



## Distribution and habitat preference of the Red Panda in Lamtang National Park of Nepal

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### Abstract

The study was carried out in Ghyangphedi Buffer Zone area of Lamtang National Park (LNP), Nepal. The objectives of this study were to identify habitat type, draw a distribution map of Red panda and know its conservation threats in Ghyangphedi, Lamtang National Park. Circular plots with a radius of 10m were taken for vegetation composition and intensity of human disturbances. The 5m x 5m within 10m radius circular plots were taken for shrubs and bamboo. Simple random sampling method was used. The presence of red pandas (*Ailurus fulgens*) was recorded in two blocks (Fedi and Tharepati) of LNP Ghangphedi buffer zone area. The results showed that depending on the faecal pellet group, red pandas appeared at altitudes of 2,900 to 3,600 meters, and the abundance of pellets increased to 3,300 meters and decreased rapidly at higher elevations. This population of red pandas preferred a mostly mixed coniferous forest with a cool broadleaved forest and a bluepine forest. The mixed coniferous forest was dominated by *Abies pindrow*, *Tsuga domosa*, *Acer campbellii* with *Symplocos sp*, *Rhododendron sp(s)*, *Daphne bholua* and bamboo undergrowth. The presence signs of the red panda were observed within 670 meters from the water sources. The bamboo species found at the study site were *Drepanostachyum arundinariarecemoso*, *Drepanostachyum intermedium* and *Arundinaria falcata*. The results showed that the maximum presence signs were observed close to the *Arundinaria falcata*. The collection of grass, timber, and bamboo was anthropogenic hazards. Further research, awareness programs about its important role in the ecosystem, classification of settlements in different areas are recommended for an effective monitoring system.

**Keywords:** *Ailurus fulgens*, Bamboo species, Conservation, Threats, Vegetation structure



## Introduction

The Red panda (*Ailurus fulgens*) is a hypercarnivore (primarily herbivorous member of the carnivore family), and is endemic to the Himalayas (Sharma 2014). With its striped tail and distinctive facial markings, the Red panda looks not dissimilar to raccoons. However, it has been recently defined in its own monotypic family, the *Ailuridae*. There are two subspecies of the red panda; *Ailurus fulgens* and *Ailurus fulgens styani* (Wei et al. 1999a). *A. fulgens* subspecies are distributed throughout the Himalayas: in Nepal, India, Bhutan, northern Myanmar and southwestern China, and *A. styani* subspecies is found in south-east China (Choudhary 2001). Previous studies (Johnson et al., 1988, Yonzon and Hunter 1991, Pradhan 1999) showed that Red panda make use of temperate and sub alpine forests at elevation ranging from 2500 to 4000 m.

In the global scenario, Nepal is home to about 1.9% of the entire international population of the Red Panda, which is based on the idea of the habitat suitability index model (DNPWC/MoFSC/GoN 2018). There are many Protected regions in Nepal endorsing the habitat of Red panda and amongst them Lamtang National Park (LNP) may be very important. LNP, founded in 1976 with an area of 1710 km<sup>2</sup> and the buffer area of 420 km<sup>2</sup>, positioned in among the Himalayan variety to the north stocks approximately 24.33% of Nepal's general Red panda populace (DNPWC/MoFSC/GoN 2018). Ghyangphedi is a small village withinside the LNP Buffer Zone region that's taken into consideration an essential habitat for the Red panda. To date, no research had been performed on red panda in any region of the Ghyangphedi region. The red panda is currently reclassified as endangered due to the fact its population has declined through 50% over the past three generations (anticipated at 18 years) and this decline is projected to continue, and in all likelihood intensify, withinside the subsequent three generations (IUCN Red List 2015). It is included through the Government of Nepal's National Parks and Wildlife Protection Act of 1973. Section 26 of the NPWC Act, 1973 provisions a fine starting from NRs. 500,000 to NRs. a million or imprisonment of five to fifteen years or each for the offenders and unlawful alternate in red panda and its body parts. Despite being at the listing of protected species, there has now no longer been the right take a look at of this species from the authorities or private sector and their numbers are declining over much of their range because of habitat loss and fragmentation. Yonzon and Hunter (1991) confirmed that LNP had three vegetation zones wherein fir and bamboo have been strongly favored through the Red pandas however it best occupied 6% of the whole region.

Poaching is likewise a primary occasion to this shy and elusive animal. There is a sudden rise in the demand of Red panda's pores and skin in the illegal marketplace ensuing in better poaching and trading. It is likewise envisioned that about 20 individual Red pandas have been hunted and killed in 2009 only (Glatston *et al.* 2015). In the course of study time, Yonzon and Hunter (1991) determined that the mortality of each cubs and adults became high: of 12-13 cubs born during the course of the field study, best 3 survived past six months of age and 4 of 9 recognised adults died at some stage in the project. Most of the deaths from recognised causes (57%) have been human-related; thus, the presence of Yak, their herders, and feral dogs became virtually destructive to the Red pandas. And above all, withinside the case



of Red panda, the maximum urgent hassle in its conservation is inadequate facts concerning its occurrence.

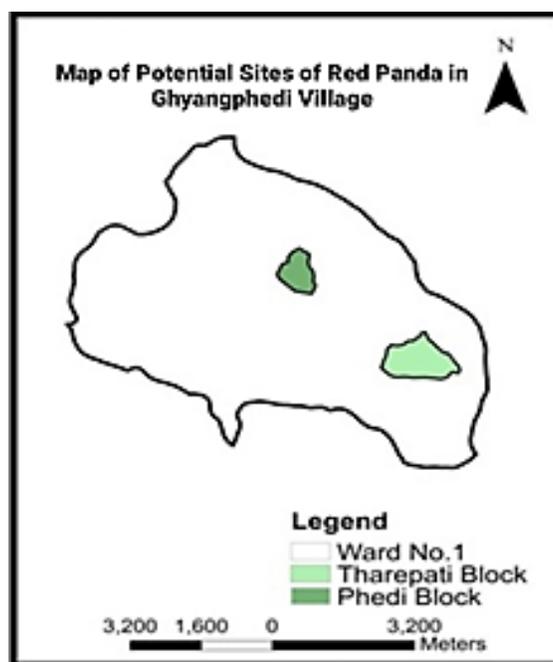
Loss of any species is a tragedy, however the Red panda is mainly vital because (1) it could be threatened during its range (Yonzon 1989), (2) taxonomically, it's far the only member of a monotypic own circle of relatives and (3) it's far a really appealing animal that might without difficulty characteristic as a flagship species to catalyze global public assist for clever Natural Resource Management during its range (Yonzon and Hunter 1991). Despite of its importance, little is thought approximately the habitat preference and conservation threats of Red panda in the study site and in Nepal even though it is indexed as protected species under Schedule I (Section 10) of the National Park and Wildlife Conservation Act 2029 (1973). It is also indexed in the Appendix-I of CITES (DNPWC 2018).

The objective of this study was to identify habitat and distribution of Red panda in Ghyangphedi, Lamtang National Park of Nepal.

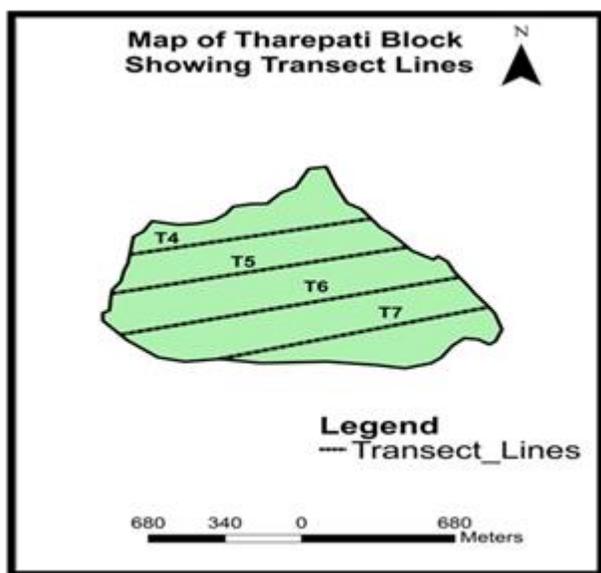
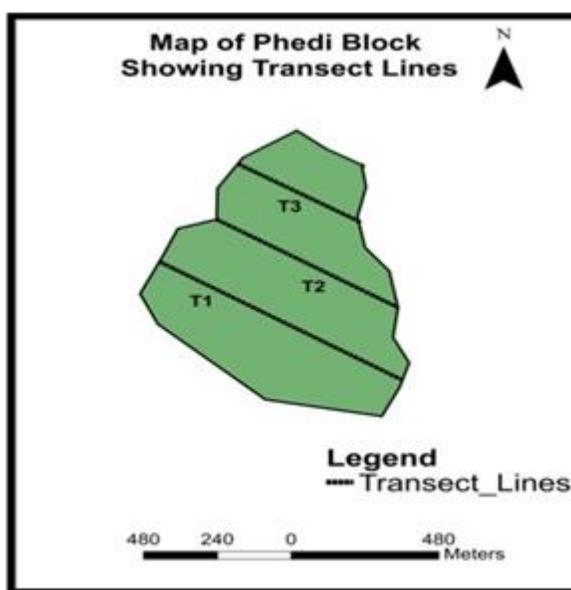
## Material Methods

### Study area

The study was carried out in Ghyangphedi Buffer Zone of LNP which is in Dupcheshwor Rural Municipality, Nuwakot district in the Bagmati zone of central Nepal. Ghyangphedi is situated at 28.01°N 85.45°E. The study consisted of two blocks and inhabited by over 800 households and more than 3000 people. Most people in the study site practice subsistence agriculture and livestock farming. While the forest type was dominated by Cool Broadleaved Forest at lower altitudes, it replaced with Mixed Conifer Forest and Fir Forest at higher altitude.



**Figure 1:** Map of potential sites of Red Panda

**Figure 2:** Tharepati Block with Transect Lines**Figure 3:** Phedi Block with Transect Lines

### Data collection

Data on the number of households, population, cattle population and any other related information were gathered from the Dupcheshwor Rural Municipality office. Other necessary data were collected from LNP, NTNC, RPT and concerned Offices and relevant literatures cited.

Counting the absolute number of most wildlife species is very expensive in terms of time, labor and money, therefore, in most cases it is almost impossible. The red pandas were difficult to encounter because of they are nocturnal, arboreal and shy (Pradhan *et al.* 2001, Wei *et al.* 2000). Instead of that, evidences like pellets and feeding signs were used to document presence or absence model as they were easier to find. This study was mainly based on the indirect evidences of red panda 'pellet count' and feeding signs on bamboo and other food species. In the simple random samples, line transects were deployed.

### Preparation of Distribution Map of the Species in the study site

A preliminary survey was carried out to assess the potential habitat of Red panda within the Ghyangphedi village. Two blocks viz. Phedi and Tharepati Block were selected for initiation of more intensive investigation of Red panda distribution. In the blocks, altogether 7 line transects were established. Evidences like pellets and feeding signs were used to document presence or absence, as they were more readily accessible. The number, and location of pellet groups to each side of every transect were counted and recorded with their elevations, as observations of Red pandas. Natural demarcations including springs, ridges and valleys were used as reference in orienting along transects. Pellet group and the red panda were checked, information such as altitude, latitude, longitude, aspect and angle were recorded in each survey. These points were then marked on a map to demonstrate the distribution of the Red panda in the research site.



### **Determination of Habitat preference**

For the determination of habitat preference, Circular plots with a radius of 10 m were taken for vegetation composition and intensity of human disturbances. The 5m x 5m within 10 m radius circular plot was taken for shrubs and bamboo (Wangchuk 2014).

### **Questionnaires in local communities assessing conservation threats of the Red panda**

Local villagers were also interviewed to get complementary information on Red panda's distribution. First, villagers were asked inquires to probe their knowledge about the local fauna. If the informant seemed knowledgeable about local fauna then specific questions about the Red panda were asked. The second round of questioning was focused on key informant survey, formal and informal discussions and questionnaire survey which revealed their past sightings and their behavior towards the animal when encountered. Moreover, the conservation issues and the roles of different agencies in Red panda conservation were assessed through interviewing different stakeholders.

### **Data analysis**

Data was statistically analyzed using the SPSS 14.0 (SPSS Inc., Chicago, IL, USA). Figures are drawn using and Microsoft Excel 16.0. For distribution map of the species Arc GIS 10.2 Version software was used. To extract the correlation among different habitat variables and Red panda pellet group densities Pearson's Product Moment Correlation Coefficient was performed.

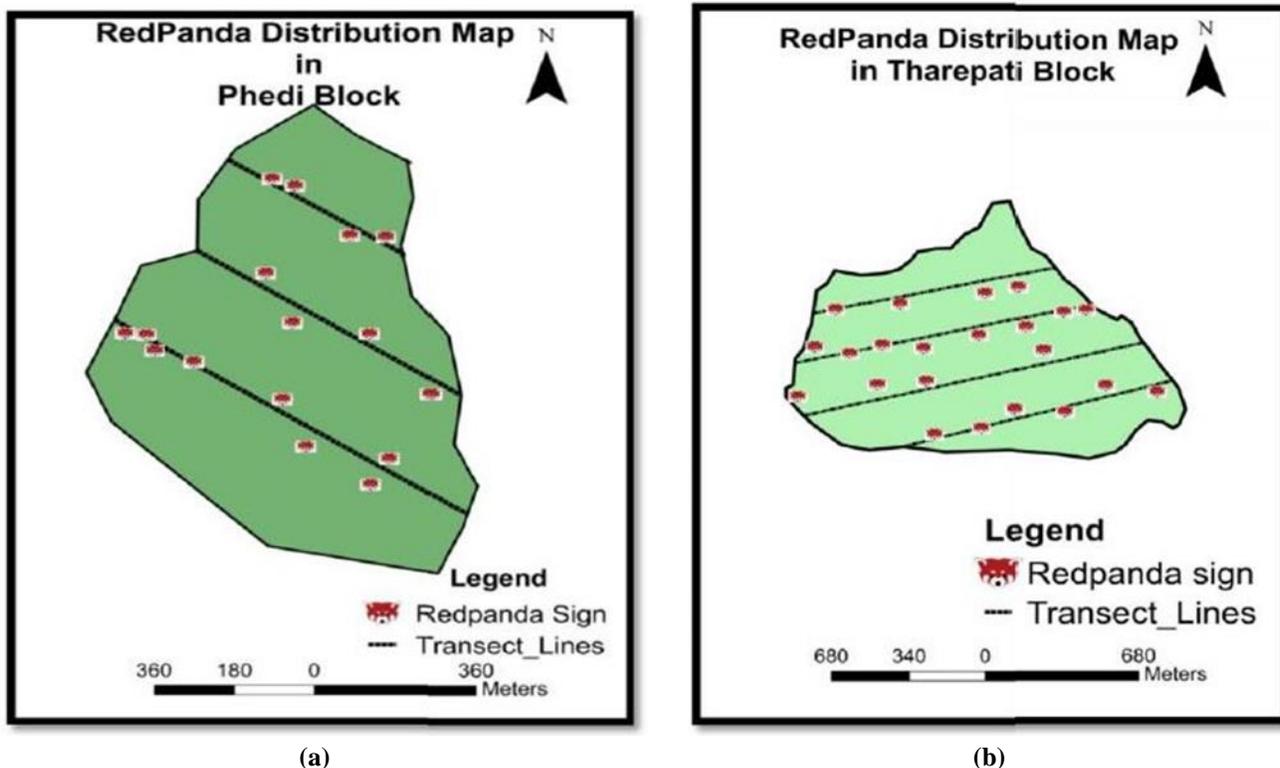
## **Results and Discussion**

### **Distribution Map**

Evidences were noted in all 2 patches within the Ghyangphedi village, and field surveys were subsequently conducted in these blocks to locate the position of the red panda. In total, 38 GPS points were recorded in seven transect lines, indicating the locations of both direct and indirect observed evidence of red panda, and these points were uploaded into Arc GIS 10.1. This information was overlaid on separate map of each block to prepare the distribution map of the red panda (Fig 4a andb).

**Table 1:** Transect Details in Phedi Block

Transects ID	Length (m)	Average Slope (Degree)	Direction	Average Elevation (m)
Transect 1(T1)	928	32	NW to SE	3390
Transect 2(T2)	695	29	SE to NW	3306
Transect 3(T3)	469	28	NW to SE	3441

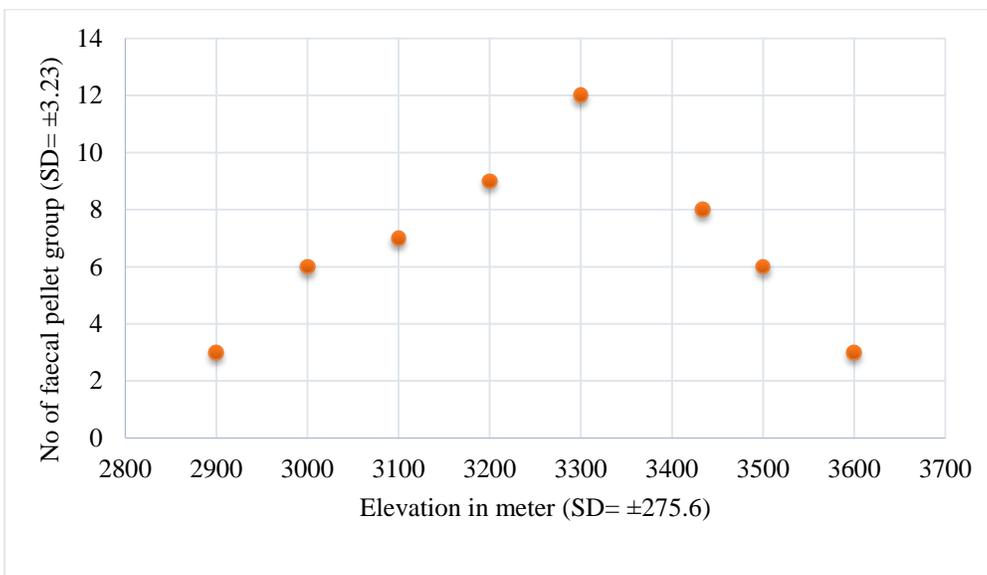


**Figure 4:** Rad Panda Distribution Map

**Table 2:** Transect Details in Tharepati Block

Transects ID	Length (m)	Average Slope (Degree)	Direction	Average Elevation (m)
Transect 4(T4)	1087	34	W to E	3114
Transect 5(T5)	1335	32	E to W	3176
Transect 6(T6)	1561	29	W to E	2985
Transect 7 (T7)	1233	30	E to W	3248

Overall, Red panda pellet groups were observed from 2,900 to 3,600 m (Fig. 5). The frequency of pellet groups increased markedly from 2,900 to 3,300 m then declined sharply at higher elevations. No pellet groups were observed at elevations greater than 3,600 m. Thus, elevations >3600 m were surveyed less intensively. Most Red pandas occur over 3,200–3,400 m a.s.l. (Jnawali *et al.* 2012) or 3,000–3,800 m a.s.l. (Panthi *et al.* 2012), and suffer disturbance from local people for livestock and collection of forest products. In Nepal, red panda's presence has been documented from 24 districts and seven protected areas with potential habitat of 23,977 km<sup>2</sup> (DNPWC and DFSC 2018).



**Figure 5:** Elevational distribution of red panda faecal pellet groups, Ghyangphedi village

Distribution of pellet groups appeared positively associated with the abundance of bamboo *Arundinaria* sp. and available water resources. Bamboos are the dominant forage species of Red pandas throughout their geographic range (Reid *et al.* 1991, Yonzon and Hunter 1991a, Pradhan *et al.* 2001). In the Tharepati block, two adult red pandas have been seen together on a *Betula utilis* tree both at 3,220 m elevation, in mid February (winter). As winter is the mating season (MoFSC 2015) these pandas could be in a pre-mating aggregation. In the wild, red pandas are solitary outside their mating period (Yonzon and Hunter 1991a).

### Habitat type

A total of 50 numbers of 10 m radius circular plots were surveyed. Out of total plots, 50% (n= 25) plots were in mixed conifer, 38% (n=19) in cold broadleaved and 12% (n=6) were in pure Blue pine forest. The mean altitude of the study area was 3237.14 m (SD=±187.64) and the mean of the slope was 30.57° (SD=±1.99).



**Figure 6:** Red Panda sighted during fieldwork in *Betula utilis* tree at Tharepati Block



### Vegetation composition

Among seven transect lines, the highest tree species was recorded in transect five, 54% (n=8), followed by 47% (n=7) species in transect four, 40 % (n=6) species in transect one, 33% (n=5) species in transect three, 27% (n=4) species in transect six and least number of tree species 20% (n=3) species in both transect second and seven. The highest basal area was recorded 96,678.27 cm<sup>2</sup> in transect five 89,067.67 cm<sup>2</sup> in transect six, 58,930.75 cm<sup>2</sup> in transect seven and 25,257.89 sq cm in transect one. The total of 15 tree species were recorded in seven transect lines. The most common individual was *Pinus wallichiana* 21.35% (n=60), *Juniperous indica* 17.79% (n=50) *Tsuga dumosa* 13.52% (n=38), *Rhododendron barbatum*12.45% (n=35), *Betula utilis*10.67% (n=30) followed by *Abies pindrow* 8.89% (n=25), *Quercus glauca* 5.33% (n=15), others 9.9 % (n=28).

### Vegetation Structure

The tree density was the highest in transect five 190 trees/ha, followed by 145 trees/ha in transect four and transect two, 125 trees/ha in transect six,130 trees/ha each in transect one and seven and the transect three had the lowest tree density 127 trees/ha (Figure 7). The mean of average tree height was 26.42 m (SD=±4.92). The maximum average tree height was recorded in transect one 35 m followed by transect seven 32 m, transect three 26 m, transect two and six 25 m, transect five 22 m, and the least average height was recorded in transect four 20 m (Fig.8). The results were as transects five and four had matured forest of blue pine, mixed conifer and *Quercus semecarpifolia* dominated cool broadleaved.

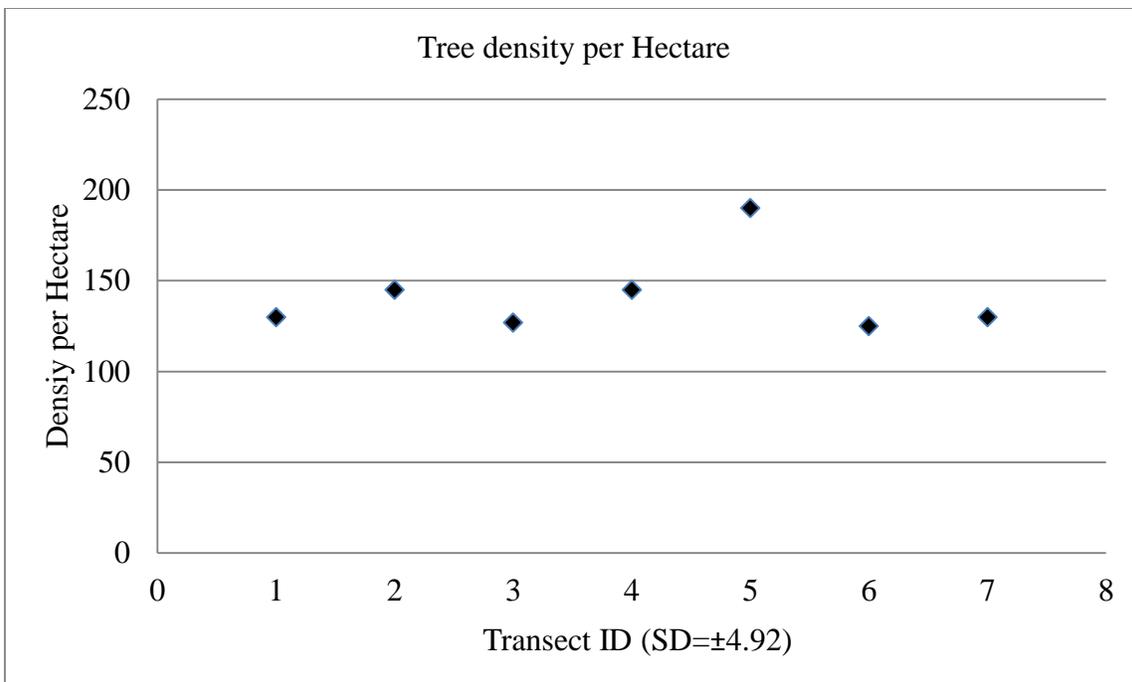
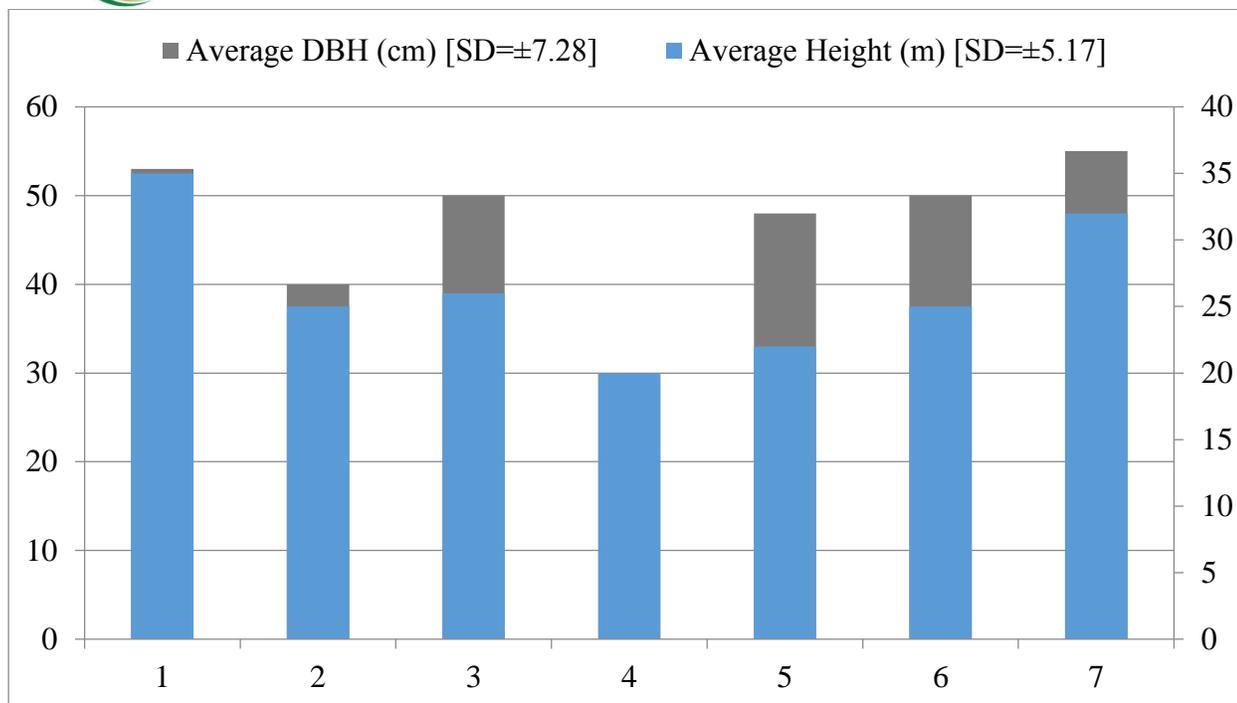


Figure 7: Transect wise density of tree per hectare



**Figure 8:** Transect wise average height and average diameter at Breast Height

The average mean DBH of the tree in all transect was 46.57 cm ( $SD=\pm 7.28$ ). The highest average tree DBH was recorded 55 cm in transect seven followed by 53 cm in transect one, 50 cm in both transect three and six, 48 cm in transect five, 40 cm in transect two and 30 cm in transect four (Fig. 8). The results were resulted as transects one and seven had matured forest of blue pine, mixed conifer and *Quercus semicarpifolia* dominated cool broadleaved.

The average mean height of individual tree species was 23.56 m ( $SD=\pm 5.17$ ). The tallest individual tree species was *Pinus wallichiana* 33 m followed by *Juniperus indica* 30 m, *Abies pindrow* 29 m, *Tsuga dumosa* 29 m, *Betula utilis* 26 m, *Rhododenron barbatum* 25 m, *Pinus wallichiana* 24 m and shorted tree species was *Rhododenron arboreum* 9 m. There was

negative association between altitude and tree GBH and height;  $r(48) = -.08, p \leq .01$ ,  $r(48) = -.24, p \leq .01$ . The *Pinus wallichiana* was most dominant tree species and had the highest of all relative density 23.6, relative dominance 46.39, relative frequency 20.23 and important value index 95.58. The least recorded tree species was *Quercus glauca* with relative density 0.39, relative dominance 0.107, relative frequency 1.02, important value index 1.495 followed by *Rhododendron lindleyi* with relative density 0.4, relative dominance 0.3, relative frequency 1.13 and important value index 1.88. This had resulted as *Pinus wallichiana* was recorded as the highest individual tree species in the study area.

The bamboo species found in the study site were *Arundinaria racemosa* (Malinge Nigalo) *Arundinaria falcate* (Common Nigalo) and *Drepanostachyum intermedium* (Tite Nigalo). The *Arundinaria racemosa* was recorded in 40% ( $n=20$ ), of the total plots followed by *Arundinaria falcata* 34% ( $n=17$ ) and *Drepanostachyum intermedium* 26% ( $n=13$ ). *Arundinaria racemosa* was found at a mean altitude of 2978 m ( $SD=\pm 147$ ), *Drepanostachyum intermedium* at mean altitude of 3215 m asl ( $SD=\pm 212$ ) and mean altitude where *Arundinaria falcata* recorded was 3064 m asl ( $SD=\pm 134$ ). The *Arundinaria racemosa* was recorded



for highest density of 32,342 individuals/ha, followed by *Arundinaria falcata* 29,601/ha and *Drepanostachym intermedium* 25,896 individuals/ha. The average height of *Arundinaria racemosa* was 5.78m, followed by *Arundinaria falcata* 5.05m and *Drepanostachym intermedium* 4.78 m. The cover percentage was dominated by *Arundinaria racemosa* 45%, *Arundinaria falcata* 35% and *Drepanostachym intermedium* 30%. As per the finding of this research the bamboo occurrence was not affected either by distance from water or aspect of the study area. The results showed that maximum presence signs were observed in *Arundinaria falcata*.

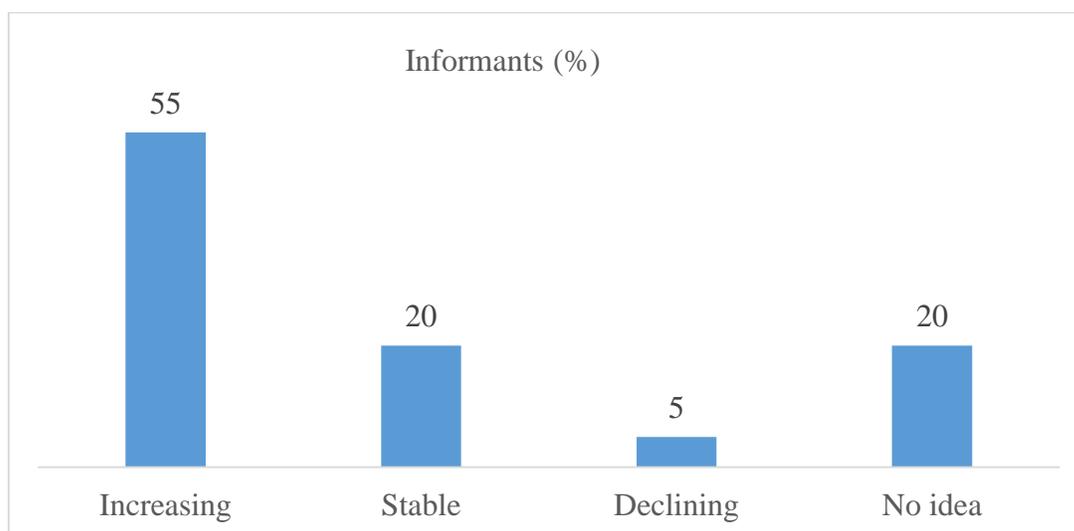
**Table 3:** Bamboo description in Phedi and Tharepati blocks

S.N.	Parameters	Phedi Block	Tharepati Block
1	Average Bamboo Height	4.67	5.67
2	Tallest Bamboo Height	6.9 m	6.5 m
3	Average Bamboo DBH	1.34 cm	1.56 cm
4	Percent Bamboo Cover	56%	49%
5	Bamboo density	63,778/ha	53,787/ha
6	Basal area of Bamboo	9.67 m <sup>2</sup> /ha	7.87 m <sup>2</sup> /ha

### Conservation Threats

#### Knowledge of the species

The interviews were carried out on people residing in three wards of Ghyangphedi village. Altogether, 50 respondents were interviewed as a part of the primary case study. Through semistructured questionnaire survey, it has been revealed that only 55% stated Red panda population is increasing, 20% stated Red panda population is stable, 5% stated population is declining, and 20% have no information about the red panda (Figure 9).



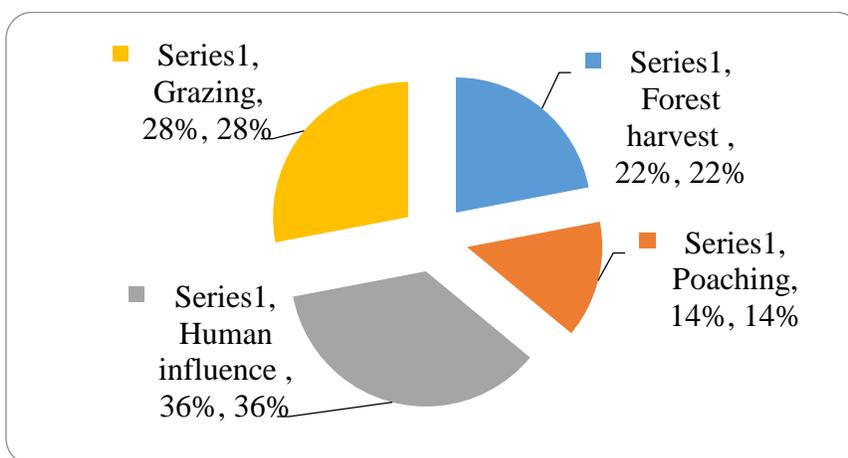
**Figure 9:** Trend of Red panda Population



Wangchuk, 2014 study revealed that only 22% (n=5) stated Red panda population is stable, 17% (n=4) stated population is declining and 61% (n=14) have no information which means they don't know anything about the red panda and will do anything to damage them.

### Percentages of disturbances

The anthropogenic disturbances were observed in all sample plots of the total 50 plots surveyed in seven different transect line. The human existence signs, grazing by livestock, forest products harvest and cattle dung was recorded as main threats and disturbances. Wangchuk (2014) pointed out that out of 53 disturbance counts, 30% (n=16) was human influence or signs of human visits, 28% (n=15) was grazing, 27% (n=14) was harvest of forest products and 15% (n=8) was cattle dung. There was also bur collection evidences along transect line three and four at the point where Red panda signs were recorded. The bur collectors may pose threats through disruption and occasions of poaching.



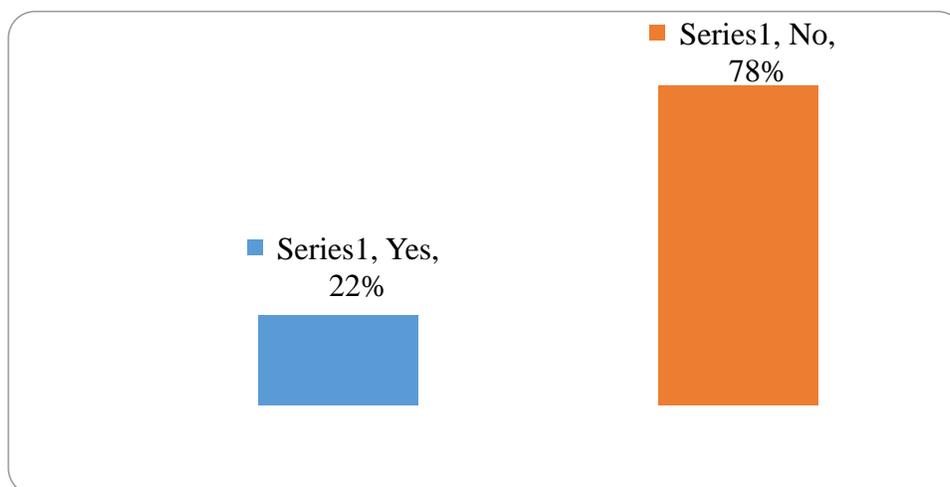
**Figure 4:** Anthropogenic various disturbance percentage to red panda

### Knowledge on the legal status of Red panda

Among the respondents, 22% stated that they have the knowledge on the legal status of the Red panda whereas 78% of the respondent stated that they didn't have any idea about the legal status of the Red panda.

### Conclusion

The red pandas preferred mostly mixed coniferous forest with a cool broadleaved forest and a bluepine forest. The mixed coniferous forest was dominated by *Abies pindrow*, *Tsuga domosa*, *Acer campbellii* with *Symplocos* sp, *Rhododendron* sp(s), *Daphne bholua* and bamboo undergrowth. The presence signs of the red panda were observed within 670 meters from the water sources. The bamboo species found at the study site were *Drepanostachyum arundinariarecemoso*, *Drepanostachyum intermedium* and *Arundinaria falcata*. The results showed that the maximum presence signs were observed close to the *Arundinaria falcata*. The collection of grass, timber, and bamboo was anthropogenic hazards. Further research, awareness programs about its important role in the ecosystem, classification of settlements in different areas are recommended for an effective monitoring system.



**Figure 5:** Knowledge of respondents on legal status of red panda.

### **Conflict of interests**

The authors had not declared any conflict of interests.

### **Author contributions**

N.K. conceived the designed the study, N.K. and S.K. collected data. N.K. and S.S. analyzed data interpreted the results. S.S. wrote the manuscript. J.S. made correction on initial draft of this manscript. All authors read and approve the final manuscript.

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