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Short Communication

Remarkable observations of melanistic leopard (*Panthera pardus pardus*) in Nepal

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Abstract

Melanism has been reported in many mammals, but records of melanistic leopards in Nepal are very few and not systematic, even though common leopards are found throughout the country and are considered one of the most problematic carnivores. In this study, we gathered data on records of five melanistic leopards that were seen or caught close to the Kathmandu Valley. Out of the five, two were captured on camera by locals, two were records of animals that were found alive but suffered injuries and passed away in captivity, and one was a record of a dead animal. All of them were recorded close to human populated areas. It is unknown what causes a high occurrence of melanosis in leopards and why it frequently occurs close to the Kathmandu Valley. It is recommended to conduct a comprehensive analysis of their population, geographic range, and habitat.

Keywords: Melanism; Human-wildlife conflict; Pelage coloration; Black panther

1 | Introduction

Evolutionary biologists have long been fascinated by differences in animal coloration (da Silva 2017). Fur and skin coloration in felid species maintains adaptive significance, carrying out various roles in behavioral and ecological processes (Ortolani & Caro 1996). Melanism is an observed coloration variant in cat species that is caused by production of melanin in the skin or hair follicles that leads to darkened skin or fur color relative to the most common phenotype (Nachman et al. 2003; Cook & Saccheri 2013). Psuedo-melanism is a rare condition that can make for some interesting-looking animals and refers to an over-development of melanin in certain areas of the skin and can also turn animals partially or completely black (Gamble & Griffiths 2004). Melanism has been reported in 11 felid species (Robinson 1976; Dittrich 1979; Eizirik et al. 2003). The pelage of common leopard (*Panthera pardus*) usually has a pattern of dark spots grouped in rosettes on a background of pale yellowish to dark golden. Primarily found in India, Nepal, Bhutan, Bangladesh, parts of Pakistan, southeast Asia, China, Russia, central Asia and Africa (Stein et al. 2016; Kabir et al. 2017) the Leopard is perhaps the best-known example of melanistic polymorphism (Robinson 1969). There have been some reports of sightings of melanistic leopards in India (Sayyed & Mahabal 2015; Aminuddin et al. 2018), Kenya (Pilfold et al. 2019), and Kangchenjunga Conservation Area, Nepal (Thapa et al.

2013), Malaysia (Kawanishi et al. 2010; Hambali et al. 2021). Melanistic felids have also been reported from Colombia and Costa Rica (González-Maya et al. 2018). According to Nowel and Jackson (1996), melanistic leopards live in tropical rainforests, temperate forests, dry deciduous forests, and northern coniferous forests. Moreover, Kawanishi et al. (2010) reported that melanistic leopards are common in south-East Asian forests. There is a single report of melanistic leopards from Nepal to date (Thapa et al. 2013). In this paper, we report on a cluster of recent observations and records of melanistic leopards in Kavrepalanchwok District, Nepal.

2 | Materials and methods

2.1 | Study area

The study was based on reports of opportunistic encounters with melanistic leopard around Kathmandu Valley, Nepal. Recent encounters were focused on the Panchkhal and Bhumlu areas of Kavrepalanchwok District in the east of Kathmandu Valley (Fig. 1). The encounters occurred in Panchkhal Municipality 9 and Bhumlu Rural Municipality 1. Panchkhal and Bhumlu are located 30–35 km east of Kathmandu Valley.

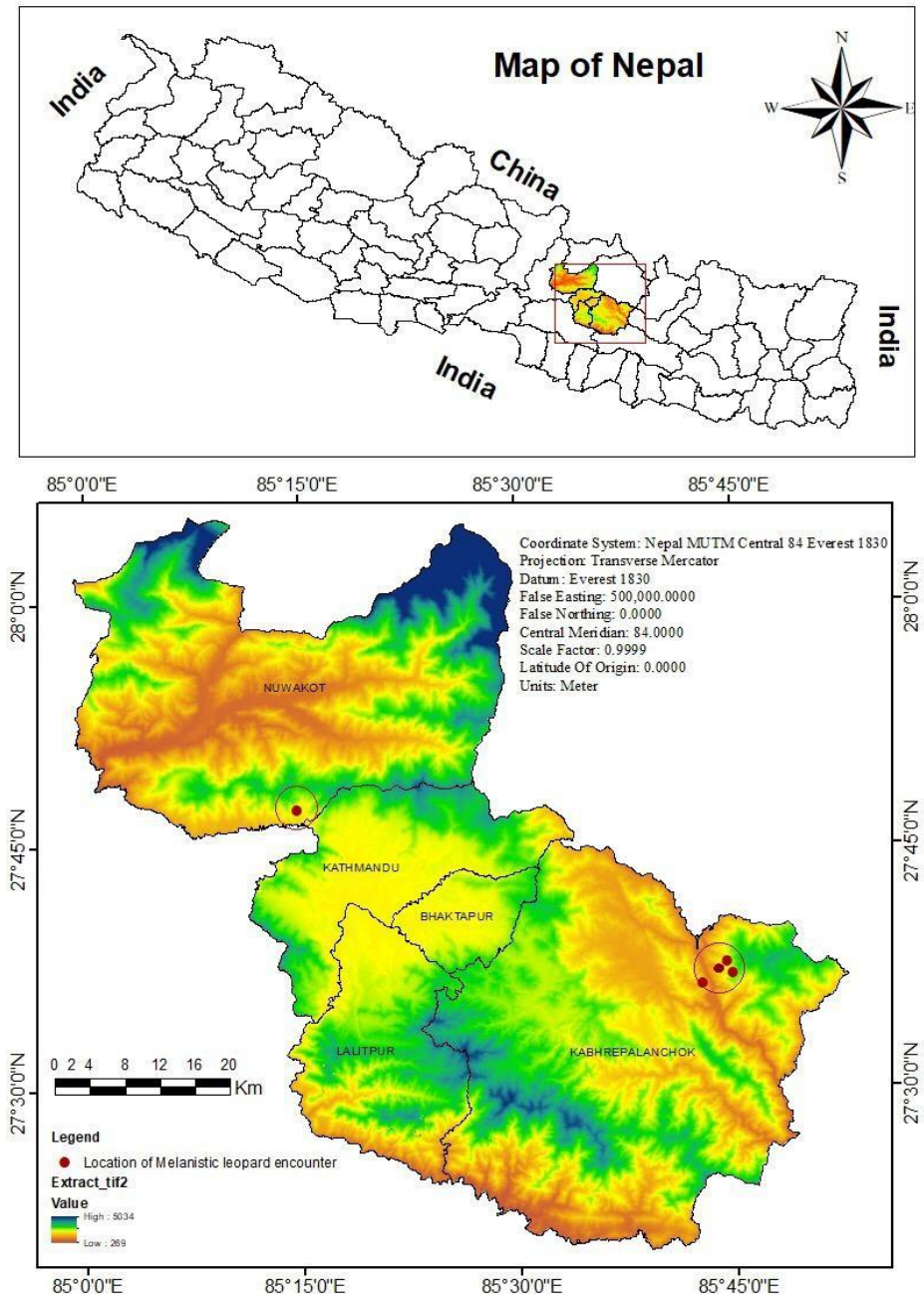

Figure 1. A map of the study area showing the location of melanistic leopard

The Sunkoshi River flows north to south between Panchkhal and Bhumlu. The area's elevation ranges from 120 to 720 meters above sea level, and it is surrounded by a temperate mixed forest of Nepal's hilly region (Timsina & Adhikary 2007). Throughout the year, daily temperatures range from an average high of 24.9 °C to an average low of 11.7 °C. Summer temperatures can reach 38 °C, and winters are usually dry, with a minimum temperature of −10 °C in 2008 and an annual average rainfall of 10.2 cm (Upadhya 2012). This mid-hill region supports rich diversity of subtropical to temperate flora due to great terrain diversity (Kafle et al. 2020). Vegetation acts as the foundation for the composition, structure, and function of the terrestrial ecosystem. In the area *Shorea robusta* is the dominant tree species with *Acacia auriculiformis, Pinus roxburghii, Castanopsis tribuloids, Euginia jambolina, Euginia nepalensis,* and *Sapium insigne* (Baral et al. 2000).

2.2 | Data collection

The first data for the study was collected from the Nepal Central Zoo. The information about this melanistic leopard from Kavrepalanchok was initially noticed after it was reported in news and social media. Later, we visited the location of black leopard encounters, which led to interviews with the person who uploaded videos and photos on social media, local people, staff of the division forest office, and Nepal police. We reviewed the official record of the black leopard and copied information from the report from the forensic laboratory. Local people were also questioned regarding their perception towards melanistic leopard.

3 | Results

Figure 2. Skin of the first melanistic leopard from Nepal at the Central Zoo, Kathmandu, Nepal (Photo credit: Narayan Prasad Koju)

3.1 | The first record of melanistic leopard in Nepal

The first melanistic leopard in Nepal was recorded from Okharpauwa, Nuwakot, 18 kilometers road distance from the center of Kathmandu. This male leopard was rescued by the Nepal Central Zoo on 27 May 1996 based on reports from local people. During the rescue process, the leopard was recorded as being severely injured,

Figure 3. A- Melanistic Leopard 'II' found dead near human habitation on 17 February 2021, at Panchkhal Municipality-9; B- Melanistic Leopard 'III' died inside the cage while being rescued on 5 December 2021, at Bhumlu RM- 1 (Photos: Division Forest Office- Kavrepalanchok).

Table 1. Information on melanistic leopards (ML) recorded in Kavrepalanchok District of Nepal

Details	ML Record I	ML Record II	ML Record III	ML Record III	ML Record IV
Status during record/observed	Captured in severely injured alive but died in zoo	Found dead	Captured alive, died on the second day	Alive. Video record of 27 seconds while leopard crossing the road	Alive. Video record of 1 minute 28 seconds on the roadside
Record location	Okharpauwa, Nuwakot	Panchkhal M- 9	Bhumlu RM Ward- 1	Bhumlu RM Ward- 1	Bhumlu RM Ward- 1
Recorded habitat	Forest near human settlement	Near human settlement and leasehold forest	Near human settlement and water source	Near roadside and human settlement	Near roadside and human settlement
Date of record	27 May 1996	17 February 2021	Captured: 4 December 2021; Died: 5 Dec. 2021	22 September 2021	29 October 2020
Body Length	175 cm	183 cm	160 cm	NA	NA
Tail Length	73 cm	76 cm	70 cm	NA	NA
Height	69 cm	92 cm	41cm	NA	NA
Upper canine length	3.37	3.52 cm	3.34 cm	NA	NA
Lower canine length	3.29	3.39 cm	3.21 cm	NA	NA
Age	Adult	Adult	Juvenile	Juvenile /Sub adult	Adult
Sex	Male	Male	Male	NA	NA
Weight	45 kg (approx.)	50 kg	21 kg	NA	NA
Remarks	Taxidermy display in Zoo	Buried under the supervision of Division of Forest,	Kept in Natural History Museum after Taxidermy	NA	NA

weak, and fatigued. It was brought to the Central Zoo but there died on 06 June 1996. It was skinned and the taxidermy was put on display as part of a conservation education exhibit in the Central Zoo Nepal (Fig. 2). The external measurement of the stuffed skin revealed a Body Length (head to base of tail) of 175 cm, tail length of 73 cm, height of 69 cm and upper canine length of 3.3 cm (Fig. 2). The information was not published in scientific records or news previously. The first scientific report of melanistic leopard from Nepal was published by Thapa et al. (2013). They recorded a single melanistic Leopard in Taplejung at an altitude of 4,300 m asl on 16 May 2012 during camera trap research on snow leopards.

3.2 | Melanistic leopard in Kavrepalanchok District of Nepal

In 2020 and 2021, melanistic leopards were observed four times in the eastern part of the Kavrepalanchok District of Nepal. Among them, two were records of captures on video by road traveler (Suman Bharati, Kavrepalanchok), one was an animal found dead and a fourth was an animal captured by local people that died a day after being captured (Table 1). Two were adults, one was sub adult and one was a juvenile. All four records were recorded in an area of five square kilometer radius. Among the two deaths recorded, one was an adult found dead 700 m from a small leasehold

Figure 4. A- Leopard 'IV' recorded while crossing the road on 22 September 2021, at Bhumlu RM Ward- 1; B- Leopard 'IV' recorded while crossing the road on 29 October 2020, at Bhumlu RM Ward- 1(Photos: Suman Bharati, Kavrepalanchok).

forest, 200m from the road, inside a human settlement on 17 February 2021. A second was a juvenile found alive but injured near a human settlement and water source on 04 December 2021. Local people captured it and kept it in an iron cage overnight, and it was found dead on the second day inside the cage (Fig. 3). This second black leopard is currently kept at the Nepal Natural History Museum and will be displayed after taxidermy. The National Forensic Laboratory did sequence a partial fragment of 12s rRNA from this individual for species identification. The report of the forensic lab recorded that the 362 bp consensus sequences obtained from this animal showed absolute similarity with common leopard (*Panthera pardus*, published on 22 December 2021, Ref/647).

4 | Discussion

A coloration is an analytical tool for recognizing mammals (Stoner et al. 2003). Pelage coloration phenotypes are also frequently thought to express adaptive characters in physiological, ecological, and behavioral processes, for instance intra- and interspecific communication, thermoregulation, and camouflage (Beddard 1985). Melanism may have a direct impact on several biological processes, including thermoregulation, disease susceptibility or response, camouflage, aposematism, sexual selection, and reproductive success and ecological factors such as circadian activity and habitat use (Majerus 2009; Graipel et al. 2019). There is abundant evidence of mammals' pelage pigmentation and pattern being similar to their backgrounds (Caro 2005), presumably for improved camouflage (Cott 1940).

Melanism results from a gene mutation that causes excessive pigment production, (Ortolani & Caro 1996) brought on by recessive gene mutations in the ASIP region in leopards (*Panthera pardus*). Interestingly, in jaguars (*Panthera onca*), melanism is caused by a dominant mutation in the MC1R region (da Silva 2017). A gene named Agouti Signaling Protein plays a main role in melanism of leopards (Schneider et al. 2015). Given that it is a recessive gene, both parents must carry it (Robinson 1970; Driskell et al. 2010). Melanism in the leopard is not an uncommon phenomenon (Sayyed & Mahabal 2015).

According to Miller (2019), up to 95% of leopards on the Malayan Peninsula are melanistic, but this trait is uncommon in African leopards. Similarly, da Silva (2017) examined 623 leopards and 980 jaguar samples, of which only 10.8% of leopards and 9.8% jaguars were melanistic. In the dense forest of Costa Rica's Talamanca Cordillera, 25 percent of jaguars were recorded as melanistic, according to Mooring et al. (2020). In order to evaluate melanism in natural populations, Mooring et al. (2020) emphasized the relative importance of genetic drift and natural selection on the dynamics of various phenotypes in various landscapes. Presumably because they better blend into their surroundings, black felids are typically found in heavily shaded environments like tropical forests (Kawanishi et al. 2010; Mooring et al. 2020). Da Silva (2017) noted that moist forests, particularly in Southeast Asia, are strongly linked to the frequency of melanism. Kawanishi et al. (2010) indicated that melanism may reach very high frequencies in leopard populations of Southeast Asia. Miller (2019) reported that the population of melanistic? leopards in Kenya is declining due to deforestation and habitat fragmentation, presumably because they cannot survive in the remaining more open habitat.

In Nepal, there has been no study and assessment on melanism in leopards and other animals except a very few opportunistic sightings and records of melanistic mammals (Ghimirey & Pal 2009; Thapa et al. 2013). In recent years, the number of encounters with melanistic leopards in the Eastern Kavrepalanchok area is increasing, but the reason is unknown. The two records of black leopards photographed there were of sub adult and adult, while the later record of a dead animal was of a juvenile, there may be two or even three individual animals involved.

It is not known how the two dead leopards were injured. They may have been hit by a vehicle on the roads or beaten or poisoned by local people as retaliation or response to their fear. Frequent encounter of melanistic leopards near human settlements may increase the human-wildlife conflict (HWC). Generally, both people and leopards are afraid of each other and run far away whenever there are encounters (Hathaway et al. 2017). The common morph of leopards can be seen at a distance, so people run away before a close encounter. In the case of the melanistic Leopard, it may not be seen clearly from a far distance, therefore, the possibility of close encounter and conflict increases. Furthermore, black coloration in animals in Nepalese society is taken as a unfortunate, dangerous or risky (Regmi & Madison 2009; Nidup et al. 2010). This belief may lead to more threats to black leopards that approach human settlements.

Morphologically, due to black hair and skin, the black leopard's body traps more heat. As a result, changing

climate may be another potential threat for them. To avoid overheating, melanistic leopards may need to avoid open areas in daylight and prefer dark dense areas where the micro-climate is comparatively cooler (Nowell & Jackson 1996; Kawanishi et al. 2010; Hambali et al. 2021). All encounters with black leopard in this study area were in the open near human settlements. The reason behind this is unknown, but scarcity of prey species, habitat fragmentation due to linear construction, or habitat degradation may have contributed. After a powerful earthquake in 2015, urbanization has shifted closer to community forests and national forests in Nepal (Rimal et al. 2017; Song et al. 2022). Building construction and urbanization close to forest areas, especially in areas near Kathmandu Valley, create disturbance to the forest and its creatures. One of the major issues is road construction through forest areas, which causes fragmentation of habitat of wild animals by limiting and affecting their movements (Acharya et al. 2017; Rimal et al. 2017; Carter et al. 2020; Koju et al. 2021; Kurmi & Koju 2021).

Numerous village roads are being built in the Kavrepalanchok district, and the human population is expanding there. Due to its proximity to the Kathmandu Valley, the forest is under more pressure, and the land use pattern and land cover are changing. Threats to human activities and wildlife conservation are posed by the frequent occurrence of melanistic leopards in populated areas. To conserve leopards in Nepal and especially this rare color morph, to lessen conflicts between humans and wildlife, and to map the geographic range of the coloration phenotypes in leopards, detailed research on distribution, habitat preference, and prey status for all leopards is urgently needed.

5 | Conclusions and implication

The rate of encountering of melanistic leopard is increasing in eastern part of Kathmandu Valley. Surprisingly all observed and recorded melanistic leopard were either dead or severely injuried indicating threat for survival of these rare morph leopards. The awareness education necessary for conservation of leopards may help reduce human leopard conflict. Furthermore, ecological study is necessary for detail information on encountering of the species in the area.

The melanistic leopard are rare morph of common leopard. Conservation of the species is important but we do not have any ecological, genetics and physiological information on this type. The paper is baseline information based on encounter and observation of the melanistic leopard, it will attract future research in ecological, and genetic status of melanisim in leopard in Nepal.

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Authors' contributions

Koju, N. P. comprehended the idea, collected and analyzed data and drafted, reviewed, and edited the manuscript; Byanjankar, S. drafted manuscript, reviewed and improved the manuscript; Thapa, D. collected data; Sharma, S. collected data; Thapamagar, A. did GIS work; Chalise, L. collected data, reviewed and improved the manuscript; Shrestha, A. Manuscript draft, reviewed and improved the manuscript; Bhandari, R. K. collected data.

Conflicts of interest

Authors declare no conflict of interest.

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