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Research Paper

Distribution, Prey Selection and Conservation Status of Common Leopard *(Panthera pardus)* in District Sudhanoti, Azad Jammu and Kashmir, Pakistan

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Abstract

Among big cats, the common leopard (*Panthera pardus*) is a widely distributed yet vulnerable predator facing threats from habitat loss, declining prey populations, and increasing human-wildlife conflict. This study investigated the distribution, dietary habits, and conservation challenges to the species across the Sudhanoti District, situated in Azad Jammu and Kashmir (AJ&K), Pakistan. Distribution was assessed using direct and indirect sign surveys (scats, pugmarks, prey remains), while dietary analysis was conducted by scat examination to identify prey composition. The study recorded the leopard presence between 418–2016 m asl, with seasonal shifts in habitat use. Scat analysis revealed 10 prey species consumed by the common leopard, comprising seven domestic and three wild meso-mammalian species. Domesticated livestock constituted 78.98% of the diet, with goats (28.29%) and dogs (21.05%) being the most frequently consumed. Wild prey accounted for 21.01% of the diet, with higher consumption observed in winter (38.08%), whereas domestic animals were predominantly consumed during summer (88.21%). Biomass consumption analysis confirmed greater reliance on livestock, increasing human-leopard conflict, with 95% of local respondents viewing leopards negatively. Conservation efforts should focus on livestock protection, habitat restoration, and community engagement to mitigate conflicts and ensure species survival. Future research should emphasize long term scientific monitoring for conflict resolution strategies to sustain leopard population in AJ&K.

Introduction

The common leopard (*Panthera pardus*) is one of the most widely distributed wild felids, exhibiting outstanding adaptability to diverse habitats ranging from dense forests to semi-arid regions (Uphyrkina et al., 2001). Although it is widely distributed, the species is facing conservation challenges due to habitat fragmentation, human encroachment, and the decline in the number of natural prey species. These factors have compelled leopards to modify their feeding habits, often leading to increased livestock predation and intensified human-wildlife conflict (Athreya et al., 2013).

Pakistan is home to four subspecies of the common leopard, of which *Panthera pardus fusca* is found primarily in the Himalayan foothills, particularly in Azad Jammu and Kashmir (Khalil and Hussain, 2008). Historically, leopards in this region have relied on a range of wild prey, including rodents, monkeys, and small to medium-sized ungulates. On the other hand, rapid deforestation, agricultural expansion, and rapidly growing human settlements have dramatically changed the reach of wild prey. As a result, leopards have had to adapt to feeding on livestock such as cattle, sheep, and goats (Dar et al., 2009; Qamar et al., 2010). This shift in food preferences poses environmental and socio-economic challenges, as local communities often view leopards as a threat to their livelihoods, leading to conflict-related killings of both livestock and leopards (Kabir et al., 2013; Jahangeer et al., 2024).

The Sudhanoti district of Azad Jammu and Kashmir provides an important habitat for the common leopard. This study investigated the distribution and dietary adaptation of the species in response to environmental changes in this area. This study examined the level of seasonal variations in reliance of leopard on livestock and prey selection by examining patterns of leopard. Comprehending these dietary changes is essential for developing conservation plans that strike a compromise between reducing human-leopard conflict and conserving leopards (Jahangeer et al., 2024). This study emphasizes the importance of conservation measures that promote coexistence between leopards and local communities. The findings from this research will contribute to the development of sustainable management plans, ensuring the survival of this apex predator while reducing economic losses for rural communities.

Methodology

Study Area

This research work was conducted in the Sudhanoti district of Azad Jammu and Kashmir, which includes the Jinjhal Hill Game Reserve, which is part of the Himalayan foothills (Khan et al., 2012). The district is located at 33.7060° N, 73.7242° E, at an altitude of 500–2000 m asl (Figure 1). The area is located 150 km south of Muzaffarabad, bordered by Poonch (Indian-Occupied Kashmir) to confined by Rawalpindi to the east, Rawalakot to the north, and Kotli to the south (Khan et al., 2012; Hussain, 2013; Hussain et al., 2019).

District Sudhanoti covers a 569-km² area with 60 villages and a population of 281,941 individuals. It consists of four subdivisions: Pallandri (headquarters), Baloch, Trarkhal, and Mang. The Jhelum River separates it from Murree-Kotli Sattian-Kahuta National Park (Hussain et al., 2019).

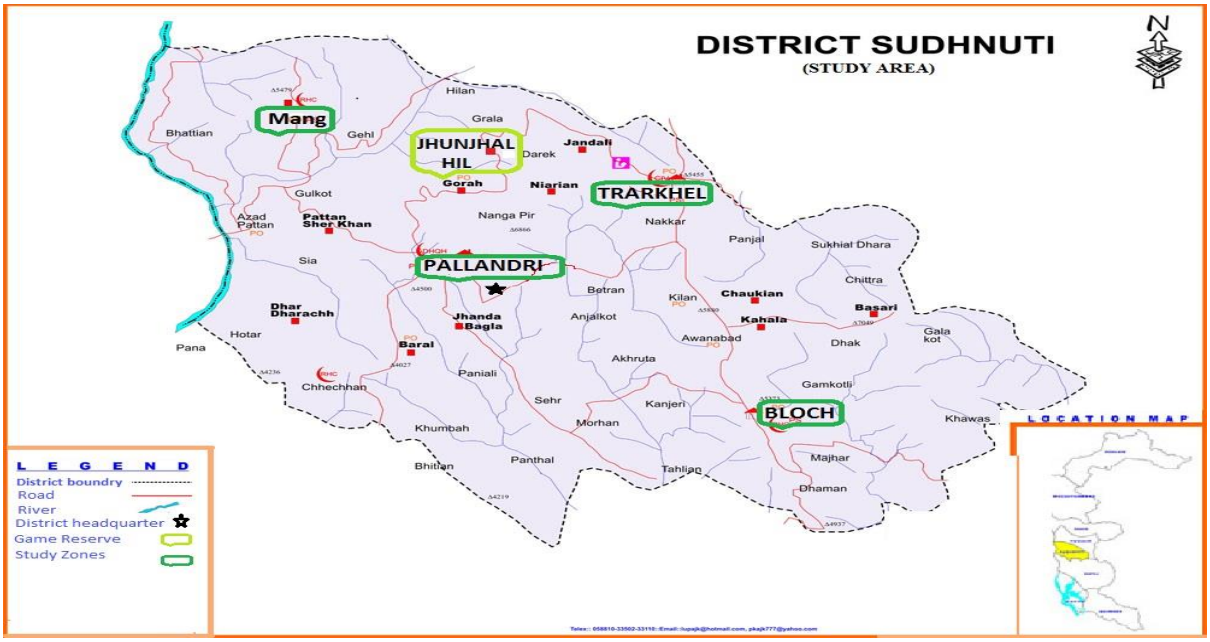

Figure 1. Map of District Sudhanoti (Study area).

The study area experiences temperate to sub-tropical climate features with a prominent winter season from September to February (severe in December–January) and peak summer heat in June–August. The temperature ranges from 6°C (December) to 36°C (June), with an annual rainfall of 99 mm, peaking at 277 mm in spring and 223 mm in July–August. Humidity (70–80%) is highest in July–August, and snowfall (5–15 inches) occurs in some areas during December–January (Hussain et al., 2019). The diverse Himalayan mixed forests and alpine-scrub ecosystem support a rich variety of flora, including tree species such as Kamala (*Mallotus philippensis*), Chir Pine (*Pinus roxburghii*), Blue Pine (*Pinus wallichiana*), Acacia (*Acacia modesta*), Himalayan Pear (*Pyrus pashia*), Neem (*Azadirachta indica*), and China Berry (*Melia azedarach*). The shrub layer consists of Indigofera (*Indigofera heterantha*), Adhatoda (*Adhatoda zeylanica*), Berberis (*Berberis lycium*), and Dodonaea (*Dodonaea viscosa*), while the ground vegetation includes Tagetes (*Tagetes minuta*), Taraxacum (*Taraxacum officinale*), Achyranthes (*Achyranthes aspera*), and Rumex (*Rumex hastatus*) (Khan et al., 2012; Hussain et al., 2019). The district is also home to a diverse range of wildlife, including *Lophura leucomelanos*, *Alectoris chukar*, *Panthera pardus*, *Vulpes vulpes*, *Canis aureus*, *Prionailurus bengalensis*, and *Paradoxurus hermaphroditus* (Hussain et al., 2019).

Data collection

Reconnaissance surveys were conducted between April 2020 and July 2021 to determine the presence and range of the common leopard along with its impact on livestock. A total of 109 locals

were interviewed to understand the conflict between humans and leopards. By selecting eight potential sites across three tehsils and recording indirect signs (scats, pugmarks, and prey remains), the Sign Survey Method was used to determine the animal's distribution based on preliminary data collected from residents (Wemmer et al., 1996; Hussain et al., 2019). Sighting reports were also gathered from hunters and shepherds, and a GIS-based distribution map was developed. The diet of the leopard was examined through scat analysis following the method of Mukherjee et al. (1994). A total of 27 scat samples were systematically collected along 25 trails, then sun-dried, broken apart, and analyzed for undigested remains of prey species, including bones, hooves, hair, and claws. Prey identification was also conducted through microscopic analysis of hair characteristics, compared with reference slides.

Results

Distribution

Surveys covered a 262 km² area, recording twenty-eight scats, fourteen pugmarks, eight prey remains, and seven leopard carcasses at various elevations between 418 m to 2016 m asl. Scats were found on trails and tracks, while pugmarks appeared near water bodies, including rivers and streams, and the remains of prey species were located in bushes and rocky areas. A distribution map indicated seasonal shifts in leopard occurrence between 418–1915 m asl in autumn/winter and 660–2016 m asl in summer, showing even distribution across seasons (Figure 2).

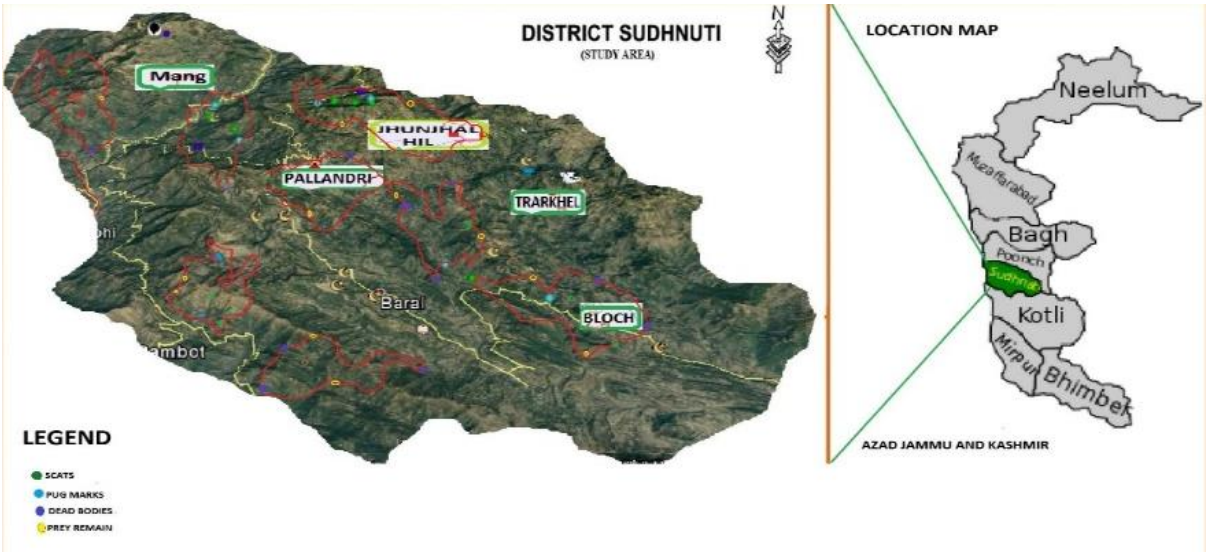

Figure 2. Distribution map of the Common leopard in District Sudhnoti (study area) during 2020-21.

A survey involving interviews with 109 residents across all four tehsils revealed intense human-leopard conflict in eight union councils. Due to economic losses from livestock depredation, 95% of respondents supported the retaliatory killings of leopards, while only 2% recognized their conservation value. During the 10-month study, the highest scat presence (n=7) was recorded at

Jandi Gallah, while prey remains were most frequent at Junjhal Hills, Jandi Gallah, and Baloch. Additionally, seven cases of leopard hunting were recorded, which highlight the severe conflict and conservation challenges (Figures 3 & 4).

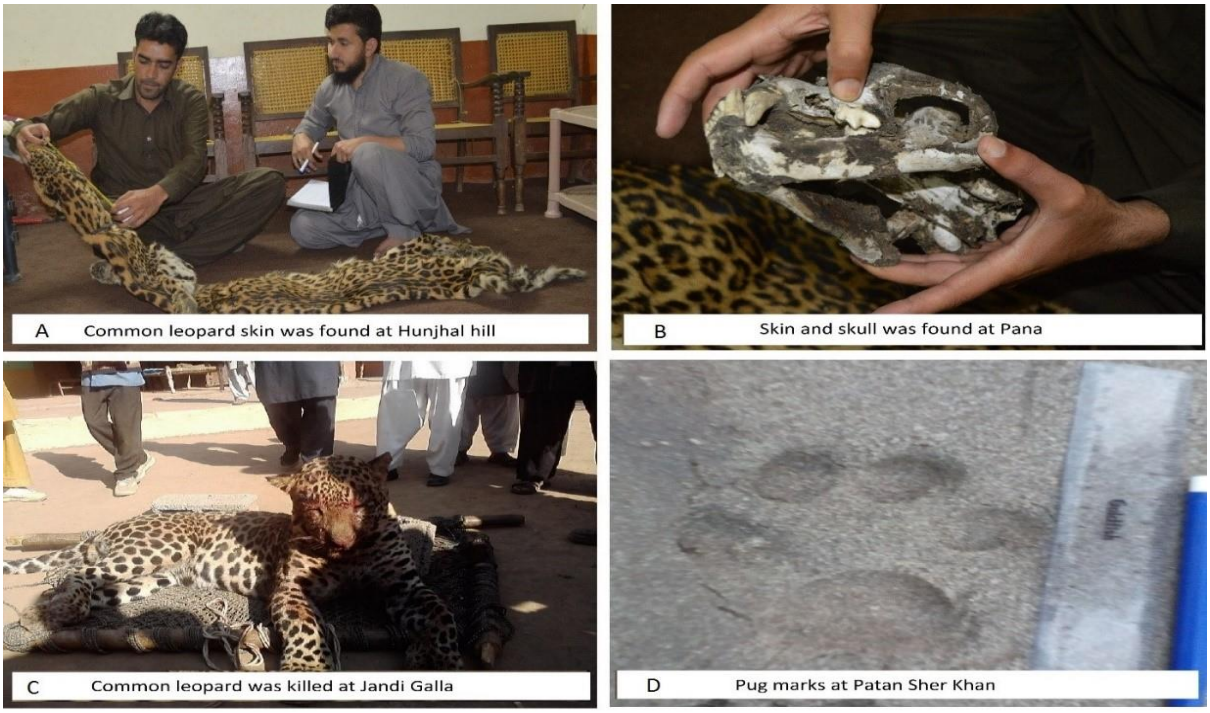

Figure 3. Some photographs of the direct and indirect signs of the Common leopard from the study area.

Figure 4. Some evidence of human-common leopard conflict from the study area during 2020-21.

Diet Analysis

Laboratory analysis of 27 scat samples revealed morphological characteristics with an average length of 21.68 ± 0.36 cm, breadth of 3.089 ± 0.07 cm, and weight of 88.79 ± 2.11 g. Scat composition primarily consisted of hairs (100% occurrence), bones (89.29%), unidentified materials (28.57%), plant matter (17.86%), and stones (14.29%). In terms of volume contribution, hairs dominated (70.27%), followed by bones (21.48%), with minor amounts of plants (2%) and stones (1.35%) (Figure 5).

Figure 5. Scats of the Common leopard collected from the study area.

Scat analysis identified 10 prey species, out of ten; seven were domesticated and 3 wild species. Domesticated prey constituted 73.66% of the common leopard's diet, goat (28.29%), dog (21.05%), and sheep (13.15%) being the most consumed. Among dominant wild prey species, the Rhesus monkey (18.42%), Cape hare (5.26%), and red fox (2.63%) were dominant species. Seasonal variation was evident, with domestic prey consumption peaking in summer (88.21%), whereas wild prey was more frequently consumed in autumn/winter (38.08%) (Figure 6; 7).

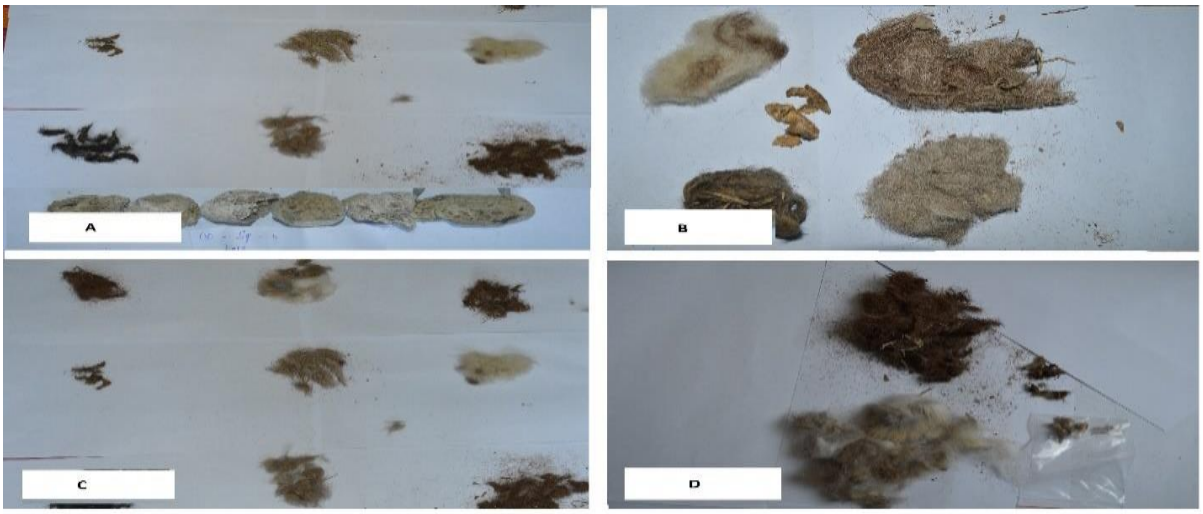

Figure 6. Photographs showing different food items recovered from the scats of common leopard (*Panthera pardus*) from the study area.

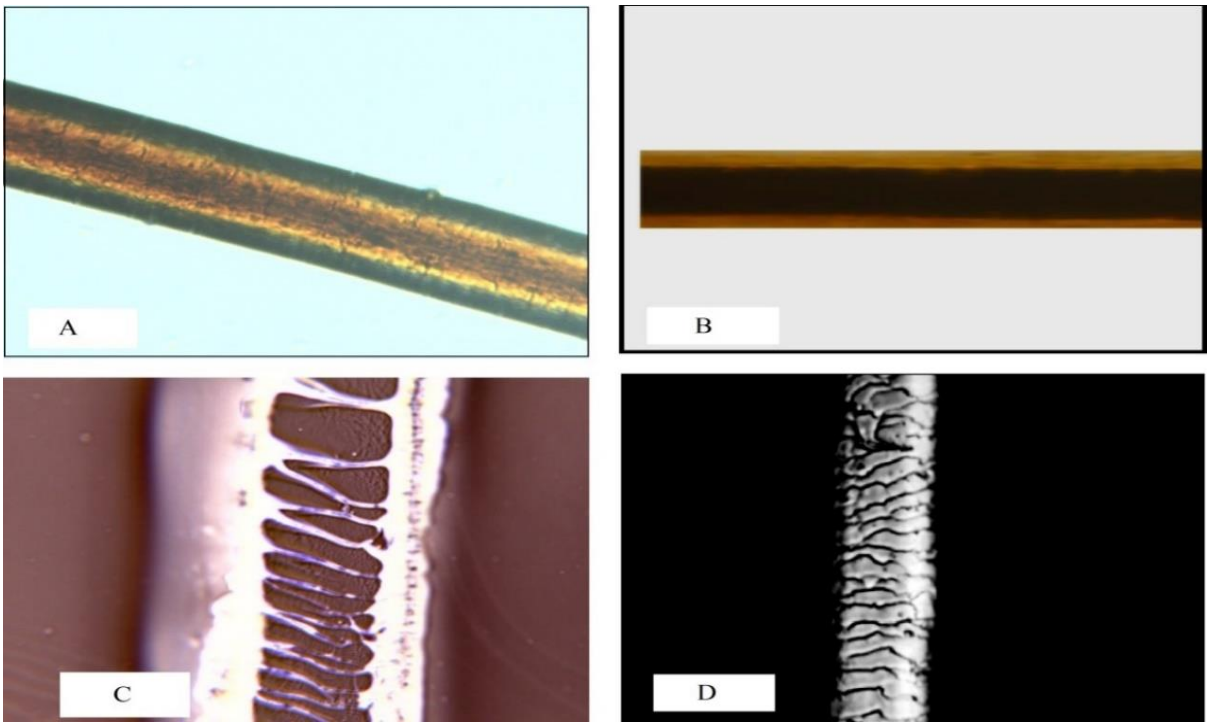

Figure 7. Photographs of goat (*Capra hircus*) hair recovered from the scats of common leopard from the study area matched with the reference hair slides: A & B whole mount slides and C&D scale replica of goat hair (100X).

Among 107.63 kg biomass consumed by the common leopard, 85.1 kg (78.98%) were contributed from domestic prey and 22.62 kg (21.01%) from wild prey. Goats contributed the highest biomass (33.33 kg, 30.96%), followed by dogs (18.58%) and sheep (13.23%). Donkeys contributed the

least to the leopard's diet, with a biomass of 3.90 kg (3.62%). Among the wild prey species, Rhesus macaques had the highest biomass contribution at 16.31 kg (15.15%), followed by the Cape hare (3.90%) and the red fox (1.96%). Seasonal biomass variation showed that autumn/winter consumption was 64.61% domestic and 35.39% wild prey, while in summer, domestic prey dominated (91.01%), with only 8.99% from wild species (Table 1).

Table 1. Biomass contribution of wild and domestic prey species in the diet of the common leopard within the study area.

Prey species	weight (kilogram)	Biomass output per scat	Scats count	Total Biomass consumed (kilogram)	Percentage of Biomass Usage (%)
Domestic Animals					
Goats	30.0	3.03	11	33.30	30.90
Sheep	25.0	2.80	5.0	14.20	13.20
Dogs	15.0	2.50	8.0	20.0	18.50
Horses	62.0	4.10	1.0	4.10	3.80
Donkeys	55.0	3.90	1.0	3.90	3.60
Buffalo’s	90.0	5.10	1.0	5.10	4.70
Cows	65.0	4.20	1.0	4.20	3.90
Sub-Total	**342**	**25.81**	**28**	**85.01**	**78.98**
Meso-mammals					
Rhesus Monkey (*Macaca mulatta*)	10	2.30	7.0	16.30	15.151
Red Fox (*Vulpes vulpes*)	3.90	2.10	1.0	2.10	1.961
Cape Hare (*Capra hircus*)	3.50	2.10	2.0	4.20	3.901
Sub-Total	**17.4**	**6.54**	**10**	**22.62**	**-**
Grand Total	**359.4**	**32.35**	**38**	**107.63**	**99.98**

Discussion

The present study examined the dietary habits and distribution of the common leopard in and around Sudhanoti District, AJ&K, Pakistan. As reported by Sheikh and Molur (2004), the species is classified as critically endangered within the country. Distribution of leopards was confirmed at an elevation range of 418–2016 m asl, with seasonal variations; between 418–1915 m asl in winter and 660–2016 m asl in summer. Similar findings were reported in AJ&K by Dar et al. (2009) and other regions like Saudi Arabia (Al-Johany et al.,2007) and India (Daniel, 1996), where leopards preferred hilly habitats to avoid human disturbance. Pugmark identification followed Karanth et al. (2003) and showed that males had larger, round pugmarks, while females had pear-shaped ones (Hussain et al., 2019).

Overall, ten prey species were identified using Scat analysis, including domesticated (7) and wild meso-mammals (3). Domestic prey comprised 78.98% of the diet, with goat (28.29%), dog (21.05%), and sheep (13.15%) being the most consumed. Among wild prey (21.01%), the Rhesus monkey (18.42%) was dominant, co-dominated by the *Capra hircus* (5.26%) and *Vulpus vulpus* (2.63%). Seasonal variation showed higher wild prey consumption in winter (38.08%), while domestic animals dominated summer diets (88.21%). Similar trends were observed in Ayubia National Park (Shehzad et al., 2015) and Sariska Tiger Reserve (Sekhar, 1998), where domestic prey dependence exceeded 85%.

Biomass consumption analysis revealed that domestic animals contributed 85.1 kg (78.98%), with goat (30.96%) and dog (18.58%) being the major contributors, while wild prey contributed 22.62 kg (21.01%), led by Rhesus monkey (15.15%). Seasonal trends showed higher livestock biomass consumption in summer (91.01%) and greater wild prey consumption in winter (38.8%), likely due to prey movement and availability. During summer, most of the livestock is left for open grazing in the area, usually without guarding, while during winter, livestock are mostly fed at homes. Similar patterns were recorded by Dar et al (2009), Qamar et al (2010) in MNP and Pir Lasura National Park (Kabir & Waseem, 2010), confirming goat as the most frequently consumed domestic species.

The results suggest that high livestock availability increases predation risk, as leopards prefer medium-sized prey (3.5–90 kg), with ungulates contributing 56.5% of biomass. Similar studies in Africa (Ray & Squist, 2001; Henschel et al., 2005) confirmed ungulates as the primary prey (60% of biomass), supporting the hypothesis that leopards shift to smaller prey when ungulate availability declines (Nowell & Jackson, 1996).

This study highlights the high reliance on domestic prey, indicating intense human-leopard conflict in District Sudhanoti. Due to huge economic losses from livestock depredation, the majority (95%) of the respondents supported the retaliatory killings of leopards, thereby compromising their conservation. Retaliatory killings of culprits and negative perceptions of the local communities about these animals have been widely recorded and many parts of the world, including AJ&K (Qamar et al., 2010; Goursi et al., 2012; Bibi et al., 2013; Ali et al., 2016; Kazmi et al., 2019). Conservation strategies must focus on livestock management and conflict mitigation to ensure leopard survival while minimizing economic losses for local communities.

Conclusion

This study confirmed the geographic distribution of *Panthera pardus* in the Sudhanoti region of AJ&K, with seasonal habitat shifts between elevation range of 418 to 2016 meters above sea level. The common leopard mostly preys on domestic livestock, accounting for 78.98% of their diet, with goats (28.29%) and dogs (21.05%) being the most common targets. Wild prey constitutes only 21.01% of their diet, with its consumption peaking in winter at 38.08%. The heavy depredation of livestock has resulted in severe negative perceptions among the local community. This trend highlights a significant human-wildlife conflict. To mitigate this conflict and ensure the species' survival, urgent conservation efforts are needed, including livestock protection, habitat

restoration, and community awareness programs. Future research should focus on long-term population monitoring and conflict resolution strategies to support leopard conservation in AJ&K.

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