Red Panda Field Survey and Protocol for Community Based Monitoring

Government of Nepal
Ministry of Forests and Soil Conservation
Singha Durbar, Kathmandu, 2016

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A Red Panda feeding on bamboo in the wild © Axel Gebauer

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Acknowledgements

Nepal has pioneered in research of the endangered Red Panda in the eighties first ever radio telemetry in the red panda range countries at Langtang National Park. That research has been a milestone on knowing the ecology, distribution and habitat of red panda. It provided a reference for the other studies that have been done so far in the smaller or larger scale.

Red panda is facing greatest challenges for its survival on its range countries due to various anthropogenic and natural threats. Despite the red panda conservation efforts illegal trade of red panda is in rise since few years. The population of red panda has declined by 50% over the last three generations. We don't have concrete population data of red panda in Nepal and other range countries. The researchers are following the different methodologies without any uniformity and the lack of tested methodologies makes it hard to persuade and harvest the scientific results.

The major aim of this protocol is to provide a uniform and concrete scientific method for researchers, students and local forest users in the research and long-term monitoring of the species. This document is based on the learning from the past field studies and ongoing monitoring initiatives on monitoring. The methodology presented in this guideline is tested in field in Community Based Red Panda Monitoring program in Eastern Nepal. Now, it has been finalized with the series of consultation with the experts from Nepal and peer reviewed with the experts from around the world.

I would like to offer my sincere thanks to the USAID funded Hariyo Ban Program/WWF-Nepal, Red Panda Network and Himali Conservation Forum for their organizational support to prepare this protocol. I thank Dr. Angela Glatston, Prof. Falk Huettmann, PhD, Prof. Karan Bahadur Shah, Dr. Sunita Pradhan, Dr. Kanchan Thapa, Mr. Brian Williams, Saroj Panthi, Judy Oglethorpe and Eric Wikramanayake for reviewing the protocol. Last but not least, I would like to thank Dr. Shant Raj Jnawali, WWF Nepal, Ang Phuri Sherpa and Damber Bista from Red Panda Network for their tireless efforts to materialize this protocol.

4 May 2016

Krishna Prasad Acharya
Chief, Planning Division

List of Acronyms and Abbreviations

A	Area
ASi	Availability of Signs
ASh	Availability of Shelter
BZCFUGs	Buffer Zone Community Forest User Groups
CF	Community Forest
CFUGs	Community Forest User Groups
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
DNPWC	Department of National Parks and Wildlife Conservation
dbh	Diameter at Breast Height
GPS	Global Positioning System
ha	Hectare
IUCN	International Union for Conservation of Nature
IVI	Importance Value Index
NRs	Nepali Rupees
TA	Travel and Accessibility
V	Visibility
VDC	Village Development Committee
W	Weather
WGS	World Geodetic System

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Section I: General Information on Red Panda

1. Introduction to the Species

The scientific classification of red panda is:

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Carnivora
Family:	Ailuridae
Scientific Name:	*Ailurus fulgens* (F.G. Cuvier, 1825)
Sub-species:	*A. f. fulgens & A. f. styani*

Groves (2011) recommended that these two sub-species should be considered two separate species.

The animal's common names in English are red panda, lesser panda, shinning cat, firefox, and fox bear. The name panda is derived from the Nepali word nigalya ponya: nigalya is thought to come from nigalo meaning bamboo, but the source of ponya is less certain, although it may come from ponja meaning the ball of the foot or claws - making the complete meaning 'bamboo foot' (Glatston, 2012). Different common names used in different places include:

Burma:	Kyaung-wun
Sikkim:	Workar
Bhutan:	AchhuDongkar (Dzongkha
China:	Chu-chieh-liang, Xia xongmao
Nepal:	Habrey (Nepali); Punde Kundo (Eastern Nepal); Hoptanga (Bhutia dialect); Sankam (Lepcha dialect); Waa (Gurung dialect in Manang); Nyakarau in Kaski; Pamsayang in Gorkha; Lita Shayal, Meta Shyal, and Charrah in Lamjung; Sagaicha in Kham Magar dialect; Nautoto in Karnali region; Thanwor in Chantyal dialect; and Wa'h in Limbu (Wikipedia, 2016 & HCF, 2016)

2. Physical Characteristics

Body length:	50 to 64 cm
Tail length:	28 to 59 cm
Weight:	Male- 3.7 to 6.2 kg and Female - 4.2 to 6 kg
Color:	Reddish-brown fur on the upper parts and blackish on the lower part looks exactly the same color as of moss and lichen found on the trees where they live. This camouflages them from predators.

Long bushy tail helps red pandas to balance while climbing down the trees. The tail's 12 to 18 alternating rings also provide excellent camouflage. Individual red panda can be identified by their tail rings and facial markings (Shrestha et al., 2015). However, red panda has no sexual dimorphism in color or size (Roberts & Gittleman, 1984).

3. Habitat, Ecology, and Behavior

Individual red pandas spend most of their time alone, except during the mating season and when the mother is with her cubs. Red panda spends most of their time for aging, and sleeping on tree branches or in tree hollows during the day. Their activity increases in the late afternoon and early evening hours (Yonzon and Hunter, 1991).

Forest habitat: Red panda is a small crepuscular, arboreal mammal living in temperate forests with abundant bamboo in the under-storey. Red panda prefers to live in forests close to water sources (within 100-200m) and with moderate tree canopy (>30%) and bamboo cover (>37%) where an average bamboo height should be more than 2.9m (Yonzon et al., 1991; Pradhan et al., 2001; Williams 2006; Dorji et al., 2012). They also prefer gentle to steep slopes with fallen logs, tree stumps, and snags (Zhang et al., 2008; Dorji et al., 2012).

Red panda also shows a preference for north, north-west and south-west aspect slopes (Yonzon and Hunter 1991, Pradhan et al. 2001, Dorjiet al. 2012). However, in eastern Nepal, they show a preference for south, southeast, and west slopes (Bista et al., in prep). Their elevational distribution ranges from 2200-4800m (Roberts & Gittleman, 1984).

Food sources and droppings: The diet of red panda consists primarily of bamboo leaves and shoots, which are more than 83% of its total food types. Since bamboo is very low in calories, red pandas spend 56% of their overall time budget eating (Yonzon & Hunter, 1991). As a bamboo eater, the red panda has a very low metabolic rate (Wei et al., 2000), which reduces its energy requirements (McNab, 1988). Red pandas use elevated objects, such as shrub branches, fallen logs, or tree stumps to reach bamboo leaves (Wei et al., 2000).

Other food includes the leaves and berries of plants such as *Sorbus spp., Acer spp., Quercus semicarpifolia, Berberis spp., Actinidiastrigosa, Rhododendron campanulata, Rosa sericera, Abies spectabilis, Juniperus spp., Rubus spp, Schlleriflora spp.* etc (Yonzon & Hunter, 1991, Pradhan et al., 2001; Sharma, 2008; Panthiet al., 2012; Thapa & Basnet, 2015, Panthi et al.2015). Red pandas also feed on birds, eggs, and insects. On occasion, zoos feed chicken to red pandas to supplement their diet (pers. Comm. Sarah Jones, 2015).

The droppings of red panda are spindle-shaped, soft, moist and light green. The color depends on their diet. Red panda usually leaves a cluster of 1-15 pellets at a feeding site in a single defecation (pers. Observation, D. Bista, 2012), and will use the same site for defecation — latrine sites — where more than 100 pellets can accumulate (Yonzon, 1989).

Reproduction and rearing young: Red panda breed in the late winter months, from January to March, so the cubs are born during the monsoon, from June to August (Northrop & Czekala, 2011). Red panda normally locate their nests in a hollow tree or a rock crevice. A female gives birth to one to four blind and deaf cubs each weighing 110 to 130 gm. Cubs begin to open their eyes at 18 days. They achieve full adult fur coloring and start to venture out of the nest when they are 3 months old (Robert & Gittleman, 1984). Red panda young leave their mother to become independent at about 8 months of age, when the mother begins a new breeding season (Schaller, 1993). The young become sexually mature at 18 to 20 months of age and first give birth at 24 to 26 months.

4. Distribution and Population Status

Distribution: The current distribution of red panda extends into areas of five countries: China, Myanmar, Nepal, India, and Bhutan (Glatston et al., 2015). The easternmost location is in Minshan Mountain and Upper Min Valley of Sichuan Province, South-Central China (104° E) and the western most record is from Kalikot district, western Nepal (81° E) (Choudhury, 2001; Dangol, 2014). The nominate form, *A. f. fulgens*, is found primarily in Nepal, India, Bhutan, Tibet and the northwestern Yunnan Province of China.The sub-species *A. f. styani* is found in Sichuan and northeastern Yunnan of eastern China and Myanmar (Wei et al., 1999; Wei & Hu, 1993). The Nujiang River seems to be a biogeographic barrier separating the two subspecies (Wei et al., 2000).

Potential habitat: The estimated potential red panda habitat available in its entire distribution range varies greatly between the different studies. Choudhury (2001) estimated the potential habitat of about 142,400 km^2, while Mahato (2010) suggested that the potential habitat available across the range is about 425,700 km^2. A recent study based on a predictive random forest model estimated the total potential red panda habitat available in the range countries to be 32,600 km^2 with most of the habitat (53.4%) in Nepal (Kandel et al., 2014).

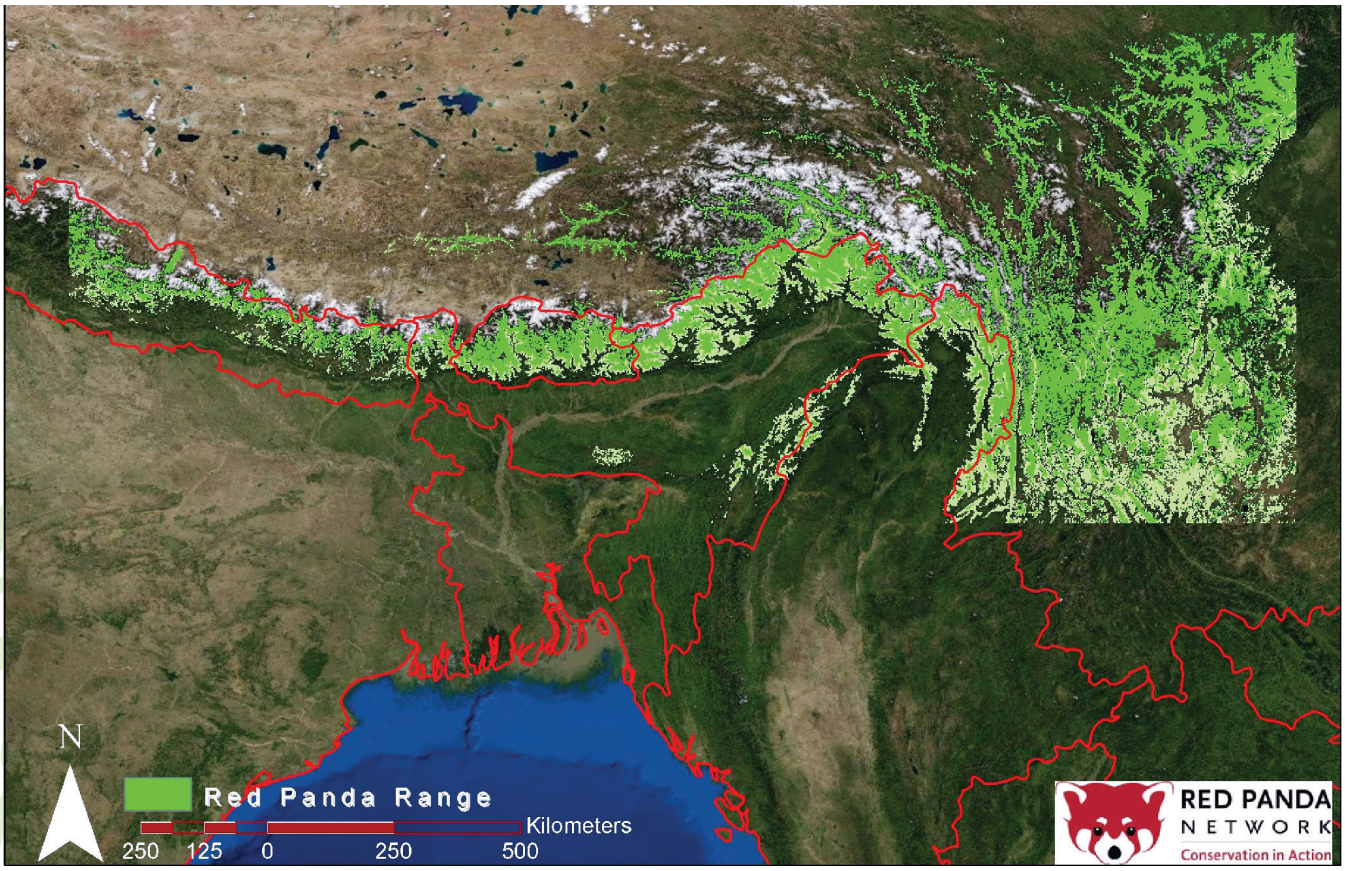

Figure 1: Potential red panda range area with the easternmost and westernmost confirmed locations

Jnawali et al. (2012) estimated that the total potential red panda habitat available in Nepal is 2,652 km^2 distributed across 36 districts. However, red panda habitation has been confirmed in only 25 districts so far (Figure 2). Two other studies suggest that the total potential habitat is far higher than this estimation; i.e., 20,400 km^2 (Mahato, 2010) & 17,400 km^2 (Kandel et al., 2014).

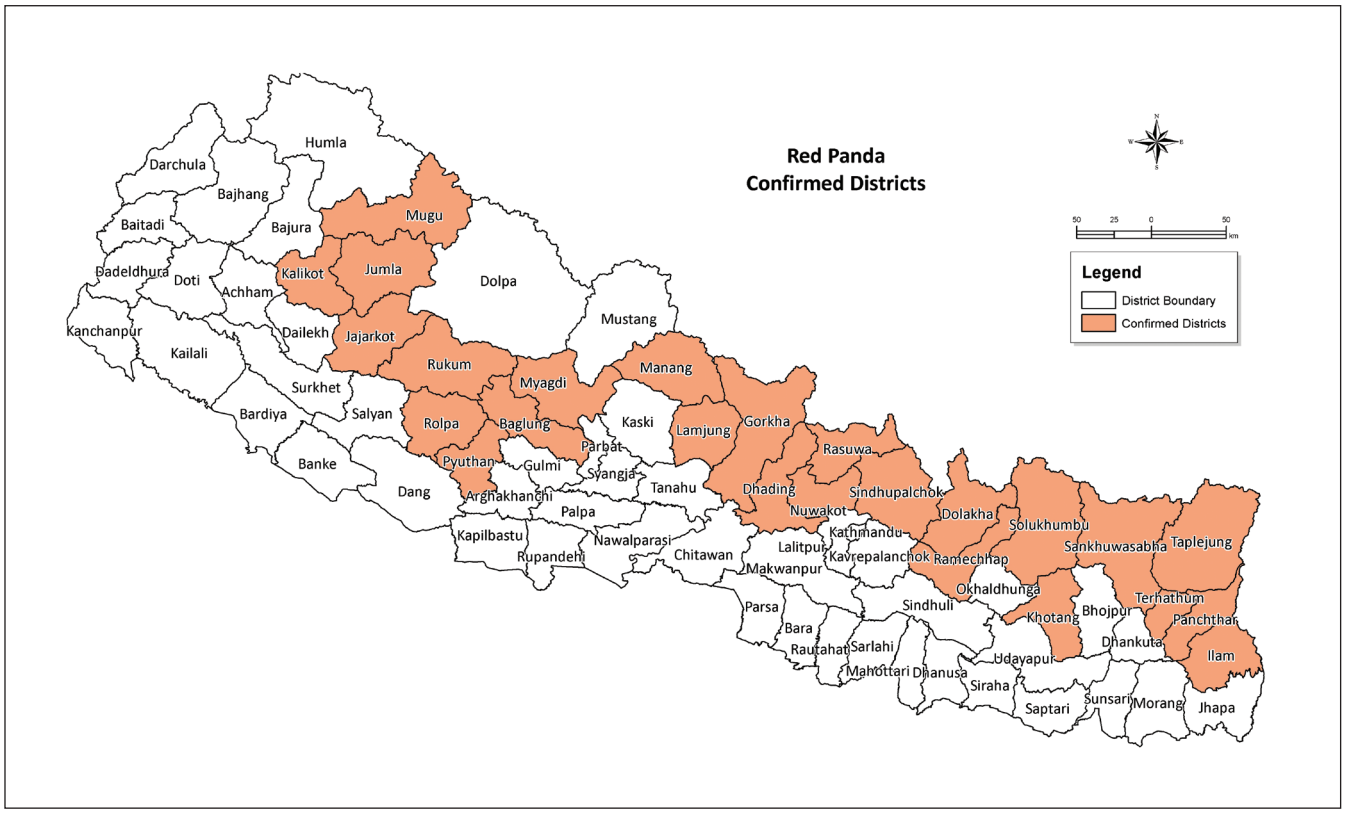

Figure 2: Red Panda presence confirmed districts of Nepal

Population: The total range-wide red panda population is estimated to be less than 10,000 mature individuals (Glatston et al., 2015). In Nepal, the population may range from 237 to 1,061 individuals within 11 different sub-populations shown in Table 1 (Jnawali et al., 2012). These estimates are based on Population and Habitat Viability Analyses, but need further assessment using techniques that are more reliable.

Table 1: Potential habitat and population estimation of red panda in Nepal

S.N.	Sub Populations	Area (Km^2)		Populations	
		Confirmed	Possible	Confirmed	Possible
1	Annapurna-Manaslu	4.18	84.23	2	34
2	Darchula	-	-	-	-
3	Dhorpatan	89.05	434.92	36	174
4	Gauri Shankar	45.17	114.15	18	46
5	Kanchenjunga	111.91	160.76	45	64
6	Khaptad	3.57	211.22	1	84
7	Langtang	47.83	125.7	19	50
8	Rara	55.63	1,099.16	22	440
9	Sagarmatha	73.71	150.96	29	60
10	Sankhuwasabha East	101.88	119.01	41	41
11	Sankhuwasabha West	59.46	152.02	24	48
	Total	592.39	2,652.13	237	1,061

5. Conservation Challenges and Threats

Across its range, the major threats to red panda conservation are the loss, degradation, and fragmentation of its habitat. Poaching of red panda, especially to trade its hide, is also increasing (Glatston, et al., 2015). As well, inbreeding depression is threatening red panda populations (Wei et al. 1999).

Human threats to red panda habitat: The dependency of local people on forest resources for firewood, fodder, timber, and other non-timber forest products is a major cause of habitat loss and degradation and an immediate cause of concern for managing red panda populations in Nepal (Panthi et al. 2012). Livestock herding practices of local people are further deteriorating the quality of the habitat.

The main food of red panda, bamboo, is being over-exploited, leading to a scarcity of food for red panda. Local people use bamboo for fodder, fencing, thatching, and harvest the tender shoots for vegetables. A natural food short age occurs when bamboo flowers at the end of its life cycle leading to a mass die-off of bamboo forest sin large areas. This may lead to the local extirpation of red panda if there are no other staple foods available in the habitat, or if the red pandas are unable to move to other areas with suitable food.

Further challenges to red panda conservation include forest fires and slash-and-burn cultivation, especially in eastern Nepal where slash-and-burn is practiced for the cultivation of Chiraito (*Swertia chiraita*). Development activities may hinder the movement of red panda, especially when rural roads are constructed through red panda habitat, which fragments the habitat.

Poaching: Another emerging challenge for red panda conservation is poaching and illegal trade as seen in the growing numbers of cases of confiscation of red panda hides. During the 8-year period from 2008 to 2015, 56 cases of trafficking red panda hides were reported in Nepal. This trade-induced threat is also reported in other red panda range countries (Glatston et al., 2015). It is believed that the threat is fueled by the demand in some parts of eastern China for hides to make hats worn during wedding ceremonies by newly married couples, which they believe brings good luck for a happy conjugal life.

Natural threats: The natural predators of red panda include martens, wild cats, leopards, dholes and eagles. There are reports that domestic and feral dogs prey upon red pandas, and are a significant threat to red panda conservation (Williams, 2004; Bista and Paudel, 2014).

Other reports of red panda mortality are due to parasitic infections and canine distemper. Infections of Trematodes and Nematodes may cause respiratory and digestive problems reported to be fatal for red panda (Lama et al., 2015). The livestock and herder's dogs that share red panda habitat are the potential source of infection (Glatston et al., 2015, Deem et al., 2000).

6. Conservation Policy

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species designates red panda as an endangered species (Glatston et al., 2015), and as an Appendix I species under the Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora (https://cites.org/). The Status of Nepal's Mammals: The National Red List Series has also listed this species under endangered C2a (i) category (Jnawali et al., 2011). The National Park and Wildlife Conservation Act, 1973 of Nepal protects this species, prohibiting its killing or capture dead or alive. There is a provision to impose a fine of NRs 40,000-75,000 and/or a jail term of 1-10 years on any person who kills or tries to kill a red panda. Other countries in the red panda range also legally protect this species (Glatston et al., 2015).

Various documents for conservation in Nepal emphasize the protection of threatened species, like the red panda. The National Conservation Strategy (1988) clearly highlights the need to preserve rare or endangered species and their habitats. The Nepal Environmental Policy and Action Plan (1993) emphasizes the need to protect and conserve endemic and endangered species and their habitats, and to conduct inventories of biological resources. The Nepal Biodiversity Strategy (2002) urges extensive research and maintenance of endangered indicator species, including red panda and their habitat. The National Biodiversity Strategy and Action Plan (2014) emphasizes the framework for managing biodiversity at the local level.

Section II: Field Survey Techniques and Community Based Monitoring Protocol

This section has two parts with field survey techniques and community-based monitoring protocol for red panda. The first part serves as a manual for biologists to carry out field studies on red panda. It provides details on how to collect and record the data on appropriate field datasheets, but does not address data analysis techniques in detail. The second part provides a guideline to carry out techniques to monitor red panda at the community level. This manual and guideline are expected to help institutionalize community-based red panda monitoring through proper guidance to build the capacity of local forest users.

1. Rationale of Protocol

Efforts to preserve red panda have not been successful in this region, so the species is still listed under the endangered category (Glatston et al., 2015). None of the previous studies produced reliable baseline data on the occupancy, abundance, distribution, habitat quality, and conservation threats for this species. The current conservation program has been and will continue to be ineffective without reliable baseline data and subsequent population monitoring.

Across its entire range, data on the distribution of red panda is deficient and there is a lack of information on the existing status of red panda in Nepal. Data on the numbers and distribution of red panda is essential to project the future trend of red panda population in Nepal (Jnawali et al., 2012). To address this need, this report presents techniques for field surveys and monitoring.

Part 1: Field Techniques for

Presence or Absence Surveys and Abundance Estimation

Information on presence or non-detection of specific wildlife is essential to develop a conservation program in a particular area or landscape. This information helps to identify potential habitat, occupancy, quality of habitat, existing and potential threats, and appropriate conservation interventions. The objectives of the survey are:

- To create a geo-referenced database of red panda presence or absence in a given area.
- To determine the abundance of red panda in given area.
- To assess the habitat suitability and conservation threats to red panda.

Presence or Absence Survey Techniques

Consult with Experts and Local People

Meeting with experts and local people helps to acquire better insights on red panda status, locality, and suitability of forests as habitat. Before leaving for the field, the survey team should consult experts and officials working in wildlife and the conservation sector.

In the field, the team should consult with local people including forest users, forest guards and herders to ask if they have seen red panda in the local forests. It helps identify the local person with the best knowledge of local flora, fauna, and topography to include in the survey team. The local herders often have this knowledge of wildlife in their locality as they spend most of their time in the forest. The team should also consult with members of Community Forest User Groups (CFUGs) who have good knowledge of their forests and biodiversity conservation measures they have been adopting.

During the consultations, show a standard photograph of red panda while recording local people's stories of red panda sightings and other anecdotal information. The locations where they have sighted red panda should be compared with the red panda habitat map. During the consultation, the team should confirm the identified grids and sub-grids for the suitability of red panda habitation before initiating the survey.

Identify Potential Red Panda Habitat

Ideally, the team should use a map of land use land cover of the survey area to identify potential red panda habitat based on the following three parameters:

- Elevation range between 2,000m to 4,400m.
- Forest Types: fir forest, rhododendron forest, birch and alpine scrub, oak forest, broad-leaf deciduous forest, broad-leaf conifer forest and coniferous forest with bamboo in the under-storey, should be identified as potential red panda habitat (Yonzon et al., 1991; Pradhan et al., 2001; Williams, 2004).
- River networks and existing locations of red panda sightings help identify potential habitat.
- Other potential habitats that are far from former sighting

In case a land use map is not available, use a topographic map or Google Earth image.

Select the Survey Area Grids and Sub-grids

Overlay the potential habitat on the map with 9.6 km^2 grids, which is the red panda's maximum size of home range in Langtang National Park. Further, divide each grid of 9.6 km^2 into 6 sub-grids, each with an area of 1.6 km^2 to ease the data collection. Randomly select at least 50% of the total grids for the survey using the Geospatial Modeling Environment built into ArcGIS version 10.2.

Within each particular grid, select three sub-grids randomly to conduct the survey looking for signs of the presence of red panda. Ensure that these three sub-grids cover the entire potential habitat, including elevation range and water availability, in the particular grid. Switch to another sub-grid if there is no representation, or if a sub-grid is inappropriate.

The team should traverse all the available transects following contours at intervals of 100m in the selected sub-grids, and note the Global Positioning System (GPS) coordinates of the start and end of each transect.

Each transect should be from 500m to 1,000m long. Each transect will be sub-divided into 500m sub-segments for systematic sampling to assess the habitat suitability (Figure 3).

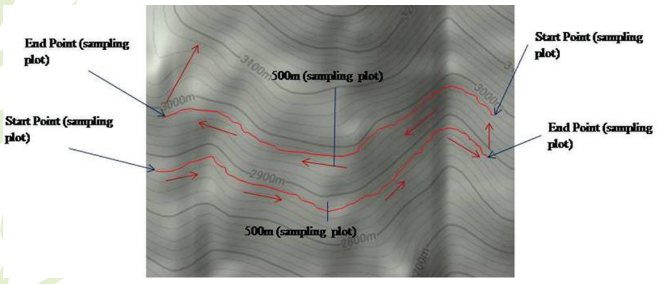

Figure 3: Schematic diagram of transect walk

Sample Circular Plots to Determine Vegetation in Habitat

To collect data on the suitability of the habitat for red panda, use a circular sampling plot to study the vegetation. Establish these plots in two different ways. Establish circular sampling plots at the start point of each transect and successive plots at intervals of 500m. Establish a similar plot at each location where there is a direct sighting of a red panda or sign. The concentric circular plots will have a larger, 10m radius plot (Area =314.28m^2) for trees, and two other sub-plots of 3m radius for shrubs and bamboo (A=28.28m^2) and 1m radius for herbs (A=3.14m^2) (Bista et al., in prep). See Figure 4. The team should record information on disturbance factors seen within each plot.

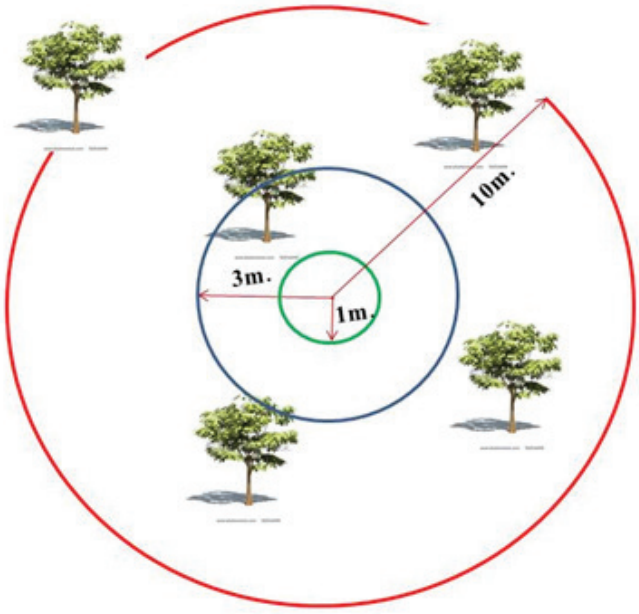

Figure 4: Circular plot sampling design

Look for Signs of Red Panda on the Transects

The team should scan the trees and other vegetation for direct sightings of red panda. The chance of spotting red panda during the survey is low, so, the surveys depend upon observations of the other indirect signs of red panda described below.

Droppings

Droppings are the most reliable evidence to document the presence of red panda. The fresh droppings of red panda are spindle-shaped, soft, moist, and green in color. The color of fresh droppings will change from dark green to pale green and whitish with aging. The remnants of leaves and other food can be seen easily if the dropping is broken up.

According to Yonzon (1989), the size of spindle-shaped pellets helps to distinguish whether the dropping is of an adult or cub/sub-adult as follows:

Dimension	Adult	Sub-adult/cub
Length (mm)	41.6 ± 6	34.7 ± 7.1
Diameter (mm)	19.2 ± 2.3	14.9 ± 2.6

Red pandas use tree branches, fallen logs, rocks, and the ground as latrine sites, which can be hidden from view. Latrine sites with piles of droppings of different ages could be found in resting sites, whereas a few pellets (1 to 16) of droppings may be defecated during other activities. However, usually, red panda repeatedly defecate in the same site, which could have more than 100 pellets (Yonzon, 1989). See Photo 1.

Photo 1: Red Panda droppings of different age

Footprints

The red panda rarely leave footprints because they are arboreal animals, spending most of their time in trees and little time on the ground. However, on some occasions foot imprints may be seen, especially on a snow, or in mud close to a water source. See Photo 2

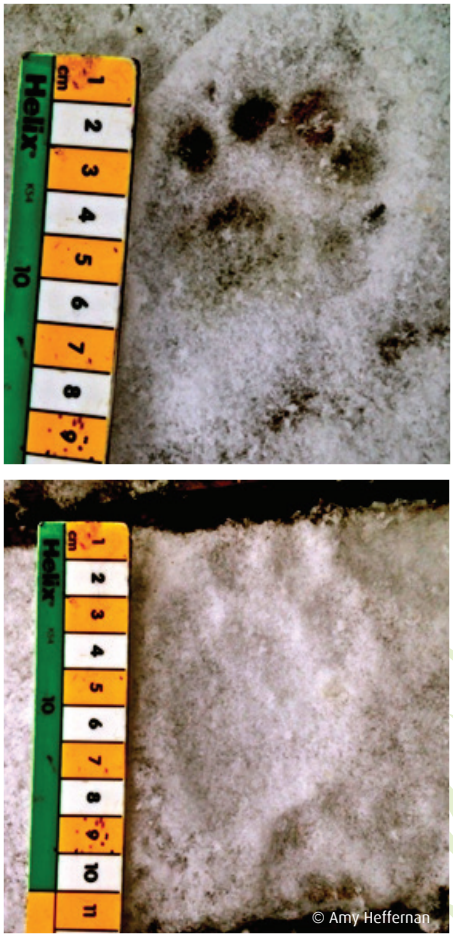

Photo 2: Red Panda footprint on snow: front foot (left) & back foot (right)

Photo 3: Bamboo leaves nipped by red panda

Foraging Marks

Red panda forage on the soft leaves of bamboo on upper bamboo stalks that are about 2m above ground and inaccessible to domestic livestock and other wild ungulates. Bamboo leaves nipped at this height can be a sign of red panda foraging. See Photo 3. These foraging indicators may be seen either at the base of the leaf or at the junction of leaf and branch. Similarly, foraging signs may be seen on the leaves of other vegetation like Bhaalu Chinde *(Schefflera impressa)*.

Scratch Marks

Red pandas use their claws and sometimes teeth to leave scratch marks on tree trunks and branches. The marks of red panda are usually about 1.5m above ground, but other animals may also leave such markings on tree trunks. Occasionally, the red panda's hair is found with the scratch marks. These marks on the bark of trees are very small scratches with no particular shape.

Body Parts

In some cases, the survey teams may find a carcass and remaining body parts (e.g., hide, skeletal remains) in the forest or in the homes of local people. When home owners keep body parts in houses, it is important to ask them about the source and place of origin of these parts, since the body parts could be from elsewhere through trade or exchange.

Required Equipment and Gear

Table 2: List of equipment and gear

Equipment and gears	Purpose
GPS	Tracking transects, and recording GPS coordinates and elevation
Compass	Aspect
Clinometer	Measurement of tree height and slope angle of location
Binocular	Observations in the forest
Camera	Photograph of direct sighting and signs, other wildlife, threats and harmful human activities
Measuring Tape (30m)	Quadrat establishment
Masking Tape	Demarcating the boundary of quadrats
dbh Tape	Measurement of dbh of tree
Spherical Densitometer	Measurement of canopy cover
Vernier Calipers	Measurement of length and diameter of droppings
Topographic and Other Maps	Tracking transects and identifying potential red panda habitat
Laminated Picture of Red Panda	Show to local people during consultation
Field Note Book	Recording information
Pen/Pencil/Eraser	Recording information
Camping Gear	Camping while away from settlements
Warm Clothes	To keep warm because the red panda habitat is cold
Rain Suits	To keep dry in rain
Trekking Boots	Protection of legs from mud, prickly bushes, and other pests like leeches, or snakes, etc.
Food/Snacks and Cooking Set	Snacks needed while working in the forest; food and cooking set necessary if staying away from settlement
Back-up Materials	Example: batteries, write in the rain paper, lead pens
First Aid Kit	For treating common body ailments and injuries

When and Which Season to Conduct the Survey

The survey can be done in most months of the year, except during the monsoon when the dense growth of vegetation in the under-storey creates problems to walk and observe in the forest. Signs, especially droppings, may be washed away which reduces the chances of recording the presence of red panda. However, some surveys need to be conducted during the monsoon season if the research question is for example, information on seasonal diets.

There are several factors affecting the success of survey including weather, travel and accessibility, visibility inside the forest, availability of signs (droppings/foot prints etc.), and availability of shelter for survey crew. The major factors to consider while scheduling the survey are shown in Table 3.

Table 3: Factors to consider when selecting the time for the survey

Season	Sign Detectability Factors					Sum
	Weather (W)	Travel (TA)	Visibility (V)	Availability of Signs (ASi)	Availability of Shelter (ASh)	
Summer	3***	2	3	3	2	13
Monsoon	1*	1	1	1	2	6
Post-monsoon	2**	2	2	2	2	10
Winter	2	2	2	3	1	10

Winter: December-February; Summer: March-May; Monsoon: June-August & Post Monsoon: September-November

Factors Affecting Survey	Abbreviation	Suitability Ranking		
Weather	W	*	1 =	Poor
Travel and Accessibility	TA	**	2 =	Acceptable
Visibility Inside the Forest	V	***	3 =	Best
Availability of Signs (Droppings/Footprints etc.)	ASi			
Availability of Shelter for Survey Crew	ASh			

How to do a Transect Walk

Before going in the field, set the GPS to metric units and degrees as 'decimal' in Map Datum WGS84. Then load the GPS coordinates of the four corners of each selected sub-grid in the GPS.

Once in the field, after reaching the nearest sub-grid, use the GPS to conduct the survey along each contour at an interval of 100m. A transect's elevation may vary slightly (± 10m) on difficult or inaccessible terrain.

Observe all the potential trees and substrates for direct sightings of red panda or indirect signs while walking along the transects. Try to see upto 25m distance on the both sides of a transect for indirect signs.

There is no limitation of distance for direct sighting. Use binoculars to confirm the observation, which reduces the chance of missing any direct sightings or indirect signs. Record the information related to the red panda observed during the survey on the data sheet (Data sheet 1).

Details of the process to follow during the transect survey are as follows:

- Use the 'GoTo' function of GPS to reach the nearest point of the selected sub-grid and begin the survey from that point. Lay out a sampling plot and record vegetation information on Data sheet 2.
- Walk the transect line along the particular elevation within the sub-grid using the GPS. Keep scanning the trees and surroundings for direct sightings and indirect signs. Use binoculars to increase the chance of seeing a red panda or sign.
- Photograph direct sightings and other signs to show the shape and size. Be sure to label and save the photograph, and transfer it correctly. Use a scale beside the sign in photographs and write down the details, such as GPS coordinates and date on a piece of paper that you place next to the sign when taking the photograph.
- Measure the distance covered along each transect using the GPS. The person carrying the GPS has to be careful to keep the GPS along the transect. If that person walks off the transect, leave the GPS on the ground so as not to increase the recorded length of the transect. Leave the GPS on the ground (or other substrate) while establishing sampling plots and taking notes.
- Establish the next sampling plot at an interval of 500m (systematic sampling) to record information on vegetation and habitat.
- Take the GPS coordinates and other related information at the end of each transect.
- After reaching at the end of the transect, follow the next selected transect along the next contour, 100 m up or down in elevation.
- Note the information for all observations recorded during the transect walk, and survey and record information on vegetation types in sampling plots and micro-habitats at the locations of direct sightings or signs. Record the GPS position.
- Repeat the process until all the transects are completed.

Opportunistic Surveys Where Locals Report Sightings

When locations where local people report having seen red panda in the past are outside the selected sampling sub-grids, the survey team should visit the location and sample the sub-grid using the same methods and protocols as for a complete sub-grid. Record all information provided by the local people, and complete the process described in the section above, "How to do a transect walk?" This opportunistic sampling is necessary in case the systematic sampling fails to record any direct sighting or signs.

Collect and Compile the Data

It is important to record the details of all field level information, including GPS locations of direct sighting/indirect signs, elevation, aspect, slope, substratum, height from ground surface, vegetation types, bamboo culm number, and distances to nearest settlement and water sources.

The information recorded on vegetation should include the species, diameter at breast height (dbh), height, canopy cover of trees, and the composition of herbs, shrubs, and bamboo species, with their number, height, and cover.

Collect and record information on human disturbances including the number of cut stumps, number of livestock seen and their droppings, livestock shelters, cattle paths, signs of forest fire, distance to nearest settlement, number of tourists, presence of electric transmission lines, roads, and other construction activity, and other visible human activities. This information matters in the preparation of conservation strategies.

Recording the Data

The annexes at the end of this report have data sheets for recording the information noted while doing the survey. Complete these datasheets while conducting the survey in the field.

- Datasheet 1: Red Panda Presence/Absence Survey
- Datasheet 2: Habitat Suitability and Threat Survey
- Datasheet 3: Red Panda Sign Monitoring
- Datasheet 4: Vegetation and Threat Monitoring
- Datasheet 5: Monitoring Data Analysis (Red Panda status)
- Datasheet 6: Monitoring Data Analysis (Habitat suitability)
- Datasheet 7: Disturbance and Threat Monitoring

Sign Data in Presence or Absence Survey

- For each transect, complete a separate Datasheet 1. Complete the information section at the top of Datasheet 1 with the name of district, Village Development Committee (VDC), Protected Area, Community Forest (CF), and number of Grid, Sub-Grid, transect, and the transect length covered. Also record the time and GPS coordinates of the start and end of each transect. These coordinates should be in decimal degrees.
- Use one row to record the direct sighting or indirect sign observed in one location. All signs observed within a 10m distance along the transect are considered as a group or cluster of signs. Record the data in a separate row if the signs are 10m or more apart along the transect.
- Note the number of red pandas seen. Record the number of dropping piles and other signs. At red panda latrine sites, count and note the number of pellets in each pile. Measure the length and diameter of one representative pellet from each pile. If you find footprints, measure the length and width of the footprints. Take photographs. Include a scale and a piece of paper with the GPS coordinates and date in the photograph.
- Note GPS coordinates, elevation, and substrate for observed signs or direct sighting of red panda on the datasheet. Document the name of the tree species if a red panda is seen on a tree. Estimate and note the distance to nearest water source, livestock shelter, road and settlement. The team can verify, confirm, and correct this information later using maps, Google Earth, and interviews with local people.
- Note any unique features, proximity to human disturbances, special behavior observed during a direct sighting, or other significant observations in the remarks section. Examples include the age of the animal (adult, sub-adult, cub), behavior, etc. Note if a mother and cubs are seen, as it is evidence of breeding.

Data for Habitat Suitability

- For each sampling plot, complete a separate Datasheet 2. Fill in the section on top of Datasheet 2 with the name of district, VDC, Protected Area, Community Forests and number of Grid, Sub-Grid, transect number, and sampling plot types (whether a sign/non-sign plot).
- Record the GPS Coordinates and elevation of the location.
- Record the distance to the nearest water sources, livestock shelter, human settlement, and any other physical infrastructure (e.g., roads, electric transmission lines, water supply line, etc.).
- Record the number of logs, snag trees, lopped trees, tree stumps, and dropping piles of livestock and wildlife within the plot. Take photographs. Include a scale and a piece of paper with the GPS coordinates and date in the photograph.
- Record the name of trees along with their height and dbh. Use a dbh tape to measure the dbh of each tree at 1.37m above the ground. Likewise, measure the canopy coverage of trees. One row should be used for one species of tree, and the value of height and dbh for each individual tree of that species could be separated by semicolon (;) or slash (/). Measure the angle of the slope with a Clinometer.
- Record the information on shrubs, bamboo, and herbs. Count the numbers of each of these vegetation features and record their height. Estimate the understory dominance of each of these vegetation types.

Data for Threats and Disturbance

- Use one datasheet (Datasheet 2) for recording information on threats and disturbances at each sampling plot.
- Fill in the section at the top of the datasheet with the name of district, VDC, Protected Area, Community Forests and number of Grid, Sub-Grid and transect number.
- Note the presence of the given variables separately under the remarks column, and estimate the scale for each of them. Use ocular estimation to scale the values for each variable as follows: 0 if the given disturbance or threat is absent; 1 if the given threat extends upto 25% of the plot; 3 if 26-50% of the threat extends up to 50% of the plot, etc.
- Consider threats within a distance of less than 200m for the variables rural road or trekking trail and settlement.

Data Management and Analysis

Data collected during the fieldwork has to be processed in a spreadsheet and analyzed to obtain the information according to the research design. The team should enter the data immediately after completing the fieldwork. Check the possibility of errors by using a double entry or by having a second person review the data.

The following software could be useful in data management and analysis.

- MS-Excel (Data management)
- R (Statistical Analysis)
- ArcGIS (Mapping and Analysis)
- PRESENCE (Occupancy Modelling)
- MaxEnt (Spatial Distribution and Habitat Suitability Analysis)

Analysis of Presence or Absence

The presence of red panda in the surveyed area is confirmed by direct sighting and the observation of droppings, carcasses/ body parts. However, be aware that predators might have carried a carcass from a nearby area. So, this sort of cases should be treated carefully during analysis.

An absence of evidence does not confirm the absence of red panda; it could be just that the team did not detect the evidence during the survey. Factors including the availability of water sources, abundant bamboo in the understory, and a good canopy of trees may indicate the possible presence of red panda. It is helpful to consult with local people when reaching conclusions about the presence or absence of red panda.

The following parameters have to be considered during the analysis:

- Local names, and cultural-religious significance (if any)
- Age structure based upon the size of pellets
- Distribution map of red panda (based on the GPS coordinates of direct sighting/indirect sign)

Estimation of Abundance

Abundance refers to the relative population of a species in a particular area at a specific time. Since red pandas are very elusive animals, it is hard to estimate their population size through direct sightings. Therefore, a standard method to suggest their relative abundance is to calculate the estimated rate of encountering their signs (number of signs/per km). Besides, the genotyping of these samples could also be performed to estimate accurate abundance.

Relative abundance helps compare the population status in two or more communities. It also helps to assess the change in population size and population structure in locales and time. Similarly, abundance estimations help to assess the impact of a particular threat, such as forest fire or bamboo flowering and die-off events. Abundance estimations can also help to assess the effectiveness of a conservation program and help the wildlife conservationist to decide when and where to focus management interventions.

Systematic sampling is essential for estimating relative abundance. The key factor during the survey is the length of transect covered, which must be properly noted for each transect. Survey teams use the data collected during presence or absence surveys to estimate the encounter rate of red panda by dividing the total numbers of sign by the total length of the transects in kilometers.

While analyzing abundance data the following two factors are considered:

- Encounter rate (signs/km)
- Distribution across different elevation and forest types

Assessment of Habitat Suitability

The term "habitat suitability" describes the complex environmental factors that affect the ability of organisms to establish and maintain a population. Data recorded in the field is useful in analyzing whether or not the habitat in a particular location can support a red panda population. This analysis can also utilize satellite imageries of that site to determine the size of the study area. In suitable habitat there should be stands of other, similar forest patches that connect via potential corridors to facilitate movement of the red panda. It is important to consider the following parameters when analyzing habitat suitability:

- Preferences in aspect, slope, and proximity to water sources
- Use of substrate, preferred tree species, and height above the ground
- Vegetation composition, canopy cover, Importance Value Index (IVI) of different species, bamboo cover, bamboo density (culm/m^2), and bamboo height

How to calculate Encounter Rate

$$\text{Encounter Rate} = \frac{\text{Total no. of sign}}{\text{Total km transect length}}$$

Research shows that the following habitat conditions are important for red panda (Yonzon et al., 1991; Pradhan et al., 2001; Williams 2006 & Dorji et al., 2011):

- Canopy cover of trees should be more than 32%
- Bamboo cover should be more than 37%
- Average bamboo height should be more than 2.5m
- Average dbh of trees should be more than 30cm
- Presence of other staple diet species; e.g., *Sorbus spp., Schefflera spp., Rubus berries,* etc.
- Presence of nearby water sources

Assessment of Threats and Disturbances

Use consultations with local people and existing field observations to identify the potential threats to red panda. Information recorded on Datasheet 2 helps in analyzing the extent of threats and disturbances. Consider the following factors while assessing and analyzing threats:

- Deforestation status based on the density of tree stumps [in Hectare (ha)]
- Livestock herding impacts based on the density of livestock droppings piles (in ha) and cattle trails, and density of lopped trees (in ha)
- Impact of wildlife poaching, forest fire, development activities, human traffic, landslides, etc.
- Proximity to settlements and rural roads or trekking trails

Estimating Red Panda Populations

Population estimation is very difficult in red panda studies. It is impractical to use a direct census method because of the amount of money and time needed to track this elusive species. Direct census would be practical only for a relatively small area, depending on the available resources. Before a census starts, demarcate the entire area of interest on map and GPS as well. The trackers should start tracking from one end, covering the entire elevation range with parallel transects.

Each tracker should have a digital camera to take good quality pictures when sighting a red panda. The survey should include camera traps installed at appropriate locations frequented by red pandas, such as latrine sites. All photographs, whether from tracker surveys or camera trapping should be compared to identify individuals and get some indication of red panda

movement patterns in the area (Annex 2, Shrestha et al., 2015). Non-invasive genetic techniques, such as collecting faecal samples and hair, can provide estimates of red pandas in larger areas. Genotyping may also further validate the findings obtained through camera trapping if both of these different methods could be integrated systematically.

Part 2: Community-Based Red Panda Monitoring (Citizen Science)

Engaging local people is crucial for the success of a conservation program. Local people have the best knowledge of their forests and wildlife so involving communities from the outset, by having them physically collect information, builds ownership of the species and their forests (Williams et al., 2011). Ensure the active participation of these local conservation stewards throughout the implementation of every conservation program to elicit the feeling of engagement and contribution towards conservation of their forest resources. Community-based monitoring programs help local forest users to build the perception that a forest can be of longer-term benefit if used sustainably, and to appreciate the inherent aesthetic value of natural ecosystems and the wildlife species. However, it is important to give communities insights into science-based conservation practices.

This Citizen Science protocol aims to build the capacity of local stewards to use structured, science-based techniques to assess the status of red panda populations, including abundance, habitat quality, and conservation threats. Empowering local forest users with science-based monitoring techniques not only educates them on issues of red panda conservation, it motivates them to sustain the initiative. This outcome was seen in eastern Nepal, where through the community-based monitoring program, cattle herders changed from being the main threat to red pandas and their habitat, to being ardent supporters of saving red pandas and their habitat (Williams et al., 2011).

A wildlife monitoring program demands huge resources in terms of time, money, and effort. Therefore, it should be designed carefully so that the program answers the relevant questions effectively, while being cost-effective and sustainable. Having the protocol helps maintain uniformity in activities to monitor red panda including site selection, and the collection, management, and analysis of data. Uniformity in the monitoring program allows its effectiveness in different locations to be compared and evaluated.

Monitoring Objective

To monitor the status and trends of red panda population abundance, habitat quality, and conservation threats over time using community information (citizen science).

Monitoring Site Selection and Transect Establishment

- Identify potential habitat and conduct surveys to confirm the presence/absence of red panda (methodology described in Part 1) by involving local people.
- Demarcate the confirmed red panda habitat on topographic maps and randomly select the potential sites for long term monitoring.
- Consult with the target community CFUGs and Buffer Zone Community Forest User Groups (BZCFUGs). Ask each group to select at least two different blocks demarcated with some natural or artificial features (e.g., streams, gorge, cliff, buildings, roads, transmission lines, etc.) for monitoring.
- Mark 1km long elevational transects along each contour line within each selected grid at intervals of 100 m. Mark each transect at the start point, end point, and at every 100m interval. Ensure that notations used for marking are uniform; e.g., the notations used to mark a transect at an elevation of 2,600m will be:
    - Start point (T1-2, 600m-0)
    - At every 100m distance (T1-100m, T1-200m.....T1-900m)
    - End point (T1-2,600m-1km)
- Use aluminum tags to mark transects on trees.
- Locate one circular plot for vegetation sampling at the mid-point (T-500m) of each transect by nailing a wooden peg to mark the plot site.

Monitoring Season and Frequency

Conduct monitoring four times a year, once in every season (Table 4). Schedule specific dates to conduct the monitoring at the same time in all sites.

Table 4: Schedule recommended for monitoring

Season	Months (Recommended for monitoring)	Description
Winter	January	This is the mating season of red panda when there are higher chances of seeing them in pairs. The monitors should take precautions so that the mating couples are undisturbed while observing them.
Summer	April	This is when poachers are active. Monitoring in this season helps in recording evidence of poaching and in dismantling the traps/ snares set for wildlife, including red panda.
Monsoon	July	This is the breeding season of red panda with good chances of identifying nesting sites as mothers spend most of her time around the nest. These observations help conserve nesting sites/ trees.
Post Monsoon	October	The cubs come out of their nest, so their droppings can be seen during this season. This will help determine the population structure and productivity.

What to Monitor?

Monitoring should assess the following:

- Status of red panda sightings, abundance, and population structure
- Red panda habitat quality
- Disturbances and threats

Therefore, the monitoring should focus on the following observation types:

- Direct sightings of red panda
- Indirect signs (droppings, foraging marks, footprints, and scratch marks)
- Direct sighting and indirect evidence of the presence of other wildlife
- Size of fecal pellets and footprints to distinguish age groups (cubs or adults)
- Vegetation (trees, shrubs, herbs, and bamboo)
- Disturbance and threats (evidence of poaching, forest fire, livestock, dogs, tree stumps, lopped trees, etc.)

Selection of Forest Guardians

Based on the resources available for a monitoring program, engage at least two local people from a CFUG or BZCFUG as forest guardians. Ask the respective community group to nominate people who are familiar with the local topography, flora/fauna, and literate enough to be capable of completing data sheets and handling equipment (e.g., GPS, Vernier Calipers, etc.). Give priority to livestock herders and ex-poachers meeting these criteria.

Training for Forest Guardians

Train all the monitors before deploying them in the field for monitoring. The training organized for them must at least include the following:

- General introduction of red panda status, ecology, conservation threats, and conservation importance
- Legal provisions concerning conservation of red panda and other associated wildlife
- Monitoring techniques, including handling equipment and recording data

Based on the quality of data they provide, provide the guardians with frequent feedback for the further improvement of their skills.

Permission from Government

Obtain permission from the relevant government agencies, including Department of National Parks and Wildlife Conservation (DNPWC) and Department of Forest (DOF) and their field offices. Likewise, collaborate with the relevant Buffer Zone User Groups (BZUGs) and CFUGs to initiate the monitoring.

Equipment

The equipment required for each guardian or team includes a GPS, camera (ideally waterproof), binoculars, measuring tape, dBH tape, vernier caliper, first aid kit, notebooks, pens and batteries.

Monitoring Techniques

- Make a checklist of all the necessary equipment and field gear, and ensure that all necessary gear is taken to the field.
- Start the monitoring from one end of each transect. Scan all the trees and substrates for indirect signs (upto 25m on both sides of the transect) and direct sightings within the range of sight while walking along each transect.
- Look for any sign left in the past three months on the substrate where signs or sightings were recorded during previous monitoring. Take notes of the observations in notebooks. Records of the number of pellets and their location or substrate will be helpful during successive monitoring. Ensure that the GPS is working properly (accuracy should be about 3m) before taking the notes of GPS coordinates and elevation. Ensure that the GPS is set to metric units and records degrees as 'decimal' in WGS84.
- Record the observations made during the monitoring on Datasheet 3, and record notes in the notebook.
- Establish a sampling plot at the permanently marked locations along each transect. Record the information on habitat suitability on Datasheet 4, according to the description provided in the previous section on sampling plots. Take care not to damage the vegetation inside the plots when sampling.
- Repeat the process for other transects.

Data Management and Analysis

Compile and present the data collected during monitoring in summary sheets for further analysis as follows:

Status of Red Panda Sighting and Abundance and Population Structure

- Use Datasheet 5 to compile data recorded on Datasheet 3 for each transect. Use a separate Datasheet 5 for each grid.
- Use the number of direct sightings, indirect signs, substrates and trees observed with signs,and the average elevation and distance to water sources calculated in each datasheet for the respective transects in Datasheet 5.
- Use information on preferred tree species to local forest users to provide insights for focusing conservation interventions.
- Note that increases (or decreases) in the numbers of direct sightings and the abundance (including that of cubs and adults) over time indicates growing (or declining) populations.

Habitat Suitability

- Use Datasheet 6 to compile information recorded on Datasheet 4 from different sampling plots of a particular grid.
- Add the values of each variable at the bottom of the datasheet, and use the mid-value for the range of vegetation cover, including trees, shrubs, herbs, and bamboo.
- Note that increases (or decreases) in the value of vegetation cover in successive monitoring, and in the height and density of bamboo indicate improving (or declining) quality of habitat.
- Note that increases in the density of wildlife dropping piles over time indicate that the habitat suitability for associated wildlife is improving.

Disturbances and Threats

- Use Datasheet 7 to compile information recorded on different transects of a particular grid.
- Replace the percentage values with the impact scale range. For example, replace 0 with 0; 0-25% with 1; 26-50% with 2; 51-75% with 3, and 76-100% with 4, which is the most serious impact.
- Add the values of each variable under the column (Total Value).
- Note that the total impact value of specific threat or disturbance provides crucial information for local forest users to determine if a further intervention is necessary or not. Different variables have impacts on the survival of red panda. Therefore, specific values show the acceptance level of each impact. A total value upto '1' indicates the level of acceptance for forest fire, rural road or trekking trail, cattle trail, landslide, settlement, bamboo die-off, solid waste, and livestock. The value should be '0' for other variables including presence of dogs, poaching signs, lopped trees, and tree stumps. Any variables exceeding these limits indicate a need for further interventions to address them.

Record Keeping and Reporting

The survey team should properly keep all the datasheets used during monitoring and data analysis for future records. Each CFUG or BZCFUG should submit copies of the Datasheets 5, 6, and 7 to relevant government authorities immediately after conducting the monitoring. Keeping these records is crucial in evaluating and monitoring the efficacy of monitoring team.

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Section III: Annexes

Annex 1: Data sheets

Data Sheet 1: Red Panda Presence/Absence Survey

District:	VDC:	Protected Area:	Community Forest:
Grid No.:	Sub Grid No.:	Transect No.:	Transect Length (m):
GPS Coordinates — Start	N	End	N
	E		E

S.N.	Types of Sign		Number of Pellets in Dropping Piles	Dropping/Foot Print (mm)		Geographic Location		Elevation (m)	Substrate (Ground/ Rock/ Tree/ Log)	Tree Species	Distance to nearest (m)			Remarks
	Direct Sighting/ Number	Indirect (Dropping Piles/ Feeding sign/ Foot Print/ Scratch Mark/ Body Parts)/ Number		Length	Diameter/ Width	N	E				Settlement	Livestock shed	Water sources	

Surveyors: -Team Leader:	Assistants:
	1.
Date:	2.

Data Sheet 2: Habitat Suitability and Threat Survey

District:_____	VDC: _____		Protected Area: _____		Community Forest: _____		
Grid No.:___	Sub-Grid No.: ___	Transect No.: ___	QuadratType:- Sign/Non-Sign	GPS Coordinates: N_____E_____		Elevation (m):.____	
Distance to (m)	Water Sources: _____		Goth: _____	Other Physical Infrastructures: _____			
Number of	Logs: ___	Tree Stumps: ___	Looped trees: ___	Snag trees: ___	Livestock dropping: ___	Wildlife dropping: ___	Poaching Sign: ___

S.N.	Tree Species	Height (m)	dBH	Canopy Cover

S.N.	Other Vegetations	Height (m)	Number	Cover
	Shrubs			
	Bamboo			
	Herbs			
				0% / 0-25% / 26-50% / 51-75% / 76-100%

Threat/Disturbance Factors	Impact Scale*					Remarks
	Absence	Low	Medium	High	Extremely High	
Forest Fire						
Rural Road/Trekking trail						
Cattle trail						
Landslide						
Settlement						
Solid waste						
Bamboo Die off						

*Impact Scale: Absence = 0; Low = 0-25%; Medium = 26-50%; High = 51-75%; Extremely High = 76-100%

Surveyors:	Assistants:
Team Leader: _____	1. _____
Date:	2. _____

Data Sheet 3: Red Panda Sign Monitoring

District: _____	VDC: _____	Community Forest: _____	
Grid No.: _____	Transect No.: _____		

S.N.	Types of Sign		Number of Pellets in Dropping Piles	Dropping/Foot Print (mm)		Geographic Location		Elevation (m)	Substrate (Ground/ Rock/Tree/ Log)	Tree Species	Remarks
	Direct Sighting/ Number	Indirect (Dropping Piles/ Feeding sign/Foot Print/ Scratch Mark/ Body Parts)/ Number		Length	Diameter/ Width	N	E				

Other Wildlife

S.N.	Name of Wildlife	Types of Sign		Number	Geographic Location		Elevation (m)	Remarks
		Direct Sighting	Indirect Signs (Dropping/ Feeding sign/ Foot Print/Scratch Mark/Body Parts)/ Calls)		N	E		

Name of Monitors: 1. _____	2. _____
Date:	

Data Sheet 4: Vegetation and Threat Monitoring

District:_____		VDC: _____		Community Forest: _____				
Grid No.:___	Transect No.: ___	GPS Coordinates: N_____E_____			Elevation (m):.____			
Distance to (m)	Water Sources: _____	Goth: _____	Other Physical Infrastructures: _____					
Number of	Logs: ___	Tree Stumps: ___	Looped trees: ___	Snag Trees: ___				
	Wildlife Dropping: ___	Livestock dropping: ___	Poaching Sign: ___					

S.N.	Tree Species	Height (m)	dBH	Canopy Cover
				0% / 0-25% / 26-50% / 51-75% / 76-100%
S.N.	Other Vegetations	Height (m)	Number	Cover
	Shrubs			
				0% / 0-25% / 26-50% / 51-75% / 76-100%
	Bamboo			
				0% / 0-25% / 26-50% / 51-75% / 76-100%
	Herbs			
				<0% / 0-25% / 26-50% / 51-75% / 76-100%

Threat/Disturbance Factors	Impact Scale*					Remarks
	Absence	Low	Medium	High	Extremely High	
Forest Fire						
Rural Road/Trekking trail						
Cattle trail						
Landslide						
Settlement						
Solid waste						
Bamboo Die off						
*Impact Scale: Absence = 0; Low = 0-25%; Medium = 26-50%; High = 51-75%; Extremely High = 76-100%						
Name of Forest Guardians: - 1. _____					2._____	
Date:						

Data Sheet 5: Monitoring Data Analysis (Red Panda status)

District:_____	VDC: _____	Community Forest: _____
Grid No.: ____	Total Transect Length: _____km	

Transect Number (C1)	Number of		No. of dropping piles		Number of signs on substrates				Name of Tree Species with highest sign (Specify the number of signs) (C11)
	Direct Sighting (C2)	Indirect Signs (C3)	L=<35mm & D=<17mm (C4)	L=>35mm & D=>17mm (C5)	Ground (C6)	Rock (C7)	Tree (C8)	Log (C9)	
1									
2									
3									
4									
5									
6									
Total									

Abundance: Total Indirect Signs (C3)/Total Transect length
Abundance of dropping piles of Cub: Total no. of dropping piles (C4)/Total Transect length
Abundance of dropping piles of Adult: Total no. of dropping piles (C5)/Total Transect Length
Preferred substrate: Substrate with Highest Total number of four types (C6, C7, C8 and C9)
Preferred Tree species: Name of tree with the highest sign

Other Wildlife

Grid No. _____

S.N.	Name of Wildlife	Number of		Remarks
		Direct Sighting	Indirect Signs	
Total				

Data Sheet 6: Monitoring Data Analysis (Habitat suitability)

District: _____	VDC: _____	CF: _____
Grid No.: _____		

Quadrat Number (C1)	Number of Wildlife Dropping Piles (C2)	Cover			Bamboo		
		Trees (C3)	Shrubs (C4)	Herbs (C5)	Height (C6)	Number (C7)	Cover (C8)
1							
2							
3							
4							
5							
Total							

Density of wildlife droppings (no/ha) =	Total of C3/314.28*no. of quadrats) X 10000
Cover of Trees =	Total of C3/No. of quadrats
Cover of Shrubs =	Total of C4/No. of quadrats
Cover of Herbs =	Total of C5/No. of quadrats
Bamboo	
Average Height (m) =	Total of C6/Total of C7
Density (culm/m2) =	Total of C7/28.26*No. of quadrats
Cover =	Total of C8/No. of quadrats

Datasheet 7: Disturbance and Threat Monitoring

District: _____	VDC: _____	CF: _____
Grid No.: _____		

Threat/Disturbance Factors	Impact Value					Total Value
	Q_1	Q_2	Q_3	Q_4	Q_5	
Forest Fire						
Rural Road/Trekking trail						
Cattle trail						
Landslide						
Settlement						
Solid waste						
Bamboo Die off						
	Number					
Poaching Sign						
Logs						
Tree Stump						
Looped Tree						
Livestock dropping						

*Replace Impact Scale with following values

0	with	0	
0-25%	with	1	
26-50%	with	2	
51-75%	with	3	
76-100%	with	4	

Poaching Sign (no/ha):	((Total number of poaching sign/(314.28*no. of quadrats)) X 10000
Logs (no/ha):	((Total number of logs/(314.28*no. of quadrats)) X 10000
Tree Stump (no/ha):	((Total number of tree stumps/(314.28*no. of quadrats)) X 10000
Looped Tree (no/ha):	((Total number of looped trees/(314.28*no. of quadrats)) X 10000
Livestock dropping (no/ha):	((Total number of livestock drooping piles/(314.28*no. of quadrats)) X 10000

Key for analysis

Threat/Disturbance Factors	Acceptance Level	Description
Forest Fire	1	Total value beyond this limit demands for further intervention
Rural Road/Trekking trail	1	
Cattle trail	1	
Landslide	1	
Settlement	1	
Solid waste	1	
Bamboo Die off	1	
Logs	1	
Tree Stump	0	
Looped Tree	0	
Livestock dropping	0	
Poaching Sign	0	

Annex 2: Individual identification through photographs

Facial features and its descriptions

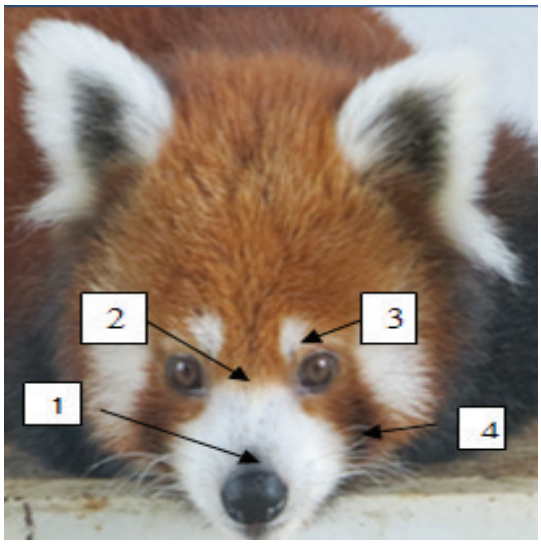
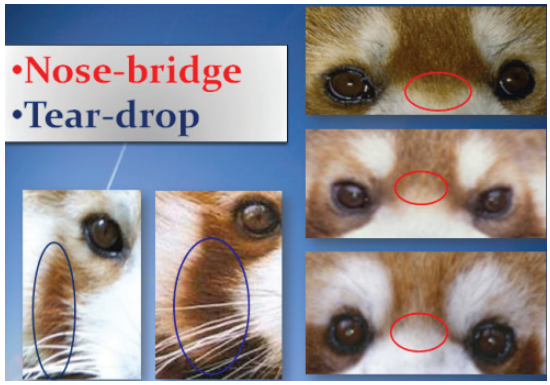
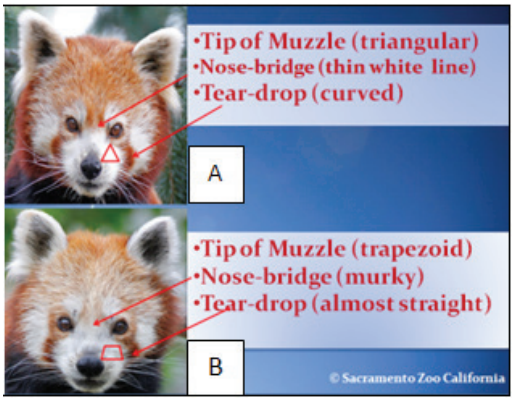
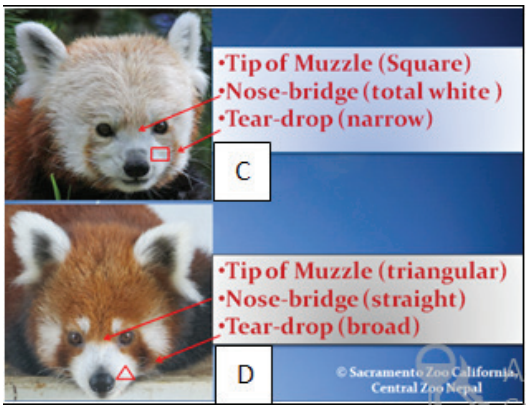
Features	Photographic representation
1. Muzzle tip (Area between eyes and nose) 2. Nose bridge (Area just above nose) 3. Crown (Area just above eyes) 4. Tear drop (Area running down the eyes)	
Nose Bridge – It may be Pointed downwards – It may be Pointed upwards – It may be elongated – It may be blur – It may be indistinguishable – It may be shapeless	
Tear drop: – It may be Thin – It may be Broad – It may be Curved – It may be Straight – It may be indistinguishable – It may be shapeless	
Muzzle tip: – Triangular, – Square – Trapezoid – Any other shape	

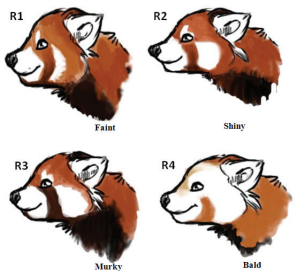
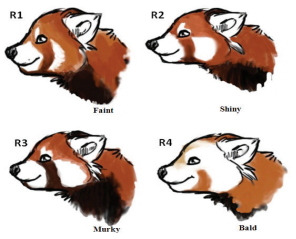
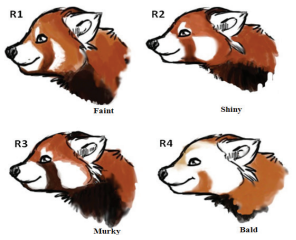
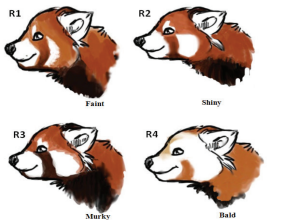
Illustration with Examples

Examples (A) a) Tip of Muzzle: Triangular b) Nose bridge: Thin white line, slightly pointed upward c) Tear drop: Curved (B) a) Tip of Muzzle: Trapezoid b) Nose bridge: Murky (indistinguishable) c) Tear drop: Almost straight	
(C) a) Tip of Muzzle: Square b) Nose bridge: Total white (indistinguishable) c) Tear drop: Narrow (D) a) Tip of Muzzle: Triangle b) Nose bridge: Straight c) Tear drop: Broad	

Morphological features of red panda identification

S.N.	Features	Description
1.	Primary features	
i.	Facial patterns	i) Faint ii) Shiny, iii) Murky iv) Bald
ii.	Nose-bridge	i) Downward pointed ii) Upward pointed iii) Irregular iv) Not visible
iii.	Muzzle tip	i) Square (□) ii) Triangle (△) iii) Trapezoid (⏢) iv) Others
iv.	Tear-drop	i) Narrow ii) Broad iii) Light iv) Dark
v.	Tail rings	Fixed number of light and dark rings (n=12, 13,....18)
2.	Secondary features	
i.	Ear rim	i) Thin ii) Thick
ii.	Ear-core	i) Visible ii) Partly visible iii) Not visible
iii.	Shape of crown	i) Single layered ii) Double layered iii) Not distinct
iv.	Shape of cheek mark	i) Thin ii) Broad iii) Triangular iv) Not distinct
v.	Fluffy white patches	May present on i) Flanks ii) Shoulder iii) Absent
vi.	White, reddish or gingery patch	i) Forelimbs ii) Hindlimbs iii) Claws
vii.	Coloration of rump	i) Dark ii) Light iii) Same that of Flanks

Facial patterns of red panda

Pattern	Features	Pictorial representation
Faint	Thin cheek mark with single layered crown	
Shiny	Cheek mark is broader and shiny	
Murky	Cheek mark is triangular and other marks clearly invisible	
Bald	White pelage coloration starting above the forehead, goes upto the muzzle, extends beyond the nose-bridge to the side of the face and tear-drops, and cheek marks indistinct	

To identify an individual at least three key features are required different from those of previously identified red pandas. Primary and secondary feature that should be examined:

1) Primary features
   - Facial pattern
   - Nose-bridge
   - Muzzle tip
   - Tear-drop
   - Tail rings

2) Secondary features
   - Ear rim
   - Ear core
   - Shape of crown
   - Shape of cheek mark
   - Fluffy white patches
   - Whitish, reddish or gingery patches on limbs and claws
   - Different coloration of rump

In addition to these primary and secondary morphological features there could be some other features which may be useful in identification of individual red panda: e.g., broken tail, incomplete external ear pattern, scars etc.

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