Orinigal Article

Assessing the Habitat Preference, Distribution and Conservation Threats to Red Panda (*Ailurus fulgens*) in Sagarmatha National Park and Buffer Zone

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Abstract: Red panda (*Ailurus fulgens*) is a vulnerable species in the list of IUCN. The preferred habitat of red panda is in the mountainous regions, so being an unspoiled region, the frequent research seems a bit difficult and a very less research on red panda was conducted in Nepal. To minimize the research gap and know-how, the attempt was made to access "Habitat Preference, Distribution Pattern, and Conservation Threats to red panda in Sagarmatha National Park and its Buffer Zone". This study conducted in red panda BZCF (Chhaplung area) of Chaurikharkha buffer zone users committee in Sagarmatha National Park. 10 transect lines was made to access the habitat of red panda in the altitudinal basis starting from 2,600 to 3,500. People nearby the red panda found area was sampled employing key informant's interview, focal group discussion, and household survey. 10 percent sampling intensity was taken to collect the people perceptions on the conservation of red panda. The distribution pattern and people's perceptions thus, collected were analyzed through Chi-square tests, Mean, frequency was analyzed by feeding the data into MS Excel 10. The GPS location of red panda pellet area were fed on Arc View GIS 10 and overlaid on Google Earth. The study site was selected on the basis of most red panda habitat area in consultation with wildlife experts and local stakeholders. Mostly pellet of red panda was found in between altitude of 2800-3100m. It seemed preferring mixed deciduous and coniferous forest with old tree and dense understory of Bamboo. The most preferred temperature was in between 15-25 degree centigrade; slope of forest was 35 degrees with North -West facing aspects. 4 plots were recorded with maximum dropping pellets of red panda. The Distribution of red panda was seen as a clumped type and they were uniformly distributed inside the study site. Livestock grazing, local dogs and some anthropogenic disturbances were the major conservation threats of red panda. Most of the people of study area were a bit concerned in conserving the red panda. The study realized the need of Park authority to pay attention in conservation of red panda since its number has been declining due to climate change impact, insufficient number of bamboo tree, livestock grazing pressure and local dogs. Local dogs should be controlled in time since they attack red panda. The conservation awareness education should be extended in mass scale. People should be encouraged to use less firewood for cooking and controlled grazing. The natural resource dependent people should be identified and park need to support them for their livelihood so that they can play pivotal role in making the favorable site for habitat of red panda.

Keywords: habitat, distribution, conservation, destruction, people perception

1. INTRODUCTION

Nepalese “poonya” means bamboo eater, hence panda, ped pandas (*Ailurus fulgens*) are the only species of the genus *Ailurus*, known as Cat Bear, Shining Cat, Habre, or Kundo. Arboreal, elusive, solitary, sparsely distributed small-bodied mammalian carnivores. The two red panda subspecies, *Ailurus fulgens* and A. f. styani, are separated by the Nujiang River. The former inhabits bamboo-dominated temperate forests in Nepal, India, Bhutan, Myanmar, and parts of China, while the latter inhabits Sichuan and Yunnan provinces in southwestern China. It is recommended that these two subspecies be considered distinct species. In January and February, red pandas travel 1.75 km linearly for breeding [1]. Though active 24/7, it is most active at dusk, dawn, and night. World conservation flagships include the red panda (*Ailurus fulgens*). Previous molecular and morphological phylogenies were inconclusive and varied in placing the red panda in the raccoon family (Procyonidae), the bear family (Ursidae), or a separate family of carnivores equidistant between the two. Later, the dental and cranial similarities to, and differences from, Ursidae and Procyonidae were carefully considered. Himalayan Red pandas (*Ailurus fulgens*) live in Nepal. Red pandas are solitary and sedentary. Sometimes seen in pairs or trios. January to March is red panda mating season. Cub mortality is 86%, which may explain its low population [2]. Red pandas have 1.38–11.57 km2 home ranges. Red pandas do not harm people or property. Some Nepalese cultures also positively affect red panda attitudes. Red pandas live in regions with temperatures between 10 and 250. It lives in mixed deciduous and coniferous forests [3]. Although carnivorous, red pandas eat bamboo. More than 83% of the red panda's diet is bamboo leaves and shoots. Bamboo is low in calories, so red pandas spend 56% of their time budget eating it [4]. Due to its bamboo diet, the red panda has a low metabolic rate and low energy needs. Red pandas reach bamboo leaves from shrub branches, logs, or stumps. Adult (captive) male and female red pandas (*Ailurus fulgens*) weigh 3.7 kg–6.2 kg. Wild adults weigh 4kg and measure 560–625 mm from head to tail, 370–472 mm from tail. No sexual dimorphism in body size or coat color [5]. About 12 red and buff rings alternate on the long tail. Animals in the sub-species styani have darker colors and distinct "tear track" markings on their faces. Red pandas use their "thumb" (an enlarged radial sesamoid bone) to handle bamboos better [6]. Red pandas are shy but active at dusk and dawn. Their seasonal activity is similar. Due to food resources—patchy fruit distribution in autumn and mating season in winter—activities are highest in autumn and winter. The average male home range is 5.12 km2 and the female home range is 2.37 km2. In the LNP, males have a larger mean range than females during mating seasons, but range overlaps between sexes and within males but not between females. Its home range and social interactions depend on habitat quality, especially food and shelter [7]. Wild pandas are elusive and arboreal, so little is known about their behavior besides feeding and breeding. It is an unusual carnivore that eats bamboo leaves. Due to their digestive system's inability to properly utilize bamboo's low nutrients, they consume a lot of bamboo to meet their energy needs. Red pandas eat bamboos like Arundinaria, Phyllostachys, Thamanocalamus, Oionobambusa, Semiarundinaria, and Pseudostachyum [8], as well as wild fruits, berries, mushrooms, roots, acorns, lichen, and succulent grasses in different seasons. They rarely eat bird eggs, insects, and grubs in the wild. Captive animals like sweet food and eat meat [9]. Red pandas can live 14 years, but most live 8-10 years in the wild. Males and females are asocial outside of mating season. The female carries sticks, grass, birch-Betula bark, and other materials to make a nest site in a hollow tree or rock crevice before giving birth [10]. Because the mother's low-energy milk slows development, the mother-offspring relationship can last more than a year. Except for mating during breeding season, red pandas only associate with their young [11]. The species is categorized as Vulnerable because its population is estimated at less than 10,000 mature individuals with a continuing decline of greater than 10% over the last three decades [12]. It is protected by the Government of Nepal’s National Parks and Wildlife Protection Act of 1973. Any person who kills or tries to kill a red panda could be fined up to NRs. 100,000-500,000 and jailed for 5–15 years,

or both. Despite being on the list of protected species, there has been limited study of this species from government/non-governmental sector and their numbers are declining over much of their range due to habitat loss and fragmentation. Poaching is also a major threat to this shy and elusive animal. It is also estimated that approximately 20 individual red pandas were hunted and killed in 2009 only. Beside these threats, the cub mortality is also a severe problem. The mortality of both cubs and adults were high: of 12-13 cubs born during the course of the field study, only three survived beyond six months of age and four of nine known adults died during the project [13]. Most of the deaths were from known causes out of which (57%) were human-related.

2. LITERATURE REVIEW

Red pandas live in high-altitude forests in northern Bhutan's Jigme Dorgi, Trumshinga, Torsa, Kulong Chu, and Black Mountain national parks. The species lives only in northeast Sikkim and Northern West Bengal, where it prefers alpine woods between 1500 and 4800m, except in tropical forests between 700 and 1400m in Meghalaya [14]. It is also limited to Sichuan, Yunnan, and Tibet in China. Over the past 50 years, their numbers may have dropped 40%. China had 6000-7000 people, 3000-3400 in Sichuan, 1600-2000 in Yunnan, and 1400-1600 in Tibet [15]. Nepal's first red panda status, distribution, and ecological study was in Langtang National Park (LNP). Nepal's uneven red panda population makes them endangered. The 2016 national red panda survey found 23,977 km2 of potential habitat, over 70% of which is outside the PAs network. Langtang, Kangchenjunga, Makalu Barun, Sagarmatha, Annapurna, Dhorpatan Hunting Reserve, Rara, and Gaurishankar Conservation Areas have reported red pandas. Ramechap, Dolakha, Sindhupalchowk, Rasuwa, Nuwakot, and Dhading; Gorkha, Lamjung, Kaski, Manang, Myagdi, and Baglung; Rolpa and East and West Rukum, Dolpa, Jajarkot, Jumla, Mugu, and Kalikot [16]. It has found that habitat, climate, geography, and disturbance strongly influence red panda occurrence. Red panda habitat variables include mixed broadleaf forest, East Himalayan oak-laurel forest, canopy cover >20%, ground substrate utilization, bamboo cover >20%, tree stump presence, fallen logs of small trees, and grazing absence. The red panda lives at 2,200–4,800 meters (7,200–15,700 ft) height in moderate temperatures between 10 and 25 °C / 50 and 77 °F with minimal annual fluctuation. It prefers mountainous mixed deciduous and conifer forests with old trees and dense bamboo understory. Red pandas rest on trees 86% of the time, preferring Abies spectabilis in summer and Junipers, Betula, Rhododendron, and Acer in winter, [17]. It found that red pandas prefer north-facing slope fir-jharpa woods at 2800–3900m height. The existence of red pandas in KCA, with Abies spectabilis being the dominant species with the greatest IVI. Compared to other shrubs, dense undergrowth ringal bamboo was most common [18]. Abies spectabilis dominated LNP's broad-leaved forest for red panda habitat. He also detected livestock impact to red panda habitat forest recovery. Based on an average density of one panda every 4.4km2, the red panda population is 16,000–20,000 in five range countries covering 142000 km2 [19]. An estimated 9200-11000 red pandas live worldwide, the habitat appropriateness index evaluated 314 individuals in Nepal, assessed 73 red pandas in Langtang National Park from four populations. More than 11 red pandas are located in Rara National Park, although most of their potential habitat is outside protected areas and their population and conservation status are unknown [20]. Red pandas number 317-582 nationwide. The red panda Population and Habitat Viability Assessment estimated between 237 and 1061 individuals. The 2016 national red panda study found 23,977 km2 of potential habitat, over 70% of which is outside the PAs network [21]. Red pandas face habitat loss and fragmentation as their greatest vulnerability. Skin and pet trade poaching pose further hazards. Fur was used to construct caps and garments for children and tail fur was given to newlyweds. Red pandas to be habitat specialists, a yak-hill cow hybrid, severely impacted red panda habitat in Langtang National Park, Nepal. Chauri, their herders, and dogs plainly hurt pandas. Chauri and red pandas did not compete for bamboo leaves, but cattle may have trampled bamboo and reduced its quantity. Rivers and steep ridges separate 24 animals into four or five groups,

according to the study. Without protection from livestock grazing and other human disturbances, Langtang National Park red pandas will go extinct [22]. Poaching is India's biggest red panda concern, the 1960s saw hundreds of red pandas abducted from Singalila National Park, including at least 300 from the park itself. Red pandas live in forests. The main threat to its long-term existence in China is deforestation [23]. Natural factors like rivers and ridges and anthropogenic ones like forest clearance, road construction, and huge bamboo blossoming can split habitat, which is a major threat to the animal. Wild animals have a wide spectrum of parasites, including Ancyclostoma duodenale, Ascaris lumbricoides, Entamoeba histolytica, and others, which could harm red pandas. Red pandas are often carriers of GI parasites, therefore livestock herding and snail interaction threaten their conservation. The Wildlife Crime Pillar of the Central Investigation Bureau (CIB) of Nepal Police reported 102 red panda hide seizures between 2008 and 2019, six in Western Nepal and one in Kathmandu, and 170 traffickers arrested [24]. However, insufficient knowledge about red panda-related crime, miscommunication during awareness-building campaigns, investigators' influence indicating a high demand for pelts, and poverty-induced, easy money-making motives may increase trafficking [25]. It is highlighted a conservation problem for Nepal's high-altitude regions, where livestock and tourists are vital for livelihoods. However, human activity threatens the red panda and its environment.

3. MATERIALS & METHODS

Sagarmatha area is an exceptional area with dramatic mountains, glaciers and deep valleys, dominated by Mount Everest, the highest peak in the world (8,848 m). Sagarmatha National Park is located in the northern mountains of eastern Nepal under Province One in Sacred Himalayan Landscape. The area of park was designated in 1976 with area 1148 sq.km having its buffer zone area of 275 km2 gazette in 2002. SNP is located in the northern part of Solukhumbu district, about 140 km east of Kathmandu valley. The outstanding features of the park are its majestic peaks higher than 8,000 m including Sagarmatha (8,848 m), Lhotse (8,501 m) and Cho Oyu (8,188 m). The elevation of SNP and its BZ ranges from 2,300 m at Surke to 8,848m at the top of Sagarmatha. The terrain is steep and rugged and broken by the deep river gorges below while there are glaciers and glacial valleys at the upper reaches. (SNP Management Plan, 2016-2020). This study has been carried out in red panda Buffer Zone Community Forests of Chaurikharka Buffer Zone User Committee in Sagarmatha National Park which lies in Khumbu Pasang Lhamu rural municipality, as this site has been regarded as major hotspot of red panda in SNPBZ after consultation with experts, SNP officials, BZUC representatives and local communities.

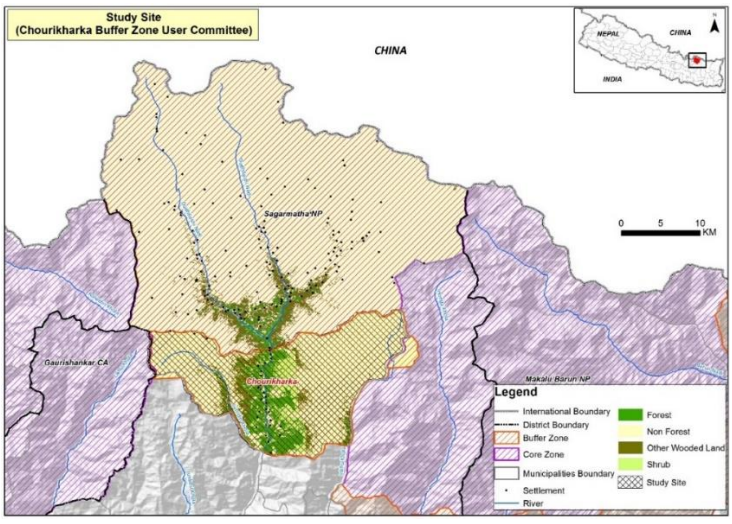

Figure 01: Area of study

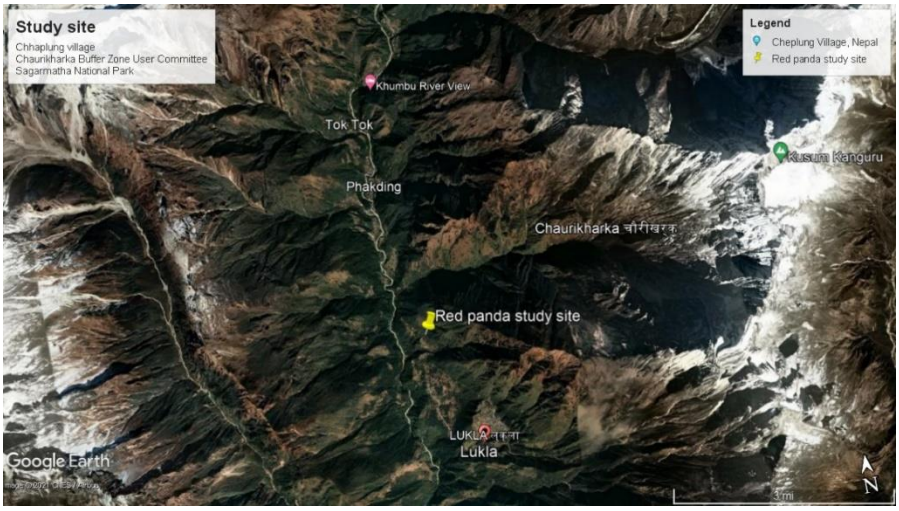

Figure 02: Site of study

The preliminary study was carried out to know the ground situation of study area and also provide important ideas to gather data from the study area. During preliminary study, consultation with Sagarmatha National Park staff and local people was done. Instead, study added that evidences like pellets and feeding signs are used to find whereabout of this species. This study also uses direct and indirect sign for documenting presence or absence of Red Panda. Generally, the red panda is seen in, August – December, which is their rutting season. This season is regarded as the active season for Red Panda for its courtship display. Primary data were collected through direct and indirect observations, and consultation with key-informants in the study site. Consultation with local communities focusing key informants, herders, and SNP staff were of great help to locate the possible habitat sites of red panda and triangulate the data collected from observations. Potential sites of red panda distribution were assessed through participatory mapping, interview and secondary sources. Field consultation and participatory mapping were done with the local communities to know the major habitat sites of Red Panda. Secondary information was collected from wildlife monitoring reports and other reports published by WWF, DNPWC library, SNP and SchEMS library. Habitat preference was calculated following [26]: based on forest type, slope and aspect of the area.

Habitat Preference (HP) = (PPE/TPP) *100 %, where,

PPE= Pellet present in each habitat type

TPP = Total pellet present in all habitat type

Red panda distribution pattern in the study area has been determined by calculating the ratio of the variance and mean as described by Odum, (1996).

If S2/a = 1 then it will indicate random distribution.

If S2/a < 1 i.e., it will indicate a regular distribution.

If S2/a > 1, it will indicate clump distribution.

Where S2 = variance=1/n Σ (x-a) 2,

x = sample value,

a = mean value.

Chi- Square contingency test was used to find out significant differences in the distribution of red panda in different sample locations.

Chi-Square (λ^2) =Σ (x-a) 2/a

Where x = observed or sample value; a = expected value or mean value.

Interviewing local people and direct observation of the field were the sources of data to assess disturbances in red panda habitat. Livestock dung encountered within the quadrates were recorded to find out livestock pressure in that area and Cut stumps found during quadrate survey were also recorded for the disturbance assessment (Karki, 2009).

$$\text{Cattle Dunk Density/ha} = \frac{\text{Total No. of Cattle Dung encountered}}{\text{No. of quadrates} \times \text{Area of a quadrate}} \times 1000$$

$$\text{Cut Stump Density} = \frac{\text{Total no, of cut stumps encountered}}{\text{No. of quadrates} \times \text{Area of a quadrate}} \times 1000$$

4. RESULTS & DISCUSSION

4.1 Habitat Preference

Habitat status of Red Panda includes various parameters such as vegetation, slope, aspect, vegetation composition and distance from nearest water sources. To determine microhabitat, a total 10 plots were measured within the elevation from 2600m-3500m. Vegetation in most of the area shows habitat suitability and preferences for the particular species that is core habitat for red panda. Altitude between 2,800-3,100m was found to be the most preferred range of red panda with Northwest facing aspect (40%) followed by North and Northwest (30%) having equally preferred. Similarly, the most preferred slope was between 26˚ to 35˚ where maximum number of Red Panda sign (40%) were observed. The total of 10 plots of 10 m radius circular plot were surveyed. Out of total plots, 60% (n=6) plots were in mixed conifer, 27 % (n=4) in cold broadleaved and 13% (n=2) are others, they can't be identified. All the measured plots were covered by trees, but herbs and shrubs couldn't be assessed due to excessive snowfall during study time. The mean altitude of the study area was 3050m.

4.1.1 Slope preferences

Research found that the most preferred slope used by red panda was from 26-35 ˚ (40%), while 30% pellets were found below 25 ˚ and 30% pellets were found above 36 ˚ slope.

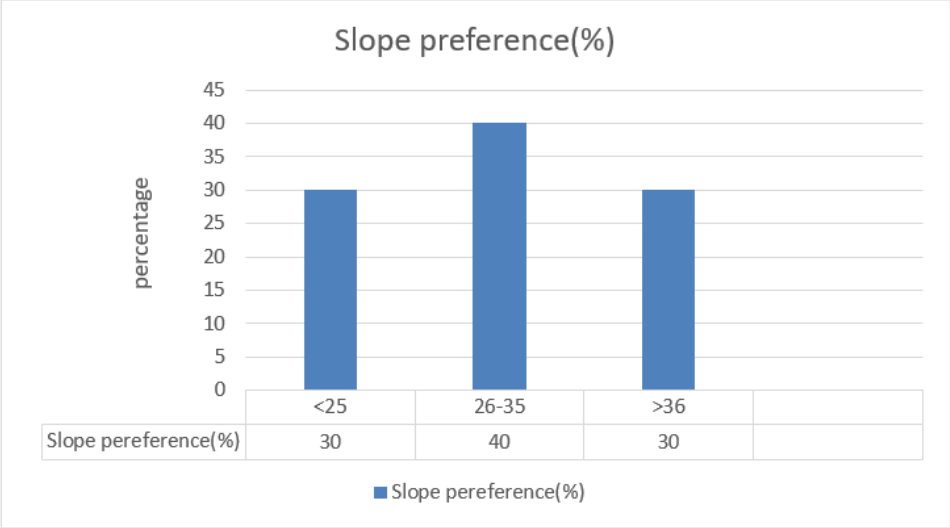

Figure 03: Slope used by red panda

4.1.2 Aspect Preference

The most preferred aspect used by red panda was Northwest (40%) followed by North East (30) and East (30%).

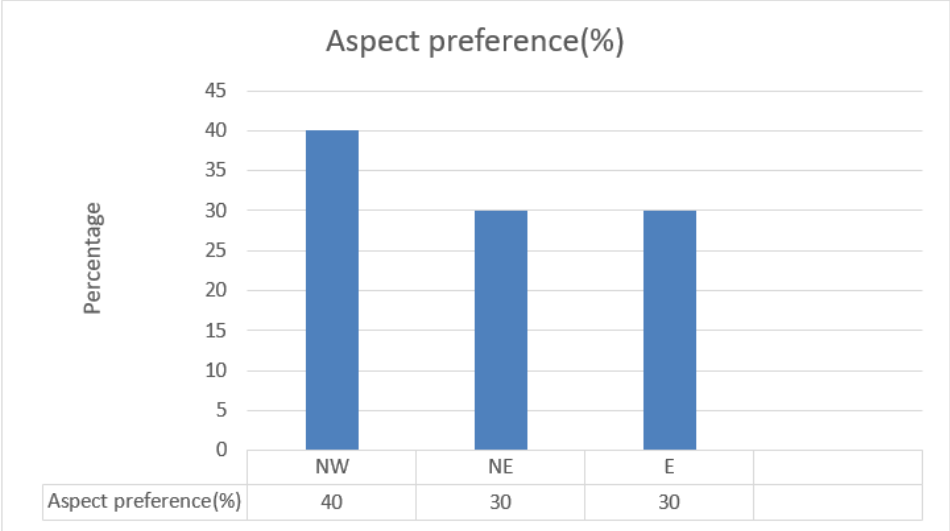

Figure 04: Aspect used by red panda

4.1.3 Forest Type Preference

The most preferred vegetation type by Red Panda was a thin forest with bamboo under-storey (60%).

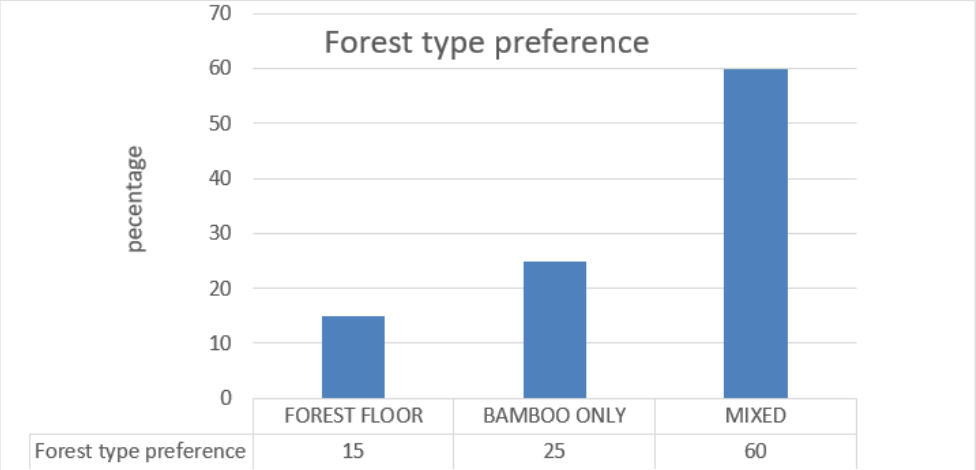

Figure 05: Forest type used by red panda

4.1.4 Water Resources

Red Panda signs were found at the distance of 50 m to 200 m from the nearest water sources in the study area. They were distributed near the streams; the flood plain was dominated by bamboos because such species area is best preferred habitat by Red Panda.

4.1.5 Bamboo cover

The bamboo species found in the study site were Arundinaria racemose (Malinge Nigalo) Arundinaria falcate (Common Nigalo) and Drepanostachyum intermedium (Tite Nigalo). The Arundinaria racemosa was recorded in 7 plots, of the total plots followed by Arundinaria falcata in 1 plot and Drepanostachym intermedium were found in 2 plots. As per findings 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 racemosa. These species were recorded in all altitudes followed by 2600m-3500m.

4.2 Distribution

Out of 10 transect lines, total four plots were recorded with maximum dropping pellets of red panda (including red panda live sighting). Most of the sign was encountered between the range 2800-3100m altitudes which comprised about 90% of red panda signs. Pattern of distribution of red panda in different altitudes was found to be clumped distribution. The value obtained from calculation was, S2/a= 2.47, which is greater than 1 so it can be concluded that distribution pattern of the red panda in different altitude is of the clump distribution.

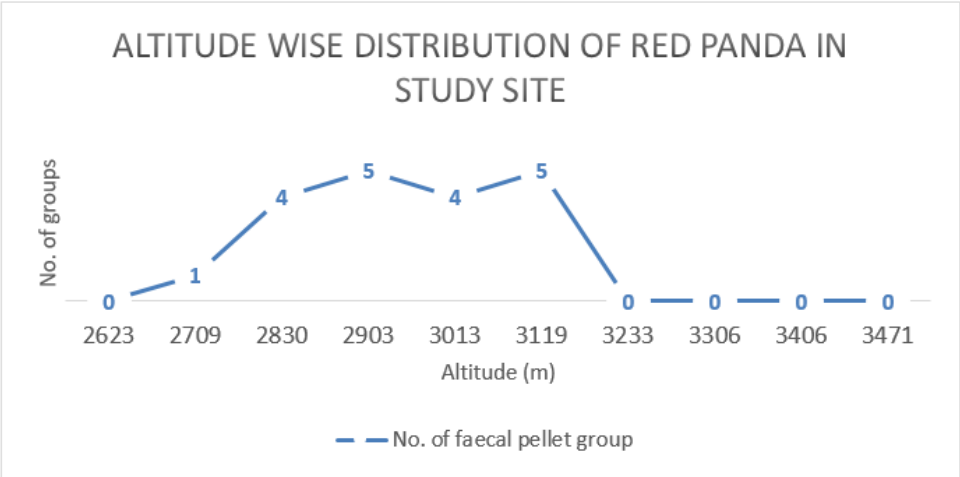

Figure 06: Altitude wise distribution of red panda fecal pellet groups

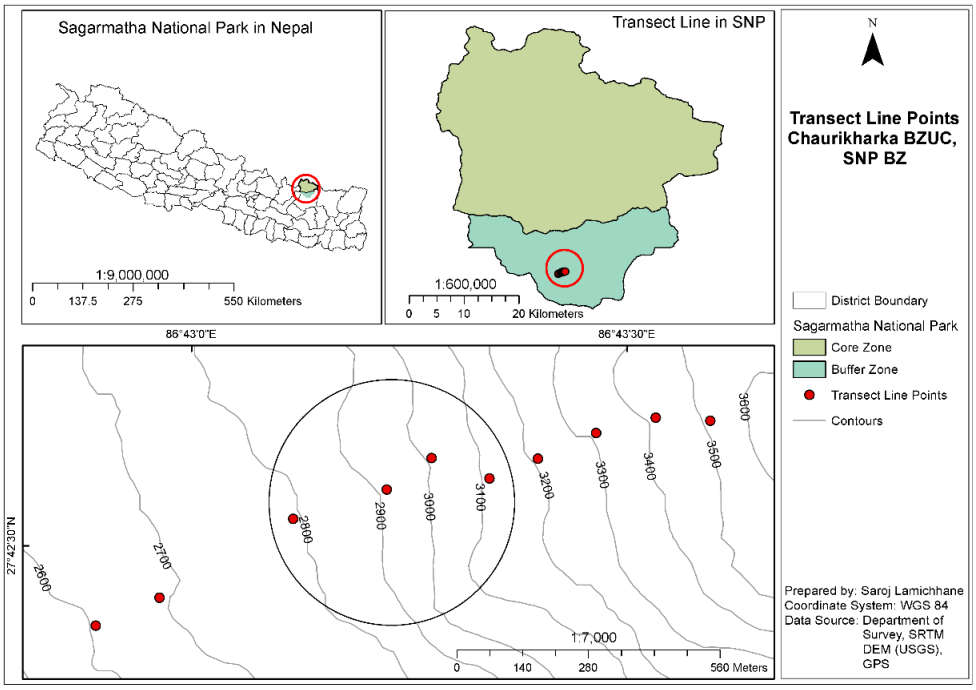

Figure07: Distribution of red panda (through transect line points)

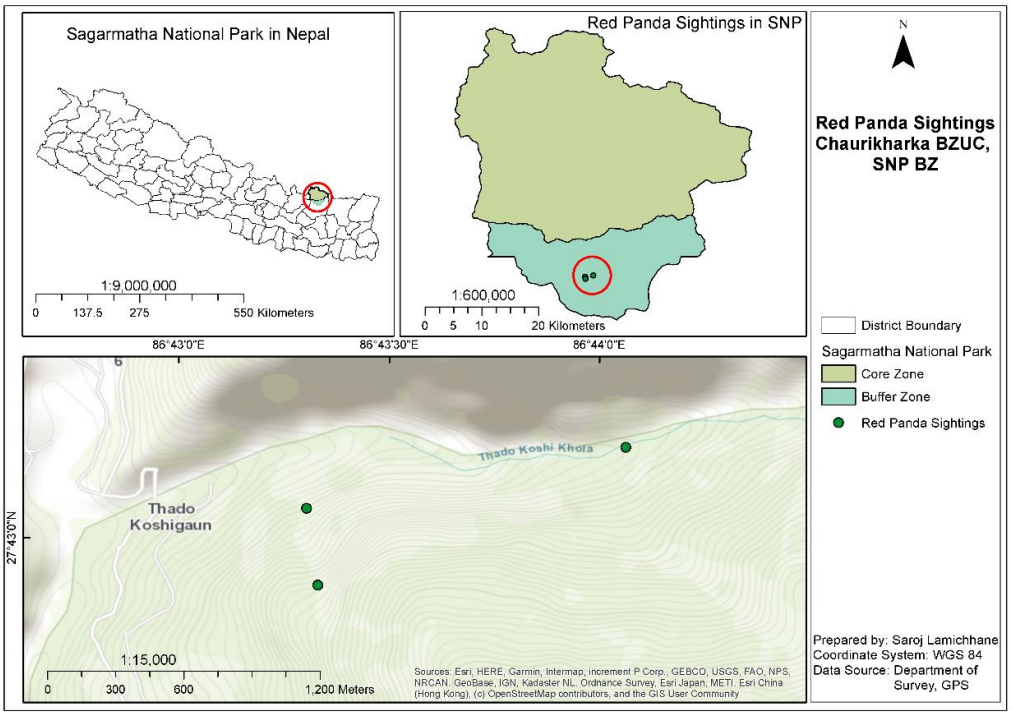

Figure 08: Red Panda Sign Sites

Research hypothesis of uniform distribution of Red Panda in the study area was failed to accept i.e., red panda is ununiformly distributed in the study area which was verified by the Chi- Square (λ^2) contingency test. The value obtained from the test was (λ^2) cal = 24.68 Since (λ^2) tab with 10% level of significance at degree of freedom (10-1) was 14.68, which is greater than calculated value 24.68. So, it is failed to accept the research hypothesis of regular distribution of the Red Panda in the study site.

4.3 Conservation Threats

Livestock grazing and forest fire collected through local people and direct observation were the key factors to determine the threats to Red Panda and its habitat. Besides, habitat fragmentation, and collection of NTFPs and forest products were the main cause for the threat to the Red Panda and its habitat. Observed habitat interference were also noted and analyzed to find out threats on Red Panda.

4.3.1 Grazing

Grazing was found to be common in the study area. Mainly Khumbhu Pasanga Lhamu rural municipality is a tourist area. People of this area mostly depend on tourism but some household livelihood primarily depends on cattle rearing but there were many households where there were no cattle in their house. Collection of forest product and livestock grazing is likely to affect the red panda. Cattle dung density inside the forest area was calculated to determine livestock pressure which resulted 15 dung/ha. Average livestock (cow, goat and sheep) number was found 2 animal per household.

4.3.2 Habitat destruction

Firewood collection is the main source of energy for cooking in Khumbhu Pasanga Lhamu rural municipality. They need large quantities of firewood for cooking and heating purpose, and is fulfilled from nearby forest where there is potential habitat of Red Panda. The collection sites lies in the buffer zone area of Sagarmatha National Park, which has provisioned of firewood collection but it showed

people used to collect firewood illegally. Number of cut stumps of trees was also recorded from the sampled plots for threat assessment of red panda. Cut stump density (CD) was found to be 32.2/ha. Trampling and browsing by cattle harmed in growth and development of the regeneration in forest.

4.3.3 Feral Dog

One of the most challenging conservation threats to red panda is feral/local dog. The locals keep dog at their home for their safety. While during funeral program according to their religion, they buried the dead body in the forest (Jungle) and they leave the dog in that place. After that, the dog become psychologically disturbed and starts to fight with other wild animals and in the process gets bitten and injured by wild animals. Such dogs start to attack the cubs and adults of Red Panda and kill them in the process. This result was based on questionnaire with BZUC People and SNP park staff. Scientific evidence for this still needs to be explored.

4.3.4 Poaching

No sign of trapping equipment and other snares were observed inside the forest which could prove the no-poaching of red panda. During local consultations with Red Panda BZUFUG, respondents also denied of any poaching of red panda in recent years due to high level of awareness regarding its conservation and legal provisions.

4.3.5 People's perception on threats to red panda

Out of 17 respondents, 38% responded the grazing was the common problem in the destruction of the red panda habitat, Similarly, Firewood/bamboo collection was described as second major threat to Red Panda as it was accounted 27% people perception. Fire as the other threat responded by people about 15%. Destructions of forest which amount for 12% and finally only 8% people responded that Hunting/ predation (including feral/local dogs) was the reason for the threats to red panda in Red Panda BZCF of Chaurikharka BZ.

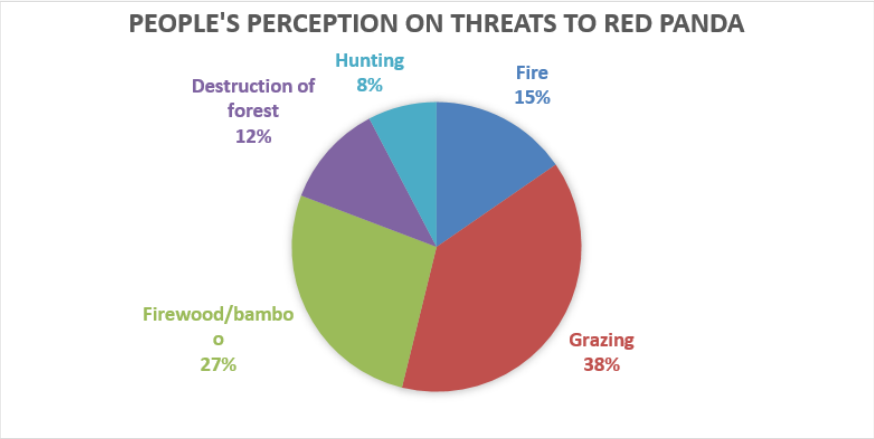

Figure 09: People's perception on threat to red panda

4.3.6 Conservation Awareness

The FGD and KII was carried out in Red Panda BZCFUG members and local inhabitants. Most of the people were very much positive towards its conservation and were aware related to prevailing laws against any wildlife crimes. More than 70% of people agreed with the statement that conservation

awareness will help in conservation of Red Panda, 25% strongly agreed and 5% people had no idea about awareness programs.

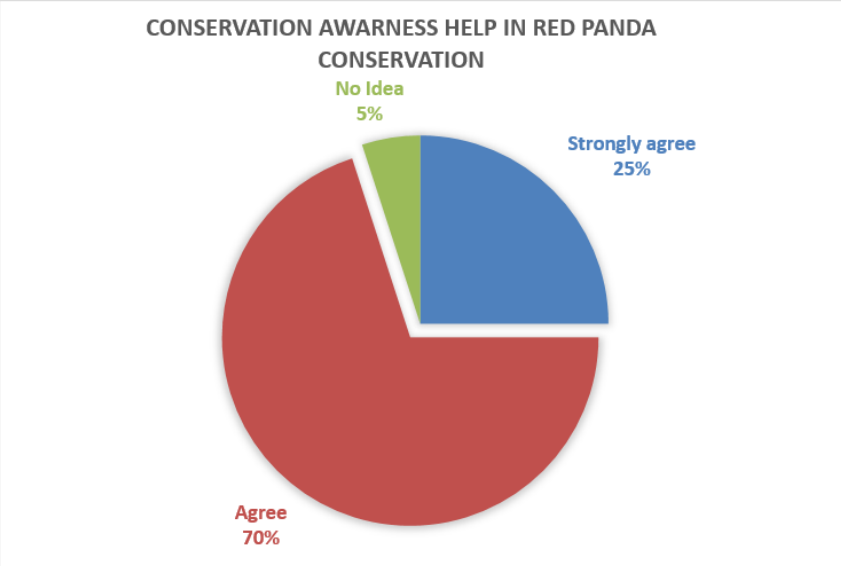

Figure 10: Conservation awareness to local people will help in conservation of red panda

4.4 Discussion

The present study demonstrated that Northwest facing Betula utilis forest with bamboo under-storey (80%) cover, terrain slope of 35˚ and altitudinal range between 2800- 3100m was discovered most suitable habitat of Red Panda. The findings were also matched with [27] study as its revealed even larger proportion (90.8%) bamboo in its diet and found that red panda preferred northwest facing average slope of 37˚ and altitudinal range of 3000m- 3200m in Langtang National Park. In contrast, discovered subalpine forest dominated by Abies spectabilis as a favourable habitat for red panda. Whereas [28] discovered Red Panda favouring slope of 36.4˚ in Riya samba forest within KCA. The present study showed out that half of the indications (57.1%), were located on mixed with bamboo, 28.6% in bamboo solely and 14.3% on the forest floor. In Yele Reserve [29] revealed that dropping sites (57.8%) were discovered on shrub branches, 49 (26.5%) on fallen logs, and just 29 (15.7%) on the forest floor. Red panda found at sites on steeper slopes with higher density of fallen logs, shrubs and bamboo culms, site close to fallen logs, shrubs and tree stumps [30]. A similar result was reached in Sikkim, where the evidence of red pandas was found on steeper slopes intermingled with fallen logs, shrubs and bamboo culms. Past research/monitoring reports suggested that Red Panda distribution was from 2600m to 3600m in SNPBZ however this study revelated Red Panda existence in range of 2800-3100 m. The little variance in its altitudinal presence can be explained by small study area among large SNPBZ. This investigation also confirmed that it was found scattered inside the Red Panda BZCF (Chhaplung region) of Chaurikharka BZUC in SNP. Importantly, the research brought that the particle size in study area is of bigger than other parts of the country. In Langtang National Park Red panda sign reported at range from 3000m to 4000m, also detected panda sign up to the 3650m in KCA. Variance and mean ratio (S2/a = 2.47) concluded clumped distribution of the red panda in the present study region [31]. Chi-Square (λ^2) contingency test proved the fact that number of red panda sign remain equal with increasing altitude up to specific level (up to 3100m) and no sign were discovered above that elevation. The highest elevation was taken 3500 in the study region. A study detected panda sign up to the 3800m in Taplejung District, where as [32] found sign up to 4028m in Manang and 2500-3000m in Illam district

respectively. The biggest hazard to the red panda discovered in the study region was local dogs, cattle grazing improper firewood, fodder, timber and other forest products gathering [33]. Fire was also one of the key concerns to the red panda; roughly 15.4% of respondents claimed that fire is also one of the causes of threats to red panda and its habitat. Hunting and predation were not much in the study area. However, [34] stated as the predation as a serious hazard in Manang district in Nepal but this study contrasts that predation is the least concerned risks to red panda in case of red panda BZCF in Chaurikharka BZ. According to prior research on red panda in this area by discovered greater encounter rate of cattle dung at altitude of 3000- 3200m where red panda abundance was also higher. Whereas [35] discovered less cattle dung density in the panda sign plots than randomly arranged plots and concluded that red panda favoured environments without any disruptions. The presence of herds of chauri, herders and dogs were the main cause for red panda mortality, extensive livestock grazing affected species composition by decreasing palatable species and productivity of the grassland [36].

5. CONCLUSION

Red panda is one of the least studied species by wildlife researchers in the Himalaya and ecology and status of this species is not adequately known. The current study on red panda in Sagarmatha National Park and its Buffer Zone provides a know-how on overview of the status of red panda. This research, however does not involve deeper analysis of habitat analysis due to weather and resource constraints. The present study revealed the clumped distribution of the red panda at an altitude between 2600m and 3500m around the Chaurikharkha buffer zone area of Sagarmatha National Park. The line transect method was adopted for the assessing the habitat and distribution pattern of red panda. GPS point was taken in every transect line spaced at an interval of 100m altitude wide. The habitat of red panda was analyzed in every transect line. Three quadrate was made in every transect line for the comparison of habitat. Mostly pellet of red panda was seen in between altitude of 2800 to 3100m. The Red panda preferred southwest facing slope with average inclination of 26˚-35˚ in Betula spps forest with under storey of bamboo species. Area having good number of resting trees and high density of bamboo species was found to be suitable habitat for red panda. Livestock grazing, local dogs and other anthropogenic disturbance (collection of fuel wood, timber, fodder and mainly NTFPs) were the major threats to red panda in the study area. Poaching and hunting is not much problem for red panda. In conclusion, red panda BZCF of Chaurikharka Buffer Zone is the prime habitat of red panda due to the presence of well resting site and abundant bamboo species.

6. RECOMMENDATIONS

Some of the recommendations based on the findings of the research are suggested below:

- Extended research and monitoring of the red panda and its habitat
- Control grazing/No Go Zone during red panda mating period
- Census of Red panda if conducted during January- May gives better result
- Extended conservation awareness at local level
- Promotion of alternative energy sources to reduce fuelwood demands and other livelihoods interventions.
- A site specific integrated red panda conservation action plan is necessary in Sagarmatha National Park.

REFERENCES

[1] Thapa, B., Gyawali, B., Neupane, J., & Thapa, T. (2022). FACTORS AFFECTING DISTRIBUTION AND HABITAT ASSOCIATION OF RED PANDA IN BHOJPUR DISTRICT, NEPAL: FACTORS AFFECTING DISTRIBUTION AND HABITAT ASSOCIATION OF RED PANDA. European Journal of Ecology, 8(1).

[2] Malla, R., Panthi, S., Adhikari, H., Pariyar, S., Baral, R., Subedi, R., ... & Poudel, M. (2023). Habitat suitability of four threatened Himalayan species: Asiatic black bear, common leopard, musk deer, and snow leopard. PeerJ, 11, e16085.

[3] Paudel, S., Yadav, S. K., Rokaya, B., & Mandal, M. K. (2023). Status, distribution, and threats of Himalayan Monal (Lophophorus impejanus) in Sagarmatha National Park. Banko Janakari, 33(1), 16-26.

[4] Sharma, R. K. (2023). Distribution and Habitat Use of Himalayan goral (Naemorhedus goral) in Lamtang National Park (Doctoral dissertation, Department of Zoology).

[5] Sumaiya Fatima & Aesha Zaheer (2023). Societal Perceptions on Animal Research. Dinkum Journal of Natural & Scientific Innovations, 2(11):706-718.

[6] Dhakal, P., Sharma, R. K., Rajak, B. R., Pandey, N., & Khanal, L. (2023). Population and Distribution of Himalayan Tahr (Hemitragus jemlahicus) in Lamtang National Park of the Nepal Himalaya: Hemitragus jemlahicus in Lamtang National Park of the Nepal Himalaya. MARKHOR (The Journal of Zoology), 02-10.

[7] Thapa, K., Schmitt, N., Pradhan, N., Acharya, H., & Rayamajhi, S. (2021). Assessing prey selection of snow leopard in Mt. Kangchenjunga, Nepal. Authorea Preprints.

[8] Karki, A., & Panthi, S. (2021). Factors affecting livestock depredation by snow leopards (Panthera uncia) in the Himalayan region of Nepal. PeerJ, 9, e11575.

[9] Paudel, P. K., Khatiwada, A. P., & Ghimirey, Y. (2022). Lens for Biodiversity Conservation in Nepal: Status, Challenges and Way Forward. Society for Conservation Biology Nepal, Kathmandu, Ne-pal.

[10] GAIRE, D., JIANG, L., ADHIKARI, B., & PANTHI, S. (2023). PREDICTING HABITAT SUITABILITY AND THREATS ASSESSMENT OF HIMALAYAN YEW (TAXUS WALLICHIANA ZUCC.) IN NEPAL. Applied Ecology & Environmental Research, 21(3).

[11] Bhattarai, B. R., Wright, W., & Morgan, D. (2022). Review of Nepal's protected area laws in relation to human wildlife conflict. Current Politics and Economics of Northern and Western Asia, 31(2/3), 123-153.

[12] Stewart, E., Espiner, S., & Simmons, D. (2023). A bibliographical review of research completed by Nepali students at Lincoln University, New Zealand (1956-2022). Lincoln University| Te Whare Wānaka o Aoraki.

[13] Gurung, K. (2022). Diet Analysis of Barking Deer (Muntiacus Vaginalis, Boddaert 1785) in Nagarjun Forest of Shivapuri Nagarjun National Park, Nepal (Doctoral dissertation, Department of Zoology).

[14] Vaidya, R. A., Shrestha, A. B., Nepal, S., & Shrestha, K. (2022). The Koshi River basin: Insights into biophysical, socioeconomic, and governance challenges and opportunities. Resource book. ICIMOD, 3.

[15] Singh, V. K., Singh, S. K., Joshi, B. D., Chandra, K., Sharma, L. K., & Thakur, M. (2022). Population genetics of the snow leopards (Panthera uncia) from the Western Himalayas, India. Mammalian Biology, 102(1), 263-269.

[16] Singh, V. K., Joshi, B. D., Dalui, S., Ghosh, A., Jabin, G., Sharief, A., ... & Thakur, M. (2023). Genetic diversity and population structure of Himalayan tahr (Hemitragus jemlahicus) from Western Himalaya. Mammalia, 87(3), 238-244.

[17] Prativa Shrestha, Bikash Shrestha, Jitendra Shrestha, Surendra karki & Jasmine adhikari (2024). AMR Active surveillance of E.coli spps. Isolates in poultry of different area of Surkhet at Veterinary Laboratory, Surkhet. Dinkum Journal of Natural & Scientific Innovations, 3(01):109-116.

[18] Dendup, P., Humle, T., Bista, D., Penjor, U., Lham, C., & Gyeltshen, J. (2020). Habitat requirements of the Himalayan red panda (*Ailurus fulgens*) and threat analysis in Jigme Dorji National Park, Bhutan. Ecology and Evolution, 10(17), 9444-9453.

[19] Lama, S., Shrestha, S., Koju, N. P., Sherpa, A. P., & Tamang, M. (2020). Assessment of the impacts of livestock grazing on endangered Red Panda (*Ailurus fulgens*) habitat in Eastern Nepal. Open Journal of Ecology, 10(3), 97-110.

[20] Subedi, A., Shrestha, P., & Ojha, P. (2022). Status, Distribution, and Threats of Red Panda (*Ailurus fulgens* Cuvier, 1825) in Nepal. Indonesian Journal of Social and Environmental Issues (IJSEI), 3(3), 233-240.

[21] Thapa, A., Hu, Y., Aryal, P. C., Singh, P. B., Shah, K. B., & Wei, F. (2020). The endangered red panda in Himalayas: Potential distribution and ecological habitat associates. Global Ecology and Conservation, 21, e00890.

[22] Kathayat, N., Shrestha, S., Khadka, S., & Shrestha, J. (2020). Distribution and habitat preference of the Red Panda in Lamtang National Park of Nepal. Scientific Reports in Life Sciences, 1(1), 38-51.

[23] Thapa, K., Thapa, G. J., Bista, D., Jnawali, S. R., Acharya, K. P., Khanal, K., ... & Sapkota, N. S. (2020). Landscape variables affecting the Himalayan red panda *Ailurus fulgens* occupancy in wet season along the mountains in Nepal. PloS one, 15(12), e0243450.
[24] Roka, B., Rai, U., Jha, A. K., & Chhetri, D. R. (2020). Selection of red panda (*Ailurus fulgens*) as an indicator species in Singalila National Park, Darjeeling, India. Ecology, Environment and Conservation, 26(1), 171-176.
[25] Javed Iqbal, Sufian Hameed & Rasheed Jahan (2023). Animal Communication: A Current Research Approach. Dinkum Journal of Natural & Scientific Innovations, 2(11):741-749.
[26] Roka, B., & Chhetri, D. R. Red Panda (*Ailurus fulgens*) on the Verge of Extinction: Threat and Conservation.
[27] Roka, B., & Chhetri, D. R. Red Panda (*Ailurus fulgens*) on the Verge of Extinction: Threat and Conservation.
[28] Dalui, S., Khatri, H., Singh, S. K., Basu, S., Ghosh, A., Mukherjee, T., ... & Thakur, M. (2020). Fine-scale landscape genetics unveiling contemporary asymmetric movement of red panda (*Ailurus fulgens*) in Kangchenjunga landscape, India. Scientific reports, 10(1), 15446.
[29] Arjun, T., Chandra, A. P., Bikram, S. P., & Bahadur, S. K. (2020). The endangered red panda in Himalayas: Potential distribution and ecological habitat associates.
[30] Roka, B., Jha, A. K., & Chhetri, D. R. (2021). A study on plant preferences of red panda (*Ailurus fulgens*) in the wild habitat: foundation for the conservation of the species. Acta Biologica Sibirica, 7, 425-439.
[31] Bhutia, S. W., Giri, A., Gupta, P., & Holeyachi, B. S. (2023). Identifying potential habitats of Himalayan Red Panda *Ailurus fulgens* (Cuvier, 1825)(Mammalia: Carnivora: Ailuridae) in Neora Valley National Park, West Bengal, India. Journal of Threatened Taxa, 15(12), 24345-24351.
[32] Dorji, S., Rajaratnam, R., Tighe, M., & Vernes, K. (2022). Local knowledge, perceptions and the cultural significance of the Red Panda (*Ailurus fulgens*) in the Himalayan Kingdom of Bhutan. Biodiversity, 23(1), 11-20.
[33] Dorji, S., Rajaratnam, R., Tighe, M., & Vernes, K. (2022). Local knowledge, perceptions and the cultural significance of the Red Panda (*Ailurus fulgens*) in the Himalayan Kingdom of Bhutan. Biodiversity, 23(1), 11-20.
[34] Hu, Y., Thapa, A., Fan, H., Ma, T., Wu, Q., Ma, S., ... & Wei, F. (2020). Genomic evidence for two phylogenetic species and long-term population bottlenecks in red pandas. Science advances, 6(9), eaax5751.
[35] Su, H., Bista, M., & Li, M. (2021). Mapping habitat suitability for Asiatic black bear and red panda in Makalu Barun National Park of Nepal from Maxent and GARP models. Scientific reports, 11(1), 14135.
[36] Dalui, S., Khatri, H., Singh, S. K., Basu, S., Ghosh, A., Mukherjee, T., ... & Thakur, M. (2020). Fine-scale landscape genetics unveiling contemporary asymmetric movement of red panda (Ailurus fulgens) in Kangchenjunga landscape, India. *Scientific reports*, *10*(1), 15446.

