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Adverse Effect of Infrastructure Development in the Habitat and Distribution of Chinese Pangolin in Chandragiri Hill, Kathmandu

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ABSTRACT

The Chinese Pangolin (*Manis pentadactyla*) is a nocturnal and elusive animal that relies on a specialized diet consisting of ants and termites. It enjoys national and international protection, but the current conservation measures remain insufficiently developed. The escalating threats of habitat loss, habitat degradation, and habitat fragmentation have pushed the pangolin to a highly endangered state in Nepal. The study conducted on Chandragiri Hill aimed to investigate the conservation status and distribution patterns of the Chinese Pangolin, as well as its habitat preferences and the potential impact of infrastructure development on both the pangolin and its habitat. The data collection process involved direct field observations, where various indicators of pangolin presence, such as burrows, were carefully documented. These observations were then utilized to generate a distribution map of pangolin burrows, employing ArcGIS-10.3 software. Out of a total of 43 burrows observed, 37 were found to be inactive while the remaining 6 were active. The study revealed that the population of burrows was highest within the elevation range of 1600m to 1700m. Furthermore, burrow density was found to be significantly higher at a distance of 100m horizontally from the cable car pathway compared to a distance of 20m horizontally from the same pathway.

INTRODUCTION

Background

Pangolin (*Manis pentadactyla*), often called scaly ant eaters, is nocturnal mammal, is covered in tough, overlapping scales. It mostly feeds on ants and termites using an extraordinarily long and sticky tongue, and can roll itself up into a tight ball quickly when threatened (Dickman & Richer, 2001) . Chinese pangolin (*Manis pentadactyla*) and Indian pangolin (*Manis crassicaudata*) are the two species of pangolins found in Nepal out of the four-known species in Asia (Baral & Shah, 2008) . The presence of both Chinese and Indian pangolin species in Nepal owes to the fact that Nepal lies on the transition zone of the Oriental and the Palearctic regions (Shrestha T., 1981) . Pangolin is shy, non-aggressive, solitary and burrowing strange mammals and is protected nationally as well as internationally but their biological details are unknown to stakeholders (Suwal, 2011).

Pangolin is derived from Malayan word "Pen Gulling", which means "rolling ball", while the term "Pholidota" is derived from Greek word meaning "scaled animals" (Chakraborty et. al., 2002). In Nepali, Chinese pangolin is called "Kalo salak" and Indian pangolin is called "Tame salak" (Jnawali *et al.*, 2011). It is distributed in Nepal, China, India, Taiwan, Japan, Bangaladesh, Lao, Myanmar, Thailand, Vietnam (IUCN, 1996). Nepal's geographical range distribute Chinese pangolin in Taplejung, Illam, Pachthar, Sinduli, Ramechhap, Panauti, Annapurna Conservation Area, Makalu-Barun Conservation area, Nagarjun, Barabise and Sundarijal and is also distributed in different places of Bhaktapur, Kavrepalanchowk and Dhading (Suwal, 2011). Gurung (1996) reported that pangolin is found in a wide range of habitat such as forests (tropical primary and secondary as well as lime stone and bamboo), grassland and agricultural fields. The habitat is generally found in red soil at open forest with less coverage in south, south-east, south-west facing slopes (Shrestha, 2005).

All the species of pangolin including Chinese pangolin sleeps in hollows and logs during the day time and emmerges in the evening to forage for ants and termites (Dickman & Richer, 2001). Large ear pinna, a post-anal depression in the skin and a narrowing near the distal end of the tail helps to distinguish the Chinese pangolin from other Asian pangolins (Pocock, 1924). It has a thick and long tail covered with larger (2-5 cm diameter), round overlapping scales formed from fused hair, dorsally rounded and ventrally flattened, prehensile and very muscular. Male Chinese pangolin is larger than female ones. The mass of Chinese pangolin ranges from 2.35 kg (young, sexually matured female) to 7.0 kg (healthy male). Similarly, body length ranges from 545 mm (adult female) and 795 (adult male) (Heath & Vanderlip, 1998). It usually gives birth to one offspring at a time and sometimes its even found 2-3 offspring with a gestation period estimated to be more than 169 days (Yang *et al.*, 2007). It digs a hole to deposit urine and faeces and cover it with earth as well as a mark it's territories with dropping (Fang & Wang, 1980).

Pangolin is under severe threats, poaching, mining, grazing, deforestation, fire and development constructional activities are the major threats to pangolin (IUCN, 2014).

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The status of Chinese pangolin is greatly affected by habitat destruction in the country like Nepal (Gurung, 1996), Taiwan and Malaysia (WCMC, 1999). Eastern Nepal (Katuwal et. al., 2013) and some places like Bhaktapur and Kavrepalanchowk districts are more vulnerable areas to pangolin trade and it is exported mostly in China border than India. Pangolin scales, both whole and in powdered form are used in traditional Chinese medicines to treat asthma, and even cancer (Duckworth *et al.*, 2008). Various repots shows that pangolin is hunted illegally from its habitat then they are traded and killed for various reasons like for its flesh,scales and for obtaining its body fats. Under the red list category of IUCN, *Manis pentadactyla* is listed as critically endangered and is therefore considered to be facing very high risk of extinction in the wild (IUCN, 2014). It is listed on CITES Appendix II (CITES, 2000) and is protected in Nepal under National Park and Wildlife Conservation (NPWC) Act 1973 in Schedule-1.

Significance of the Proposed Research

Infrastructure developments are associated with wildlife impacts. The impacts may vary in terms of severity, time and space. As development projects do not take much account of environment and especially wildlife, their impacts on wildlife remain largely unknown. In the case of Chandragiri Cable Car project, impacts on wildlife and biodiversity have not been studied. Furthermore, no previous studies and researches have been conducted in Chandragiri hills to estimate the Manis population. Additionally, Chandragiri is deemed to be identified as an area rich in biodiversity forest but assessment of human activities that effect in the biodiversity has been made. Recent construction of the recreation site & Chandragiri cable car also need proper guidance. It is our responsibility to conserve the species under threats. This study has been carried out to assess the status and habitat conditions of Chinese Pangolin in Chandragiri forest with reference to cable car infrastructure.

OBJECTIVE

General Objective

To study the impact of infrastructure development to the habitat and distribution of Chinese pangolin.

Specific Objective

a. To determine the distribution of Pangolin and explore the habitat preference

b. To identify the impact of infrastructure development to the Chinese Pangolin and its habitat.

LIMITATIONS

Despite a huge scope of this study, it will have following limitations:

- Limited time and resources pose fundamental constraints on conducting this study.
- The Pangolin could have been affected by local people activities as well as various environmental factors, which can lead to underestimations or incomplete data.
- The topographic conditions in the study area can complicate efforts to conduct accurate habitat surveys.

LITERATURE REVIEW

A pangolin survey conducted in the protected Nagarjung Forest found fifty old burrows along a four kilometer distance in Raniban (Gurung, 1996). He observed site among which ten old burrows were close to human settlements above the Ratamata and mostly in the grasslands where *Imperata cylindrica* as dominant species. The burrows were about 21-23 cm in diameter and 2m in depth. No live specimens of pangolins were found but active burrows were identified. A skin of pangolin was found in one of the village. A study carried out in Shivapuri National Park on pangolin found the closer relationship between red soil and burrow distribution. The burrows were found in the red soil at open forests with less covarage on south, south-east, south-west facing slopes (Shrestha B. , 2005). As the area were used for fodder collection, trees cutting and livestock grazing, the burrows were disturbed causing decline of species.

According to Gurung (1996) a pangolin survey conducted in the protected Nagarjung Forest during January 1-7, and found fifty old burrows along a four kilometer distance in Raniban. He observed six new and ten old burrows close to human settlements above the Ratamata and mostly in the grasslands where the dominant species were *Imperata cylindrica*. He had found the burrowsof about 21-23 cm in diameter and about 2 m in depth. He noted the similarities in pangolins habitat in Nagarjung Forest with the report from Tumlingtar of Sankhuwasabha in eastern Nepal, Chainpur of Dhading and Balephi of Sindhuplachok district. He found a close relationship between the red soil and burrow distribution.

Shrestha (2005) studied pangolin in Shivapuri National Park and found the burrows in red soil at open forests with less coverage on south, south-east, south-west facing slopes. The burrows were disturbed by fodder collection, trees cutting and livestock grazing causing decline of species. Chinese pangolin is distributed throughout most part of Asia. In South East Asia, it is distributed in Taiwan, and most of the Southern China, including North India, Bhutan, Nepal and Banglades. The habitat of pangolin in different habitats including primary and secondary forests, bamboo forests, grasslands and agricultural fields. Very little information is available on the status of pangolins anywhere in its range (WCMC, 1999). It is classified by IUCN as "critically endangered" species. In Nepal Chinese pangolin are reported from ACAP, MBNP, Taplejung, Illam, Panchthar, Dhading, Sindhuli, Ramechhap, Baglung, Kavrepalanchowk and Bhaktapur.

In general evidence suggested that pangolin are able to adopt to modified habitas, provided their termite food resource remain abundant and they are not unduly persecuted. However, habitat destruction is indicated as a factor affecting the status of pangolin in countries like Nepal (Gurung, 1996). Pangolin is reported to be under pressure from habitat destruction, especially by insecticide

spraying in Taiwan. Road killings are apparenty common as well as habitat loss, particularly the opening of new areas to oil palm monoculture and threats to pangolin in Malaysia (WCMC, 1999).

As recent report, they are the most trafficked mammals in Asia including Africa. Poaching is identified as a negative impact on Manis species in China, Nepal, India and Taiwan.The greater threat to the conservation of pangolin is illegal hunting for trade, largely to supply the demand in China for meat and scales, which are used for tonics and traditional medicines. Surveys in China have found pangolin (live or parts) are commonly available in the markets (Li & Wang, 1999).

METHODOLOGY

Study Area

Chandragiri is a hill, specifically in the Kathmandu valley, lies on the south-west from heart of Kathmandu and is 2551 meters from sea level. The hills covered with lush green blanket of flora with high biodiversity makes Chandragiri truly a great pristine landscape. (Daman-Palung-Phulchoki-Chandragiri is one the natural forest ecosystems of Nepal that have high conservation value (MoFSC, July 14). Phulchowki-Chadragiri Biodiversity Conservation Program is one of the priority projects planned by NBSIP (2006), but it is still to be implemented by GoN (July 14). It is a popular tourist destination known for its scenic beauty, panoramic views of the Himalayas, and historical significance. The hill is home to Chandragiri Cable Car, a way to reach the hilltop. Chandragiri also holds cultural and religious significance, with the presence of the Chandragiri Fort, which has historical connections to the kings of Nepal. Overall, Chandragiri offers a blend of natural beauty, cultural heritage, and recreational opportunities for visitors to explore.

Materials Required

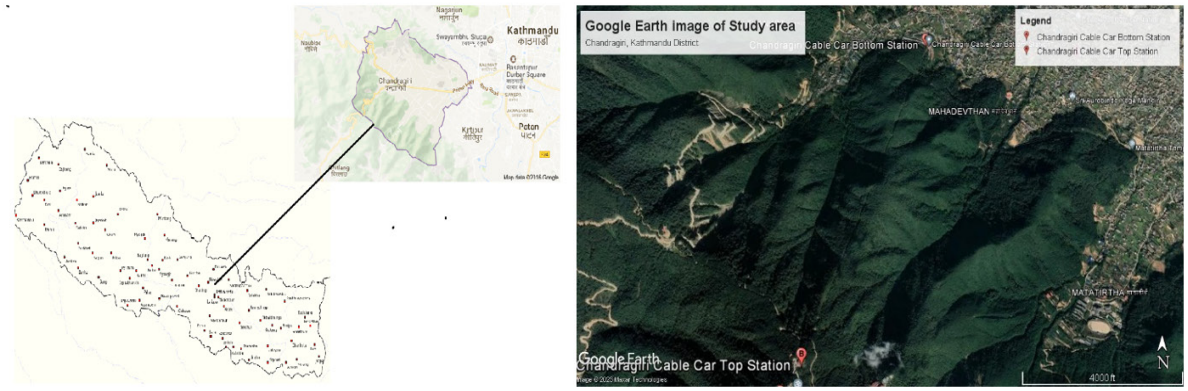

Figure 1: Study Area, Chandragiri area

For the quantitative sampling of habitat analysis in the Chandragiri area, various types of materials were used, which are listed below

- GPS
- Camera
- Clinometer

Activities of Field

Sample Selection

A random area was selected and delineated with the help of GPS tracker. Two vertical transect lines on either side of the cable car pathway were taken at the distance of 20 meter and 100 meters.

Data Collection

Data collection was done by indirect method field observation. As no any direct sign was seen during the field observation.

Indirect method-The indirect sign like burrows, digs, scales, dropping, footprint and food of pangolin (ant and termites) was observed and recorded to analyze the distribution and conservation status of pangolin in the study area.

• Objective I: To identify the distribution patterns, linear sampling method was used. Two vertical transect on either side of the cable car pathway and sampling was taken along the vertical transect.

• Objective II: During the on-field visit, GPS point of each burrow was taken. The points were displayed on the study area map using ArcGIS 9 software. Point like aspect, elevation, soil type (color and texture) ground cover and crown cover to analyze the preferred habitat of pangolin.

• Objective III: Chandragiri does not come under protected area and due to the construction of cable car in the Chandragiri hill, the flora and fauna including pangolin habitat might be disturbed by human activities. The disturbance by human activities of pangolin was observed by field visit.

Data Analysis

The data was analyzed and presented in tabulated form with the use of MS EXCEL. Arc GIS 9 was used to prepare the distribution map of pangolin.

RESULTS AND DISCUSSION

Results

Distribution

The distribution of pangolin in the study area is shown by the evidence of indirect sign such as burrows, digs,

scales, dropping, footprint and food of pangolin (ant and termites). The distribution of pangolins in the study area is inferred based on the presence of indirect signs, including burrows, digs, scales, droppings, footprints, and the availability of their food sources, such as ants and termites. These indirect signs serve as evidence of the presence and activity of pangolins in the area. This information helps in understanding the spatial distribution of the species and contributes to conservation efforts and habitat management strategies.

Figure 2: Burrow of pangolin observed during field

Distribution Map

The ArcGIS map has been generated to depict the distribution of pangolin burrows within the study area, focusing on the altitudinal range of 1600m to 1700m. The map specifically highlights the locations of burrows situated at distances of 20m and 100m horizontally from the cable car pathway. This visualization provides valuable information regarding the spatial distribution of pangolin burrows in relation to altitude and proximity to the cable car pathway is prepared (Figure 2).

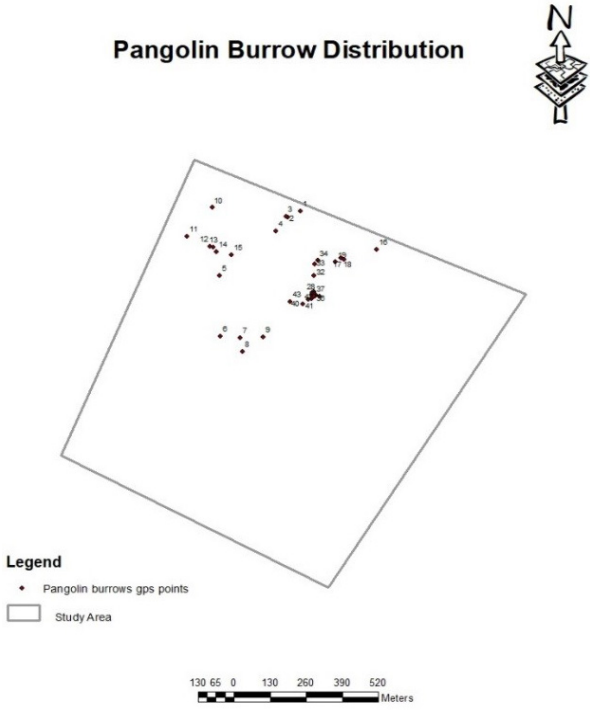

Figure 3: Map showing distribution of Pangolin burrows, prepared using ArcGIS

Altitudinal Distribution of Pangolin Burrows

The altitudinal distribution of pangolin burrows revealed that the highest concentration of burrows was found within the range of 1600m to 1700m. This finding indicates a preference for this particular elevation range by the Chinese Pangolin. The distribution of pangolin burrows according to altitude is prepared (figure 3).

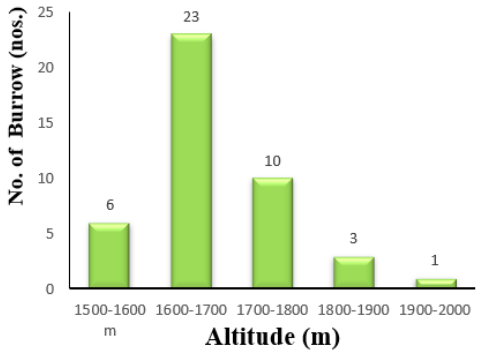

Figure 4: Altitude wise distribution of burrows

Habitat Preference

The identified areas with burrows were characterized by red and moist soil, indicating a strong preference for this soil type over other types. The moisture content in the soil was attributed to the rainy season, further influencing the habitat selection of the Chinese Pangolin. The study also revealed a higher preference for forested areas, specifically those with abundant tree species such as *Schima wallichii, Myrica esculenta, Alnus nepalensis, Morus nigra,* and *Melia azedarach*, in close proximity to the burrows. Regarding vegetation cover, the findings indicated a higher preference for canopy cover ranging from 50% to 100% (58%) compared to canopy cover ranging from 0% to 50% (41%). In terms of ground cover, a preference was observed for areas with ground cover ranging from

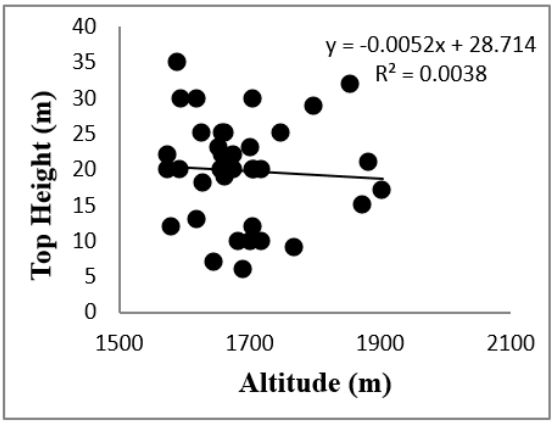

Figure 5: Scatter Chart showing top height along altitude

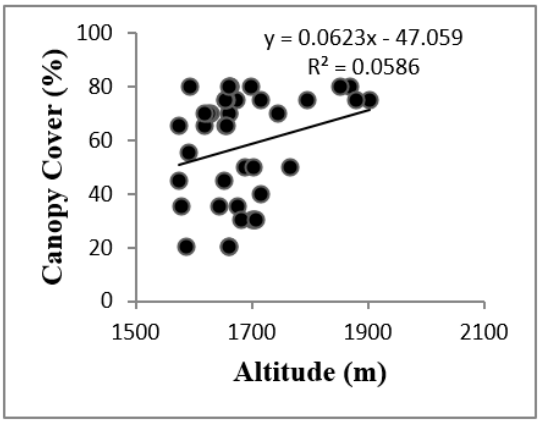

Figure 6: Scatter chart showing canopy cover along altitude

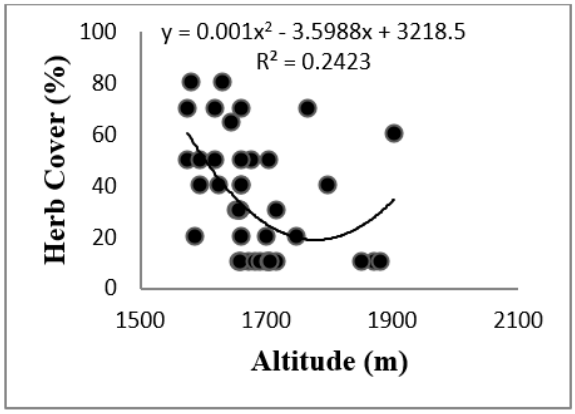

Figure 7: Scatter chart showing herb cover along altitude

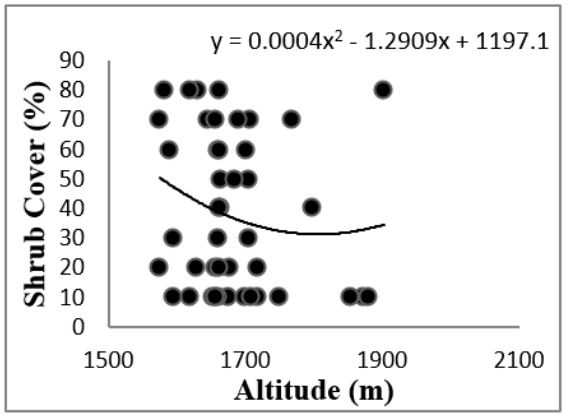

Figure 8: Scatter chart showing Shrub cover along altitude

0% to 50% rather than areas with ground cover ranging from 50% to 100%. The study further highlighted that the elevation class ranging from 1700m to 1800m was more preferred by the Chinese Pangolin where 1600m to 1700m was more preferred.

To visually represent the relationship between the Chinese Pangolin's habitat preferences and various ecological factors, scatter charts were prepared, showcasing the correlation between canopy height, canopy cover, herb cover, shrub cover, and altitude. These scatter charts, depicted in figures 4, 5, 6, and 7, provide a graphical representation of the associations between these factors and the altitudinal gradient, aiding in understanding the habitat preferences of the Chinese Pangolin in relation to these variables.

Impact of Infrastructure Development

To assess the impact of infrastructure development in the study area, two vertical transects were observed on both sides of the cable car pathway. The observations

Table 1: Burrows sample at 20m and 100m horizontal from cable car pathway

Burrows sample at 20-meter horizontal from cable car pathway				Burrows sample at 100-meter horizontal from cable car pathway			
S.N.	**Longitude (x)**	**Latitude (y)**	**Altitude (z)**	**S.N.**	**Longitude (x)**	**Latitude (y)**	**Altitude (z)**
1	27.68576	85.21413	1579.813	1	27.68408	85.21566	1575.48
2	27.68555	85.21364	1629.569	2	27.68413	85.21554	1574.796
3	27.68559	85.21359	1619.523	3	27.68401	85.21533	1594.303
4	27.68511	85.21322	1644.762	4	27.68303	85.21452	1660.29
5	27.68369	85.21111	1768.087	5	27.68292	85.21452	1652.766
6	27.68166	85.21106	1902.623	6	27.68288	85.21451	1655.519
7	27.68158	85.21177	1872.329	7	27.68293	85.21455	1660.653
8	27.68112	85.21184	1881.229	8	27.68299	85.21451	1656.583
9	27.68158	85.21261	1854.208	9	27.683	85.21446	1658.624
10	27.68597	85.21091	1797.728	10	27.68299	85.21444	1663.442

11	27.68504	85.20998	1627.342	11	27.68298	85.21446	1659.253
12	27.68467	85.21078	1663.175	12	27.68297	85.21449	1656.455
13	27.68464	85.21091	1674.57	13	27.68293	85.21446	1660.84
14	27.68448	85.21101	1699.69	14	27.68293	85.21445	1662.121
15	27.68436	85.21155	1717.859	15	27.6829	85.21444	1662.121
16	27.68439	85.21685	1676.593	16	27.68358	85.21454	1619.831
				17	27.68397	85.21457	1595.345
				18	27.68407	85.21468	1588.943
				19	27.68288	85.21469	1704.771
				20	27.68289	85.21452	1705.821
				21	27.68289	85.21451	1701.377
				22	27.68282	85.21441	1683.362
				23	27.68278	85.2143	1690.185
				24	27.68263	85.21409	1704.882
				25	27.68263	85.21409	1707.81
				26	27.68265	85.21408	1717.744
				27	27.68274	85.21363	1747.613

were conducted at two specific distances horizontally from the pathway: 20 meters and 100 meters. By examining these two transects, the study aimed to understand how infrastructure development, particularly the presence of the cable car pathway, influenced the area. The choice of these specific distances allowed for a comparison of the effects at different proximity levels. This approach provided valuable insights into the potential impacts of infrastructure development on the surrounding environment, including factors such as habitat fragmentation, disturbance levels, and changes in the distribution and behavior of the Chinese Pangolin population.

Burrows Distribution at 20-meter and 100-meter Horizontal from Cable Car Pathway

The distribution of burrows at 20m and 100m horizontal from the cable car pathway shows that, the pangolin preferred places away from the human disturbance such as cable car, building, road way, etc.

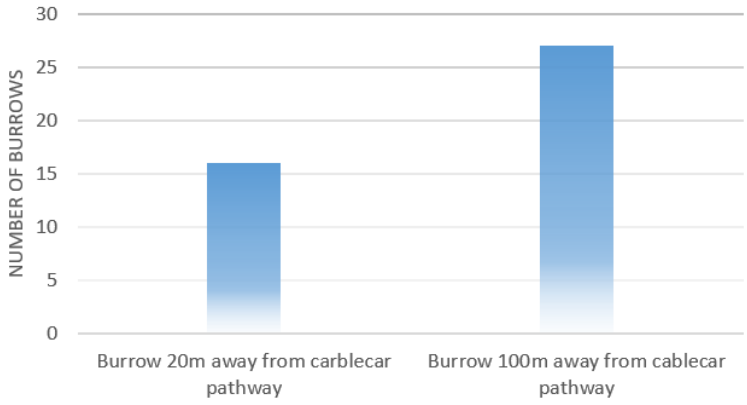

Figure 9: Bar graph showing the percentage of burrows at 20m and 100m horizontal from cable car pathway

DISCUSSION

Distribution Map of Pangolin Burrows

The distribution map of pangolin burrows was prepared based on the GPS points using ArcGIS-10.3 software. Pangolin were not seen during the field visit as the survey of burrows was undertaken on the day time, as pangolins are nocturnal animals. Forty-three burrows were observed among them 37 burrows were inactive burrows and 6 were active burrows. The burrows were distributed from 1575m to 1905 m of altitude. According to IUCN red list of threatened species, the pangolin is confined to elevations below or approximately1500m and the species prefer sub- tropical region (IUCN, 1996). But in the study area, the burrows were found more in the elevation of 1600m and up to the highest elevation of 1905m. Although the burrows were found up to elevation of 1905m, pangolin can be in higher elevation if detailed study is done. According to (Suwal, 2011), there is non-uniform distribution of burrows in all the aspects. The non-uniform distribution of pangolin burrows in the area is due to food availability, vegetation pattern, human activities and other requirement. Another reason for

uneven distribution might be since the pangolin selects the place with direct sun rays, south, south-east, south-west facing slopes (Shrestha, 2005).

Habitat Preference of Pangolin

According to Gurung (1996), during his survey he found a close relationship between red soil and burrows distribution in the protected Nagarjuna Forest. During the field observation the area with burrows had red and moist soil. Thus, red soil is highly preferred by pangolin. Although pangolin preferred places with red soil with direct sunlight, the present of moisture was due to rainy season. Similarly, forest land with high vegetation is highly preferred. As the area had high diversity but the burrows were observed in the area near tress like *Schima wallichii, Myica esculenta, Alnus nepalensis, Morus nigra* and *Melia azedarach.*

As observed from the scatter chart, there is no significant increase in canopy height with altitude. The canopy height at 1600m is heighest.The average canopy height was found to be 20m. Likewise, the herb cover and Shrub c over along the altitude from 1500m to 2000m is decreased. Highest percentage of herb and shrub cover was observed in 1700m. Although there is significant decrease in herb and Shrub cover with altitude, there is increase in canopy cover. The canopy cover of 50-100% (58%) is more preferred than canopy cover of 0-50% (41%) while ground cover of 50-100% is less preferred than ground cover of 0-50%. The result shows that elevation class from 1600-1700m is more preferred compared to the elevation class from 1900-2000m.

Impact of Infrastructure Development

There are direct and indirect factors that affect the population and habitat status of pangolin. Hunting and poaching by humans are direct factors, whereas habitat loss, habitat degradation, habitat fragmentation and environmental condition are indirect factors. Habitat destruction is indicated as a factor affecting the status of pangolin in countries like Nepal (Gurung, 1996). During the filed visit, habitat destruction due to human activities like infrastructure development such as cable car, building and pathway construction in the forest area was observed. Furthermore, habitat fragmentation due to road and hotel construction near the forest area was also observed during the field visit.

The burrows of pangolin at 20m and 100m horizontal from the cable car pathway shows that, the pangolins preferred places away from the human disturbance. The observation shows that number of burrows at 20m horizontal from cable car pathway was less in number compared to burrows at 100m horizontal from cable car pathway. This might be due to the infrastructure development. The infrastructure development such as cable car, building, pathway and tower in the Chandragiri hill as directly and indirectly impact endangered animals like pangolin along with other biodiversity available in the area. As the area was highly influenced by the modern life style no any forest resources like fodder, fuelwood and NTFP collection was observed.

Under the red list category of IUCN, pangolin is listed as critically endangered and is therefore considered to be facing very high risk of extinction in the wild (IUCN, 2014). Pangolin is protected nationally and internationally but the observation shows conservation measures for the protection have not been carried out yet. Conservation awareness, formulation of strict laws and declaration of pangolin conservation areas are the measures that can be adopted for the protection and conservation of pangolin and its habitat.

CONCLUSION

Chandragiri in Kathmandu valley provides a suitable habitat for the Chinese pangolin. Burrows were distributed on Chandragiri hill, with higher numbers observed 100m away from the cable car pathway, indicating the impact of infrastructure development on the pangolin population. The study area contained 43 burrows (37 inactive and 6 active), mainly concentrated between 1600m to 1905m altitude. The burrows were found in areas with red and moist soil, which is highly preferred by pangolins. Despite their preference for places with red soil and direct sun rays, the soil's moisture was due to the rainy season. *Schima wallichii, Myrica esculenta, Alnus nepalensis, Morus nigra* and *Melia azedarach* trees were observed near the burrows of pangolin. The scatter chart (XY chart) shows no significant increase in canopy height with altitude. The highest canopy height, 20m, was observed at 1600m elevation. Herb and shrub cover decreased from 1500m to 2000m, with the peak percentage at 1700m. Despite this decrease, canopy cover increased. Canopy cover of 50-100% is preferred over 0-50%, while ground cover of 0-50% is preferred over 50-100%. The study area experienced habitat destruction due to human activities like cable car, building, and pathway construction in the forest, as well as habitat fragmentation from road and hotel construction near the forest.

Pangolin burrows at 20m and 100m from the cable car pathway indicate a preference for places away from human disturbance. The number of burrows at 20m was lower compared to those at 100m, likely due to infrastructure development. Chandragiri hill's cable car, buildings, pathways, and towers have directly or indirectly impacted endangered animals like pangolins and other biodiversity in the area. The high influence of modern lifestyle has led to the absence of forest resources like fodder, fuelwood, and non-timber forest products (NTFP) collection in the region.

RECOMMENDATION

The Central Government should collaborate with local government, biodiversity conservation organization and civil society to organize awareness companion for local and neighboring community to enhance the knowledge and importance of Chinese Pangolin and raise awareness about its ecological importance.

Local Government i.e. Chandagiri municipality should make a bylaws and regulation that enhance the concept

of green infrastructure, promoting and preserving its local biodiversity.

Based on research findings, area with red and moist soil is most favorable for Chinese Pangolin. Thus, concern authorities should be aware to prevent native land and soil from its degradation.

Based on research findings, it is crucial to implement strict zoning restrictions area and protection measures in the area within a 200-meter radius from the Chandragiri cable car, it's the habitat for Chinese Pangolin. This will help safeguard the area from infrastructure development and poaching activities.

The canopy cover of 50-100% is more preferred than canopy cover of 0-50% (41%) by Chinese Pangolin. Thus, the local and central government should prioritize addressing the loss of canopy cover, caused by climate change and rapid infrastructure development, as it significantly impacts the preferred habitat of Chinese pangolins in Chandragiri Protected Area.

Furthermore, address the limited information available regarding the habitat, distribution, behavior, and threats faced by pangolins, it is imperative to conduct detailed research. This research should focus on collecting comprehensive data to enhance our understanding of pangolins and their ecological requirements.

Abbreviations

ACAP	Annapurna Conservation Area Project
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DFO	District Forest Office
GIS	Geographic Information System
GoN	Government of Nepal
IUCN	International Union for Conservation of Nature
MBNP	Makalu Barun National Park
MoFSC	Ministry of Forest and Soil Conservation
NPWC	National Park and Wildlife Conservation
NTNC	National Trust for Nature Conservation
SMCRF	Small Mammals Conservation and Research Foundation
TU	Tribhuvan University
WCMC	World Conservation Monitoring Center
WWF	World Wildlife Fund

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