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Pervasive human disturbance on habitats of endangered red panda *Ailurus fulgens* in the central Himalaya

Krishna Prasad Acharya [a], Saroj Shrestha [b], Prakash Kumar Paudel [c], Ang Phuri Sherpa [b], Shant Raj Jnawali [d], Sakshi Acharya [e], Damber Bista [b, *]

[a] Department of Forests, Ministry of Forest and Soil Conservation, Government of Nepal, Babarmahal, Kathmandu, Nepal
[b] Red Panda Network, PO Box 2785, Baluwatar, Kathmandu, Nepal
[c] Center for Conservation Biology, Kathmandu Institute of Applied Sciences, PO Box 23002, Kathmandu, Nepal
[d] WWF Nepal, PO Box 7660, Baluwatar, Kathmandu, Nepal
[e] ZSL Nepal, PO Box 5867, Bishalnagar Road, Bhatbhateni, Kathmandu, Nepal

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ABSTRACT

Red pandas (*Ailurus fulgens*) live in the dense forests of mid-hills of the Himalaya and feed almost exclusively on bamboo. They are vulnerable to extinction due to human induced disturbances. Habitat loss, degradation and fragmentation along with poaching are the most pressing anthropogenic threats to red panda conservation. The extinction risk to red pandas is further compounded by their life history traits. However, there is a paucity of information regarding human impact on red panda habitats. We have used presence and absence data collected from entire red panda range in Nepal, including habitat both inside and outside the Protected Areas (PAs) to examine the impact of human disturbance on their distribution. Our findings indicate that red panda prefer less disturbed habitats but will occupy human disturbed areas. Signs of poaching and cattle trails were significantly associated with red panda presence throughout Nepal while livestock faeces and landslides were negatively associated. Plant disturbance, presence of solid waste and proximity to herders' shed were significantly associated with presence of red panda in PAs whereas landslides and livestock faeces were significant disturbance variables outside the PAs. The findings show that red panda habitats are invariably disturbed and that integrated conservation programs such as awareness, livelihood support that reduces human dependency on forests, and regulations are must.

1. Introduction

The red panda (*Ailurus fulgens* Cuvier, 1825) occurs in subalpine areas of Nepal, India, Bhutan, Myanmar and China within a preferred altitudinal range of 2300–4000 m (Glatston et al., 2015). They inhabit temperate broadleaf forests with a bamboo understory. In Nepal, red pandas are documented in 23 districts with the majority of habitat falling outside the PA networks within the available potential habitat of 23,977 km^2 (MoFSC, 2016). The red panda is listed as endangered in the IUCN Red Data Book and is included on Appendix I in CITES (Glatston et al., 2015). It is protected by law in its all range countries, including in Nepal, by the National Parks and Wildlife Conservation Act (1973).

* Corresponding author.
E-mail address: damber.bista@redpandanetwork.org (D. Bista).

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Red pandas are reported to prefer areas with dense forest (tree canopy cover over 30%), abundant bamboo cover (>37%) and bamboo height (2.9 m) and in close proximity to water sources (within 100–200 m), (Bista et al., 2017a; Dorji et al., 2012; Pradhan et al., 2001; Yonzon and Hunter, 1991a). Some authors indicate red pandas prefer habitats with gentle while others indicate a preference for steeper slopes all agree preferred area include fallen logs, tree stumps, and snags. They generally seem to prefer to inhabit slopes with north and north-west aspects although in some authors report that they occur on slopes with south-west aspects (Zhang et al., 2008; Yonzon and Hunter, 1991a). Bamboo leaves and shoots constitute 83% of the overall diet of red pandas (Reid et al., 1991; Wei et al., 1999a, 1999b; Yonzon et al., 1991). Even though, red pandas are crepuscular, they enjoy foraging and basking during the day (Yonzon and Hunter, 1991a). Although they are generally assumed to be a solitary species; they are found in small groups, probably mothers with their offspring, during the breeding season (Hu, 1991; Roberts and Kessler, 1979).

Even though red pandas have no negative impact on humans (Glatston, 1994), they still face anthropogenic threats (Bista et al., 2017a; Panthi et al., 2017). These animals have been observed to have preferred habitat with higher bamboo cover avoiding areas disturbed by livestock or close to human settlements (Dendup, 2016). Yonzon et al. (1991) had also reported bamboo loss as one of the key threats to the red panda survival. Like other wildlife species, the red panda is also threatened due to the habitat alteration of the landscape by humans. The impact of habitat loss and degradation for red pandas varies throughout the country (Jnawali et al., 2012). Agriculture and livestock herding remain the principal economic activities (79.85%) in mountain areas where nearly 95% of households depend on wood as energy source for cooking and heating (CBS, 2014). All these activities and the resulting deforestation and habitat loss are considered as the major conservation challenges for red pandas throughout their range (Bista et al., 2017a; Glatston et al., 2015; Choudhury, 2001). Increasing incidents of red panda hide confiscation in recent years have indicated that poaching and illicit trade are an emerging threat (Bista et al., 2017a). The dogs, either feral or reared by the herders, are also harmful for red pandas and other wildlife. Red panda kills due to dog attacks have been reported in Nepal (Yonzon and Hunter, 1991a; Williams et al., 2011; Bista and Paudel, 2014). In addition to unrestricted livestock grazing, excessive harvesting of forest resource and habitat fragmentation due to infrastructure development, have created an unprecedented level of threat to red panda survival (Sharma et al., 2014a; Sharma and Belant, 2010; Williams, 2003; Roder et al., 2002; Gratzer et al., 1999). Mass flowering and die off of bamboo is one of the critical issues that could extirpate a local population of red pandas from a particular habitat (Paudel, 2009; Steffens, 2004). Dying off of bamboo makes forest floor dry which is highly prone to forest fire. Albeit, impact of forest fires on small mammals like red panda has not been documented well, anecdotal evidences suggest that the forest fire has negative effects on red pandas (Williams et al., 2011).

Previous studies of red pandas in Nepal have provided important insights into site-specific conservation issues (e.g., community forests, national parks) (Bista et al., 2017a; Sharma et al., 2014b; Panthi et al., 2012; Sharma and Belant, 2010; Yonzon and Hunter, 1991a). However, these findings are not enough to allow the development of a landscape level conservation strategy at national level. Therefore, this study aims to provide a snapshot of impacts of human activities on red panda habitats by answering following questions:

- Does the red panda respond equally or at different level to various human disturbance variables?
- How does the red panda respond to human disturbances within and outside the Protected Areas (PAs)?

2. Methods

2.1. Study area and sampling design

Based on the previously available red panda presence data (Bista et al., 2017a; Kandel et al., 2015; Bhatta et al., 2014) and environmental parameters including 23 environmental variables (19 bioclimatic variables, altitude, slope, aspect, and land cover), Maximum Entropy Modeling –MaxEnt (Phillips et al., 2006) helped us identify potential red panda habitats (MaxEnt version, 3.3.3 k) (Bista et al., 2017a). The predictive distribution model developed in MaxEnt at the Area Under Curve (AUC) value of 0.926 was considered the potential red panda habitat. Thus, identified potential habitat was overlaid with grids of 9.6 km^2, which is equivalent to maximum home range of red panda reported in Langtang National Park (Fox et al., 1996). Grid cells with more than 50% area suitable habitat were considered for random sampling. We randomly selected 50% of the suitable grid cells and overlaid each with 6 sub-grids (area = 1.6 km^2). We selected 3 grids randomly as sampling sites (MoFSC, 2015) and a total of 557 sub-grids were sampled across the entire habitat.

All existing transects, with an average of three to five transects, each ranging from 500 m to 1000 m in length were traversed at an interval of 100 m contour available within a sub-grid. GPS coordinates of start and end points of all available transects within a sampling sub-grid were sorted out and loaded in GPS to ease tracking in field. In each transect, the presence or absence of red pandas was determined in a circular plot with radius of 10 m (hereafter referred to as the sampling plot) at start point and successive intervals of 500 m. Presence was indicated by direct sighting or by observation of indirect signs such as droppings, paw prints, foraging signs, scratch marks or remains of a dead animal. Human disturbance variables were also recorded (Table 1). The first seven of these variables number of tree logs, tree stumps and lopped trees, livestock droppings, human tracks, cattle trails and dumped solid waste were recorded in each plot together with the distance to the nearest