Snow Leopard REPORTS

Research Note

Snow Leopard Reports, 3 (2024): 46-56
http://dx.doi.org/10.56510/slr.v3.23128

An unusual lowest elevation record of snow leopard (*Panthera uncia*) in Nepal

Madhu Chetri [1,2,*] · Birendra Gautam [1] · Ramesh Kumar Yadav [3] · Raj Kumar Gurung [1] · Parbat Jung Thapa [1] · Naresh Subedi [1] · Chiranjibi Prasad Pokheral [1]

1 National Trust for Nature Conservation, P.O. Box. 3712, Khumaltar, Lalitpur, Nepal
2 Faculty of Applied Ecology, Agricultural Sciences and Biotechnology, Inland Norway University of Applied Sciences, NO-2480 Koppang, Norway
3 Ministry of Forests and Environment, Department of National Park and Wildlife Conservation, Koshi Tappu Wildlife Reserve, Kusaha, Sunsari
* Corresponding author: mchetri@gmail.com

Key words
Dispersal, movement, new record, lowest elevation, *Panthera uncia*

Abstract

The snow leopard, *Panthera uncia,* is a flagship species of the mountainous region in South and Central Asia. In Nepal Himalayas, the species is distributed from 3000 to 6000 m. The present finding of a snow leopard on 23 January 2024 at an elevation of 146 m. in Charghare, Urlabari of Morang District was an unusual record. This is the first recorded case of a snow leopard at such a lower elevation. Fortunately, the leopard was rescued promptly and subsequently transferred to the Central Zoo, located in Jawalakhel, Lalitpur for further treatment. An observation of leopard behaviors obtained from a week's CCTV footage reveals that the leopard was very elusive. Two snow leopard scats were collected within a week from the enclosure. These scats were then analyzed using fecal analysis techniques to

ARTICLE HISTORY:
Submission: March 27, 2024
Revision submission: September 2, 2024
Accepted: September 8, 2024
First published online: October 9, 2024

EDITOR: Munib Khanyari munib@ncf-india.org

identify the prey hair remains in the scats. The analysis revealed that the leopard had consumed naur (*Pseudoys nayaur*) and an unidentified rodent species, as evidenced by the hair samples present in the scats. Additionally, several claws, likely from small rodents, were also recorded, which remain unidentified. This finding strongly suggests that the snow leopard had descended from its usual higher elevations. It is plausible that the leopard may have lost its way and ended up in densely populated human settlements. This has opened a new avenue for research in this area. There is now a pressing need for joint collaborative research to assess the corridors and connectivity crucial for the survival of these magnificent species.

Introduction

The snow leopard, *Panthera uncia*, is a flagship species of the mountainous region in South and Central Asia. They are sparsely distributed across twelve countries in Central Asia. Research on this species has been limited due to its elusive nature and the harsh habitats it inhabits. Several threats have been identified and documented throughout their distributional ranges. Major threats included are – retaliatory killing due to livestock depredation, poaching, and degradation of habitat due to anthropogenic activities and global climate change (McCarthy et al. 2017). The species is listed as Vulnerable on the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species (McCarthy et al. 2017). Snow leopards are also listed in Appendix I of the Convention of International Trade in Endangered Species (CITES). In Nepal, the species is protected under the National Park and Wildlife Conservation Act, 1973, and is listed as Endangered in the National Red List Series (Jnawali et al. 2011). The range of the Snow Leopard extends from the Himalayas in the south, across the Qinghai-Tibet Plateau and the mountains of Central Asia to the mountains of southern Siberia in the north (McCarthy et al. 2027). According to McCarthy et al. (2017), the estimated number of mature individuals in the wild is roughly in the range of 2710-3386. In Nepal, a robust estimate is still unavailable, however, it is believed to be in the range of 301-400 (MoFSC, 2017).

Snow leopards inhabit mountainous range at elevations of 3000 to 6000 m in the Himalayas and Tibetan Plateau but can also found as low as 500 m in the Altai region of Mongolia (Snow Leopard Network 2014). Although snow leopards are known to exist in relatively flat or rolling areas such as in parts of Mongolia and the Tibetan Plateau (Schaller et al. 1998, McCarthy 2000), within their habitat, they favor steep, rugged, and broken terrain and rocky outcrops (Jackson et al. 2010). There is substantial variation in the reported home range sizes for snow leopards. In Nepal, Jackson and Ahlborn (1989), using ground based very high frequency (VHF) tracking reported home ranges of five individuals between 12 and 39 km^2, with substantial overlap between individuals and sexes. McCarthy et al. (2005) reported the home range size of four snow leopards based on VHF tracking in Mongolia to range between 13 and 141 km^2. Recently, based on 16 GPS collars snow leopards, Johanson et al. (2016) estimated that the mean home range size based on the local convex hulls (LoCoH) was 207 km^2 ± 63 SD for adult males and 124 km^2 ± 41 SD for adult females. These estimates were 6–44 times larger than earlier

estimates based on VHF technology.

Dispersal is a key component of population dynamics and plays a critical role in the expansion of species distribution and helps in recolonization and maintaining the genetic structure of animal populations (Bohrer et al. 2005, Clobert et al. 2009, Zimmermann et al. 2005, Morales-González et al. 2021, Marucco et al. 2022). In snow leopard, dispersal behaviors are typically observed when cubs reach 20-22 months (Johanson et al. 2021). However, the age of dispersal showed much variation ranging from 23 to ≥ 33 months in both males and females (Johanson et al. 2021). Johanson et al. (2024) observed that both male and female made a long exploratory foray after natal dispersal, often repeating these until they find a suitable area for settling. One female had four excursions before findings a suitable place for settlement. During her excursion, she traveled at least 84 km and turned back to her natal place covering a total distance of at least 157 km. (Johanson et al. 2024). Using GPS collar on three young leopards (2F, 1M), Johannson et al. (2024), found that they traveled a cumulative distance ranging from 16 to 157 km, making multiple attempts until they settled permanently.

The snow leopard recorded in the month of January 2024 from the lowland Tarai region of Nepal at an elevation of 146 m have raised many questions among conservationists (Photo 1). Here, we aim to present possible explanations with regarding the presence of snow leopard in lowland Tarai area of Nepal.

Photo 1. *The snow leopard at bamoo clumps at Chareghare, Urlabari, Morang, in Nepal. The snow leopard hides in bamboo clumps from where it was rescued successfully. (Photo Credit: Gopal Dahal).*

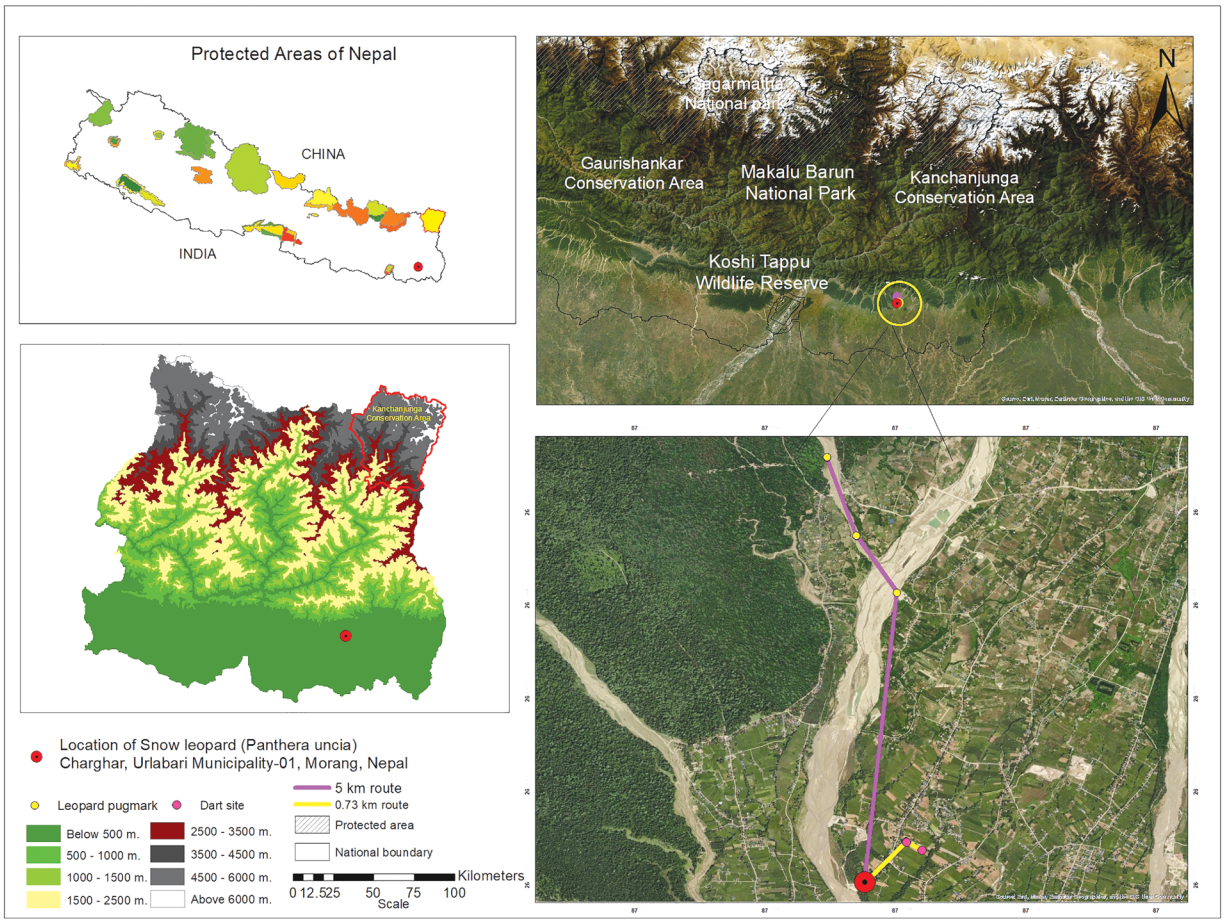

Figure 1. *Location map of the field site where snow leopard was found in lowland Tarai, Nepal.*
Note: The nearest aerial distance at an elevation range of 2500-3500m. from the snow leopard location is between 47 to 57.5 km.

Methods

Field Survey

Between January 28-30, 2024, a team comprised of officials from the subdivision forest office, Urlabari and the National Trust for Nature Conservation-Koshi Conservation Center (NTNC-KCC), visited the snow leopard's first sighting site (Fig 1). The team thoroughly examined the area and interacted with the residents of Charghare. In the Northern part, Bakra Khola (river) is connected to the foothills of the Churia range. A 5 km transect walk on foot along both banks of the dry riverbeds was walked/conducted to search signs such as pugmarks and scrapes.

Behavioral observation and scat analysis

The snow leopard which has been rescued from the lowland Tarai (on 23 January 2024), was carefully monitored within the confines of NTNC Central Zoo, Jawalakhel, Lalitpur. The Zoo is located at an elevation of 1320 m. The leopard was kept in a specialized intensive care zone where it is being nourished with chicken and buffalo meat. The leopard was under CCTV surveillance to monitor its behavior

and activities. After six days of rescue, on 29 January 2024, the first scat was found within the enclosure. Following this on 30 January 2024, another scat was collected by zookeepers. The collected scats were analyzed using micro-histological techniques (Chetri et al. 2017) to determine the presence of any remains of wild prey hairs in the scat samples.

Results

Field survey

The team visited the first sighting spot and collected a few hair samples. A five km transect walk along both sides of dry riverbeds at Bakra Khola revealed leopard pugmarks in three distinct locations (Fig 1). However, it was difficult from the pugmarks to identify that it belonged to the same leopard. Field observation revealed that a farmer first spotted the cat around 9:30 hrs on 23 January 2024 in the mustard farm and thought it to be a domestic cat. The farmer hit the leopard with a big mud block and the leopard ran in the opposite direction. When the animal escaped, the farmer realized it was not a domestic cat and started shouting and calling nearby neighbors. Residents then started chasing the animal. The leopard found a secure place amidst a bamboo bush to hide (see Photo 1). Approximately, 400 people gathered, encircling the hiding leopard, and used bamboo sticks from all sides to trap the animal. A resident promptly relayed the message to the Division Forest Office, and immediately, the team from the forest department and NTNC-KCC technicians visited the site and rescued the animal. As the leopard was very weak and injured, it was subsequently transferred to the NTNC-Central Zoo Animal Hospital for further treatment and care. The weight of the leopard was 37 kg. Based on canine and premolar teeth observation, the present leopard is a sub-adult male possibly between 1.5 to 2 years (Stander 1997). The claws are intact, with no enamel flaking and no tearing of the canine and premolar teeth (Photo 2). In addition, no wound marks on the forehead or body parts.

Behavioral observation and scat analysis

The leopard was under CCTV surveillance for observation. We scan the video footage of the leopard movement and behavior for 3 days from 24 to 27 January 2024. The first movement was observed on 25 January 2024 at 4:00 hrs. The leopard woke up; checked his meal, i.e., chicken breast and leg piece and water pot, and started licking the water. He licked the water for 4 minutes, and 17 seconds, remained quiet for another 42 seconds, and settled down. On 26 January 2024, he woke up at 3:53 hrs., checked the meal, and ate the chicken very slowly until 4:02 hrs. From 4:02 to 4:04 hrs. he licks the water, checks the water pots and the cage turning his head around. Later, he bites and crushes the aluminum pot. On 27 January 2024, he started the movement at 20:55 hrs., stretched his body, and seemed quite relaxed. He sat down and licked the water for one minute, shook his body, and again started licking the water, stopped, and turned around to inspect the cage. Later on, he ate the meal very slowly from 20:57 to 21:04 hrs. and settled down. On 12 March 2024, the leopard was shifted to a bigger enclosure.

Two scat samples that were obtained from the cage were analyzed using the methods adopted by Chetri et al. 2017. First, the scats were washed using warm soapy water,

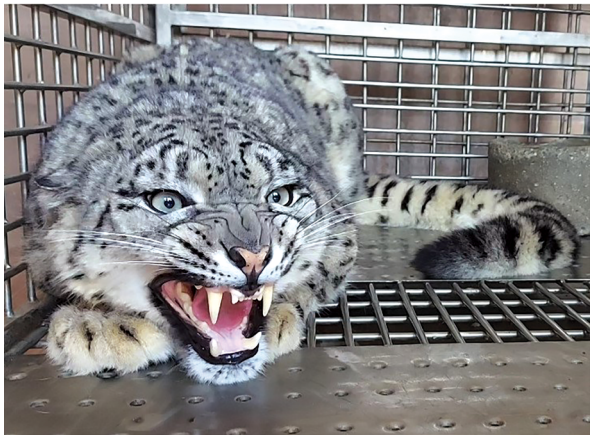

Photo 2. a) *Photo of snow leopard showing its dentition. There is no enamel flaking, full canine eruption, teeth white with no wear. Photo taken after 15 days of rescue, i.e. 06.02.2024.*
b) *Snow leopard in aggressive mood, photo taken after 39 days of rescue, i.e., 01.03.2024 after shifted to bigger enclosure in intensive care zone at Central Zoo.*
(Photo Credit: Madhu Chetri).

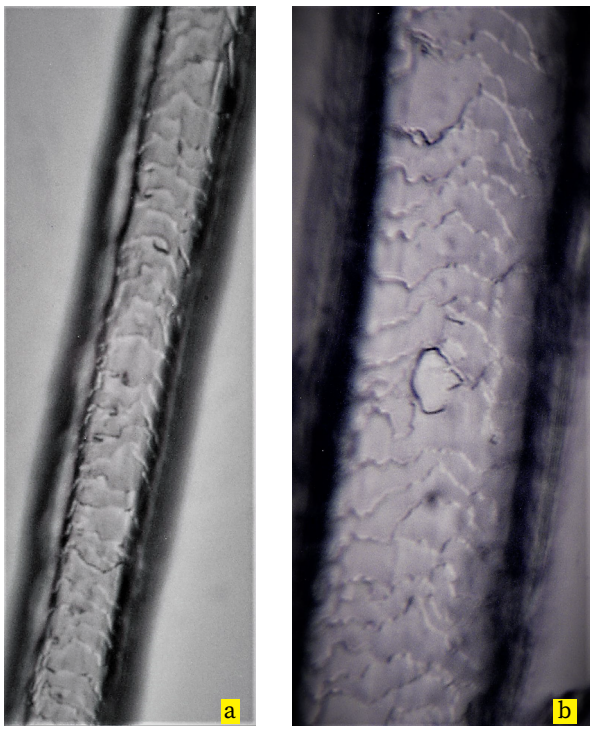

Photo 3. a) *Cuticular section of original naur hair sample,*
b) *hair impression obtained from scat (Apical section); 200x magnification.*

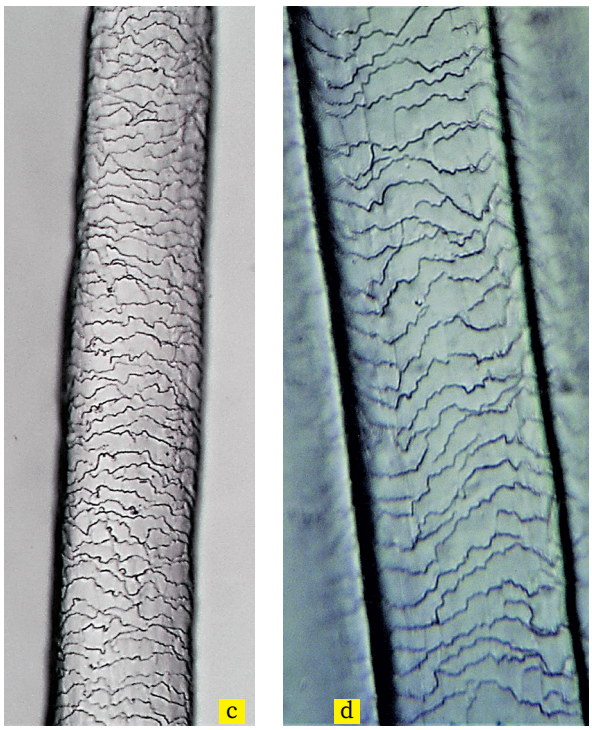

Photo 3. c) *Cuticular section of original naur hair sample,*
d) *hair impression obtained from scat (medial section); 200x magnification.*

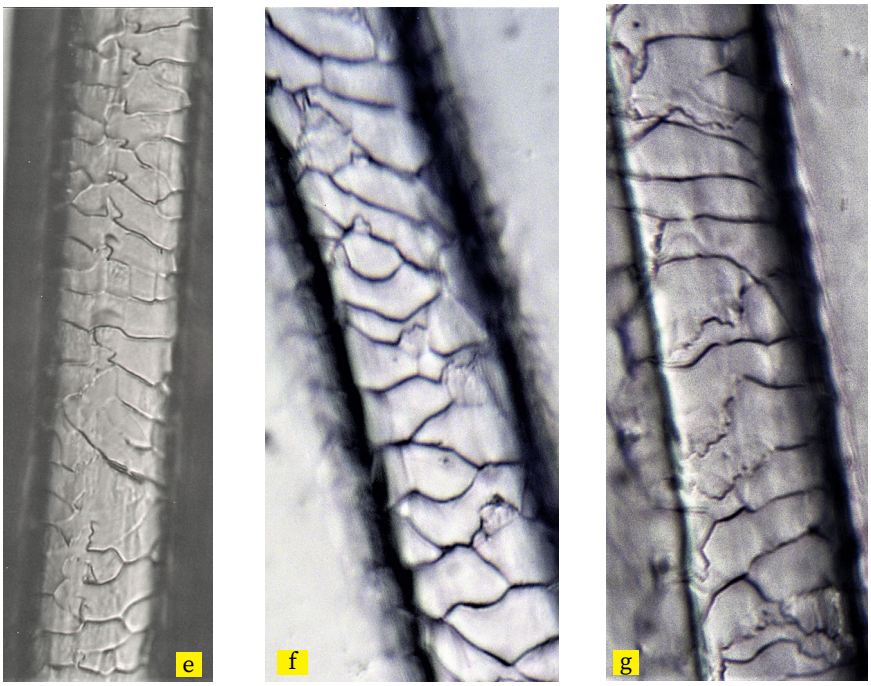

Photo 3. e) *Cuticular section of original naur hair sample,*
f & g) *hair impression obtained from scat (basal section); 400x magnification.*

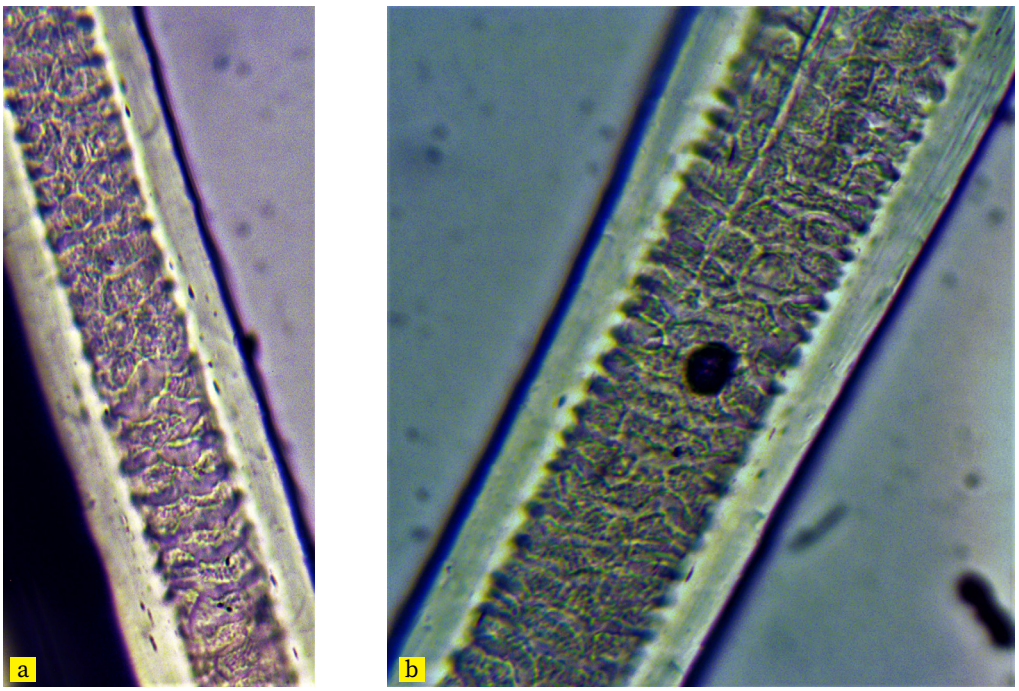

Photo 4 a & b. *Unidentified, possibly of rodent spp.; 400x magnification.*

followed by a rinse with Acetone to remove the dirt. Subsequently, hair, bone, and other materials were separated. The selected hair sample was mounted on a slide using transparent nail polish and gelatine glue to make a cuticular impression (see Chetri et al. 2017 for detailed methods). The impression was later compared with the reference hair sample that was cataloged in a library using a binocular microscope equipped with a camera and photographs were taken. Upon screening hair samples, it was found that the leopard had consumed blue sheep hereafter known as naur (*Pseudois nayaur*, Photo 3). Other small rodents' hair was also observed which remains unidentified (Photo 4). In addition, a few unidentified nails were also recorded in scats (Photo 5). This indicates that the snow leopard had descended from higher elevations as naur are only found at higher elevations above 3000 m in Nepal Himalayas.

Photo 5. *Unidentified claws, possibly of small mammals.*

Discussion

Dispersal is a key demographic process and plays a crucial role in population dynamics, comprised of three key stages: emigration, settlement, and transience, each of which is influence by individual, social, and environmental factors (Morales-González et al. 2021). The dispersal process significantly affects the dynamics and persistence of populations, as well as the distribution and abundance of species, and plays a vital role in shaping the unique spatial and temporal texture of communities and ecosystems (Zimmermann et al. 2005). Dispersal is a common phenomenon among carnivores, including snow leopards, and often occurs when the cubs reach adulthood and leave their mother's territory in search of a permanent home range. The inquisitive naive sub-adult/adult sometimes travels a long distance to find a place for settlement and to establish a permanent home range. Their long excursion trip occasionally ends up in such unexpected places as in the present case. One possible explanation could be due to obstruction from habitat fragmentation and anthropogenic barriers such as highways, fences, and roads which prevented the leopard from returning to its original place. Research indicates that habitat fragmentation poses negative threats to the species during dispersal (Stoner et al. 2013, Johanson et al. 2016). The snow leopard investigation task force report of the government of Nepal highlighted that the existing forest patches connecting KCA to the north and the current location of the

snow leopard are highly fragmented. The report also highlighted the possible travel pathways tracing the existing ridgeline at an elevation of 1500 to 2500m. (DNPWC, 2024). Landscape connectivity emerges as a crucial factor facilitating the movement and dispersal of carnivores (Huck et al. 2010, Johanson et al. 2016). In addition, habitat fragmentation and anthropogenic or natural barriers can result in unsuccessful dispersal attempts (de Oliveira et al. 2022). The dispersal distances are shorter in fragmented habitats due to anthropogenic obstacles compared to those in natural and contiguous landscapes (Stoner et al. 2013). The aerial distance from the current location of snow leopard to the nearest mountain protected area, i.e., Kanchenjunga Conservation Area at an elevation range of 2500-3500 m is between 47 to 57.5 km. Research suggests that it is probable for an exploratory snow leopard to travel such distances within 2 to 3 days (Johanson et al. 2024).

We also examined the temperature patterns during the ten days i.e., 15 to 24 January 2024 from the nearest weather stations in Urlabari, Morang, and Taplejung in Kanchenjunga Conservation Area, the likely origin of snow leopards, using data from the weather channel website. The average maximum temperature over these 10 days in Urlabari and Taplejung ranged from 22.1°C to 13.7 °C and the minimum temperature ranged from 9.2°C to 3.4°C respectively (The Weather Company, LLC 2024). The mean difference in maximum and minimum temperature during these periods in Urlabari and Taplejung was found to be only 8.4°C (SD=0.97) and 5.8°C (SD=0.92) respectively. In Taplejung, temperatures in July reach up to 22.5°C (Bhatta et al. 2018). Comparing this with the average temperature in Urlabari, Morang during January (22.1 maximum and 9.2°C minimum), it seems that temperature might not be a limiting factor for the snow leopard's movement in the lowlands of the Tarai during the winter months. However, the implications of such forays in the future possibly increase conflict with humans and other sympatric species like common leopards at lower elevations.

The video footage obtained from CCTV surveillance showed that the leopard was shy and aggressive (see Photo 2). These behavioral observations indicate that the animal was not held in captivity. Analysis of the snow leopard diet indicates that it had consumed naur before appearing in the lowland Tarai. We speculated that if it had been traded or kept as a pet, the diet would have been different. However, our findings as revealed by the hair samples detected in the scats do not support this (Photo 3). We also recorded unidentified rodent spp. hairs and claws in the scats (Photos 4 & 5).

A field observation reveals that the leopard was chased, cornered, and tortured by locals for nearly six hours. It is likely that the snow leopard had descended from a higher elevation as revealed by the naur hair sample in the scat. The naur is the most important diet of snow leopards (Chetri et al. 2017), and are found only at an elevation range of 2500 to 5500 m throughout their distributional range (Harris 2014). It was only due to the collective efforts of the rescue team that the leopard survived. As the leopard was in bad health condition to release it immediately into its natural habitat, therefore, the Government of Nepal decided to keep it for some period under intensive care at NTNC-Central ZOO hospital. This finding

has opened an avenue for further research. For example, the snow leopard's long-distance foray into the lowlands is likely a result of a combination of dispersal behavior, exploratory tendencies, resource availability, genetic factors, environmental pressures, and seasonal movements. Therefore, assessing how the interplay between these factors influences snow leopard's dispersal and movement will likely be an important ecological research question. Immediate intervention is necessary to initiate biological research focusing on the north-south corridor linking the Kanchenjunga Conservation Area with low-land forest and protected areas. Understanding landscape features, habitat patches and maintaining connectivity from lowlands to highlands will be crucial in minimizing such incidents and facilitating the movement of snow leopards and other important species.

Acknowledgments

We are thankful to all the people who are directly or indirectly involved in rescue operations. Special thanks go to the Rescue team of NTNC-KCC, Koshi Tappu Wildlife Reserve staff, Mr. Bishnulal Ghimire (DFO), Mr. Nabin Raj Dahal (AFO), Divisional Forest Office Morang, Mr. Bishal Ghimire, province secretary, ministry of Tourism, Forest and Environment, Koshi Province for their co-ordination and support. Also, we are grateful to the people of Charghare, Urlabari, Morang for timely informing the authorities to rescue the animal. We would like to thank Bibash Chaudhary for preparing the map.

Conflict of Interest

No known conflicts of interests.

References

Bhatta, S., Dhamala, M. K., Aryal, P. C., Chauhan, R. and Dawadi, B. 2018. Climate variability and associated response of Larix griffithii in Kanchenjunga conservation area of Nepal. Applied Ecology and Environmental Sciences, 6(1): 23-30. http://dx.doi.org/10.12691/aees-6-1-4

Bohrer, G., Nathan, R. and Volis, S. 2005. Effects of long-distance dispersal for metapopulation survival and genetic structure at ecological time and spatial scales. Journal of Ecology 93:1029–1040. https://doi.org/10.1111/j.1365-2745.2005.01048.x

Chetri, M., Odden, M. and Wegge, P. 2017. Snow leopard and Himalayan wolf: food habits and prey selection in the Central Himalayas, Nepal. PloS one, 12(2), e0170549.

Clobert, J., Le Galliard, J-F., Cote, J., Meylan, S. and Massot, M. 2009. Informed dispersal, heterogeneity in animal dispersal syndromes and the dynamics of spatially structured populations. Ecology Letters 12: 197–209. https://doi.org/10.1111/j.1461-0248.2008.01267.x

de Oliveira, M. E., Saranholi, B. H., Dirzo, R. and Galetti Jr, P. M. 2022. A review of philopatry and dispersal in felids living in an anthropised world. Mammal Review, 52(2), 208-220. https://doi.org/10.1111/mam.12275

DNPWC. 2024. An investigation and research report on Snow Leopard that was found in Urlabari Rural Municipality 1 (in Nepali). A task force report submitted to the Department of National Park and Wildlife Conservation, Babarmahal, Kathmandu. 19 pp.

Harris, R.B. 2014. Pseudois nayaur. The IUCN Red List of Threatened Species 2014: e.T61513537A64313015. https://dx.doi.org/10.2305/IUCN.UK.2014-3.RLTS.T61513537A64313015.en. Accessed on 25 August 2024.

Huck, M., Jędrzejewski, W., Borowik, T., Miłosz-Cielma, M., Schmidt, K., Jędrzejewska, B., Nowak, S. and Mysłajek, R.W. 2010.Habitat suitability, corridors and dispersal barriers for large carnivores in Poland. Acta Theriologica 55: 177–192. https://doi.org/10.4098/j.at.0001-7051.114.2009.

Jackson, R. and Ahlborn, G. 1989. Snow leopards (*Panthera uncia*) in Nepal: home range and movements. National geographic research, 5(2): 161-175.

Jackson, R. M., Mishra, C., McCarthy, T. M. and Ale, S. B. 2010. Snow leopards: conflict and conservation. The biology and conservation of wild felids, 2: 417-430.

Jnawali, S.R., Baral, H.S., Lee, S., Acharya, K.P., Upadhyay, G.P., Pandey, M., Shrestha, R., Joshi, D., Lamichhane, B.R., Griffiths, J., Khatiwada, A. and Amin, R (compilers) (2011). The status of Nepal mammals: the National Red List Series. Department of National Parks and Wildlife Conservation, Kathmandu, Nepal, 276 pp.

Stander, P. E. 1997. Field age determination of leopards by tooth wear. African Journal of Ecology, 35(2), 156-161.

Johansson, Ö., Rauset, G. R., Samelius, G., McCarthy, T., Andrén, H., Tumursukh, L. and Mishra, C. 2016. Land sharing is essential for snow leopard conservation. Biological Conservation, 203: 1-7.

Johansson, Ö., Ausilio, G., Low, M., Lkhagvajav, P., Weckworth, B. and Sharma, K. 2021. The timing of breeding and independence for snow leopard females and their cubs. Mammalian Biology, 101(2): 173-180.

Johansson, Ö., Alexander, J.S., Lkhagvajav, P., Mishra, C. and Samelius, G. 2024. Natal dispersal and exploratory forays through atypical habitat in the mountain-bound snow leopard. Ecology e4264. https://doi.org/10.1002/ecy.4264

Marucco, F., Pilgrim, K. L., Avanzinelli, E., Schwartz, M. K. and Rossi, L. 2022. Wolf dispersal patterns in the Italian Alps and implications for wildlife diseases spreading. Animals, 12(10), 1260. https://doi.org/10.3390/ani12101260

McCarthy, T.M. 2000. Ecology and conservation of snow leopards, Gobi brown bears, and wild bactrian camels in Mongolia. Ph.D. Dissertation, University of Massachusetts, Amherst, 133.

McCarthy, T. M., Fuller, T. K. and Munkhtsog, B. 2005. Movements and activities of snow leopards in Southwestern Mongolia. Biological Conservation, 124(4), 527-537. https://doi.org/10.1016/j.biocon.2005.03.003

McCarthy, T., Mallon, D., Jackson, R., Zahler, P. and McCarthy, K. 2017. *Panthera uncia. The IUCN Red List of Threatened Species* 2017: e.T22732A50664030. https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T22732A50664030.en. Accessed on 09 February 2024.

MoFSC. 2017. Snow Leopard and Ecosystem Management Plan (2017–2026). Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Schaller, G. B., Junrang, R. and Mingjiang, Q. 1988. Status of the snow leopard Panthera uncia in Qinghai and Gansu Provinces, China. Biological Conservation, 45(3): 179-194.

Snow Leopard Network. 2014. Snow leopard survival strategy. Seattle, Washington, USA, 1-145.

Stoner, D. C., Wolfe, M. L., Mecham, C., Mecham, M. B., Durham, S. L., and Choate, D. M. 2013. Dispersal behaviour of a polygynous carnivore: do cougars Puma concolor follow source-sink predictions?. Wildlife Biology, 19(3): 289-301.

The Weather Company, LLC. 2024. The Weather Channel (https://weather.com/en-IN/weather/monthly/l/86c6ed4ff75b47bccb9f7f2085e40c934f28d214c61dd3c3aa8531990ea8cd59)

Zimmermann, F., Breitenmoser-Würsten, C. and Breitenmoser, U. 2005. Natal dispersal of Eurasian lynx (Lynx lynx) in Switzerland. Journal of Zoology, 267(4), 381-395. https://doi.org/10.1017/S0952836905007545