Winter Habitat Preferences of Endangered Red Panda *(Ailurus fulgens)* in the Forest Research Preserve of Ugyen Wangchuck Institute for Conservation and Environmental Research, Bumthang, Bhutan

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The endangered red panda *Ailurus fulgens* in Jigme Dorji Natonal Park, Gasa (Photo: BK Koirala, JDNP)

Abstract

Knowledge about habitat preferences of the endangered red panda *Ailurus fulgens* is limited in Bhutan. This Study of the red panda in the forest research preserve (11 km^2) of the Ugyen Wangchuck Institute for Conservation and Environmental Research (UWICER) was conducted from December 2015 to February 2016. The purpose of the Study was to confirm red panda presence within the preserve and assess its winter habitat preferences. Following a systematic sampling design, the entire preserve was divided into 500m X 500m grids. With reference to the centroid of a grid, 50m radius plot was laid to record the presence of red panda and associated 16 habitat variables.

This Study revealed that in the winter, the red panda is found between 3154m and 3707m elevation in the forest research preserve of UWICER.

Habitat preferences by red panda were calculated using Ivlev's electivity index. Mixed conifer forests with highly dense bamboo understories within an elevation of 3600m to 3700m were preferred. Red panda selected

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slopes >30^0 and preferred southeast and east aspects within 70m of a water source. *Borinda grossa* with the average height of <50cm was preferred over bamboo (*Yushania maling)*. Canopy cover of less than 20% of tree species such as Himalayan birch (*Betula utilis),* Himalayan hemlock (*Tsuga dumosa),* and wild Himalayan cherry (*Prunus cerasoides)* with the understory of Himalayan birch (*B. utilis),* Bhutan fir (*Abies densa),* Himalayan maple (*Acer campbellii),* and rhododendron (*Rhododendron keysii)* were most preferred forested habitats. These findings suggest a potential seasonal difference in habitat preferences by the red panda.

Keywords: Bhutan; Fallen Logs; Tree Stump; Woody Plant Species

Introduction

Understanding habitat preferences of endangered species is an important goal for wildlife conservation (Xu 2012) as preferred habitats likely include essential resources for survival and reproduction (Zhang et al. 2006). For most wildlife species, habitat loss is a major driver of population decline, particularly for endangered species that are often very sensitive to changes in their environment. Behavioural responses of wildlife may indicate habitat disturbances (Hickman et al. 1993). Studies on the behavioural responses of sensitive species are especially useful when they provide knowledge on species resource use (Johnson 1980). Ultimately, such knowledge on species habitat preferences should provide insights into competition for resources, predation, human disturbances, and other factors that affect the species' habitat preferences and distribution (Ottaviani et al. 2004; Rhodes et al. 2005).

The red panda (*Ailurus fulgens)* is a species of conservation concern and the sole member of the family *Ailuridae* (Glatston 1994). It is listed as endangered on the IUCN Red List (Glatston et al. 2015). Although the red panda is widely distributed, its populations continue to decline. It is estimated that 10000 adult red pandas are distributed across Bhutan, China, India, Myanmar and Nepal (Glatston et al. 2015). Red panda populations are mainly threatened by habitat loss, fragmentation, poaching, and other anthropogenic activities (Yonzon et al. 1991; Glatston et al. 2015). The current global potential habitat of the red panda is estimated to be about 47000km^2 with 13100km^2 in China, 3200km^2 in India, 2900km^2 in Myanmar, and 22400km^2 in Nepal (Kandel et al. 2015). The red panda is endemic to the eastern Himalayan broad-leaved and coniferous forests (Olsen & Dinerstein 1998) and in the eastern Himalayas, they are found within an altitudinal range of 1500m to 4800m, particularly in areas with dense bamboo undergrowth (Choudhury 2001). The red panda is known to select specific habitat and the quality of such habitat reflects population performance (Zhou et al. 2013).

Bhutan is one of the global biodiversity hotspots in the eastern Himalaya (Myers et al. 2000) and has been recognized as a conservation priority area in the eastern Himalayan region (Tempa et al. 2013). In Bhutan, red pandas are usually found in cool broadleaf and conifer forests at 2110m to 4389m and Bhutan is centrally located in red panda distributional range (Dorji et al. 2011). The red panda is a highly protected mammal species listed in Schedule I of the Forest and Nature Conservation Act of Bhutan (Ministry of Agriculture 1995). Red panda primary habitat consists of fir forest with an undergrowth of bamboo species (Dorjee 2009, Dorji et al. 2011; Dendup et al. 2016). Despite their preference for the bamboo forest with fallen logs and tree stumps, habitat quality and micro-habitat features could be a determining factor for habitat selection for any species (Zhang et al. 2006; Panthi et al. 2012).

Several studies on the habitat preferences of

the endangered red panda were carried out in India, China and Nepal (Choudhury 2001; Zhou et al. 2013; Bhatta et al. 2014). However, in Bhutan, there are wide knowledge gaps on its habitats. In this Study, we aimed at assessing winter habitat preferences of the red panda in the forest research preserve of UWICER to fill those knowledge gaps

Methods

Study site

The Study was conducted in the forest research preserve (27°31' - 27°33'N and 90° 41' - 90°44'E) of UWICER (Figure 1), measuring 11 km^2 and with an elevation range of 2831m to 4021m. The preserve falls within the Chokhor Gewog (sub-district) in Bumthang Dzongkhag (district) in central Bhutan and is administratively controlled and managed by UWICER. Owing to the altitudinal variations, the study site has a vegetation composition of bluepine forest, mixed conifer forest, and fir forest. Common dominant tree species recorded in the preserve include Bhutan fir (*Abies densa)*, Himalayan whitebeam (*Sorbus cuspidate)*, Himalayan yew (*Taxus baccata)*, Himalayan maple (*Acer campbelii)*, Himalayan hemlock (*Tsuga dumosa)*, Himalayan birch (*Betula utilis)*, Himalayan juniper (*Juniperus recurve)*, rhododendron (*Rhododendron arboretum)*, wild Himalayan cherry (*Prunus cerasoides)* and bluepine (*Pinus wallichiana).* Common understory plants include rhododendrons (*Rhododendron* spp.*)* and bamboos (*Borinda grossa, Yushania maling* and *Y. microphylla)*. Some of the wildlife species present are tiger (*Panthera tigris)*, red panda (*Ailurus fulgens)*, Asiatic golden cat (*Catopuma temminckii)*, common leopard (*P. pardus)*, Asiatic wild dog (*Cuon alpinus)*, sambar (*Rusa unicolor)*, red fox (*Vulpes vulpes)*, yellow-throated marten (*Martes flavigula*), wild pig (*Sus scrofa)*, and

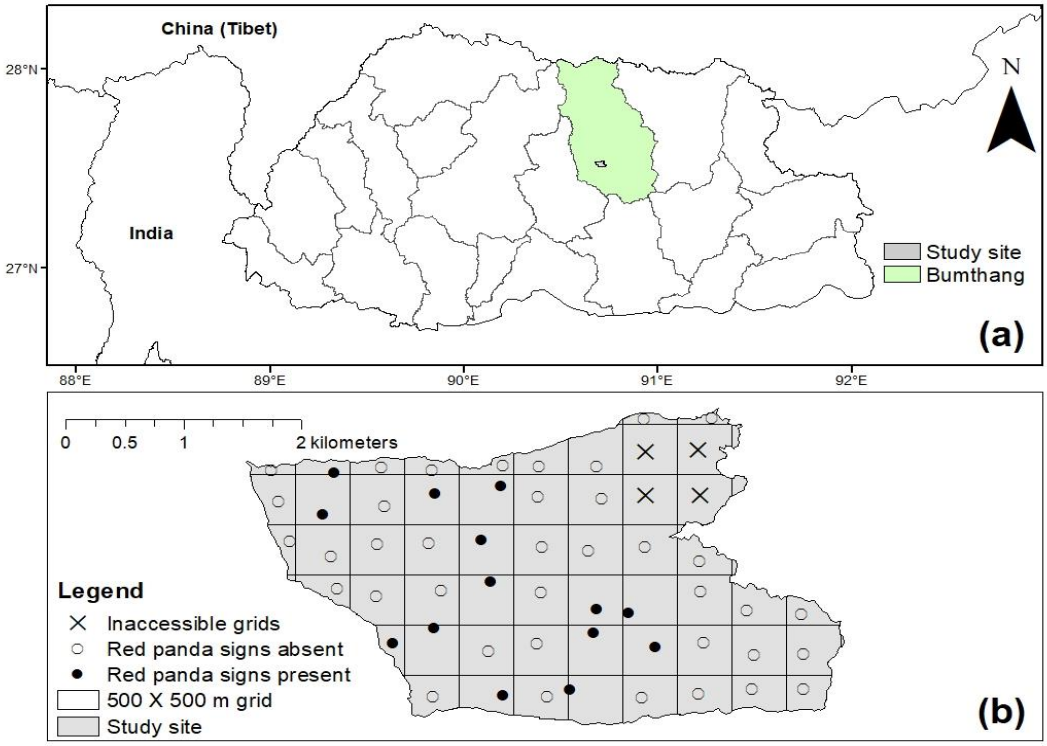

Figure 1 (a): Bhutan map showing the location of study site in Bumthang district. (b): Study site showing 500 x 500 m grids and red panda sign locations

Himalayan black bear (*Ursus thibetanus).*

There are human settlements around the study site that depend on the research preserve for their livelihood. Monks of Tharpaling Monastery collect firewood for their domestic use and the villagers of Lamithang Village collect firewood and bamboos for both domestic and commercial purposes. Besides the collection of firewood and bamboo, people also collect mushroom (*Exidia* sp.) for commercial purpose and this particular mushroom grows on the host plant *Rosa sericea,* which is one of the major food supplements for the red panda in the summer (Pradhan et al. 2001). At the time of mushroom collection, it was found that people often destroyed the host plants and these practices will have negative impacts on red panda survival. The study site also serves as an important watershed and the streams flowing out of the site are the main drinking water and irrigation source for communities living nearby.

Survey design and data collection

Field data was collected between December 2015 and February 2016, corresponding to the winter season in the northern hemisphere. Since direct sightings of the red panda was very difficult due to rugged terrain and thick bamboo understory, red panda faecal pellets were used as evidence of presence. In order to correctly identify the faecal pellets, survey members used photographs of red panda faecal pellets taken during the previous red panda survey at Phrumsengla National Park. Two follow up surveys were conducted in each plot to confirm red panda presence by the same survey members following the protocol developed for the previous study.

A systematic sampling method was used for this Study. The research preserve was divided into 56, 500m X 500m grids (Hawths Tool extension, ArcGIS, version 9.3.1, ESRI, Redlands, California, USA). For each grid, a centroid point was identified and their coordinates were uploaded to a handheld Global Positioning System (etrex VISTA HCx, Garmin, Redmond, WA, USA) to locate the plot centroids in the field. At the centre of 52 of the 56 500m X 500m grids (four grids could not be accessed safely and were excluded from our analysis), we created a 50m radius (area 7854 square meter) circular plot. Following Dendup et al. (2016), within this radius, we searched for red panda faecal pellets, an indicator of the species' presence in the habitat. If red panda faecal pellets were found, the plot was categorized as used (U) and the plot center was shifted to the location of faecal pellets for measurement of vegetation. Otherwise, the plots were categorized as absent (A) and the plot center was not shifted.

Table 1: Description of habitat variables used in this study

Habitat Variables	**Description**
Altitude	Altitude of each 7854-m^2 plot measured in meters
Aspect	Aspect of each 7854-m^2 plot, defined as nine categories; east, west, north, south, northeast, northwest, southeast and southwest
Slope	Slope of each 7854-m^2 plot defined as four categories; < 10^o, 10-20^o, 20-30^o and >30^o
Vegetation type	Defined by the most dominating canopy cover in the 50m radius plot. Three categories; bluepine forest, mixed conifer forest and fir forest
Distance to the nearest water source	Distance to the nearest water source of each 7854-m^2 plot measured in meters. Water source is defined as any flowing streams or stagnant ponds

Canopy cover	Canopy of dominating trees in each 7854-m^2 plot defined as five categories; <20%, 20-40%, 40-60%, 60-80%, >80%.
Bamboo species	Species of bamboos present in each 16-m^2 plot
Bamboo cover	Percentage of bamboos present in each 16-m^2 plot defined as 4 categories; Absent = 0 culm, Less dense = 1-100 culms, Moderately dense = 101-200 culms, Highly dense = >200 culms
Bamboo number (culms)	Total number of bamboo culms present in each 16-m^2 plot
Bamboo height	Average height of bamboos in each 16-m^2 plot (cm). (5 culms are measured randomly in each plot)
Tree species	Species of trees present in each 100-m^2 plot (Trees are classified as plants above 3m height and 5cm DBH)
Tree numbers	Total number of trees present in each 100-m^2 plot
Tree diameter	Measurement of tree diameter at breast height (cm) in each 100-m^2 plot
Number of fallen logs	Total number of fallen logs (> 30cm diameter) in each 100-m^2 plot
Number of tree stump	Total number of tree stumps (> 30cm diameter) in each 100-m^2 plot
Understory	Total number of woody or tree species below 3 meters in height in each 16-m^2 plot

To study vegetation, in each plot, tree quadrats (10m X 10m) were superimposed on the centre of each 50m radius plot and understory quadrats (4m X 4m) were superimposed on the centre of the tree quadrats. In both the used plots (U) and absent plots (A), habitat measurement was followed after Schemnitz (1980). The vegetation covariates and other habitat variables (modified from Wei et al. 2000) which had a biologically meaningful relationship with red panda habitat use (Dorji et al. 2012; Zhou et al. 2013; Dendup at al. 2016)were collected in both used and absent plots (Table 1). Forest types were categorized following Dendup et al. (2016).

Data analysis

We have calculated tree diversity in different forest types, following Panwar and Bhardwaj (2005), Shannon – Wiener Diversity Index (H') was calculated using equation 1.:

$$H = \sum_{i=1}^{s} - (Pi * \ln Pi) \qquad \text{Equation (1)}$$

Where:

H = the Shannon diversity index

P_i = fraction of the entire population made up of species i

S = numbers of species encountered

$\sum$ = sum from species 1 to species S

We used Ivlev's electivity index to analyze the habitat preferences of red panda following methods by Yonzon & Hunter (1991); Panthi et al. (2012) and Bhatta et al. (2014) which is expressed as in equation 2.

$$IV = (U\% - A\%)/(U\% + A\%) \qquad \text{Equation (2)}$$

Where:

"A" indicates "absent plots" and "U" indicates "used plots" and the value of index ranges from -1 to 1. Habitat preferences index score were grouped into six categories following Zhou et al. (2013) as $-1 \leq IV \leq 1$ and are shown as follows:

1. IV = 1, especially preferred (EP), indicating a complete preference of habitat characteristic.
2. IV = 0.1 < IV < 1.0, preferred (P), indicating that red pandas showed a slight to strong preference for the habitat characteristic.
3. IV = 0, randomly selected (RS), indicating

that red pandas did not show any preference or avoidance of the habitat characteristic.

4. IV = -0.1 < IV < 0.1, almost randomly selected (AR), indicating a very weak preference or avoidance of the habitat characteristic.
5. IV = -1 < IV < -0.1, not preferred (NP), indicating a slight to strong avoidance of the habitat characteristic.
6. IV = -1, not selected (NS), indicating complete avoidance of the habitat characteristic.

Results

Thirty-eight plots did not have red panda signs while 14 plots had red panda faecal pellets. We surveyed 52 plots in three broad vegetation types, namely blue pine forest (2831m to 3000 m), mixed conifer forest (3000m to 3592 m), and fir forest (3592m to 4021 m). 45% (n = 23) were in fir forest, 42% (n = 22) were in mixed conifer forest, and 13% (n = 7) were in blue pine forest. We found red panda sign in 27% (n = 14) of the 52 surveyed plots, at elevations between 3154m to 3707m. Red panda signs were found in 6 plots of fir forest, 8 plots of mixed conifer forest, and 0 plots of blue pine forest. During the entire survey period, we did not sight a single red panda, so the presence of the red panda was based on faecal pellets. Used plots had a minimum of 7 faecal pellets and a maximum of 32 faecal pellets (Figure 2).

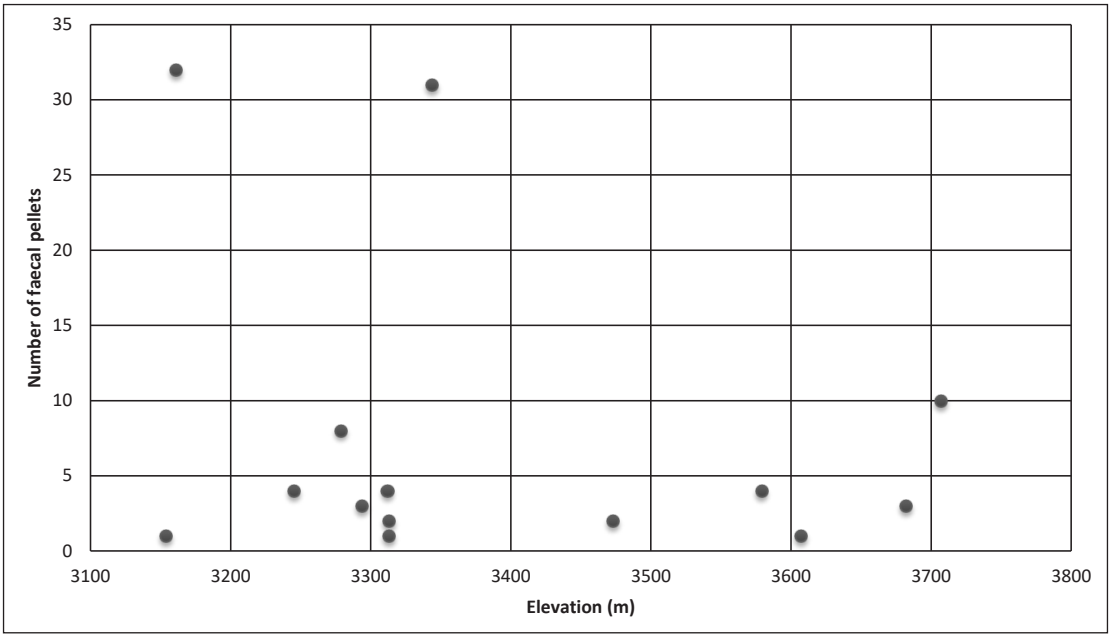

Figure 2: Elevational distribution of red panda faecal pellet in the study site

Habitat preferences

Red panda preferred mixed conifer forest (IV = 0.25), almost randomly selected fir forest (IV = -0.06) and not selected bluepine forest (IV = -1.0). Red panda preferred elevation range of 3600m to 3700m (IV = 0.39), followed by elevation of 3200m to 3300m (IV = 0.34). Red panda also preferred elevation of 3300m to 3400m (IV = 0.21) and randomly selected 3500m to 3600m (IV = 0.01). Red panda signs were not recorded in elevations below 3200m and above 3700m.

Slopes across the study site ranged between 1° and 55°. Red panda were only documented in areas with slopes >20°. Red panda almost randomly selected slopes >30° (IV = 0.08), almost randomly selected slopes between 20° to 30° (IV = -0.08),

and not selected slopes <20° (IV = -1.0). Red panda preferred southeast (IV = 0.75) and east aspects (IV = 0.72). Northeast and north were not preferred (IV = -0.20 and IV = -0.66 respectively) while aspects such as south, southwest, and northwest aspects were all not selected (IV = -1.0, IV = -1.0 and IV = -1.0 respectively).

Red panda preferred habitats within 70m of a water source (IV = 0.24) and did not select habitats with water sources > 70m (IV = -1). One hundred percent of the plots with red panda signs were located within 70m distance of water source. Plots with red panda sign had more fallen logs (>30cm diameter; ~6 logs/ha)

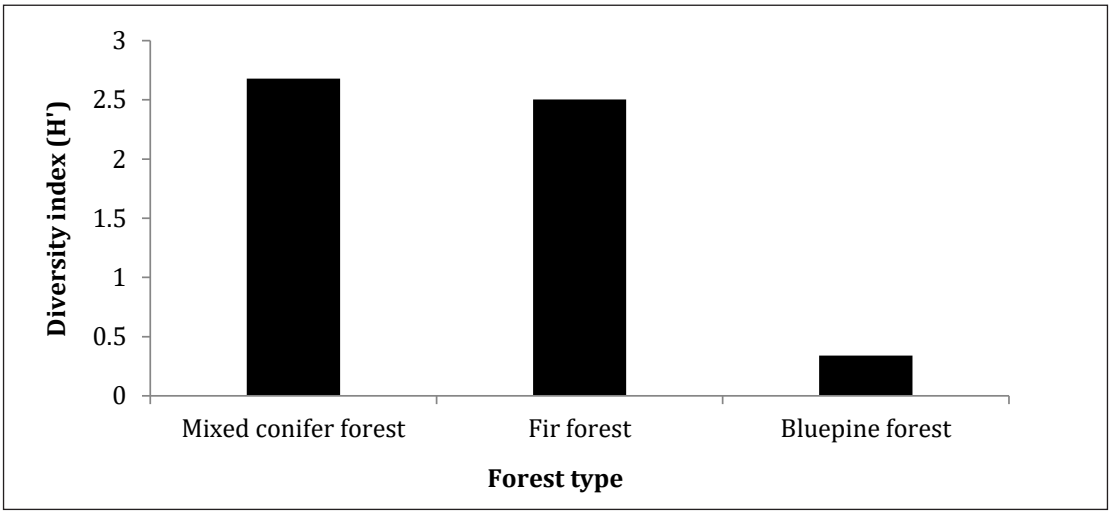

Figure 3: Diversity index in different forest types in the study area.

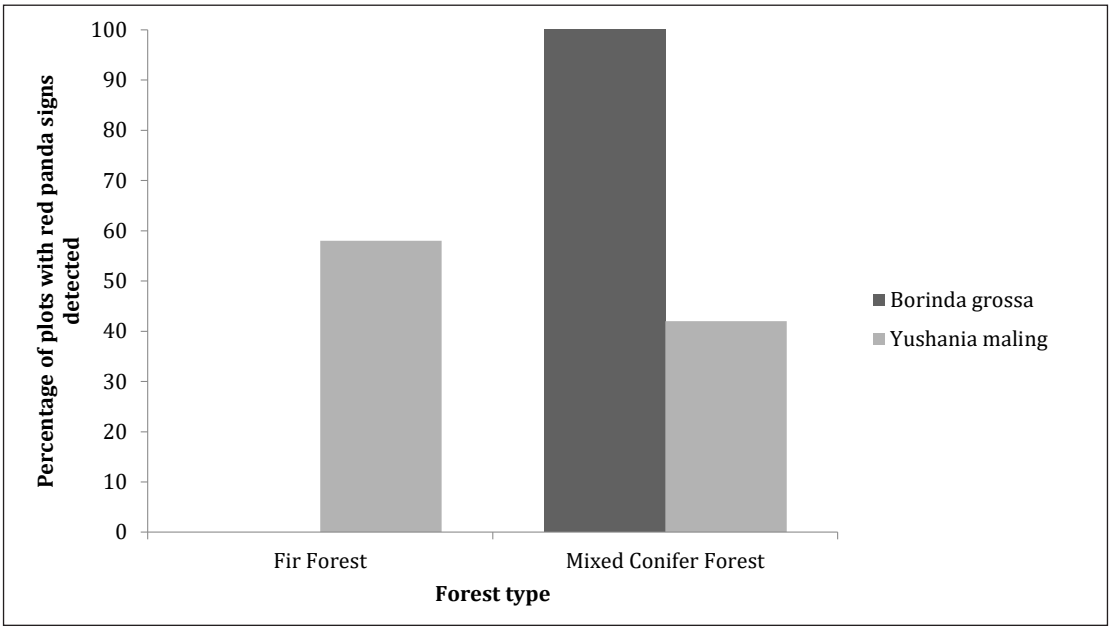

Figure 4: Percentage of plots with red panda signs detected according to habitat type in *Yushania maling* and *Borinda grossa* bamboos.

and tree stumps (>30cm diameter; ~3 stumps/ha). Red panda preferred canopy cover <20% (IV = 0.39) followed by 20% - 40% (IV = 0.29) and 40% - 60% (IV = 0.10). Canopy cover >60% was not selected (IV = -1).

Vegetation preferences

Twelve tree species and 19 understory species were recorded in the 52 plots. Mixed conifer forest and fir forest had more tree diversity as compared to blue pine forest (Figure 3).

Reporting on individual tree species, red panda preferred *B. utilis* (IV = 0.47) followed by *T. dumosa* (IV = 0.16) and *P. cerasoides* (IV = 0.15) (Table 2).

Two types of bamboo species were present and the red panda preferred *Borinda grossa* (IV = 0.76) with average height of <50cm (IV = 0.26) and did not prefer *Yushania maling* (IV = -0.18). Highly dense bamboo cover was preferred (IV = 0.34), followed by moderately dense bamboo cover (IV = 0.18) and not preferred less dense bamboo cover (IV = -0.37).

Table 2: Tree and understory preferences of red panda in the study site

Preference Index Score	**Tree Species (IV)**	**Understory Species (IV)**
Especially Preferred	*Nil*	*Betula utilis (1.00)*
Preferred	*Betula utilis (0.47)*	*Rhododendron keysii (0.64)*
	Tsuga dumosa (0.16)	*Abies densa (0.64)*
	Prunus cerasoides (0.15)	*Rhododendron campylocarpum (0.33)*
	Juniperous recurva (0.12)	*Acer campbellii (0.32)*
		Tsuga dumosa (0.13)
		Rhododendron kesangiae (0.12)
Randomly selected	*Nil*	*Rhododendron arboreum (0.08)*
Almost Randomly selected	*Abies densa (-0.07)*	*Nil*
Not preferred	*Rhododendron kesangae (-0.13)*	*Rhododendron hodgsonii (-0.35)*
	Acer campbellii (-0.20)	*Rhododendron barbatum (-0.72)*
Not Selected	*Pinus wallichiana (-1.00)*	*Daphne bholua (-1.0)*
	Rhododendron arboreum (-1.00)	*Berberis asiatica (-1.0)*
	Sorbus cuspidata (-1.00)	*Sarcococca wallichii (-1.0)*
	Taxus baccata (-1.00)	*Rosa sericea (-1.0)*
	Unknown (-1.00)	*Rhododendron cinnabarinum (-1.0)*
		Taxus baccata (-1.0)
		Pinus wallichiana (-1.0)
		Rubus sp. (-1.0)
		Rhododendron succothii (-1.0)

Discussion

We documented the presence of red panda within the forest research preserve of UWICER and identified different habitat variables and vegetation that are preferred by this species. Red panda in the study site preferred elevations between 3600m to 3700m and this finding may be attributed to the presence of dense bamboo cover (*Yushania maling* and *Borinda grossa*). Our Study also indicated that red panda preferred areas with highly dense bamboo cover and 50% (n = 3) of the plots with a highly dense bamboo cover which had red panda faecal pellets were found within these preferred altitudinal range. This finding is also supported by Sharma and Belant (2009) who reported that the distribution of pellet groups positively associated with the abundance of bamboos and availability of water sources. The dense bamboo cover may also conceal the red panda from their predators.

Other studies in Bhutan had shown that red pandas preferred *A. densa* forest with bamboo undergrowth in the Jigme Dorji National Park, Phrumsengla National Park (Dorji et al. 2011) and the Sakteng Wildlife Sanctuary (Dorjee 2009). While in the Jigme Singye Wangchuck National Park, red pandas preferred mixed conifer forest with bamboo undergrowth (Wangchuk 2013). In the present study area, red panda preferred mixed conifer forest dominated by *T. dumosa, B. utilis* and *P. cerasoides* with *Y. maling* and *B. grossa* as understory. The preference to mixed conifer forest over fir forest may be associated with the colder air temperatures during our study. This Study was conducted during the winter months, thus our findings could reflect a seasonal habitat preference in red panda, where individuals may have shifted their range toward mixed conifer forest to avoid cold temperature. As compared to fir forests, mixed conifer forests are located in lower elevations.

The preference of *B. utilis* and *T. dumosa* may be related to their diameter and the largest diameters recorded were 65cm and 213cm, respectively. Trees with larger diameters likely provide ideal nesting and resting locations. In Pangchen Valley in Arunachal Pradesh, India, red panda habitat is dominated by *R. campanulatum*, *R. grande, Sorbus* sp., *Betula* sp. and *A. densa* (Chakraborty et al. 2013). In the Dhorpatan Hunting Reserve, the habitat of the red panda was dominated by *A. spectabilis, R. campanulatum, B. utilis*, *Juniperus indica* and *Arundinaria* spp. (Sharma & Belant 2009). While in Jumla District of Nepal, the habitat of the red panda was dominated by *Quercus semecarpifolia*, *A. spectabilis*, *B. utilis* and *Acer s*pp. (Bhatta et al. 2014).

Borinda grossa and *Yushania maling* were the only bamboo species recorded in the study site. *Y. maling* dominated the area and were found growing in all the forest types while *B. grossa* was found inhabiting only under mixed conifer forest. Though *Y. maling* bamboos were dominating, red panda preferred *B. grossa* with the average height of <50cm. The preference for *B. grossa* may be due to the presence of its regeneration. The majority of *B. grossa* were in a regeneration stage with newly formed leaves while *Y. maling* was not. It was reported that red pandas prefer newly formed bamboo leaves as it is most nutritious and contained the highest proportion of crude protein and the lowest of cellulose (Wei & Zhang 2011). Concerning the small body size, the height of the bamboo stems become a limiting factor for red panda and the taller the bamboo stems, lesser are the chances of bamboo leaves availability (Wei & Zhang 2011) and therefore bamboo stem with the average height of <50cm was most preferred. We also found the majority of red panda pellets in the areas with high densities of fallen logs and tree stumps. It was reported elsewhere that because of their small body size, red pandas may utilize fallen logs and tree stumps

to gain access to bamboo leaves (Zhang et al. 2006). Since no other food supplement (Reid et al. 1991; Zhang et al. 2009) was recorded during the survey, red pandas were probably highly dependent on these two-bamboo species during the winter months.

Red panda in our study site almost randomly selected steep slopes >30° and did not prefer slopes <30°, as has been reported elsewhere in Nepal and China (Wei et al. 1999; Zhou et al. 2013; Bhatta et al. 2014). Their random selection for steep slopes may be due to fewer human disturbances and availability of moderate to highly dense bamboo stands. Red panda preferred slopes with southeast aspects, which may be a mechanism for red pandas to escape cold winter weather (Zhou et al. 2013). However, Bhatta et al. (2014) reported that red panda in Jumla District in Nepal preferred southwest and northwest aspects and suggested that this might be related to more food availability in these aspects, as their study was conducted during the onset of monsoon season.

In our study site, red panda preferred canopy cover of <20% and this may be related to maintaining of body temperature and for thermoregulation as indicated by other studies. The dense canopy cover was reported to provide an ideal place for hiding, resting, shelter, and protection from predators, and facilitates movement between trees (Zhou et al. 2013), but it also obstructed sunlight which was reported to be a valuable resource for keeping red panda warm in the winter. Direct sunlight was found to be valuable for thermoregulation and preference to the canopy cover of <20% could allow red panda in receiving direct sun for quick thermoregulation as reported by Reid et al. (1991). The same study also found that during clear winter days, red pandas rest in direct sunlight to minimize heat loss as compared to overcast winter days. In Nepal, during the summer season, Panthi (2011) and Bhatta et al. (2014) reported a preference for dense canopy cover by the red panda.

Our study suggested the importance of nearby water sources to red panda as they were never detected farther than 70m from a water source. Likewise, in Jigme Dorji National Park, 70% of red panda droppings were encountered within 100m of a water source, while 30% were within 150m of a water source (Dorji et al. 2011). Studies conducted in Singhalila National Park, Darjeeling, indicated that 79% of red panda presence records were within 100m of water bodies, indicating that the presence of water may be an important habitat requisite for red panda (Pradhan et al. 2001). In Mabian Reserve, red pandas were frequently found to forage at sites less than 200m from a water source (Wei et al. 1995) and in Latang National Park, 90% of droppings were found within 100m of the nearest water source (Yonzon & Hunter 1991a). In contrast, Chakraborty et al. (2013) reported the non-significant relationship between the occurrence of the red panda and the presence of water bodies in Pangchen Valley as 75% of the red panda data were collected during the winter months when the seasonal water sources are mostly dry. Others have suggested that proximity to a water source is probably important to supplement the low water content associated with bamboo leaves (Reid et al. 1991, Yonzon & Hunter 1991a; Pradhan et al. 2001).

Conclusion

Mountain ecosystems are sensitive to global warming and climate change is a serious concern for endangered species such as the red panda (Zuckerberg et al. 2011, Huettmann 2012). Climate warming is likely to drive accelerating shifts in species distribution (Araujo et al. 2004) and species in high elevation are predicted to shift towards higher elevations and habitats projected to experience

severe habitat fragmentation (Dirnbock et al. 2003). Since the red panda has specific winter habitat preferences, climate change might affect these preferences. Other anthropogenic threats such as habitat destruction and hunting may also affect habitat preferences and survival. Hunting of red panda in Bhutan is non-existent. Bhutanese believe the sighting of the red panda as a good omen and also red panda is believed to be the reincarnation of a Buddhist monk (Dorji et al. 2012). Though livestock presence was low in our Study, its presence had negative impacts on red panda occurrence and distribution elsewhere (Sharma at el. 2014a, Dendup et al. 2016) and, therefore, should be restricted in the preserve. Since our study was conducted in the winter, a summer investigation is warranted, particularly to better understand the potential impacts of climate change.

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About Author

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