle-aged group were intermediate between the two opinions. Studies done in South America on humans coexisting with jaguars indicate that younger people were more willing to be tolerant (Caruso et al., 2021). Furthermore, research on the human perspective in Africa evinces that the young generation was more supportive of the conservation of lions and leopards than the older natives (van der Meer and Dullefont, 2020). A similar inclination was observed in the local communities coexisting with lions in India (Meena, 2021). In Sri Lanka, older people also exhibited a more positive response towards the leopard which contradicts the usual trend (Uduman et al., 2021). Fluctuations were observed at certain places from the general trend (based on the majority) which suggests that the deviation in perception from the global outlook is in relation to the local scenario and is context-specific (Caruso et al., 2021).

### Gender

When gender was taken as a predictor in the reviewed research papers, males were reckoned to be more positive towards the big cats as compared to females. This general opinion was largely based on fearful attitude and risk perception (Mkonyi et al., 2017). In places where big cats live in close proximity to humans and frequent contact is common

(seeing a big cat proved to influence positively). Men are more prone to big cat attacks while engaging in hunting-related activities but fatality is higher in incidences of big cat attacks on women and children (Treves and Naughton, 1999). Both the sexes equally showed an equally positive attitude towards conservation but females were more reluctant regarding coexistence (van der Meer et al., 2020). There are plausible underlying factors that govern the general perception of women around the world. They are usually the most affected when there is any human-wildlife conflict as a result of increased labour and excursion (Suryawanshi et al., 2014).

### Education

Imparting knowledge about the conservation of these magnificent cats and being aware of their significance in sustaining ecosystems affirms a positive response to coexistence. Perception studies reveal that people who are more educated and informed were more tolerant toward coexisting with big cats (Constant et al., 2015). The engagement of people in discussion groups about conservation created a positive bias and it also assuaged the negative image of these carnivores (Meena, 2021). People who were well-informed about the felid ecology and the economic benefits of the big cats were more willing to coexist with them (Uduman et al., 2021).

### Livelihood status

The occupation and the number of income sources were prominent predictors in coexistence studies around the world. There was no steady trend observed as the perspective was based on the local state of affairs; but people who have only single

means of livelihood (especially livestock) were more vulnerable to depredation and consequently had a negative perspective globally (Constant et al., 2015). Farmers considered crop losses caused by wild herbivores to be more concerning than any potential threat a carnivore could represent to their personal safety (Goodale et al., 2015). Overall, farmers acknowledged improved crop production as a result of ecosystem services received as a result of their closeness to protected areas, as well as big cats' role as apex predator (Meena, 2021).

### Religious and cultural beliefs

In the contemporary world, religious and cultural beliefs still steer the way people perceive things. Likewise, these beliefs have a significant role in determining the willingness of people to coexist with these big cats. In Gir India, the Maldhari community has been living with lions for ages as they associate a sense of pride with sharing the landscape with the lions (Banerjee et al., 2013). Similarly, in south Mongolia, studies have shown locals to be more tolerant toward snow leopards than wolves owing to their aesthetic value (Samelius et al., 2021). In Sumatra, the tiger is believed to be a spiritual being and holds a religious significance. Religious sentiments are more prevalent in countries like India and Ethiopia where these big cats have been thriving for years. In developed countries, due to scientific advancement and a dearth of religion or culture as perception determinants, there is less tolerance as compared to developing countries where these factors are still the core of people's lifestyles (Struebig et al., 2018).

### Legal and population status

A new concept of Wildlife Stakeholder Carrying capacity is emerging which hints at the tolerance level of the stakeholders (people involved and affected concerning coexistence) in relation with the wildlife population in their area (big cats in this case). This gives a vital insight into the tolerance level of people. In Bangladesh, an impression of increment in tiger population led to a negative attitude within the local people whereas a sense of dwindling population stimulated a positive attitude (Inskip et al., 2016). The same pattern was observed in the case of puma in the state of Montana, USA (Riley and Decker, 2000). In India, a lack of knowledge about the legal status of leopards led to a negative perception of the big cats whereas positive responses converged for the lions despite the fact that they caused more loss as compared to leopards (Meena, 2021).

### Residency time

The recent studies on coexistence have taken residency time or the time period of local people living in close proximity to the big cats as one of the determinants to analyse local perception (Mkonyi et al., 2017). In Masai Mara, Kenya, there has been a shift observed in the younger generation due to changes in values over time (Homewood et al., 2009).

The old people have been coexisting with the big cats (lion, leopard and cheetah) for a long time and regard them as part of their lives whereas the younger generation is comparatively less tolerant of the cats as a result of economic loss and focuses mainly on their short-term relationship with the cats (Banerjee et al., 2013). Interestingly, in a case study in Denver, USA, people residing in the more urbanized area were intolerant of mountain lions in case of pet-killing incidences and favoured immediate removal of the animal. In contrast, people living in the foothills, with more encounters with the mountain lion, such extreme responses were provoked in cases of human mortality which is a more common scenario worldwide too (Michael et al., 2013). This shows that people who have been dealing with the big cats more often and longer are more patient with the wild felids.

### Intervention of Government and Non-Government Organizations (NGOs)

Humans are more likely to gravitate towards a cause where tangible benefits are involved. In wildlife conservation, efforts of the government, local organizations and scientific institutes go a long way in shaping the viewpoint of people. The incentive initiatives in Asia for years played a major role in the strategic conservation of tigers and leopards (Treves et al., 2013). Measures like ex-gratia payment, provision of employment in wildlife conservation and eco-tourism in collaboration with the conduct of conservation programmes for the local public to create awareness about big cats have proved to significantly influence people and strengthen tolerance for these charismatic cats (Constant et al., 2015; Laurie et al., 2015; Bargali et al., 2018). The positive dynamism of these initiatives also proved to have lessened the rate of retaliatory killings of the cats and are proved to be a useful conservation tool in situations where there is extreme threat to biodiversity, and sustainable funding sources are available (Banerjee et al., 2013; Bauer et al., 2015). In Mongolia, livestock insurance programs assisted in increasing the local tolerance towards the snow leopards and influenced the general attitude positively (Alexander et al., 2021). In India, such practices have been carried out for more than 30 years which makes it a more tolerant country than other Asian countries; albeit a negative attitude might stir if the locals perceive that the conservation efforts impede their daily-life priorities (Karanth et al., 2012).

### Discussion

With the advancement of mankind, the balance between nature and development teeters on a tightrope which is further aggravated by the growing human population. This brings humans and the apex predators (big cats) into conflict due to settlement expansion and habitat loss respectively. As part of the wide diet spectrum of felids, livestock has been depredated throughout the world (Inskip and

Zimmerman, 2009). Livestock depredation causes serious damage to local economies and creates or reinforces negative attitudes toward conservation initiatives and felids. Moreover, conflicts may result in lethal control of felids of high conservation value. Coexistence is the emerging pro-conservation strategy that ensures the future of these big cats and thus human attitude and tolerance capacity have an integral part in the conservation of these magnificent cats. This review's focal point is to evaluate the human perception with respect to the big cats globally and analyse the potential of coexistence as a conservation approach.

In accordance with the review, there has been growing research regarding coexistence in recent years which strengthens its scope. The review of global perception of people suggests that social-demographic factors i.e., age, gender and education or knowledge about the big cats and their ecology have proved to be the most significant predictors with respect to the coexistence of humans and big cats in a shared landscape. The younger generations, being more aware and informed, were more willing to coexist with the big cats in their locality. The rigid mind-set of older people is harder to change and thus nurturing the young generation by conducting more conservational programs will lead to a better future for these cats. Females were more commonly dismissive toward the cats due to various underlying reasons. Incorporation of women's self-help groups and encouragement of women empowerment might prove to be influential. This would further help in creating awareness and informing people about the significance of these cats as discussion groups were found to have a positive effect. Other secondary determinants include religious and cultural beliefs, the population status of the big cats, residency time etc.

## Conclusion

The initiatives taken by governments and local NGOs and communities in various areas have been instrumental in shaping the general opinion of the stakeholders. Provision of incentives and compensation, insurance schemes, eco-tourism, involvement and employment of people in wildlife conservation has proved to be crucial in establishing coexistence according to the review and must be further motivated. There has been a recent revision of compensation rates with an amount of Rs. 5,00,000 being offered for human death; Rs. 2,00,000 for grievous injury and around about Rs. 500 to Rs. 3000 for livestock damage which is decided upon by assessment by Forest Officials in association with Revenue Officials (source- [loksabhaph.nic.in](http://loksabhaph.nic.in); [megforest.gov.in](http://megforest.gov.in); [tdma.tripura.gov.in](http://tdma.tripura.gov.in)). In India, more transparency in the procedure to claim this compensation is required; wherein tigers and leopards were the most covered species in these policies (Karanth et al., 2018). Better livestock management strategies like fencing,

corralling livestock, less foraging time, mixed herd, awareness about the cat ecology etc. specific to the native species can notably decrease the depredation rate and increase tolerance in people who are most vulnerable to the negative impacts of conflict. There is a need for more empirical research that will offer a deep insight into the mechanism of coexistence without ignoring the context-specific factors. Its successful execution with the assistance of the government, local communities and the concerned citizens will secure the future of the big cats.

## Acknowledgments

This review article was carried under the research project work "Study on leopard (*Panthera pardus* L.) presence, identification of conflict zones and developing suitable mitigation measures on human-leopard interactions in the urban areas of Jabalpur and Indore, Madhya Pradesh". A special thanks to Principal Chief Conservator of Forest (Wildlife), Madhya Pradesh Forest Department for financial support towards this project. We are grateful to Mr Amitabh Agnihotri, Director State Forest Research Institute for granting us permission to carry this study and his encouragements. Mr Amit Kumar Singh, Assistant Director is highly acknowledged for his overall support. We convey our special thanks to Christ (Deemed to be University) and Leopard project intern Mr. Jasti Sai Krishna for their valuable contribution. We are thankful to anonymous reviewers and especially Professor Francesco Maria Angelici for several rounds of review. We would also like to acknowledge Professor Bruce Patterson for his valuable comments and native English editing.

## Author contributions

Majumder A., Suryan T. and Raghav G. devised the project, the main conceptual ideas and methodology. Suryan T. and Raghav G. conducted the formal analysis and wrote initial draft which was supervised, investigated, revised and validated by Majumder A. and Tripathi R. M.. All the authors discussed the results and contributed to the final manuscript.

## Conflict of interest

All the authors declare that there are no conflicting issues related to this review article.

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**Appendix 1:** Additional articles utilized to assess the literature published on big cats.

S. No.	Publications
1	Acharya, K. P., Paudel, P. K., Neupane, P. R. and Köhl, M. (2016). Human-wildlife conflicts in Nepal: patterns of human fatalities and injuries caused by large mammals. <i>PLoS ONE</i> , 11 (9): e0161717.
2	Ahmed, R. A., Prusty, K., Jena, J., Dave, C., Das, S. K., Sahu, H. K. and Rout, S. D. (2012). Prevailing human carnivore conflict in Kanha-Achanakmar corridor, Central India. <i>World Journal of Zoology</i> , 7 (2): 158–164.
3	Amit, R. and Jacobson, S. K. (2017). Understanding rancher coexistence with jaguars and pumas: a typology for conservation practice. <i>Biodiversity and Conservation</i> , 26 (6): 1353–1374.
4	Augugliaro, C., Christe, P., Janchivlamdan, C., Baymanday, H. and Zimmermann, F. (2020). Patterns of human interaction with snow leopard and co-predators in the Mongolian western Altai: Current issues and perspectives. <i>Global Ecology and Conservation</i> , 24: e01378.
5	Banerjee, K., Jhala, Y. V., Chauhan, K. S. and Dave, C. V. (2013). Living with lions: the economics of coexistence in the Gir forests, India. <i>PLoS ONE</i> , 8 (1): e49457.
6	Benson, J. F., Abernathy, H. N., Sikich, J. A. and Riley, S. P. (2021). Mountain lions reduce movement, increase efficiency during the Covid-19 shutdown. <i>Ecological Solutions and Evidence</i> , 2 (3): e12093.
7	Bhandari, S., Mawhinney, B. A., Johnson, D., Bhusal, D. R. and Youlatos, D. (2019). Coexistence of humans and leopards in shivapurnagarjun national park, Nepal. <i>Russian Journal of Ecology</i> , 50 (6): 590–592.
8	Bhatia, S., Redpath, S. M., Suryawanshi, K. and Mishra, C. (2020). Beyond conflict: exploring the spectrum of human–wildlife interactions and their underlying mechanisms. <i>Oryx</i> , 54 (5): 621–628.
9	Bhattacharjee, A. and Parthasarathy, N. (2013). Coexisting with large carnivores: a case study from Western Duars, India. <i>Human Dimensions of Wildlife</i> , 18 (1): 20–31.
10	Bhattarai, B. R., and Fischer, K. (2014). Human–tiger <i>Panthera tigris</i> conflict and its perception in Bardia National Park, Nepal. <i>Oryx</i> , 48 (4): 522–528.
11	Boast, L. K. (2014). Exploring the causes of and mitigation options for human-predator conflict on game ranches in Botswana: How is coexistence possible?. Thesis. Department of Biological Sciences, Faculty of Science, University of Cape Town, South Africa.
12	Boast, L. K., Good, K. and Klein, R. (2016). Translocation of problem predators: is it an effective way to mitigate conflict between farmers and cheetahs <i>Acinonyx jubatus</i> in Botswana? <i>Oryx</i> , 50 (3): 537–544.
13	Boomgaard, P. (2010). Tigers and people in the Malay world: four centuries of confrontation and coexistence in comparative Asian perspective, In: <i>Tigers of the World</i> . William Andrew Publishing, pp. 349–356.
14	Breck, S. W. (2004). Minimizing carnivore-livestock conflict: the importance and process of research in the search for coexistence. In: <i>People and predators: from conflict to coexistence</i> . pp. 13–27.
15	Bredin, Y. K., Lescureux, N. and Linnell, J. D. (2018). Local perceptions of jaguar conservation and environmental justice in Goiás, Matto Grosso and Roraima states (Brazil). <i>Global Ecology and Conservation</i> , 13: e00369.
16	Cavalcanti, S. C., Marchini, S., Zimmermann, A., Gese, E. M. and Macdonald, D. W. (2010). Jaguars, livestock, and people in Brazil: realities and perceptions behind the conflict.
17	Chen, P., Gao, Y., Lee, A. T., Cering, L., Shi, K. and Clark, S. G. (2016). Human–carnivore coexistence in Qomolangma (Mt. Everest) nature reserve, China: patterns and compensation. <i>Biological Conservation</i> , 197: 18–26.
18	Ching, A., Choi, J., Hart, R., McNeil, L. and Urso, A. (2021). Human-leopard conflict and coexistence in Northern Kenya. In partnership with San Diego Zoo Wildlife Alliance and Loisaba Conservancy. 67 pp.
19	Clark, T. W. and Munno, L. (2005). Mountain lion management: Resolving public conflict. Coexisting with large carnivores: Lessons from Greater Yellowstone, 71–98.
20	Crook, S. E. (2014). Information spread in a region of human–mountain lion coexistence. <i>Human Dimensions of Wildlife</i> , 19 (6): 555–558.
21	Das, C. S. (2015, December). Causes, consequences and cost-benefit analysis of the conflicts caused by tiger straying incidents in Sundarban, India, In: <i>Proceedings of the Zoological Society</i> , Springer, India. 68 (2): 120–130.
22	de la Torre, J. A., Camacho, G., Arroyo-Gerala, P., Cassaigne, I., Rivero, M. and Campos-Arceiz, A. (2021). A cost-effective approach to mitigate conflict between ranchers and large predators: A case study with jaguars in the Mayan Forest. <i>Biological Conservation</i> , 256: 109066.
23	Dellinger, J. A., Macon, D. K., Rudd, J. L., Clifford, D. L. and Torres, S. G. (2021). Temporal trends and drivers of mountain lion depredation in California, USA. <i>Human–Wildlife Interactions</i> , 15 (1): 21.
24	Dickman, A. J. (2010). Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. <i>Animal Conservation</i> , 13 (5): 458–466.
25	Dickman, A. J. and Hazzah, L. (2016). Money, myths and man-eaters: Complexities of human–wildlife conflict. In: <i>Problematic Wildlife</i> . Springer, Cham. pp. 339–356.
26	Dickman, A. J., Macdonald, E. A. and Macdonald, D. W. (2011). A review of financial instruments to pay for predator conservation and encourage human–carnivore coexistence. <i>Proceedings of the National Academy of Sciences</i> , 108 (34): 13937–13944.
27	Dickman, A., Marchini, S. and Manfredi, M. (2013). The human dimension in addressing conflict with large carnivores. <i>Key Topics in Conservation Biology</i> , 2 (1): 110–126.
28	Distefano, E. (2005). Human-wildlife conflict worldwide: collection of case studies, analysis of management strategies and good practices. Food and Agricultural Organization of the United Nations (FAO), Sustainable Agriculture and Rural Development Initiative (SARDI), Rome, Italy. Available from: FAO Corporate Document repository <a href="http://www.fao.org/documents">http://www.fao.org/documents</a> .
29	Doubleday, K. F. (2020). Tigers and “good Indian wives”: feminist political ecology exposing the gender-based violence of human–wildlife conflict in Rajasthan, India. <i>Annals of the American Association of Geographers</i> , 110 (5): 1521–1539.
30	Figel, J. J., Durán, E. and Bray, D. B. (2011). Conservation of the jaguar <i>Panthera onca</i> in a community-dominated landscape in montane forests in Oaxaca, Mexico. <i>Oryx</i> , 45 (4): 554–560.
31	Fletcher, R. and Toncheva, S. (2021). The political economy of human-wildlife conflict and coexistence. <i>Biological Conservation</i> , 260: 109216.
32	Frank, B. and Glikman, J. A. (2019). Human-wildlife conflicts and the need to include coexistence, In: <i>Human-wildlife interactions: Turning conflict into coexistence</i> . Cambridge University Press, UK. pp. 1–19.
33	Goswami, V. R., Vasudev, D., Kamad, D., Krishna, Y. C., Krishnadas, M., Pariwakam, M. and Siddiqui, I. (2013). Conflict of human–wildlife coexistence. <i>Proceedings of the National Academy of Sciences</i> , 110 (2): E108.

## Appendix 1: (Continued).

S. No.	Publications
34	Guerisoli, M. D. L. M., Luengos Vidal, E., Franchini, M., Caruso, N., Casanave, E. B. and Lucherini, M. (2017). Characterization of puma–livestock conflicts in rangelands of central Argentina. <i>Royal Society Open Science</i> , 4 (12): 170852.
35	Hanson, J. H., Schutgens, M. and Leader-Williams, N. (2019). What factors best explain attitudes to snow leopards in the Nepal Himalayas? <i>PLoS ONE</i> , 14 (10): e0223565.
36	Harihar, A., Verissimo, D. and MacMillan, D. C. (2015). Beyond compensation: Integrating local communities' livelihood choices in large carnivore conservation. <i>Global Environmental Change</i> , 33: 122–130.
37	Hazzah, L. N. (2007). Living among lions ( <i>Panthera leo</i> ): coexistence or killing? Community attitudes towards conservation initiatives and the motivation behind lion killing in Kenyan Maasai land. Ph.D. thesis. University of Wisconsin-Madison. 156 pp.
38	Hazzah, L., Mulder, M. B. and Frank, L. (2009). Lions and warriors: social factors underlying declining African lion populations and the effect of incentive-based management in Kenya. <i>Biological Conservation</i> , 142 (11): 2428–2437.
39	Hemson, G., MacLennan, S., Mills, G., Johnson, P. and Macdonald, D. (2009). Community, lions, livestock and money: a spatial and social analysis of attitudes to wildlife and the conservation value of tourism in a human–carnivore conflict in Botswana. <i>Biological Conservation</i> , 142 (11): 2718–2725.
40	Hunold, C. and Mazuchowski, M. (2020). Human–wildlife coexistence in urban wildlife management: insights from nonlethal predator management and rodenticide bans. <i>Animals</i> , 10 (11): 1983.
41	Inskip, C., Ridout, M., Fahad, Z., Tully, R., Barlow, A., Barlow, C. G. and MacMillan, D. (2013). Human–tiger conflict in context: risks to lives and livelihoods in the Bangladesh Sundarbans. <i>Human Ecology</i> , 41 (2): 169–186.
42	Jackson, R. M. (2015). HWC ten years later: successes and shortcomings of approaches to global snow leopard conservation. <i>Human Dimensions of Wildlife</i> , 20 (4): 310–316.
43	Karanth, K. U., Gopalaswamy, A. M., Karanth, K. K., Goodrich, J., Seidensticker, J. and Robinson, J. G. (2013). Sinks as saviors: Why flawed inference cannot assist tiger recovery. <i>Proceedings of the National Academy of Sciences</i> , 110 (2): E110.
44	Knopff, A. A., Knopff, K. H. and St. Clair, C. C. (2016). Tolerance for cougars diminished by high perception of risk. <i>Ecology and Society</i> , 21 (4): 1–9.
45	Knox, J., Negrões, N., Marchini, S., Barboza, K., Guanacoma, G., Balhau, P. and Glikman, J. A. (2019). Jaguar persecution without “cowflict”: insights from protected territories in the Bolivian Amazon. <i>Frontiers in Ecology and Evolution</i> , 7: 494.
46	Koziarski, A., Kissui, B. and Kiffner, C. (2016). Patterns and correlates of perceived conflict between humans and large carnivores in Northern Tanzania. <i>Biological Conservation</i> , 199: 41–50.
47	Kshetry, A., Vaidyanathan, S. and Athreya, V. (2018). Diet selection of leopards ( <i>Panthera pardus</i> ) in a human-use landscape in North-Eastern India. <i>Tropical Conservation Science</i> , 11: 194008291876463.
48	Kumbhojkar, S., Yosef, R., Benedetti, Y. and Morelli, F. (2019). Human-leopard ( <i>Panthera pardus fusca</i> ) co-existence in Jhalana forest reserve, India. <i>Sustainability</i> , 11 (14): 3912.
49	Kusi, N., Sillero-Zubiri, C., Macdonald, D. W., Johnson, P. J. and Werhahn, G. (2020). Perspectives of traditional Himalayan communities on fostering coexistence with Himalayan wolf and snow leopard. <i>Conservation Science and Practice</i> , 2 (3): e165.
50	Lagendijk, D. D. and Gusset, M. (2008). Human–carnivore coexistence on communal land bordering the Greater Kruger Area, South Africa. <i>Environmental Management</i> , 42 (6): 971–976.
51	Lamichhane, B. R., Persoon, G. A., Leirs, H., Musters, C. J. M., Subedi, N., Gairhe, K. P. and De longh, H. H. (2017). Are conflict-causing tigers different? Another perspective for understanding human-tiger conflict in Chitwan National Park, Nepal. <i>Global Ecology and Conservation</i> , 11: 177–187.
52	Loveridge, A. J. S. W., Wang, S. W., Frank, L. and Seidensticker, J. (2010). People and wild felids: conservation of cats and management of conflicts, In: Macdonald, D. W. and Loveridge, A. J. (Eds.), <i>Biology and conservation of wild felids</i> . Oxford University Press, New York. pp. 161–195.
53	Madden, F. (2004). Creating coexistence between humans and wildlife: global perspectives on local efforts to address human–wildlife conflict. <i>Human Dimensions of Wildlife</i> , 9 (4): 247–257.
54	Madden, F. M. (2008). The growing conflict between humans and wildlife: law and policy as contributing and mitigating factors. <i>Journal of International Wildlife Law and Policy</i> , 11 (2–3): 189–206.
55	Marchini, S. and Macdonald, D. W. (2020). Can school children influence adults' behavior toward jaguars? Evidence of intergenerational learning in education for conservation. <i>Ambio</i> , 49 (4): 912–925.
56	Marchini, S., Ferraz, K. M. P. M. B., Zimmermann, A., Guimarães-Luiz, T., Morato, R., Correa, P. L. and Macdonald, D. W. (2019). Planning for coexistence in a complex human-dominated world, In: Frank, B., Glikman, J. and Marchini, S. (Eds.), <i>Human–wildlife interactions: turning conflict into coexistence</i> . Cambridge University Press, Cambridge, United Kingdom. pp. 414–438.
57	McGovern, E. B. and Kretser, H. E. (2015). Predicting support for recolonization of mountain lions ( <i>Puma concolor</i> ) in the Adirondack Park. <i>Wildlife Society Bulletin</i> , 39 (3): 503–511.
58	McKay, J. E., St. John, F. A., Harihar, A., Martyr, D., Leader-Williams, N., Milliyawati, B. and Linkie, M. (2018). Tolerating tigers: Gaining local and spiritual perspectives on human-tiger interactions in Sumatra through rural community interviews. <i>PLoS ONE</i> , 13 (11): e0201447.
59	Miller, J. R. and Schmitz, O. J. (2019). Landscape of fear and human-predator coexistence: applying spatial predator-prey interaction theory to understand and reduce carnivore-livestock conflict. <i>Biological Conservation</i> , 236: 464–473.
60	Miller, J. R., Jhala, Y. V. and Jena, J. (2016). Livestock losses and hotspots of attack from tigers and leopards in Kanha Tiger Reserve, Central India. <i>Regional Environmental Change</i> , 16 (1): 17–29.
61	Miquelle, D., Nikolaev, I., Goodrich, J., Litvinov, B., Smirnov, E. and Suvorov, E. (2005). Searching for the coexistence recipe: A case study of conflicts between people and tigers in the Russian Far East, In: Woodroffe, R., Thirgood, S. and Rabinowitz, A. (Eds.), <i>People and wildlife, conflict or co-existence?</i> Cambridge University Press, Cambridge, UK. pp. 305–322.
62	Mishra, C., Redpath, S. R. and Suryawanshi, K. R. (2016). Livestock predation by snow leopards: conflicts and the search for solutions, In: McCarthy, T. and Mallon, D. (Eds.), <i>Snow leopards: biodiversity of the world: conservation from genes to landscapes</i> Academic Press, USA. pp. 59–67.
63	Mkonyi, F. J. (2022). An integrated approach for the management of human-carnivore conflict: a review of conflict management interventions in Tanzania. <i>Mammalian Biology</i> , 102: 2061–2081.



## Appendix 1: (Continued).

S. No.	Publications
64	Naha, D., Chaudhary, P., Sonker, G. and Sathyakumar, S. (2020). Effectiveness of non-lethal predator deterrents to reduce livestock losses to leopard attacks within a multiple-use landscape of the Himalayan region. <i>PeerJ</i> , 8: e9544.
65	Naha, D., Dash, S. K., Kupferman, C., Beasley, J. C. and Sathyakumar, S. (2021). Movement behavior of a solitary large carnivore within a hotspot of human-wildlife conflicts in India. <i>Scientific Reports</i> , 11 (1): 114.
66	Nyhus, P. J. and Tilson, R. (2004). Characterizing human-tiger conflict in Sumatra, Indonesia: implications for conservation. <i>Oryx</i> , 38 (1): 68–74.
67	Nyhus, P. J. and Tilson, R. (2010). <i>Panthera tigris</i> vs <i>Homo sapiens</i> : conflict, coexistence, or extinction, In: <i>Tigers of the world</i> . William Andrew Publishing. pp. 125–141.
68	Odden, M., Athreya, V., Rattan, S. and Linnell, J. D. (2014). Adaptable neighbours: movement patterns of GPS-collared leopards in human dominated landscapes in India. <i>PLoS ONE</i> , 9 (11): e112044.
69	Porfirio, G., Sarmiento, P., Leal, S. and Fonseca, C. (2016). How is the jaguar <i>Panthera onca</i> perceived by local communities along the Paraguai River in the Brazilian Pantanal? <i>Oryx</i> , 50 (1): 163–168.
70	Prasad, A. (2020). Leopard Hills of Jawai: harbinger of human-wildlife coexistence. <i>Science Reporter</i> , 57 (11): 44–46.
71	Rabinowitz (2005). Jaguars and livestock: living with the world's third largest cat. <i>Conservation Biology Series-Cambridge</i> , 9: 278.
72	Ramírez-Álvarez, D., Napolitano, C. and Salgado, I. (2021). Puma ( <i>Puma concolor</i> ) in the neighborhood? Records near human settlements and insights into human-carnivore coexistence in Central Chile. <i>Animals</i> , 11 (4): 965.
73	Rashid, W., Shi, J., ur Rahim, I., Sultan, H., Dong, S. and Ahmad, L. (2020). Research trends and management options in human-snow leopard conflict. <i>Biological Conservation</i> , 242: 108413.
74	Romanach, S. S., Lindsey, P. A. and Woodroffe, R. (2007). Determinants of attitudes towards predators in central Kenya and suggestions for increasing tolerance in livestock dominated landscapes. <i>Oryx</i> , 41 (2): 185–195.
75	Rust, N. and Hughes, C. (2018). Social science methods to study human–cheetah interactions, In: Marker, L., Boast, L. and Schmidt-Kuentzel, A. (Eds.), <i>Cheetahs: biology and conservation</i> . Academic Press, London, UK. pp. 483–493.
76	Schauer, J. R. (2021). Willingness to coexist with jaguars and pumas in Costa Rica. <i>Society and Animals</i> , 1: 1–21.
77	Schuette, P., Creel, S., and Christianson, D. (2013). Coexistence of African lions, livestock, and people in a landscape with variable human land use and seasonal movements. <i>Biological Conservation</i> , 157: 148–154.
78	Schulz, F., Engel, M. T., Bath, A. J., Oliveira, L. R. and O'Neal, C. (2017). <i>Human-wildlife interaction: the case of big cats in Brazil</i> , In: Campbell, M. O'. (Ed.), <i>Biological Conservation in the 21st Century: a conservation biology of large wildlife</i> . Nova Science Publishers, Inc. New York, USA. pp. 31–57.
79	Sibanda, L., Johnson, P. J., van der Meer, E., Hughes, C., Dlodlo, B., Mathe, L. J. and Loveridge, A. J. (2022). Effectiveness of community-based livestock protection strategies: a case study of human–lion conflict mitigation. <i>Oryx</i> , 56 (4): 537–545.
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