Online ISSN: 2588-3526
Journal of Wildlife and Biodiversity
Research Article
*Volume 8(4): 276-293 (2024) (*http://www.wildlife-biodiversity.com/*)*

# Coexistence and conflict: Exploring the dynamics of traditional livestock farming and wildlife in the community conserved area, Hyrcanian region

**Shirin Parhizkar[1], Negin Sheikholeslami[1], Peyman Moghadas[2], Fariborz Hatami[3], Bagher Ghaffari Chelavi[4], Mohammad S. Farhadinia[5, 6] , Pooriya Sepahvand[1, 7]*, Seyed Mahmoud Ghasempouri[1]***

[1]Environmental Science and Engineering Department, Tarbiat Modares University, 46417-76489, Noor, Iran
[2]Conservationist and wildlife biologist, Tonekabon, Mazandaran, Iran
[3]Environmental Expert and activist, Tehran Province, Tehran, Iran
[4]People's campaign of Hyrcanian Maral, Chelav, Amol, Mazandaran, Iran
[5]Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Canterbury, UK
[6]Department of Biology, University of Oxford, Oxford, UK
[7]Caprinae Specialist Group (IUCN)
[*]Email:pooriya.sepahvand@modares.ac.ir , ghasempm@modares.ac.ir
Received: 28 June 2024 / Revised: 15 September 2024 / Accepted: 19 September 2024/ Published online: 23 September 2024.
**How to cite:** Parhizkar, S., Sheikholeslami, N., Moghadas, P., Hatami, F., Ghaffari Chelavi, B., Farhadinia, M.S., Sepahvand, P., Ghasempouri, S.M. (2024). Coexistence and conflict: Exploring the dynamics of traditional livestock farming and wildlife in the community conserved area, Hyrcanian region, Journal of Wildlife and Biodiversity, 8(4), 276-293. **DOI**: https://doi.org/10.5281/zenodo.13825921

## Abstract

The Chelav Community Conserved Area, located along the southern Caspian Sea, hosts 39 livestock farms. Despite the pressures of traditional farming, the ecosystem remains vibrant, with an increase in leopard and bear sightings but a decline in wolf populations over the past 20 years. Ranchers have reported more frequent leopard and bear encounters, while wolf sightings have decreased. Approximately 94.87% of respondents express indifference toward leopard and bear attacks, and 89.74% feel the same about wolf attacks. Although most ranchers are indifferent, 10.25% indicated they would kill wolves that repeatedly attack their livestock. The presence of shepherds and guard dogs has been shown to reduce wildlife attacks, with shepherds notably more effective at deterring leopards compared to wolves. The absence of livestock bells has been linked to increased leopard and wolf attacks (p-value < 0.01). Inconsistent protective measures have likely allowed carnivores to remain in the area, as there are few reports of livestock attacks in adjacent basins. This study underscores the necessity for sustainable coexistence strategies that protect both local livelihoods and wildlife in the Chelav region.

**Keywords**: human-wildlife conflict, semi-structured interview, large carnivores, Persian leopard

## Introduction

Human-wildlife conflict is a pressing challenge for wildlife management and conservation, exacerbated by global population growth, increased resource consumption, and habitat loss, which forces wildlife to encroach upon human settlements. This encroachment leads to competition for space and resources, often resulting in conflict (Frank et al., 2019; Conover, 2001; IUCN, 2003; Madden, 2004). The hostility towards large carnivores stems from real and perceived threats to human health and livelihoods, prompting efforts to eradicate these species (Treves et al., 2003; Chapron et al., 2014).

The conflict is particularly intense for larger carnivores, as over 75% of the world's cat species are affected by HWC, with the intensity of conflict generally increasing with the size of the species (Inskip et al., 2009). The conservation of large carnivores is thus a significant challenge for biodiversity (Chapron et al., 2014). The unique characteristics of these animals, including their extensive space requirements and protein-rich diets, can lead to livestock predation and threats to human safety, significantly when their habitats are encroached upon (Dhakal et al., 2023; Chapron & Lopez-Bao, 2016; van Eeden et al., 2017).

Human-wildlife conflicts are increasingly common near agricultural and urban areas or protected zones. High numbers of animal killings are reported for various reasons, including trade, road accidents, food, and medicine (Irshad et al., 2023). Conflicts often arise when wildlife damages crops, injures or kills livestock, or threatens human life, leading to retaliatory killings of carnivores, which can drive local extinctions (Frank et al., 2019; Treves & Bruskotter, 2014; Treves & Karanth, 2003). In regions like the Middle East and Central Asia, livestock losses to predators are a primary cause of HWC (Khorozyan et al., 2022; Soofi et al., 2022a). The illegal killing of predators, such as the Persian leopard, due to livestock predation is a significant concern (Karlstetter, 2008).

Globally, various large carnivores, including wolves, brown bears, pumas, and tigers, frequently prey on livestock, leading to widespread conflict (Kaczensky, 1999; Karanth, 2002; Sıkdokur et al., 2024). Managing HWC remains contentious, with livestock predation identified as the primary source of conflict (Khorozyan et al., 2015). The socio-economic costs of livestock losses can lead to negative attitudes towards carnivore conservation (Khorozyan et al., 2020; Soofi et al., 2022b).

Wild prey availability significantly influences carnivore behavior; leopards may preface on livestock when wild prey is scarce (Khorozyan et al., 2015; Braczkowski et al., 2018). However,

even in the presence of abundant wild prey, conflicts can arise due to increased predator populations and interactions with livestock (Soofi et al., 2022a).

The Persian leopard's distribution has declined due to habitat encroachment and retaliatory killings, highlighting the need for coexistence strategies (Soofi et al., 2022c). The brown bear also faces significant conflict in Iran, impacted by historical events and population pressures (Ambarli & Bilgin, 2008; Can et al., 2014; Fortin et al., 2016; Bombieri et al., 2019; Sıkdokur et al., 2024).

Conflict, while often viewed negatively, can indicate multi-species coexistence and a catalyst for change (Hill, 2021). It is prevalent not only in protected areas but also in community and local conserved areas. Indigenous and community-conserved areas (ICCAs) are vital ecosystems that local communities voluntarily protect, fostering a strong relationship between people and their environment (Berkes, 2009).

The Chelav Community Conserved Area, located in Mazandaran Province, is characterized by high biodiversity and a significant presence of livestock. The increasing overlap of human activities with wildlife habitats drives resource competition (Madden, 2004). Direct causes of HWC include human population expansion, intensified land use, and habitat fragmentation (Madden, 2008). Failure to address these conflicts undermines conservation efforts and public support (Madden, 2004).

In rural Iran, human-wildlife conflicts are common, yet there is a growing focus on developing solutions (Behdarvand et al., 2014; Hosseini-Zavarei et al., 2013; Khorozyan et al., 2017). The Chelav region has reported various conflicts between wildlife and local ranchers, raising concerns about the sustainability of wildlife populations without proper conflict management.

The study aims to investigate changes in wildlife populations and rancher attitudes towards wildlife in the Chelav region, assessing the status of conflicts and identifying information gaps regarding their causes. It will also examine the correlation between shepherd presence and the frequency of wildlife attacks on livestock, mainly focusing on the role of shepherds with or without bells in deterring these attacks.

## Martial and methods

### *Study area*

Chelav region is located in the center of the Hyrcanian forest, 30 km southeast of Amol, with the Haraz road to the west (Fig. 1). The altitude ranges from 850 to 1900m, and the area is about 95 km2 contains rural areas, forests, pastures, and agricultural land use. A wide range of species have been recorded, among which the most prominent are wild boar (*Sus scrofa*), Persian leopard, brown

bear (*Ursus arctos*), wolf (*Canis lupus*), golden jackal (*Canis aureus*), lynx (*Lynx lynx*), Caspian red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*).

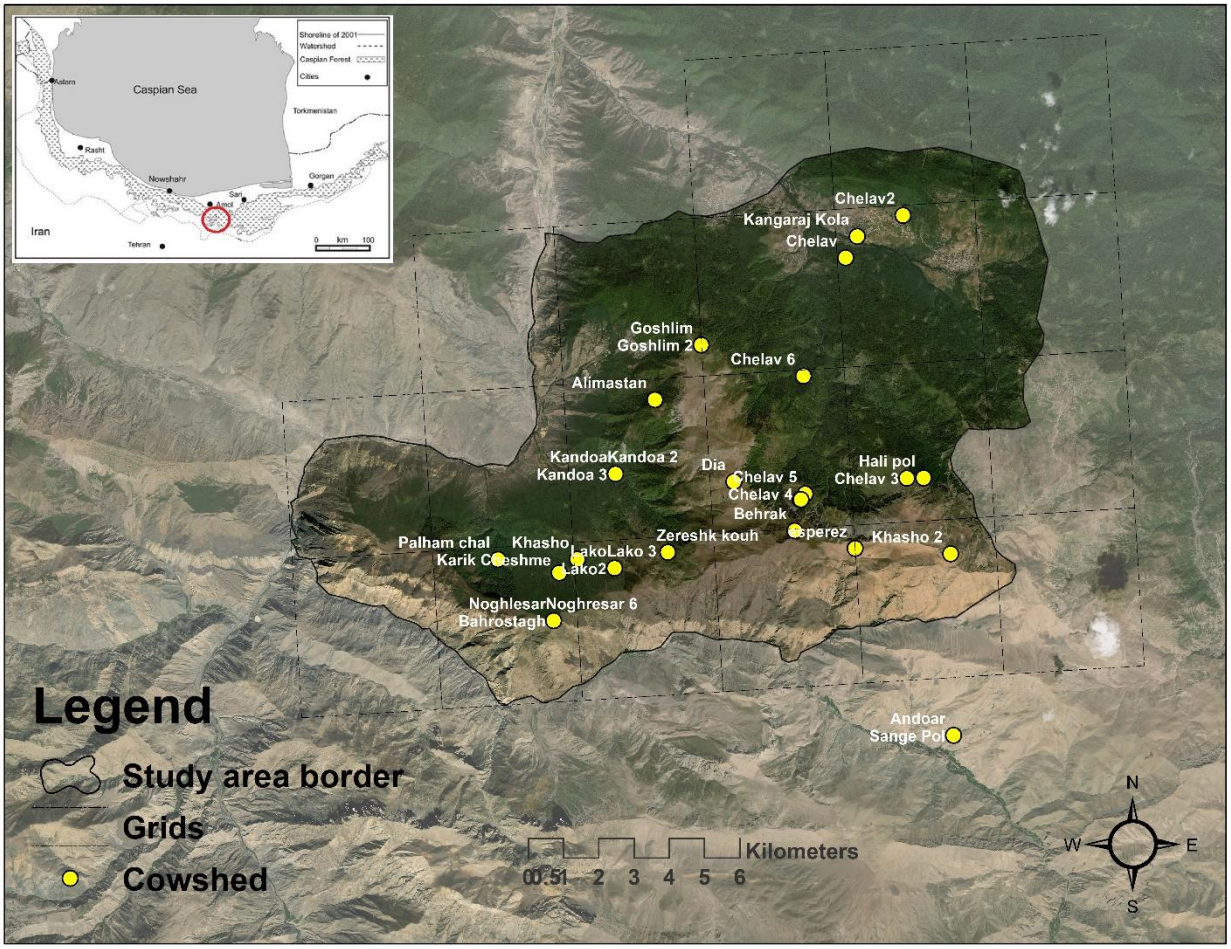


**Figure 1.** The study area in the southern Caspian Sea, including the central zone of the Hyrcanian forest, had 39 active livestock farms in 21 points, and face-to-face interviews were conducted with the ranchers.

### *Sampling methods*

This research was conducted using a questionnaire and semi-structured interviews with 39 ranchers and livestock owners across 21 locations in the Chelav region. This sample size effectively encompasses most ranchers in the study area. The primary objectives of this research were to investigate the status of conflicts between various wildlife species and ranchers in the region and changes in the population of large mammals, and it was carried out from winter 2021 to spring 2022.

The semi-structured face-to-face interview approach was selected for its adaptability, comparability, and potential for generalizing the results to diverse cultural contexts. Researchers conduct these types of interviews using a few key questions, allowing them to expand on those questions through relevant cultural explorations and meet flexibility and comparability criteria (Dayer et al., 2007).

The questionnaire designed for this study consisted of three sections. The first section included four questions to assess the interviewees' knowledge of the species and attitudes. The second section, with three questions, examined the changes in the abundance of target species over the past twenty years. The third section investigated the extent and history of conflicts and the ranchers' responses to these conflicts. Finally, personal details, the date, and the interview location were recorded.

***Assessing changes in wildlife observation***

To assess the extent of changes in wildlife occurrence from the perspective of local livestock farm owners, quantitative questions were used to extract the relevant results. A map depicting the locations of the face-to-face interviews within the region was generated using the coordinates of each livestock farm within a GIS (Geographic Information System) environment. The interview locations were then symbolized as points on the map (Fig. 2). Additionally, the region was divided into a grid of 20 cells, each measuring 4.5 × 4.5 km. The movement range of the ranchers and the grazing area of their livestock within each of these grid cells were identified.

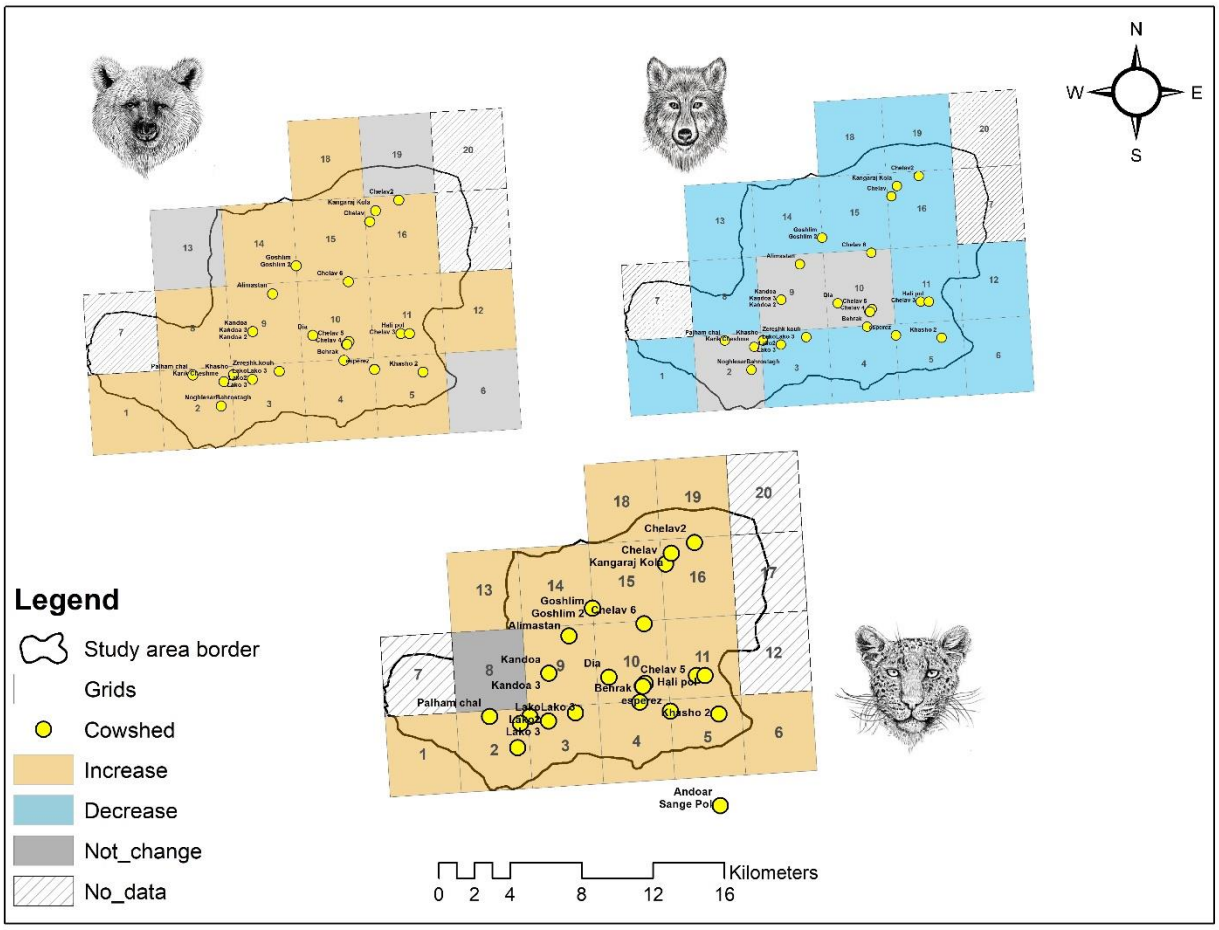


**Figure 2.** Population observation of carnivore indicator species during the last 20 years.

### *Statistical analysis*

The Chi-square test was used to measure the correlation between the presence of a shepherd and a bell as a deterrent against attacks by carnivorous species. The Chi-square test is a nonparametric (distribution-free) tool that analyzes group differences when the dependent variable is measured at the nominal level. The hypothesis was that the presence of a shepherd with a bell significantly reduces the frequency of wildlife attacks on livestock compared to the presence of a shepherd without a bell. (McHugh, 2013). Interviews and data collection were conducted by the ethical protocol of the Tarbiat Modares University (TMU) Research Deputy.

## Results

The results of the semi-structured interviews, conducted across three distinct sections, are now available for analysis and examination. The first section focused on individuals' knowledge and

attitudes toward various species, the second section examined observation changes of target species over the past 20 years, and the third section explored conflicts between different species and ranchers.

Of the 39 interviewees, 87.17% (n = 34) were exclusively ranchers, relying solely on income from this profession. The remaining interviewees combined livestock farming with various occupations, including driving, agriculture, retirement, facilities management, and forest ranger duties. Notably, 71.79% of the interviewees lacked insurance coverage for damages caused by wildlife, citing reasons such as lack of awareness or failure to pursue compensation.

Regarding species recognition, 26% of the interviewees identified all three target species: brown bear, leopard, and wolf. Additionally, 22% of respondents were familiar with the lynx. During the interviews, 28% of people reported sighting wolves, 26% observed bears, and 24% observed leopards. Furthermore, 87.17% of respondents expressed interest in leopards, while 82.05% showed interest in bears. Only 25.64% of individuals expressed no interest in wolves.

The questionnaire also explored people's reactions to wildlife attacks, revealing that 94.87% of respondents remain indifferent to leopard and bear attacks, while 89.74% are indifferent to wolf attacks. Among the respondents, 10.25% stated that they would kill a wolf if it attacked them repeatedly.

Interviewees perceived that the observation of leopards and bears has increased during the past two decades, while the wolf occurrence has decreased in the studied region (Figure 2). The observation of leopards has increased in northern and southern cells, with no significant change in western cells. Conversely, for wolves, the trend is almost the opposite. According to ranchers, wolf density has decreased in areas where leopard occurrence has increased. Except in the eastern part, bear observations have generally increased compared to 20 years ago.

Diseases are the leading cause of non-attack-related losses, with a minimum of 22 cases per herd recorded. Additionally, falling from cliffs and theft are other reasons for losses. Overall, among 39 ranchers, 78 livestock deaths were estimated due to attacks by leopards, wolves, and golden jackals. Specifically, 35 leopard attacks, 21 wolf attacks, and 3 jackal attacks were recorded (Table 1).

**Table 1.** The number of attacks and losses of wolf, leopard, and golden jackal on herds.

| Cause of livestock loss | Number of attacks | The type of livestock lost | Number of losses |
|---|---|---|---|
| Wolf predation | 21 | Cow/Sheep/Goat | 29 |
| Leopard predation | 35 | Cow/Sheep/Goat | 46 |
| Golden jackal predation | 3 | Goat | 3 |
| Eating the seeds of Gum arabic tree | | Cow | 2 |
| Theft | | Cow (2 cases, the type of livestock is not mentioned) | 15 |
| Poisonous plant | | Cow | 1 |
| Sickness | | Cow (11 cases; the type of livestock is not mentioned) | 22 |
| Throwing off the cliff | | Cow (2 cases, the type of livestock is not mentioned) | 10 |
| | **Total 59** | | **Total 128** |

The results indicate that the type of livestock is more significant for wolves in comparison of leopards. Chi-square results showed that wolves are more selective in choosing prey items (p-value $< 0.01$). Specifically, 81% of wolf attacks are directed only at sheep, while 34% of leopard attacks target sheep, and 66% of their attacks are on cattle (Fig. 3).

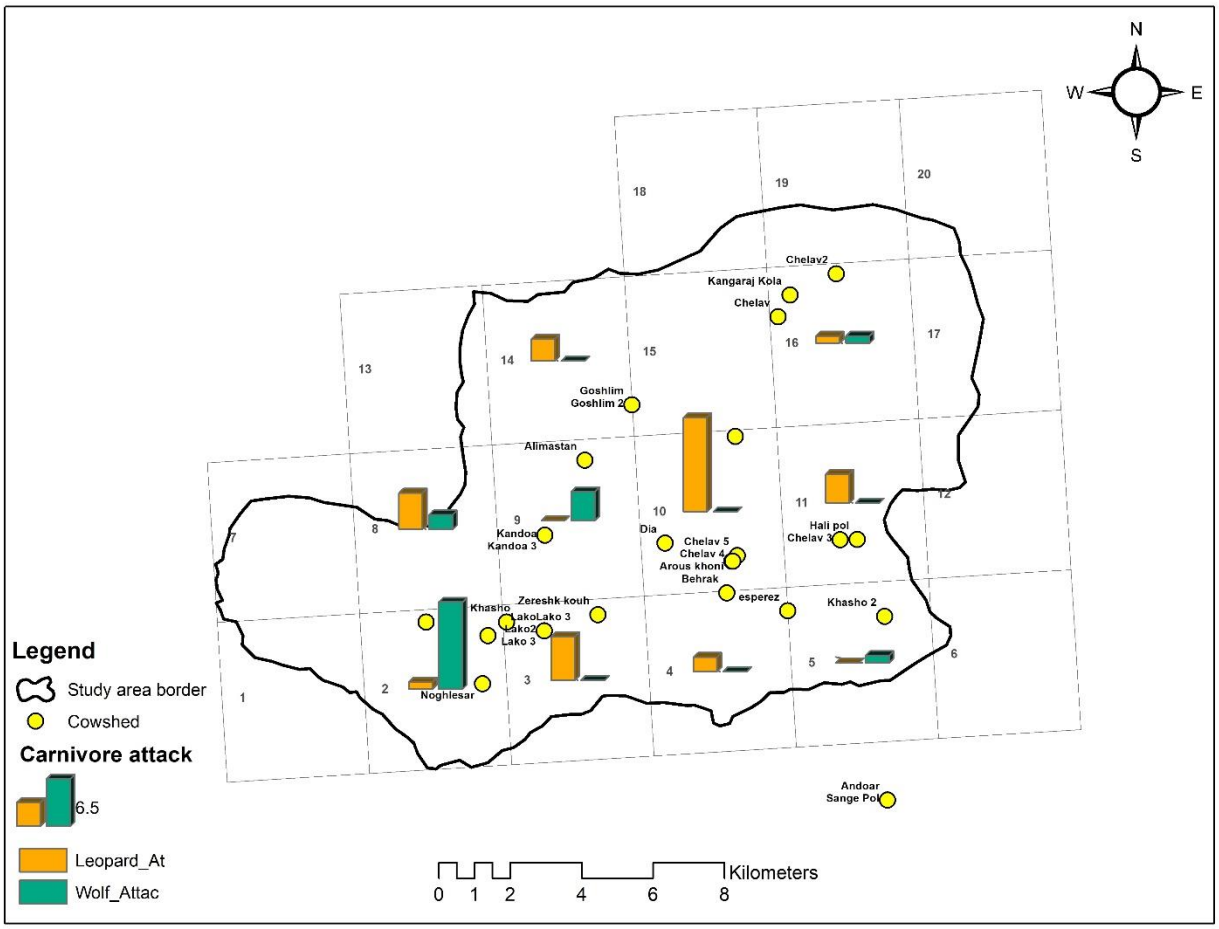


**Figure 3.** The frequency of leopard attacks compared to wolves on domestic livestock in the study area.

### *Seasonal and Temporal Patterns of Attacks*

In examining the timing of attacks by season, statistics show that wolves have the highest number of attacks in summer (57.14%), while leopards have the highest in winter (41.17%). For jackals, only three attacks were reported in winter. Leopard attacks occur more frequently at night, with 20 attacks, compared to 15 during the day. As for wolves, there were 18 attacks during the day, two at night, and one at an unspecified time. For the jackal species, all three attacks were reported during the day. According to ranchers and various reports from different regions of the country, the presence of wolves in an area coincides with the presence of domestic livestock herds. Here, the number of wolf attacks has significantly increased due to the mountainous terrain and the favorable summer climate, where multiple herds are present.

***Spatial distribution of attacks***

Among the locations subject to attacks and conflicts, most wolf attacks occurred in northern and semi-forested areas. The highest leopard attacks were reported in the regions of Baliran, Afrasare Miyasar, Rik Cheshmeh, and Gataban Chelav pasture, with the most significant losses occurring during two leopard attacks in the Gouardan area (9 casualties). Of the 24 areas where livestock were attacked by leopards and the ten areas where wolves attacked livestock, only the common Noghlban area was affected by both species.

***Role of shepherds and bells***

Regarding ranchers whose animals were attacked by carnivorous species (wolves, jackals, and leopards), three additional questions were asked:

1. Whether the shepherd was present during the attack or not.
2. The presence or absence of a bell (used to deter predators).
3. Whether the person observed the attacking animal during the attack or not.

***Deterring Attacks***

It is worth noting that some individuals left specific questions unanswered. According to the interviewees' opinions, the results indicate that out of the 21 wolf attacks, 13 occurred when the shepherd was present. In comparison, out of the 35 leopard attacks, 24 occurred without the shepherd. There were also three jackal attacks, with two happening when the shepherd was present. We also used the Chi-square test to investigate the correlation between the presence or absence of shepherds and attacks by carnivores. The results indicate a significant correlation between a noticeable reduction in leopard attacks when shepherds are present. However, there are doubts regarding the relationship between wolf attacks in the presence of shepherds. Furthermore, the results show no significant correlation between attacks by these two carnivore species when shepherds are present. However, during the absence of shepherds, there is a significant correlation between wolf and leopard attacks (Table 2).

**Table 2.** Results of the Chi-Square test in two Conditions: presence or absence of shepherds with the herd and Bell during attacks by leopard and wolf.

| | ***Carnivorous species*** | | ***The significance level*** |
|---|---|---|---|
| | **Percentage of conflict with wolf** | **Percentage of conflict with Leopard** | |
| ***Absence of shepherds*** | 65% | 69% | P>0.05 |
| ***Presence of shepherds*** | 35% | 31% | P>0.05 |
| ***The significance level*** | P<0.01 | P<0.001 | |

### *Effectiveness of Bells*

When shepherds accompanied the herds and the livestock had bells, only 10% of wolf attacks occurred in some repetitive hotspots. However, in situations where shepherds were absent and there were no bells for the livestock, 28% of wolf attacks occurred. An important point to note is that in situations where shepherds were present but there were no bells, wolf attacks occurred significantly. Conversely, when shepherds were absent and bells were present, it was similar to when the shepherds accompanied the flock. This highlights the importance of bells for livestock in reducing wolf attacks (P<0.01). Due to limited data on jackal attacks, we decided not to perform this test for that species.

### *Attacks on Humans*

In the analysis of attack statistics on people, four species—bears, boars, leopards, and wolves—reported ten attacks, with the respective numbers being 5, 2, 2, and 1. Bears had the highest number of attacks, accounting for 50% of all attacks on people, occurring in all seasons except summer.

### *Ethology and beliefs of local people*

The Galesh people are cattle farmers who reside in the mountainous regions of the Alborz, particularly in Guilan, Mazandaran, and Golestan, Iran. They practice a traditional livestock farming method involving seasonal migration: They move to the plains during the cold months (Qashlaq) and ascend to the highlands in warmer months (Yilaq) to optimize resource use. The Galesh primarily raise indigenous and forest cattle that are well adapted to the cold and rugged climate. Their livestock farming methods are sustainable and rooted in traditional practices passed down through generations, contributing to both local food needs and the cultural identity of the Galesh. Additionally, the Galesh share cultural and religious themes with the ancient Sumerians, as reflected

in their beliefs, such as the reverence for a mythical creature called the "Siyāh Gāleš" or Black Sheperd which is seen as a guardian of Hyrcanian wildlife and livestock (Arakelova, 2024). This belief influences their hunting practices, leading traditional hunters to avoid poaching endangered species like red deer and leopards, demonstrating their commitment to environmental conservation (Gholamdoust et al., 2022).

Local ranchers try to avoid direct interactions with wolves as much as possible. Based on the authors' observations, they burn fallen tree stumps, which can continue for weeks. Ranchers have discovered that the smell of smoke helps to deter wolves from the area. It appears that the smell of smoldering wood smoke does not deter leopards.

## Discussion

### *Human-Wildlife Conflict*

The human population worldwide continues to expand, leading to increased conflicts and confrontations in regions where large carnivores reside (Penteriani et al., 2016; Van Eeden et al., 2018). The conflict between humans and wildlife intensifies when local communities perceive that wildlife needs or values precede their needs. Wildlife uses areas under human control outside of protected zones for survival, which results in interactions and conflicts between humans and wildlife (Madden, 2008; Sıkdokur et al., 2024). Human-wildlife conflict is a complex issue (Hoare, 2001). Negative attitudes toward carnivores often escalate following attacks on humans, potentially having long-term conservation consequences for large carnivore populations (Conover, 2008; Penteriani et al., 2017).

Iran is experiencing rapid human population growth and urbanization, leading to a profound socio-demographic shift from primarily agricultural to a developing country (Taravat et al., 2017). This demographic-social change has resulted in fundamental land use changes and increased human-wildlife conflicts in Iran (2010; Meinecke et al., 2018). Researchers believe that the intensity of human-carnivore conflicts in Iran has increased in the past decade, with species such as brown bears, Persian leopards, and wolves playing a significant role in these conflicts (Farhadinia et al., 2017; Qashqaei et al., 2014; Khorozyan et al., 2020). Therefore, understanding the precise patterns of conflict is essential for mitigating potential attacks (Parchizadeh et al., 2021).

### *Findings from the Chelav Region*

Our current study found that conflicts between wildlife and humans in the Chelav region primarily occur due to carnivores attacking livestock and humans. These conflicts can have negative consequences for both parties, including economic losses for ranchers, fear and anxiety for humans, and harm to wildlife. Interestingly, despite these conflicts, Chelav's ranchers do not view wolves positively. This lack of positive perception may stem from multiple negative experiences of wolf attacks on their livestock.

Our results indicate that leopard attacks significantly outnumber wolf attacks, with wolves primarily targeting sheep (81%) and leopards targeting cattle (66%). These attacks can result in more significant financial losses. However, the farmers exhibit a positive attitude toward species like leopards and bears. 95% of the interviewed individuals responded indifferently to leopard and bear attacks, suggesting that even high mortality rates caused by leopards have not changed their perception. It appears that leopards hold a special place in the cultural beliefs of these people, and they recognize the importance of conserving them. In Turkey, sixty percent of all conflicts arose from bears foraging in or around human settlements, while 12% stemmed from human activities in forested areas. Additionally, 57% of these conflict incidents directly injured humans or bears (Sıkdokur et al., 2024).

The situation of HBCs in Turkey is also noteworthy. The risk of conflict significantly increases by 43% within a 10-kilometer radius around protected areas. The most important factor related to HBCs in Turkey was the distance to villages (37%), with the distance to agricultural lands (16%) also playing a significant role. These findings highlight the significant dependency of Turkish brown bears on human resources, as 67% of all conflicts in our dataset were related to foraging activities in human settlements, including damage to livestock (32.2%), beehives (25.1%), and crops (9.5%) (Sıkdokur et al., 2024). The annual rate of bear attacks on humans in Turkey was calculated at 13.2 attacks per year, surpassing the overall rates in North America (11.4 attacks per year) and Europe (10 attacks per year, excluding Romania) (Bombieri et al., 2019). The statistics on illegal brown bear hunting in Turkey, with 11 cases, are also noteworthy (Sıkdokur et al., 2024).

### *Mitigating Human-Wildlife Conflicts*

A comprehensive and multidisciplinary approach involving all stakeholders is necessary to address human-wildlife conflicts effectively. Increasing awareness and education about wildlife interactions is crucial for mitigating such attacks. For instance, our study revealed that the presence of shepherds,

livestock guardian dogs, and bells significantly reduces wolf and leopard attacks. In situations where shepherds accompanied the herd, and livestock wore bells, only 10% of wolf attacks occurred. This demonstrates that simple management actions can reduce conflicts between humans and wildlife.

Over the past 20 years, changes in key species within the Chelav region have occurred despite heavy pressure from traditional livestock farming and conflicts. The increase in leopard and bear observation may be due to factors such as enhanced conservation efforts and increased prey availability. Conversely, the decline in wolf observation could result from competition with other carnivores or direct persecution by ranchers.

Human-wildlife conflict is a complex issue that requires a multifaceted approach. The findings from the Chelav region highlight the importance of understanding the nuances of these conflicts and implementing targeted mitigation strategies to promote coexistence between humans and wildlife.

## Conclusion

This study provides important insights into traditional livestock farming and wildlife coexistence dynamics in the Chelav Community Conserved Area, a significant location within the Hyrcanian region. Despite the high density of livestock farms and conflicts with large carnivores, the region maintains a diverse and thriving wildlife population, including increasing observation of leopards and bears. The results indicate that human-wildlife conflicts primarily arise from attacks by wolves, leopards, and golden jackals on livestock. Factors such as the presence of shepherds and bells on livestock were inversely related to the number of attacks. Specifically, the presence of shepherds was significantly associated with a decrease in leopard attacks. On the other hand, although ancient beliefs such as Siyāh Gāleš were effective in protecting wildlife in the past, they are doubtful for the present and for young ranchers.

The study suggests several measures to resolve these conflicts and promote sustainable coexistence, including supporting ranchers, implementing preventive measures like employing shepherds and using bells, conducting educational programs, and promoting eco-tourism. Continued monitoring and research will also be crucial to understand the factors influencing wildlife population changes. This study highlights the complex dynamics of human-wildlife interactions in community-managed conservation areas. It provides a framework for developing effective conflict mitigation strategies that balance people's and wildlife's needs.

**Acknowledgments:** We wish to acknowledge the support from Tarbiat Modares University (TMU) under the Ministry of Science, Research, and Technology (MSRT) (Grant No: 40140841001-2).

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