Red Panda (*Ailurus fulgens*) in Nepal
A Population and Habitat Viability Assessment (PHVA) and Species Conservation Strategy (SCS) Workshop

2-6 September 2010

National Trust for Nature Conservation NTNC,
Kathmandu, Nepal

WORKSHOP REPORT

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Convened and Facilitated by:
Rotterdam Zoo/Zoo Outreach Organisation/
CBSG South Asia/CBSG, Europe

In collaboration with the
Conservation Breeding Specialist Group
(CBSG) of the IUCN Species Survival Commission

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31 January 2012

CONSERVATION BREEDING SPECIALIST GROUP

Red Panda (*Ailurus fulgens*) in Nepal
A Population and Habitat Viability Assessment (PHVA) and Species Conservation Strategy (SCS) Workshop

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I. Executive Summary
Red Panda in Nepal: A Population and Habitat Viability Assessment and Species Conservation Strategy (SCS) Workshop

A Population and Habitat Viability Assessment (PHVA) and Species Conservation Strategy (SCS) Workshop for the Red Panda (*Ailurus fulgens*) in Nepal was held from 2-6 September 2010, in the offices of the National Trust for Nature Conservation, NTNC, in Kathmandu. This was one of the first PHVAs to incorporate elements of the IUCN Species Conservation Strategy approach into the workshop process developed by the Conservation Breeding Specialist Group (CBSG).

The workshop was organized by Rotterdam Zoo of The Netherlands, Zoo Outreach Organization of Coimbatore, India and National Trust for Nature Conservation of Kathmandu, Nepal. It was hosted by Government of Nepal, Department of National Parks and Wildlife, Department of Forest, and the National Trust for Nature Conservation, NTNC. The *PHVA* was facilitated by a joint team of CBSG South Asia and CBSG Europe. Funding was provided by WWF Germany, Rotterdam Zoo and members of the European Association of Zoos and Aquariums (EAZA).

Workshop participants included representatives of three range countries – Nepal, India and Bhutan as well as from USA and Europe. The vision expressed by the participants was to “Secure viable populations of Red Panda distributed in contiguous natural habitat throughout the Himalaya regardless of national boundaries where this flagship species brings benefits to the region and is valued and protected by all stakeholders”.

One working group focused on the status and distribution of the wild population and used GIS technology to map the confirmed and possible occurrence of Red Pandas in Nepal. They identified 11 subpopulations and concluded that the meta-population was likely to hold roughly between 230 to 1060 individuals.

A second working group developed a Vortex computer model, which helped to establish that the majority of the subpopulations are so small that they have a high probability of extinction, even in the absence of human threats. Larger subpopulations also have a high risk of extinction in the short to medium term if current levels of threat persist.

A third working group identified the threats and prioritized them for each of six regions.

All working groups developed goals, objectives and concrete actions, taking account of the vision and all the information gathered in the meeting. These actions will provide the first steps towards achieving the vision for this flagship species of the Himalaya.

The Workshop Process
CBSG’s PHVA and Strategic Planning workshop processes provide an objective environment, expert knowledge, and neutral facilitation that support the sharing of information across institutions and stakeholder groups, fostering agreement on the issues and information, and enabling stakeholder groups to make useful and practical management recommendations for the taxon and habitat system under consideration. This approach has been successful in unearthing and integrating previously unpublished information that is frequently of great value to the decision-making process. This interactive and participatory workshop approach supports and promotes effective conservation by fostering the creation of species management plans and the political and social support of the local people needed to implement these plans. In addition, PVA simulation modeling is an important tool in this process, and provides a platform for testing assumptions, data quality, and alternative management scenarios.

Red Panda, Gorlitz Zoo, Germany. © Axel Gebauer

Kangchenjunga landscape, Sikkim, West Bengal and Nepal triangle viewed from Maenam WLS, Sikkim, India.

Overview of the Population and Habitat Viability Assessment (PHVA) and a Species Conservation Strategy (SCS)

Kristin Leus and Sanjay Molur

This workshop is one of the first times some new approaches have been integrated into the "traditional PHVA process". These new approaches involved conservation planning as related in the Species Conservation Planning handbook developed in 2008 by the IUCN SSC Species Conservation Planning Task Force. The Task Force was chaired by Dr. Robert C. Lacy, then Chair of CBSG, with members and chairs from many other SSC Specialist Groups (IUCN/SSC 2008). The section below provides information on the history and philosophy of the PHVA process, of the SSC Species Conservation Planning approach and the actual process used during the Red Panda PHVA workshop in Nepal.

Population and Habitat Viability Assessment (PHVA) workshop process

The PHVA workshop evolved more than 20 years ago from the process of Population Viability Analysis using population modeling computer software packages and the need for a participatory, multi-disciplinary, scientific methodology for evaluating scenarios surrounding declining species and populations. Dr. Ulysses S. Seal, then Chair of the Conservation (then Captive) Breeding Specialist Group and his Executive Director, Dr. Thomas J. Foose together developed the PHVA process which is effectively a Population Viability Analysis (PVA) integrated with facilitated social interaction between all kinds of stakeholders and has the ability to serve as a conservation plan. The PHVA includes habitat as well as population concerns and a range of other considerations (such as socio-economic factors etc.) while creating a plan or strategy to save a species.

The CBSG PHVA Workshop process is based upon biological and sociological science. Effective conservation action is best built upon a synthesis of available biological information, but is dependent on actions of humans living within the range of the threatened species as well as established national and international interests. There are characteristic patterns of human behaviour that are cross-disciplinary and cross-cultural and that affect the processes of communication, problem-solving, and collaboration: 1) in the acquisition, sharing, and analysis of information; 2) in the perception and characterization of risk; 3) in the development of trust among individuals; and 4) in 'territoriality' (personal, institutional, local, national). Each of these has strong emotional components that shape our interactions. Recognition of these patterns has been essential in the development of processes to assist people in working groups to reach agreement on needed conservation actions, collaboration needed, and to establish new working relationships. Frequently, local management agencies, external consultants, and local experts have identified management actions. However, an isolated narrow professional approach that focuses primarily on the perceived biological problems seems to have little effect on the needed political and social changes (social learning) for collaboration, effective management and conservation of habitat fragments or protected areas and their species components. CBSG workshops are organized to bring together the full range of stakeholders with a strong interest in conserving and managing the species in its habitat, or the consequences of such management.

One goal in all workshops is to reach a common understanding of the state of scientific knowledge available and its possible application to the decision-making process and to needed management actions. We have found that the decision-making driven workshop process with risk characterization tools, stochastic simulation modelling, scenario testing, and deliberation among stakeholders is a powerful tool for extracting, assembling, and exploring information. This process encourages developing a shared understanding across wide boundaries of training and expertise. These tools also support building of working agreements and instilling local ownership of the problems, the decisions required, and their management during the workshop process. As participants appreciate the complexity of the problems as a group, they take more ownership of the process as well as the ultimate recommendations made to achieve workable solutions. This is essential if the management recommendations generated by the workshops are to succeed. CBSG's interactive and participatory workshop approach produces positive effects on management decision-making and in generating political and social support for conservation actions by local people.

Traditional approaches to endangered species problems have tended to emphasize our lack of information and the need for additional research. This has been coupled with a hesitancy to make explicit risk assessments of species status and a reluctance to make immediate or non-traditional management recommendations. The result has been long delays in preparing action plans, loss of momentum, and dependency on crisis-driven actions or broad recommendations that do not provide useful guidance to the managers. The CBSG PHVA workshop process recognises that the present science is imperfect and that management policies and actions need to be designed as part of a biological and social learning process. The workshop process provides a means for designing management decisions and programs on the basis of sound science while allowing new information and unexpected events to be used for learning and to adjust management practices.

During the PHVA process, participants work in small groups. Each working group produces a report on their topic, which is included in the PHVA document resulting from the meeting. A successful workshop depends on determining an outcome where all participants, coming to the workshop with different interests and needs, “win” in developing a management strategy for the species in question. Local solutions take priority – workshop recommendations are developed by, and are the property of, the local participants.

The use of stochastic simulation modelling in the PHVA process

Stochastic simulation modelling is an important tool as part of the process and provides a continuing test of assumptions, data consistency, and of scenarios. A stochastic population simulation model attempts to incorporate the uncertainty, randomness or unpredictability of life history and environmental events into the modelling process. Events whose occurrence is uncertain, unpredictable, and random are called stochastic. Most events in an animal’s life have some level of uncertainty. Similarly, environmental factors, and their effect on the population process, are stochastic – they are not completely random, but their effects are predictable within certain limits. Simulation solutions are usually needed for complex models including several stochastic parameters. There are many reasons why simulation modelling is valuable for the workshop process and development of management tools, among which:

Population modelling forces discussion on biological and physical aspects and specification of assumptions, data, and goals. The lack of sufficient data of useable quality rapidly becomes apparent and identifies critical factors for further study (driving research and decision making), management, and monitoring. This not only influences assumptions, but also the group’s goals.

Population modelling allows the simulation of scenarios and the impact of numerous variables on the population dynamics and risk of population extinction.

Population modelling facilitates explaining and demonstrating population biological issues to non-biologically oriented groups.

Population modelling explicitly incorporates what we know about dynamics by allowing the simultaneous examination of multiple factors and interactions – more than can be considered in analytical models. The ability to alter these parameters in a systematic fashion allows testing a multitude of scenarios that can guide adaptive management strategies.

Population modelling results can help provide support for perceived population trends and the need for action. It can help managers to justify resource allocation for a program to their superiors and budgetary agencies, as well as identify areas for intensifying program efforts.

Our most commonly used model for use in the population simulation modelling process is a software program called Vortex. Developed by Robert Lacy (Chicago Zoological Society), Vortex is designed specifically for use in the stochastic simulation of the extinction process in small wildlife populations and was developed in collaboration with the CBSG PHVA process. The model simulates deterministic forces as well as demographic, environmental, and genetic events in relation to their probabilities. It includes modules for catastrophes, density dependence, meta-population dynamics, and inbreeding effects. The Vortex model analyses a population in a stochastic and probabilistic fashion. Whenever relevant, other simulation models are used instead of, or in conjunction with, the Vortex model.

IUCN / SSC Species Conservation Strategy

The guidelines presented in the IUCN/SSC Species Conservation Planning handbook were developed through the work of the SSC’s Species Conservation Planning Task Force. At that time initiation of the task force many taxon based specialist groups had developed an Action Plan (the first was published in 1986), but comparatively few species were being saved as a result of the action plans, despite improvements made over the two and a half decades of their existence. While proving to be incredible sources of biological information, their relevance to practical conservation programmes was often not clear. There were many challenges encountered that prevented Action Plans from being as effectively implemented as they might. The output of the work of the Species Conservation Planning Task Force is contained in the Handbook that describes how to develop a conservation strategy for species (be it range-wide, regional, or national; single or multiple species) that is inclusive of all relevant parties and results in rigorously tested and realistic actions that can be monitored, evaluated and adapted. The Handbook provides detailed chapters on the SCS (Species Conservation Strategy) approach, its essential components

(Status Review, Vision, Goals, Objectives, Actions, and associated Targets), and steps involved in developing a SCS. It also contrasts the SCS process with earlier species Action Plan preparation processes and emphasizes the importance of broad-based, participatory processes, such as stakeholder workshops, in all phases of SCS preparation, as a basis for successful implementation.

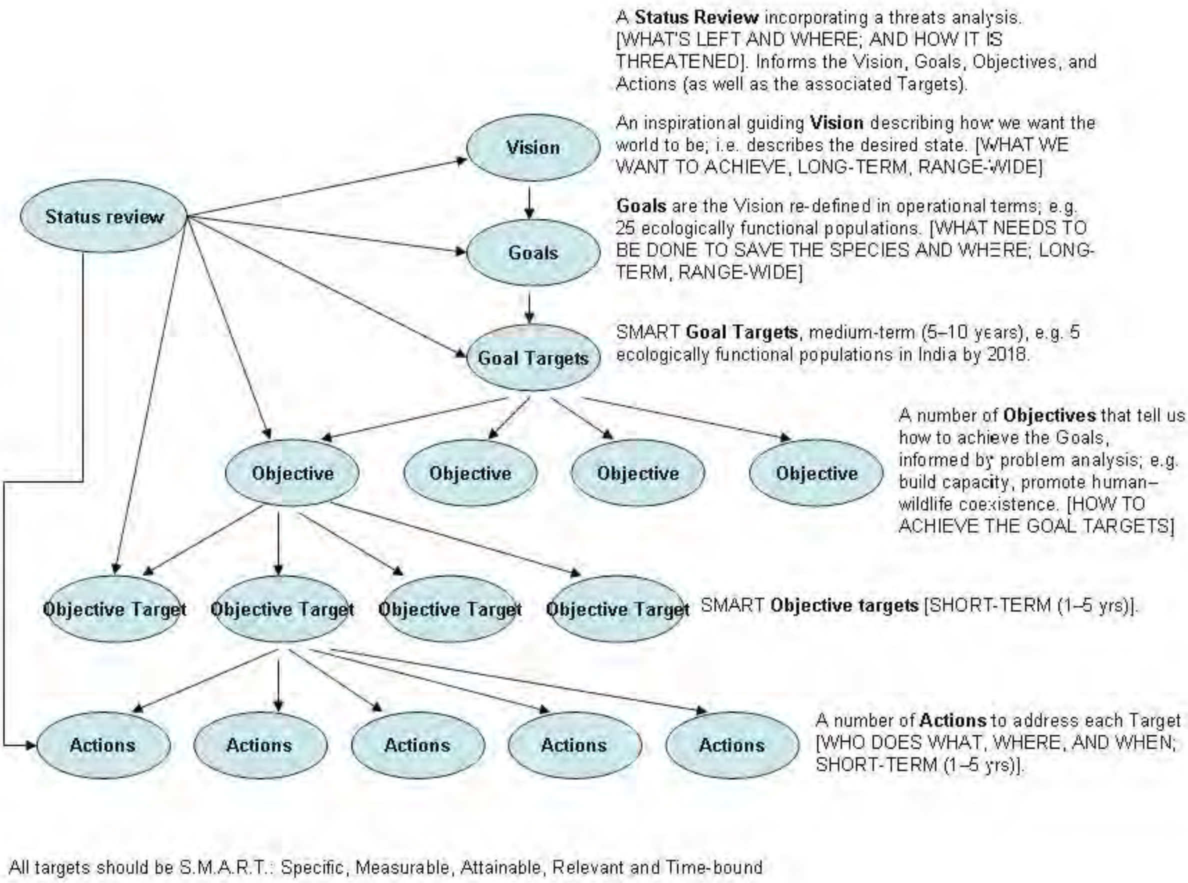
In 2010 the task force was replaced by the SSC Species Conservation Planning Sub-Committee (SCPSC) which represents the SSC mechanism to catalyse effective planning for the conservation of species.

Components of a Species Conservation Strategy (taken from (IUCN/SSC 2008):

A range-wide Status Review incorporating a threat analysis. This Status Review defines the historical and current distribution of the species, states population sizes (or at least gives some measure of relative abundance), evaluates population trends, and identifies losses and threats. The Status Review should, where available, be informed by the appropriate Red List Assessment(s) and supporting documentation from the Red List Unit of the IUCN Species Programme and the Species Information Service (SIS). The completed Status Review should also in turn feed back into the Red List process.

A range-wide (or in some cases a regional) Vision, which is an inspirational description of the participants' desired future state for the species, and a set of associated Goals. These Goals are a rephrasing of the Vision in operational terms to capture in greater detail what needs to be achieved, and where, to save the species. Both the Vision and the Goals have the same geographical and temporal scale. The Goals have a set of associated Goal Targets, which are a medium-term (typically 5–10 years) subset of the Goals. Goal Targets represent those Goals (and/or the necessary steps towards those Goals) that can realistically be achieved over the lifetime of the SCS. Like all targets, Goal Targets should be SMART (*Specific, Measurable, Achievable, Realistic, and Time-bound.)*

A set of Objectives needed to achieve the Goal Targets over the stated timespan. Objectives address the main threats to the species identified in the Status Review process and the other



constraints on achieving the Vision and Goals. In fact, Objectives can be thought of as the inverse of key threats and constraints. Each Objective should also have a SMART Objective Target. Objectives are typically developed using some form of problem analysis (e.g., “problem tree” methods; see Chapter 7). Each Objective is usually associated with one or more SMART Objective Targets (*In a few conservation planning processes, the term "Target" is used to refer to the entity being conserved. This document follows the conventional usage of the concept of targets, which is also that widely used by IUCN).*

Actions to address each Objective Target. Actions are the activities which need to be performed in order to achieve the Objectives, Goals, and, ultimately, the Vision. Recommendations for Actions should ideally provide details of what needs to be done, where, when, and by whom (see Chapter 8). Actions are typically short-term (usually 1–5 years).

The Species Conservation Strategy differs from most earlier approaches in its:

- Requirement to explicitly define what it would mean to save a species,
- evelopment of a plan that is judged sufficient to achieve that end,
- Emphasis on multi-stakeholder participation explicitly included in all steps.

If SCSs and national or local action plans can be agreed by key stakeholders, this would avoid the all-too-common situation where a series of competing action plans and strategies are produced by different organizations, duplicating effort and wasting resources.

In the Red Panda Workshop, elements of both the PHVA process and the SCS provess were used to achieving our objective of saving the species.

Structure of the Red Panda workshop

The general sequence of events during the Red Panda workshop in Nepal was as follows:
In preparation for the workshop, participants were requested to provide publications, unpublished reports, maps and any other briefing materials with information on the status of, and threats to, the Red Panda and its habitat, in Nepal and other range countries. These documents were sent to the participants before the workshop and were available during the workshop.

Opening of the workshop: Opening addresses Introductory presentations on IUCN/SSC CBSG, the workshop process and working agreements, recent and ongoing Red Panda conservation, research and census initiatives and the use of vortex in the PHVA process.

Introduction of workshop participants: all participants were asked to introduce themselves by stating their name, institutional affiliation or the group of people they were representing, and how they thought they might be able to contribute to the workshop.

Vision setting

- Presentation on the meaning of, and the process for, developing a vision (see section IV).
- Facilitated brainstorm session during which the participants identified issues that they felt should be mentioned in the vision statement for conservation of Red Pandas in Nepal (see section IV)
- A small group of volunteers made a first draft of the vision statement during the first workshop session, which was then presented to plenary for comments, following which the final statement was produced and then accepted during the next plenary session.

Presentation by the facilitators on: procedures for working in working groups, the "work field" of each working group and the tasks of each working group.

Three working groups were formed that were each given a series of tasks:

Vision drafting group:
Take the results of the vision brainstorm session and formulate a first draft of the vision. Report back in plenary session. Join other groups once vision statement has been approved in plenary. (see section IV for details).

Wild population working group (see section V for details):
Map the presence of Red Panda in Nepal using GIS maps, indicating some degree of confidence for the presence, and for each discrete area, identify in as much is known:

- Total surface area
- Total surface area in altitudinal range of Red Panda
- Total forest area in altitudinal range of Red Panda
- Total suitable forest area in altitudinal range of Red Panda
- Red Panda density/population size
- Trend of Red Panda population (increasing, decreasing, stable, unknown)

Keeping the vision that was set in mind

- Set long term goals (same time frame as the vision)
- Set shorter term goals (5-10 yrs)
- Identify actions to achieve the goals

Threats working group (see section VI for details):
Brainstorm all current and realistic future threats acting on red panda and their habitat. Draw on GIS map where which threats are active and prioritise these threats. Overlay wild population map and threat map. Try to identify "chains of events" in the threats.

Keeping the vision that was set in mind

- Set long term goals (same time frame as the vision) to alleviate the highest priority threats
- Set shorter term goals (5-10 yrs)
- Identify actions to achieve the goals

Each working group reported back to plenary regularly for comments and feedback, produced a report while working, and provided factual material to the Vortex modeler for input into the computer model. At relevant stages in the workshop, the facilitators presented the expected format for goals and actions.

At this PHVA no separate Vortex working group was formed because hard data for input into the model was scarce and the model could therefore not be very elaborate or intricate. The workshop facilitators carried out the modeling based on input from the literature and from the workshop participants. The results from the model were presented in plenary for comments and feedback and so the results could be used by the working groups during their work. (see section VII for details)

The working group reports are published as part of the overall workshop report. The goal is to develop an effective management strategy for the species that is acceptable by everyone in the workshop. Achieving consensus is of crucial importance to the recommendations being carried out for the benefit of the targeted species and its projected survival. The workshop report is developed from the output of the modeling and other groups by the organizer and facilitators who interact with the participants, the host and attending agency personnel to fine-tune the final report. The Report is brought out by CBSG but the workshop report recommendations are developed by, and owned by the local participants.

Red Panda, Darjeeling Zoo, West Bengal, India. © Axel Gebauer

Intact habitat, Pangolakha WLS, 3,000m asl: mixed conifer forest with a species-rich undergrowth.
© Axel Gebauer

III. Overview of Conservation History of Red Panda

Angela R. Glatston

This Red Panda PHVA was the result of many years planning and is hopefully the first of a series of such workshops that will examine the conservation status of the Red Panda throughout its range. Many people hearing about this series of workshops will probably wonder "Why the Red Panda?", after all this is a rather obscure species which is neither familiar to the general public nor to many professional biologists. The answer to this is that the Red Panda is unique; it belongs to its own family and is the terminal relic of a once flourishing group, a living fossil, which is not closely related to any other extant species. As such, it is both extremely significant biologically and of high conservation value. We are only just beginning to understand its biology and appreciate its adaptations to the very specialized niche of a bamboo-eating carnivore and we still have much to learn. In addition, it is a very attractive, charismatic species and as such has the potential to become a flagship for conservation of the Himalayan region. Unfortunately this unique species is vulnerable to extinction both in captivity and in the wild and it may even disappear before we have a chance to fully understand it. These PHVA workshops are intended as the first step in reversing this risk of extinction in the wild.

The Red Panda is found in the temperate forests of the Himalayan regions of Nepal, Bhutan, Northern India, Myanmar and China. The one possible exception to this is the small population of Red Pandas which have been reported in the semi-tropical forests of Megalaya (Choudhury, 1997), northeastern India. The first PHVA, which is reported here, dealt with the status of Red Pandas in Nepal, which lies at the extreme western end of the Red Panda's range. The next PHVA which is planned for 2012 will focus on China and possibly Myanmar. A last PHVA, for which no date has been agreed, will cover the Red Panda's situation in India and possibly Bhutan.

Prior to this first PHVA, we knew relatively little about the numbers of Red Pandas surviving in the wild. Although we were aware of the habitat requirements and distribution of the species, we remained ignorant of its actual numbers and of the availability of suitable habitat within their range. However, we do know that its habitat is under increasing threat and this is the main reason why this PHVA was so timely. We urgently need to know exactly what is happening to the Red Panda in the wild. Existing indicators would tend to suggest that they are encountering problems; the human population is growing throughout its range and with this growth more forest is being cleared for fuel, agriculture and infrastructure. The expanding human population brings with it dogs which may not only attack pandas and disturb nursing females but also may bring the threat of canine distemper; a disease to which the Red Panda is extremely susceptible. Therefore, if we are to preserve the Red Panda for future generations, we need to know exactly what impact these challenges are having on the population in the wild.

Until now, the best estimate we have had for the numbers of Red Pandas surviving in the wild was that published by Choudhury (2001). He estimated the amount of Red Panda forest habitat available and then used this figure to compute the potential number of Red Pandas living in them. He estimated that there were some 70,000km^2 of potential habitat remaining within the Red Panda's range, much of which did not lie within protected areas. He assumed that about 49% of this forest would be used by Red Pandas and that within these areas utilised, the density of pandas would be of the order of 1 animal per 4.4 km^2. Using these assumptions he calculated that there were about 16,000-20,000 Red Pandas surviving in the wild; 5,000-6,000 in India, 6,000-7,000 in China and the remaining 5,000-7,000 distributed through the rest of the range. Although his figures for China appear to agree with those provided by Wei & Zhang (2011 (1991), his estimates for the rest of the range seem to be optimistic; Yonzon et al. (1991) found only 68 pandas in the 470 km^2 of forest in the Langtang National Park indicating a substantially lower density than that used in Choudhury's calculations. If we consider the Indian population, Jha (2011) reported only 78 animals in the Singhalila National Park, an area of comparatively high Red Panda density while Ziegler et al. estimated there were only about 250-300 individuals surviving in the whole of Sikkim. Even with a potential of 3,000 Red Pandas in Arunachal Pradesh, this only gives us a maximum of 3,500 Red Pandas in India instead of the 5,000-6,000 given in the original estimate. In fact Choudhury himself later revised his estimate, in the IUCN Red Databook (2010), he and Yonzon indicated that they believed the actual number of Red Pandas may be as low as 10,000 individuals.

This figure is particularly worrying in the light of a recent publication by Groves (2011) which suggested we may not be dealing with a single species of Red Panda with two subspecies (the nominate form, *A.f. fulgens,* and the Chinese form, *A.f. styani*) but rather with two evolutionary individual units, i.e. effectively we are dealing with two separate species of Red Panda. A total of

10,000 individuals for these two species combined means we are dealing with very small populations if we are to ensure their survival. In addition the population is not stable, rapid declines have been reported in recent years; Choudhury estimated that the population had declined by 50% over the last 50 years while Wei estimated that the numbers of Red Pandas in China had declined by 40% over the last 50 years and said that if the trend continues the species will be virtually extinct in China by 2050. Many of the threats which lead to the observed declines are still present; much of the forest area inhabited by Red Pandas has been subject to deforestation which reduces and fragments the Red Panda's habitat. Even where the rate of tree loss has been reduced, the damage may have already been done because deforestation changes context of remaining habitat. In addition, poaching, capture and illegal trade remain constant threats to the remaining Red Panda population.

The survival of the Red Panda in the wild will depend very much on human intervention. The conservation initiatives deriving from PHVAs such as this one are an essential part of that process, providing data, indicating areas of research and liaising with local communities. The Red Panda is a very beautiful, appealing species and one that is becoming something of a cultural icon in the modern world. Public interest in the species is growing and we need to harness and exploit this to conserve the Red Panda and its environment. Habitat loss, destruction and fragmentation do not only threaten the Red Panda, these are issues facing the whole of the Himalayan region. The Red Panda is in an exceptional position to function as one of the flagships for Himalayan conservation. If it we can protect it, we will be able to use its uniqueness, charm and growing popularity to generate interest and concern for the whole region.

Red Panda youngster, Gorlitz Zoo, Germany. © Axel Gebauer

IV. Vision setting

By means of a presentation the facilitators explained to the participants that:

A vision statement is a short statement that outlines the desired future state of the species (i.e. describes what it means to "save the species") and is long term and ambitious.

There may be several different components to a vision statement that they might want to consider:

Representation: E.g., think about whether to conserve one population in one place or different populations in different places, because they represent, for example:

- major ecological settings
- genetic differences across the range
- different country regions
- or, because they help minimise extinction due to catastrophes, etc.

Functionality: E.g., think about how functional individual populations should be, and/or how "natural" should they be? E.g.

- sustainable for long term?
- sustainable for the long term without intensive management?
- conserve ecological roles of Red Pandas?
- conserve "typical" natural history characteristics? etc.

Human needs/desires: E.g., think about issues such as: does conservation of Red Pandas need to take into account any human socio-economic or cultural needs/desires/concerns? etc.

The facilitators also presented some example vision statements from other workshops for other species/ taxa and then facilitated a brainstorm session during which the participants identified issues in terms of representation, functionality and human needs/desires that they felt should be mentioned in vision statement for the conservation of Red Pandas in Nepal.

A small working group then worked on a first draft of a vision statement that was brought back to plenary. After a plenary discussion of the first draft and some wordsmithing, the following final vision statement for the conservation of Red Pandas had consensus agreement:

"Secure viable populations of Red Panda distributed in contiguous natural habitat throughout the Himalaya regardless of national boundaries where this flagship species brings benefits to the region and is valued and protected by all stakeholders".

The workshop participants felt that Red Panda conservation in Nepal had to be framed within the overall conservation of the subspecies and therefore the vision should be set at range level. Participants from the neighbouring range countries of India and Bhutan agreed with this vision.

Red Panda pair, Gangtok Zoo, Sikkim, India. © Axel Gebauer

Red Panda habitat, Dothrey forest, Pangolakha WLS, Sikkim, India. © Axel Gebauer

V. Working Group Report: Wild Populations in Nepal

Group members: *Khadga Basnet (Group Leader), Karan Bahadur Shah, Mukesh Chalise, Rinjan Shrestha, Narendra Man Babu Pradhan, Hem Sagar Baral, Brian H. Williams, Alex Gebauer, Kasrishma Kakati, Partha Sarathi Ghose, Jangchu Wangdi, Namgay Dorji , Ramesh Prasad Bhushal, Hemanta Kumar Yadav, Raj Kumar Gurung, Haribansa Acharya, Ram Chandra Nepal, Babu Ram Lamichhane, Arjun Thapa, Sher Singh Thagunna, Ram Nandan Shah, Hari Prasad Sharma, Sabita Malla, and Manij Upadhyaya*

1. Introduction

The Red Panda (*Ailurus fulgens*) serves as an indicator species for the broadleaf and conifer ecoregions of the Eastern Himalaya (Wikramanayake et al. 2001). Despite it's ecological significance and taxonomic uniqueness, very little is known about the species. Observational data collected over the past several decades suggest that the species' population has been in decline, and that threats to its persistence are accelerating. Several countries and organizations have established a framework for long-term conservation of the Red Panda along its entire range (Wei et al. 1999, 2000; Ghose and Dutta 2010; Red Panda Network-Nepal 2010; Williams et al. 2010; Zeigler et al. 2010). However, targeted conservation efforts towards the species and the ecological community it represents cannot be effectively implemented until additional scientific information becomes available.

The Red Panda is considered an endangered species in Nepal and is listed as Vulnerable on the IUCN Red List of Threatened Species (Wang et al. 2008). The species is also included in Appendix I of the CITES and is protected by Nepal's National Parks and Wildlife Conservation Act of 1973. Yonzon et al. (1997) estimated a Red Panda population of 314 in the potential habitat area of 912 km^2. Habitat loss, habitat fragmentation, livestock grazing, predation by dogs, poaching, poor conservation awareness and weak law enforcement are some of the threats to the species.

2. Objectives

The objectives were to:
1. Map Red Panda populations including their (i) potential and (ii) confirmed ranges
2. Set long term goals
3. Set short term goals
4. Recommend priority actions

3. Methods

The wild population working group consisted of protected area (PA) managers and conservation officers working in Red Panda areas representing the Department of National Parks and Wildlife Conservation (DNPWC), Department of Forests (DoF) and National Trust for Nature Conservation (NTNC). The group also included biologists from Tribhuvan University (Central Department of Zoology, Natural History Museum, and Institute of Forestry), The Mountain Institute, Red Panda Network Nepal and WWF Nepal. Participants from neighboring countries, Bhutan and India were also present in the group (Annex 1).

We used an iterative process of group discussion to establish an understanding of the current state of information on the wild Red Panda population in Nepal. We arrived at our conclusions and outputs based on the following methodologies.

3.1 Identification of districts and village development committees (VDC) within each district with confirmed Red Panda distribution / occupancy

Looking at district and village level political maps, based on personal experience, and literature review (e.g., Yonzon et al. 1991; Mahato 2004a,b; Sharma and Belant 2009; Wang et al. 2008; Williams et al. 2010) we identified all of the districts and villages with confirmed Red Panda presence based on both direct observations and indirect evidence.

3.2 Identification of Red Panda habitat at the village and district levels

Using forest cover, forest type and elevation (2,000–4,000 m) as a measure of potential Red Panda habitat, we created a map of all potential Red Panda habitats in Nepal. We overlaid this map with the village level map to produce a confirmed distribution map.

3.3 Assessment of the extent of Red Panda habitat within the confirmed range

We assessed the Red Panda habitat within the confirmed range. With method 3.1, the range of Red Panda was confirmed based on districts but this does not represent all Red Panda habitats. Therefore at a finer scale we measured a VDC-wise extent of the Red Panda habitat. For this we first demarcated the VDC boundaries and subsequently used individual VDC perimeters to scoop out portions of the potential Red Panda habitat within using ArcGIS 9.3 and the area was calculated using the GIS framework. The potential Red Panda habitats for individual VDCs of a given district were summed up to measure the total habitat within that district. The Red Panda habitats were then segregated as confirmed and potential habitats based on the criteria mentioned in points 3.1, 3.2 and 3.3.

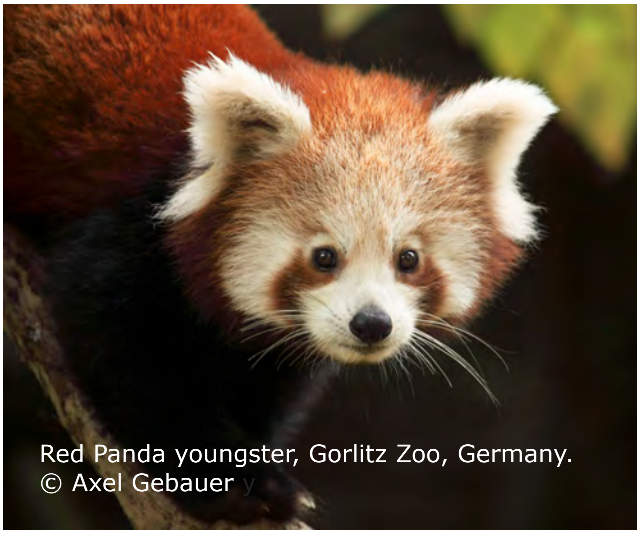
3.4 Division of the Confirmed Red Panda Range in Nepal

We divided the confirmed range into three regions—east, central, and west—and we calculated the probable number of Red Pandas that could occur in these three regions.

Based on the literature on the species and its habitat within the regions, we decided to use different density values to calculate probable numbers of Red Pandas for each of the identified regions. For eastern Nepal, we used density estimate of 1 individual per 1.67 km^2 based on the study carried out in Singhalila National Park (Pradhan et al. 2001). Similarly, we used the density estimate of 1 individual per 2.09 km^2 and 1 individual per 2.90 km^2 for central and western Nepal, respectively based on the study carried out in Langtang National Park (Yonzon et al. 1991).

3.5 Delineation of sub-populations and complexes

Based on the geographical location and landscape characteristics we divided the three regions into 11 subpopulations and then we segregated these 11 subpopulations into six complexes based on the complexes created by the threats working group. For each of the six complexes we calculated the probable number of Red Panda that could occur by dividing the total confirmed habitat by the mean value of all known density estimates (2.50 individuals per square kilometer) published by Yonzon and Hunter (1991), Bahuguna et al. (1998), Pradhan et al. (2001), Williams (2004), Ghose and Dutta (2010), and Ziegler et al. (2010).



Red Panda youngster, Gorlitz Zoo, Germany.
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Table 1. Districts with confirmed Red Panda distribution

	District
1	Taplejung
2	Panchthar
3	Ilam
4	Sankhuwasaba
5	Solukhumbu
6	Ramechap
7	Dolkha
8	Sindhupalchowk
9	Rasuwa
10	Gorkha
11	Manang
12	Baglung
13	Myagdi
14	Rukum
15	Rolpa
16	Mugu
17	Darchula
18	Doti
19	Acham
20	Bajura
21	Bajhang
22	Therathum
23	Nuwakot
24	Pyuthan

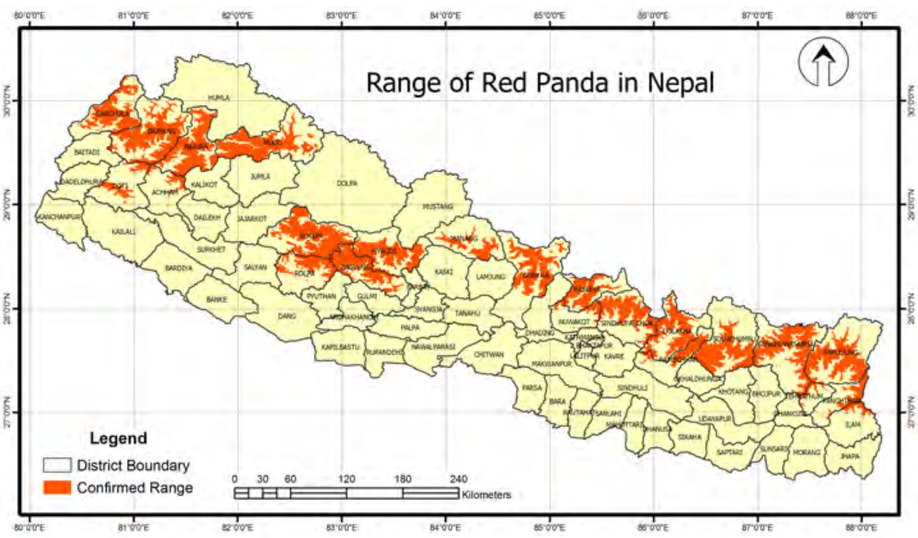


Figure 1. Districts with confirmed range of Red Panda in Nepal

Table 2. Districts with potential Red Panda habitats

	District
1	Bhojpur
2	Khotang
3	Okhaldunga
4	Dhading
5	Lamjung
6	Kaski
7	Mustang
8	Dolpa
9	Jajarkot
10	Humla
11	Jumla
12	Kalikot

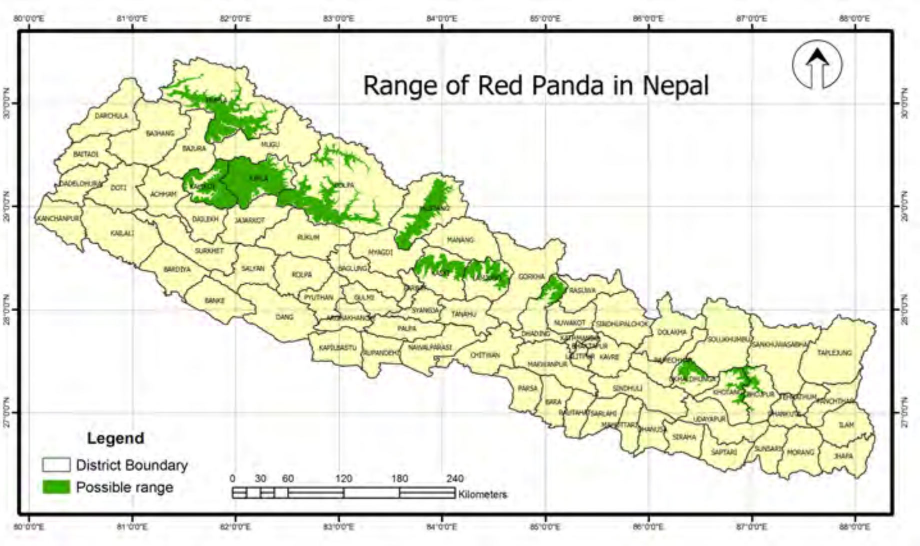


Figure 2. Districts with potential Red Panda habitats

Table 3. The major population complexes and their respective subpopulations

Complexes	Locations / Areas	No. of subpopulations
Eastern Complex		
1. Kanchanjungha Ilam	Ilam, Panchthar, Taplejung	1 – Kanchanjungha
2. Makalu Sagarmatha	MBNP, SNP and surroundings	3 – Sankhuwasabha East, Sankhuwasabha West and Sagarmatha
Central Complex		
3. Langtang Gaurishankar	LNP and GCA	2 – Gaurishankar and Langtang
4. Annapurna Manaslu	ACA and MCA	1 – Annapurna
Western Complex		
5. Rara Dhorpatan	Rara, Dhorpatan and surrounding areas	2 – Rara and Dhorpatan
6. Api Nampa Khaptad	ANCA, KNP and surroundings	2 – Api Nampa and Khaptad

Notes: ANCA = Api Nampa Conservation Area, GCA = Gaurishankar Conservation Area, KNP = Khaptad National Park, LNP = Langtang Nationals Park, MBNP = Makalu-Barun National Park, MCA = Manaslu Conservation Area, SNP = Sagarmatha National Park

4. Results

Districts with confirmed and potential Red Panda range

Based on our discussion we found out that there are 24 districts within Nepal with confirmed Red Panda distribution (Table 1 and Figure 1). In addition to this we identified 12 additional districts that have potential Red Panda habitats (Table 2).

Calculation of confirmed and potential Red Panda habitat for VDCs, subpopulation regions and complexes

Based on our assessments we found that the overall confirmed Red Panda habitat ranges up to 592 km^2 while the extent of the potential Red Panda habitat measures up to 2653 km^2 (Figure 3). The confirmed Red Panda habitat is distributed among 11 subpopulation areas comprising of Kanchanjungha-Ilam Complex subpopulation, Sankhuwasabha East subpopulation, Sankhuwasabha West subpopulation, Sagarmatha subpopulation, Gaurishankar subpopulation, Langtang subpopulation, Annapurna Manaslu Complex subpopulation, Dhorpatan subpopulation, Rara subpopulation, Api Nampa subpopulation, and Khaptad subpopulation (Figures 1-3). These 11 subpopulations were clumped into six population complexes distributed over three regions – East, Central and West (Table 3).

Table 4. Confirmed and possible ranges of Red Panda in Nepal (see 3.1 and 3.2).

	District	VDC Name	Area (km²)
1	Baglung	Bowang	33.18
2	Baglung	Nisi	5.19
3	Dolakha	GauriSankar	24.87
4	Dolakha	Kalingchok	0.44
5	Doti	Khaptad National Park	3.57
6	Gorkha	Sirdibas	4.07
7	Ilam	Jamuna	0.16
8	Ilam	Maimajhuwa	0.99
9	Kaski	Ghandruk	0.20
10	Mugu	Pina	26.07
11	Mugu	Rara(Gilas)	16.17
12	Mugu	Seri	13.39
13	Myagdi	GurjaKhani	9.75
14	Myagdi	Lulang	15.56
15	Panchthar	Chyangthapu	13.52
16	Panchthar	Falaicha	17.67
17	Panchthar	Memeng	7.73
18	Panchthar	Prangbung	7.27
19	Panchthar	Sidin	5.42
20	Ramechhap	Chuchure	10.80
21	Ramechhap	Gumdel	31.77
22	Rasuwa	Bridhim	6.94
23	Rasuwa	Langtang	6.00
24	Rasuwa	Syafru	2.67
25	Rasuwa	Timure	6.34
26	Rasuwa	Yarsa	6.43
27	Rukum	Ranmamaikot	25.29
28	Sankhuwasabha	Chepuwa	48.86
29	Sankhuwasabha	Hatiya	17.15
30	Sankhuwasabha	Keemathnka	0.20
31	Sankhuwasabha	Makalu	35.25
32	Sankhuwasabha	Pawakhola	47.11
33	Sankhuwasabha	Sabhapokhari	10.15
34	Sankhuwasabha	Sisuwakhola	0.01
35	Sankhuwasabha	Yafu	2.61
36	Sindhupalchok	Fulpingkatti	8.85
37	Sindhupalchok	Gloche	0.10
38	Sindhupalchok	Gumba	10.98
39	Sindhupalchok	Motang	8.37
40	Solukhumbu	Beni	13.86
41	Solukhumbu	Chaurikharka	24.11
42	Solukhumbu	Namche	4.18
43	Taplejung	Kalikhola	5.18
44	Taplejung	Lelep	0.50
45	Taplejung	Olangchunggola	0.18
46	Taplejung	Surumakhim	21.49
47	Taplejung	Yamfudin	31.81
			592.41

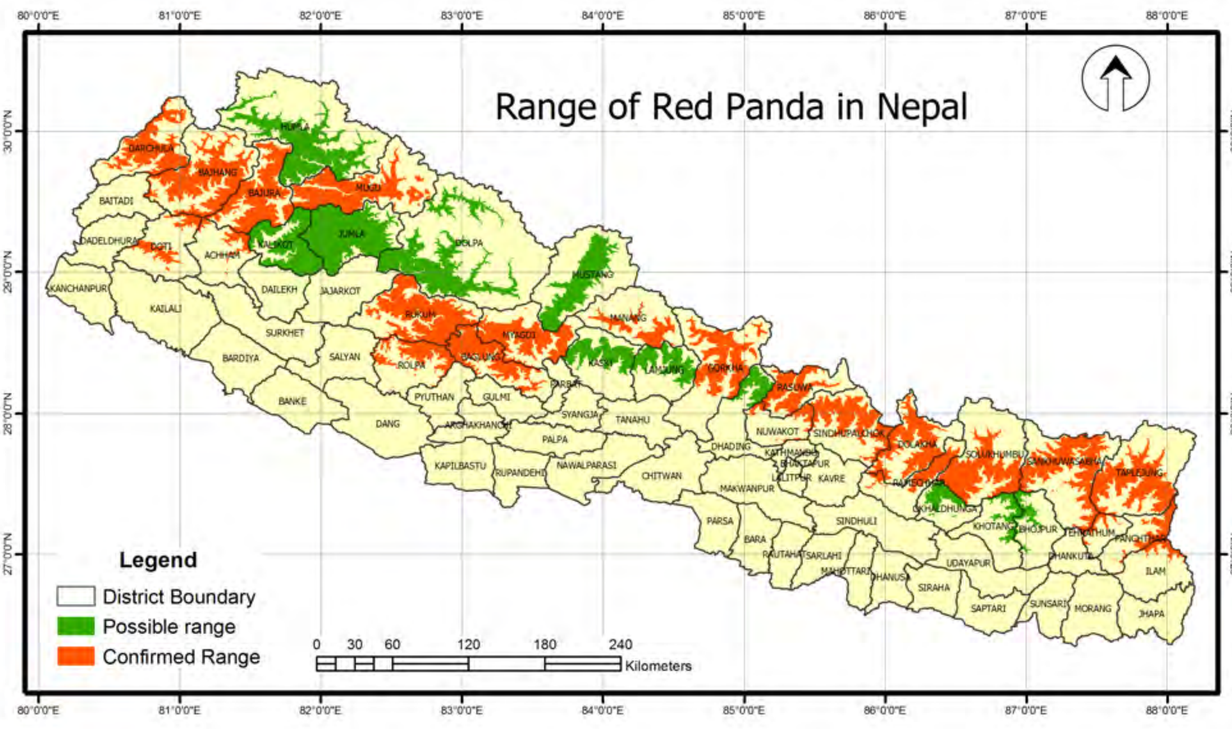
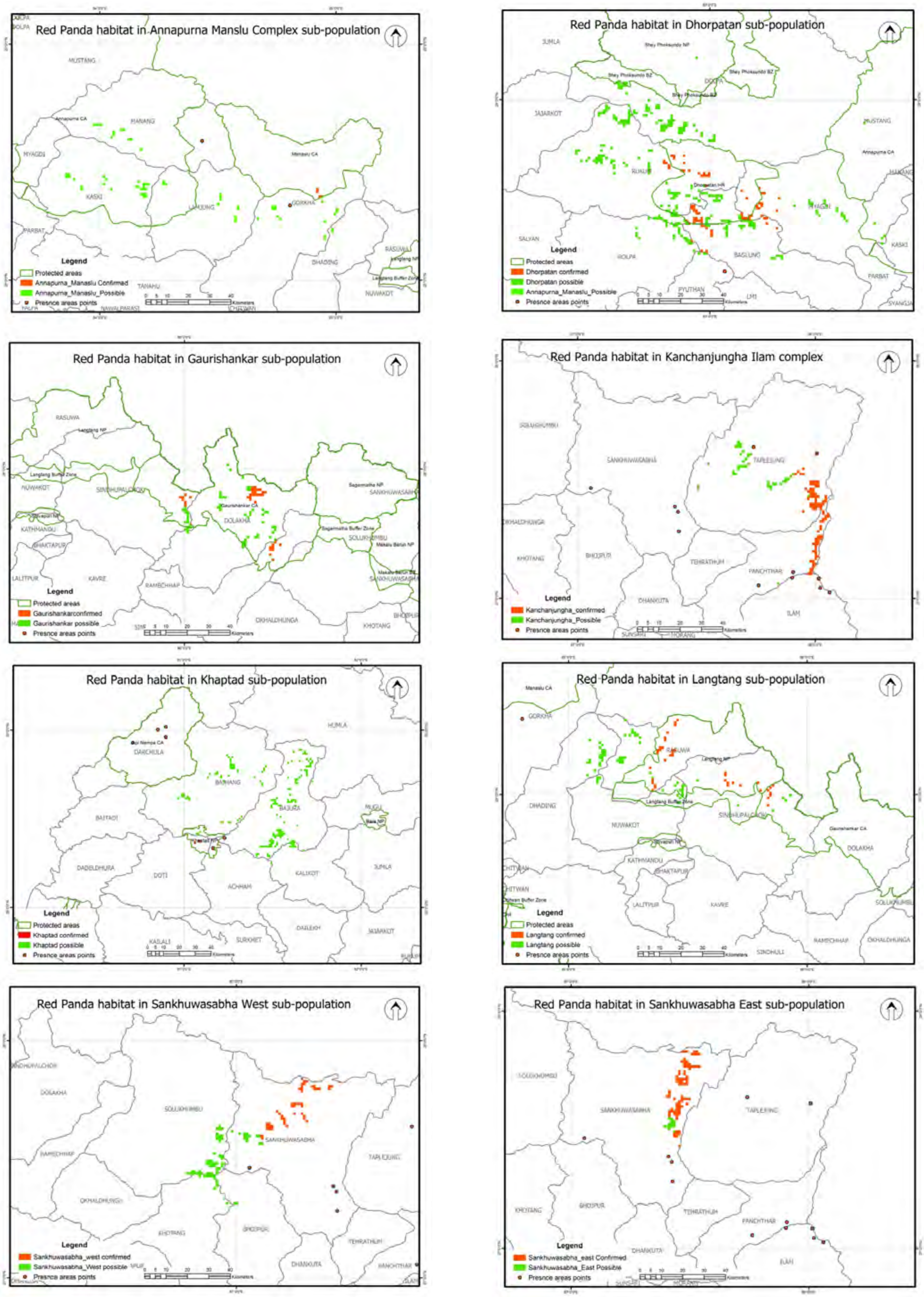


Figure 3. Map showing confirmed and potential range of Red Panda habitat in Nepal

Figure 4. Distribution of subpopulations (a-j)



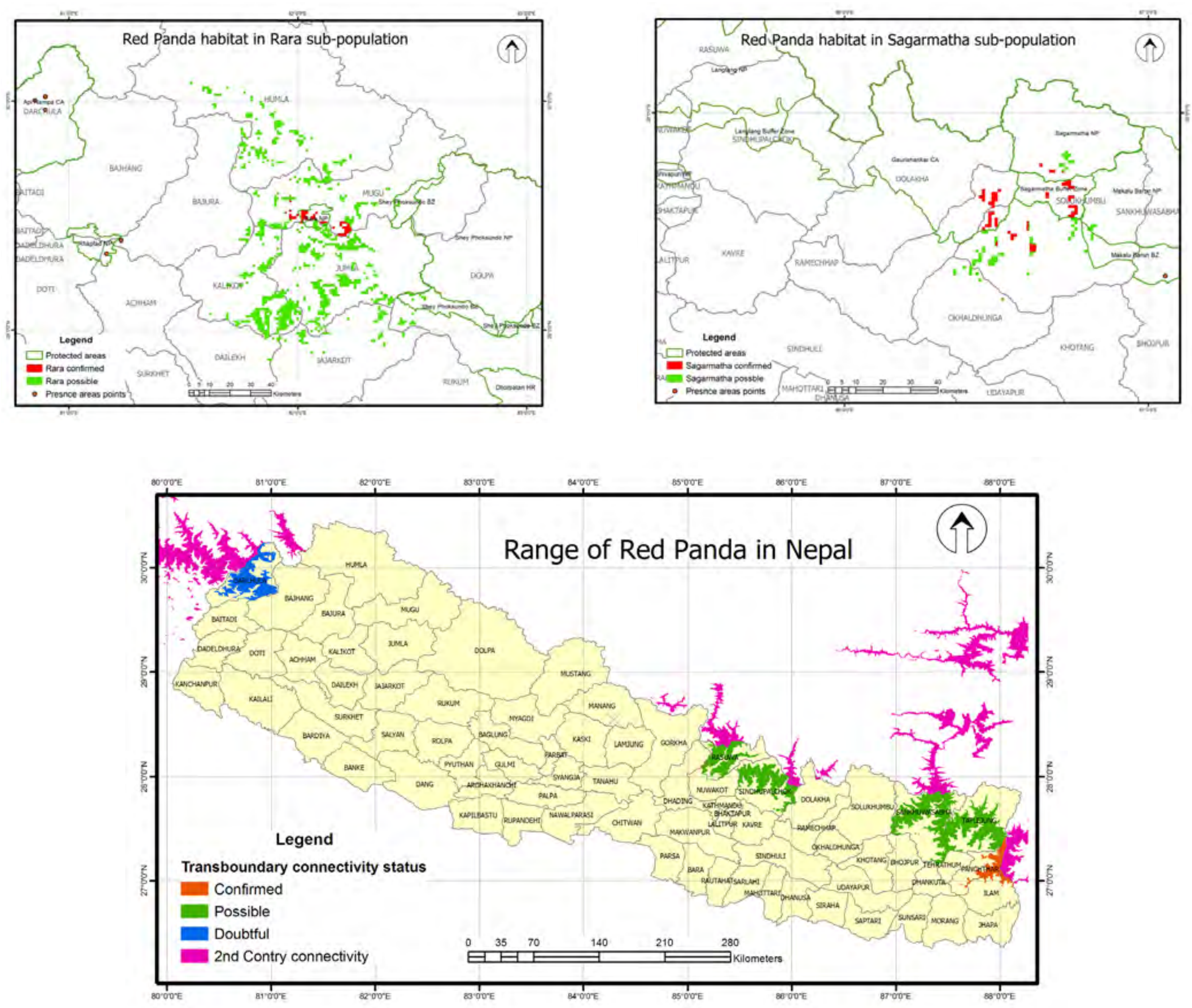


Figure 5. Map showing possible trans-boundary Red Panda habitats

Table 5. The confirmed and possible extents of Red Panda habitat included under each identified subpopulation areas and tentative numbers that could occupy the confirmed and possible habitats under each identified subpopulation area.

	Sub pop	Confirmed	Possible	Density	Population (Confirmed)	Population (Possible)
		Area in sq. km				
1	Annapurnna-Manaslu	4.18	84.23	0.4	2	34
2	Darchula		-			
3	Dhorpatan	89.05	434.92	0.4	36	174
4	Gaurishankar	45.17	114.15	0.4	18	46
5	Kanchanjungha	111.91	160.76	0.4	45	64
6	Khaptad	3.57	211.22	0.4	1	84
7	Langtang	47.83	125.7	0.4	19	50
8	Rara	55.63	1099.16	0.4	22	440
9	Sagarmatha	73.71	150.96	0.4	29	60
10	Sankhuwasabha East	101.88	119.01	0.4	41	48
11	Sankhuwasabha West	59.46	152.02	0.4	24	61
	Total	**592.39**	**2652.13**		**237**	**1061**

Table 6. Red panda populations in the three major regions identified

	East (East of Solukhumbu)	Central (Rukum to Dolakha)	West (west of Rukum)	Total
Area of occupancy (km^2)	315.40	217.79	59.20	592.39
Density (indv/ km^2)	0.60	0.48	0.34	0.53
Population	188.86	104.21	20.41	313.48

Population estimates for Red Panda in Nepal

Population estimates for Red Panda in Nepal was produced for the 11 subpopulation areas, for the six main complexes under which these 11 subpopulations are included and at the three major regions of which these six population complexes are part. These assessments were conducted for the confirmed and possible habitats available for the species.

Significant trans-boundary areas of Nepal

Nepal shares contiguous boundaries with India and China and the Red Panda habitats of this Himalayan country extend into its neighboring countries towards the east in India and towards north it extends into China in small pockets. This makes trans-boundary cooperation to conserve the species an important practice. Since most of the PAs and biodiversity hotspots of Nepal lie along the international boundaries, Nepal has already initiated trans-boundary conservation and cooperation through these PAs and biodiversity complexes (Basnet 2003). In connection to the Red Panda, we have also identified the districts that are important from the point of view of trans-boundary cooperation (Table 7).

Table 7. Districts identified as significant trans-boundary localities

	District	Transboundary
1	Panchthar	Confirmed
2	Ilam	Confirmed
3	Taplejung	Possible
4	Sankhuwasaba	Possible
5	Sindhupalchowk	Possible
6	Rasuwa	Possible
7	Darchula	Doubtful

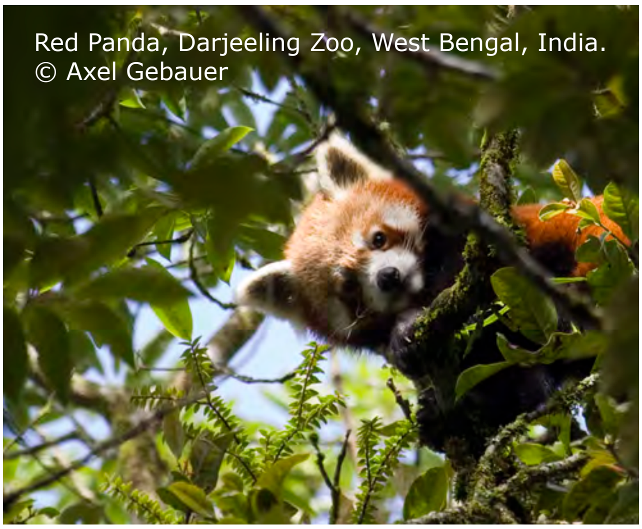
Goals

Long term goals

- Ensure persistence of demographically viable populations in each of the six complexes, namely, Kanchanjungha (1 subpop), Makalu-Sagarmatha (3 subpops), Gaurishankar (2 subpops), Annapurna Manaslu (1 subpop), Rara-Dhorpatan (2 subpops) and Api-Khaptad (2 subpops), managed in a way to maximize retention of gene diversity, by 2040.
- Enhance active participation of local people for protection of Red Panda and its habitat ensuring equitable benefit sharing.
- Strengthen trans-boundary cooperation to ensure Red Panda conservation.

Short term goals

- To create baseline data of all potential habitat and populations by 2016.
- To conduct research on population dynamics and behavioral ecology.
- To minimize threats to Red Panda to enhance its survival
- To improve organizational/institutional capacity for the management of potential Red Panda habitats.
- To develop ownership and ensure equitable sharing of Red Panda conservation benefits to local communities.
- To strengthen trans-boundary cooperation


Red Panda, Darjeeling Zoo, West Bengal, India. © Axel Gebauer

Recommended priority actions

	Activities	Responsibility	Time line	Anticipated out-come	Measurable Products	Cost in NRs (thou-sands)
1. Create baseline data of all potential habitat and populations by 2014						
1.1	Review/adopt pre-PHVA baseline survey protocol	DNPWC, DoF and part-ners (WWF, NTNC, Uni-versities & others)	by 2011	Approved baseline survey protocol	Baseline survey reports	1,000
1.2	Prioritize complexes and survey sites based on threats, ecological significance (least explored)	DNPWC, DoF, WWF, NTNC, Universities & others	by 2012	Complexes and survey sites iden-tified	Maps and re-ports	500
1.3	Conduct surveys (habitat and popula-tions)	DNPWC and partners (WWF, NTNC, Universi-ties, & other partners)	2012- 2014	Confirmation of Red Panda occur-rence & popula-tion status	Reports	9,000
1.4	Information dissemi-nation	DNPWC and partners (WWF, NTNC, Universi-ties, & others partners	2014	Workshops, awareness cam-paign	Workshop re-ports, articles and brochures, & documentaries	200
2. Conduct research on population dynamics and behavioral ecology.						
2.1	Review and select standard methodol-ogy	DNPWC and partners (WWF, NTNC, universities and others)	By 2011	Selected standard metho-dology	Protocols	500
2.2	Select representative research sites	DNPWC and partners (WWF, NTNC, universities and others)	2012	Long term study sites selected	Vegetation/ habitat maps produced using GIS and RS	2,500
2.3	Research on sex ratios, age class, natality, dispersal, mortality, food habits, threats	DNPWC and partners (WWF, NTNC, Universi-ties, scientists	2014	Demo-graphic information	Report, paper	5,500
2.4	Information dissemi-nation	DNPWC and partners (WWF, NTNC, Univer-sities, scientists and experts, local NGOs and CBOs)	2014	Workshops, awareness cam-paign	Workshop re-ports, articles, brochures, & documen-taries	200
3. Minimize threats of Red Panda to enhance its survival See threat mitigation actions developed by the Threats Working Group.						
4. Improve organizational/institutional capacity for the management of potential Red Panda habitats.						
4.1	Formation/ mobiliza-tion of local institu-tions	PAs, DFOs, local NGOs	By 2012	Active participa-tion of local people	Number of con-servation com-mittees / institu-tions involved	1,000
4.2	Training need and skill assessment	DNPWC, DoF	2012	National capac-ity on Red Panda conserva-tion	TNA reports, skill assessment reports	1,000
4.3	Conduct training on Red Panda population and habitat monitor-ing	DNPWC, DoF, NGOs and local communities	2016	National capac-ity on Red Panda conserva-tion	Number of train-ings/trained manpower	10,000
4.4	RIMS (Red Panda Information manage-ment system)	DNPWC, DoF, NGOs	2012	Information centre established	RIMS Data base	500

	Activities	Responsibility	Time line	Anticipated out-come	Measurable Products	Cost in NRs (thou-sands)
4.5	Create Red Panda desk under each re-gional forest director-ate and DNPWC	DNPWC, RD	2011	Coordination and manage-ment sys-tem established	Desk in place	1,200
5. Develop ownership and ensure equitable sharing of Red Panda conservation benefits to local communi-ties.						
5.1	Promote ecotourism activities, develop Red Panda eco trails	PAs, DFOs, VDCs, DDCs, CBOs, NGOs, NTB	By 2016	Local people's live-lihood improved	Increased num-ber of tourists and tourism facilities	50,000
5.2	Launch IGA programs	PAs, DFOs, VDCs, DDCs, CBOs, NGOs	By 2016	Diversified income sources of local people	Number of IGA trainings, skill development programs	50,000
5.3	Nature orientation trainings	PAs, DFOs, VDCs, DDCs, CBOs, NGOs	By 2016	Trained resource persons	Eco-friendly tourism in place, 6 events train-ing reports	1,800
5.4	Eco-clubs, Educa-tional programs, tours and exposure visits	PAs, DFOs, VDCs, DDCs, CBOs, NGOs, Schools	By 2016	Awareness among local people	Number of clubs formed, educa-tion/ promo-tional materials developed	5,000
5.5	Coordination with lo-cal agencies	PAs, DFOs, VDCs, DDCs, CBOs, NGOs	By 2016	Better coordina-tion and coop-eration among local agencies for conserva-tion	Coordination meetings min-utes	1,000
6. Strengthen trans-boundary cooperation.						
6.1	Bi-lateral agreement implementation	MOFSC	Annual	Joint management plan of Red Panda in place	Regional Man-age-ment plan published	2,000
6.2	Information sharing among range coun-tries	DNPWC, PAs, DFOs, NTNC, WWF, ICIMOD	Biannual	Regular update	Website, bul-letin, newsletter etc	1,000
6.3	Conduct coordination meetings	PAs, DFOs, DDCs,	Biannual meetings at local level and once a year at national level	Cooperation for Red Panda conser-vation in place	Meetings min-utes	2,000


Red Panda in the breeding den, 9 weeks old Gorlitz Zoo, Germany. © Axel Gebauer

Red Panda habitat, Kangchenjunga landscape Sikkim, West Bengal and Nepal triangle - mixed fir/ rhododendron forest, 4000m. © Axel Gebauer

VI. Threats to Red Panda in Nepal

Working Group Members: *Santosh Rayamajhi (Group Leader), Jeewan Thapa, Sonam Choden, Anwaruddin Choudhury, Awadhesh Kumar, Bed Kumar Dhakal, Bidur B Kuinkel, Dipankar Ghose, Fanindra R. Kharel, Gokarna Jung Thapa, Hari Bhadra Acharya, Hari Prasad Sharma, Kamal Thapa, Madhu Chetri, Naresh Subedi, Sunil Shakya, Thakur Silwal*

Threats to Red Panda (*Ailurus fulgens*) in Nepal

1. Introduction

Human beings have co-existed with nature, evolving and shaping the landscape they inhabited, for thousands of years. However, the balance between man and wildlife resource has been questioned in more recent times due to an increased human population and demand for their welfare factors like food, shelter, water and space. Initial ideas of wildlife conservation involved the strict protection of natural areas from human consumptive use value. This adversely impacted indigenous population who were denied access to, and even evicted from, their homelands (Muller-Boker 1999).

Red Panda is threatened throughout its range by several kinds of threats. Red Panda population and its habitats in Nepal is under threats due to heavy human dependence on the forest resource for livestock grazing, timber logging, agricultural expansion, collection of firewood and nontimber forest products. Mahato (2004) reported the highest livestock dung density in between 3200 m and 3400 m altitude in Nepal, which enumerated overgrazing pressure in this altitude that are the prime habitats of Red Panda in the region. Similarly Sharma and Belant (2009) observed most livestock grazing and bamboo collection at elevations of greatest Red Panda use. Some amount of poaching and trapping of Red Pandas have also been reported from the country. This chapter presents the findings of group discussion carried out by Red Panda threats group during the Red Panda PHVA, 2-6 Sep 2010 in Kathmandu on threats to Red Panda survival and mitigation measures there of in Nepal.

The group consisted of senior officials of Department of National Parks and Wildlife Conservation (DNPWC), Department of Forest, District Forest Officer and Conservation Officers from Red Panda bearing District forest and protected areas. Scientists from Institute of Forestry, and Tribhuvan University. Field officials from National Trust for Nature Conservation, Manaslu Conservation Area, Annapurna Conservation Area, WWF Nepal, The Mountain Institute, and researchers from Red Panda Network Nepal. Participants from neighboring countries, Bhutan and India were also present in the group (List of participants-Annex 1).

Information sources also consisted of published (Yonzon et al. 1991; Kharel 1997; DNPWC 2000, 2008; Rayamajhi et al. 2000; Kharel et al. 2001; Williams 2004 and 2006; Mahato 2004; WWF 2007) and unpublished materials from the team members and others.

2. Methods

The group started by listing all the threats related to Red Panda after discussion. One recorder listed the threats on a flip chart and the other recorder simultaneously noted the points on a notebook PC. After the listing of 55 different types of threats, the group agreed to club together similar threats into broad categories. A total of seven different categories of threats were identified and the 55 different types of threats were accordingly merged under these categories.

All these categories of threats were also listed against the six different Red Panda landscapes in Nepal, which were identified by the group members on the second day. These six landscapes were then mapped using the available potential Red Panda distribution map of Nepal. For each of these six landscapes, threats were prioritized into seven threat categories identified on the first day. Then for each category of threats, the chain of events (cause and effect) was identified to assess the effects of these threats on Red Panda and its habitats. For each broad threat category, mitigation measures were proposed for current and future actions.

After the prioritization of listed threats, further threats were prioritized on the basis of severity as Severe (S), Medium (M) and Low (L) for the six Red Panda conservation complexes. The severity of threats have been categorized and defined as follows:

Severe: Where high natural and anthropogenic pressure occurs on Red Panda population and its habitats thereby leading the population towards local extinction.

Medium: Where natural and anthropogenic pressure occurs on a medium level; however, the population and its habitats are not significantly affected but could lead the population towards severe risk of local extinction if threats still persist.

Low: Where natural and anthropogenic pressure occurs on a low scale and is not a prime factor for the current situation but needs attention to ensure the overall well being of Red Panda and its habitat.

After mitigating the current and future action the threats were identified and long-term and short-term action plans were formulated.

2.1 GIS Methods

Geographic Information System (GIS) was used for the entire analysis during the workshop. ArcView 3.2a and ArcGIS 9.3 version software and spatial analyst extension was used to calculate, clip and analyse the raster and vector datasets. SRTM 30 dem was used to extract the potential Red Panda habitat. Administrative boundaries and protected area boundaries were used to analyze the data. Lastly, the flow chart was developed for each process of analysis of threats. Flow chart 1 to 4 provides the details of methodology and the way of expression of each and every step that was adopted during the analysis.

3. Results and Analysis

After detailed discussion, all listed threats were grouped intothe following seven broad categories by clubbing together similar threats.

- Habitat loss and degradation
- Poaching
- Developmental activities
- Weak law enforcement
- Inadequate awareness/ education/ research/ funding
- Natural threats
- Trans-boundary issues

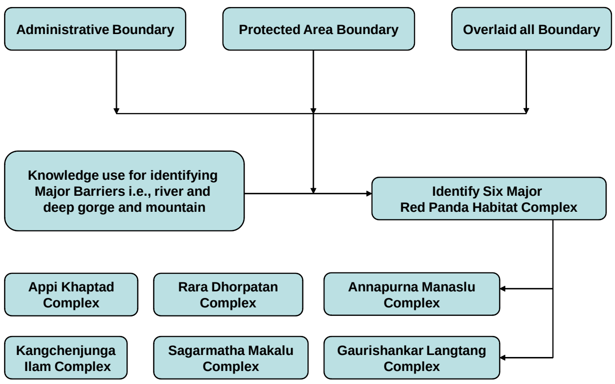
The threats covered by these broad categories are presented below:

Habitat loss and degradation

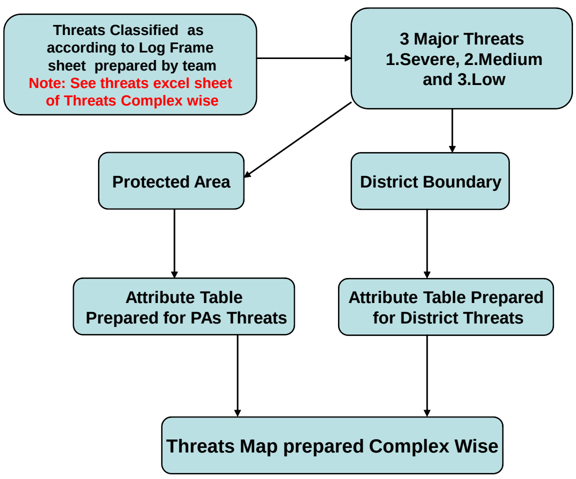
- Forest Fire
- Uncontrolled grazing/ cattle herding
- Lack of effective pastureland management
- Conflict between Red Panda and transhumance pastoralist

Flow Charts 1-4

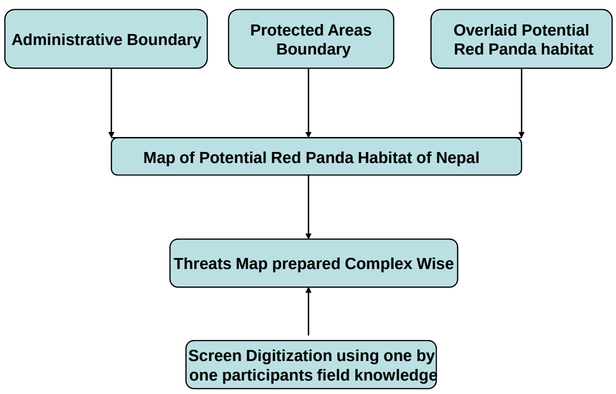
Red Panda Habitat Complex Map



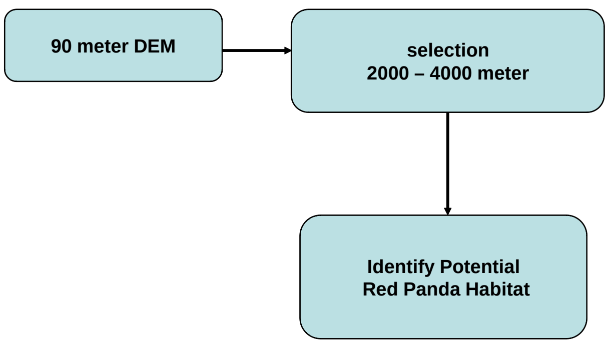
Detail Threats Mapping Complex Wise (PAs and District wise)
(Threats further classified in different sub criteria)



Threats Mapping (Polygon)



Identify Potential Red Panda Habitat



- Firewood collection for cooking and room heating
- NTFP collection (*Cordyceps*)/ bamboo and bamboo shoot collection

Habitat loss and degradation induced by humans and different anthropogenic activities are the main causes of decline in Red Panda populations and its habitat in Nepal. The annual deforestation rate in the Nepal Himalaya is 1.2%. The population growth rate is about 2.1% and the number of livestock in the mountain is on the increase.

Forest fires are very common in Nepal during the dry season. Cattle herders set fire to get new flush for their cattle. Additionally, seasonal movement of pastoralists and their cattle herds is a traditional practice in the mountain region. Large numbers of livestock move seasonally from lower altitude to higher altitude during the Red Panda calving season, i.e., May to August in Nepal. The most threatening agent for the Red Panda, especially when they move between fragmented habitats, is that by pet dogs which are a main cause of mortality. Occasionally, the cattle herders also poach Red Pandas for fur to make hats.

Annual consumption of firewood in Langtang Valley alone was reported to be ca. 313,000 kg. Similar situation exists in KCA, SNP, DHR, MCA, ACA, and Api Nampa CA.

Yonzon and Hunter (1991) reported over 500 Chauri grazing in the Red Panda habitat in Cholang-Dhokache area within Langtang NP during the breeding season. Over 50,000 cattle were reported to be grazing annually in Dhorpatan HR alone. Fifty- to sixty-thousand sheep and goats are brought annually from Koralla transit of Tibet towards Nepal during the Dashain festival. Similarly, in Kanchengha area thousands of cattle are brought from the Indian side for seasonal grazing.

Encroachment and shifting cultivation problem in the mountain is exacerbated by the current political instability in Nepal. The problem is more severe in Sagarmatha, Makalu Barun NP, and Kanchenjungha CA.

Compared to the past, NTFP collection and marketing from the mountains has increased dramatically in recent years. Thousands of people enter the PAs to collect bamboo shoot, Cordyceps, and other medicinal plants. The collectors indiscriminately fell trees, set camps and poach some wildlife species. Furthermore, their dogs harm Red Panda and other wildlife.

Poaching

- Poaching for skins and for meat
- Use of Red Panda body parts for socio-cultural purposes
- Trading of Red Panda body parts
- Trapping for adopting as pets

Brief Description of Yarsagumba and its impacts

Yarsagumba (*Cordyceps sinesis*) literally means summer plant and winter insect in Tibetan. Before the rainy season begins, spores of the cordyceps mushroom settle on the heads of caterpillars that live underground. The fungus grows out through the caterpillar's head feeding and finally killing the insect. During April-June, thousands of people are involved in its collection and it is a major source of income. Mostly exported to China and valued high in the international market, it is believed to have aphrodisiac properties and is used as tonic (Sherchan et al, 2005). It is estimated that one villager can earn up to Rs. 2,500 (approximately $35) a day by collecting Yarsagumba, which is beyond the monthly salary of many Nepalese households. Yarsagumba collection has heavily impacted Red Panda habitats due to collection of firewood, trampling and disturbances during its collection. Crodyceps collection is more severe in the western parts compared to the east.

Photo 1. Yarsagumba (*Cordyceps sinensis***)**

Although the Red Panda is not a targeted species for poaching, it has been found trapped in Musk Deer snares and in traps set for other species in the mountains. In some cases, the poachers and cattle herders kill Red Pandas for fur and for making hats. In Dhorpatan area, the cattle herders capture Red Pandas to raise them as pets (Ser Singh Thagunna, Warden, DHR). Red Panda fur has not been found in recent seizures of wildlife parts in different transit points in Nepal, which may indicate that it is not a preferred species for poaching.

Developmental activities

- Construction of road/ hydropower/ power lines
- Collection of fallen log
- Encroachment of economic interest over conservation
- Encroachment of forest by agriculture
- Use of pesticides (leaching to forest)
- Invasive/ exotic species (plant/animal)
- Lack of integration of habitat management and income generation through ecotourism
- Pilgrimage (Gosainkunda mela at Langtang, Pathibhara mela at Taplejung in which thousands of people intrude in the sensitive habitat of Red Panda for a week).

The cheese factories established during 1980s in Langtang Valley were found very harmful to the conservation of forest and forest dependant wildlife species (see Yonzon and Hunter 1994). The increasing number of tourists in Langtang and Sagarmatha NP put pressure on the forest resources and deposit garbage (plastics and bottles). The increasing number of hotels and lodges at Langtang and Sagarmatha has negative impacts on Red Panda habitats from encroachment. Similar types of impacts are expected at Makalu Barun and Kanchanjungha areas with the increase in tourist numbers. Simultaneously, construction of roads and hydropower dams are other threats to mountain biodiversity. The road construction at Annapurna, Dhorpatan, Gaurishankar, and Khaptad and the hydro-power dams at Api Nampa and Gaurishankar areas seem to pose adverse effects to the habitat and wildlife.

Weak law enforcement

- Inadequate enforcement of government laws and regulations
- Lack of political will and interest
- Political instability
- Insufficient coordination of stakeholders/ funding/ human resources

Law enforcement in some of the mountain PAs is very weak because of many reasons. The law enforcement in conservation areas is weaker compared to national parks. The inadequate staffing and low salaries in the complex and the unstable political situation in Nepal renders enforcement very weak. Conservation is not yet a priority in the region.

Job commitments and responsibilities by the staff are weak as there is no clear mechanism for reward and punishment, and no implementation. Coordination and collaboration among local government bodies is very weak. Frequently, there is a conflict of interest between the rights of the local communities and jurisdiction. For example, District Development Committees can make a decision to use any resources of the district irrespective of conservation.

Inadequate awareness/education/research/funding

Although most of the PAs conduct regular awareness programs, it is yet to impact the targeted populations due to shortage of funds in some PAs while in others due to lack of sufficient man power. Although the Red Panda is in the protected list in Nepal, very little research work has been conducted due to lack of funding.

Natural threats

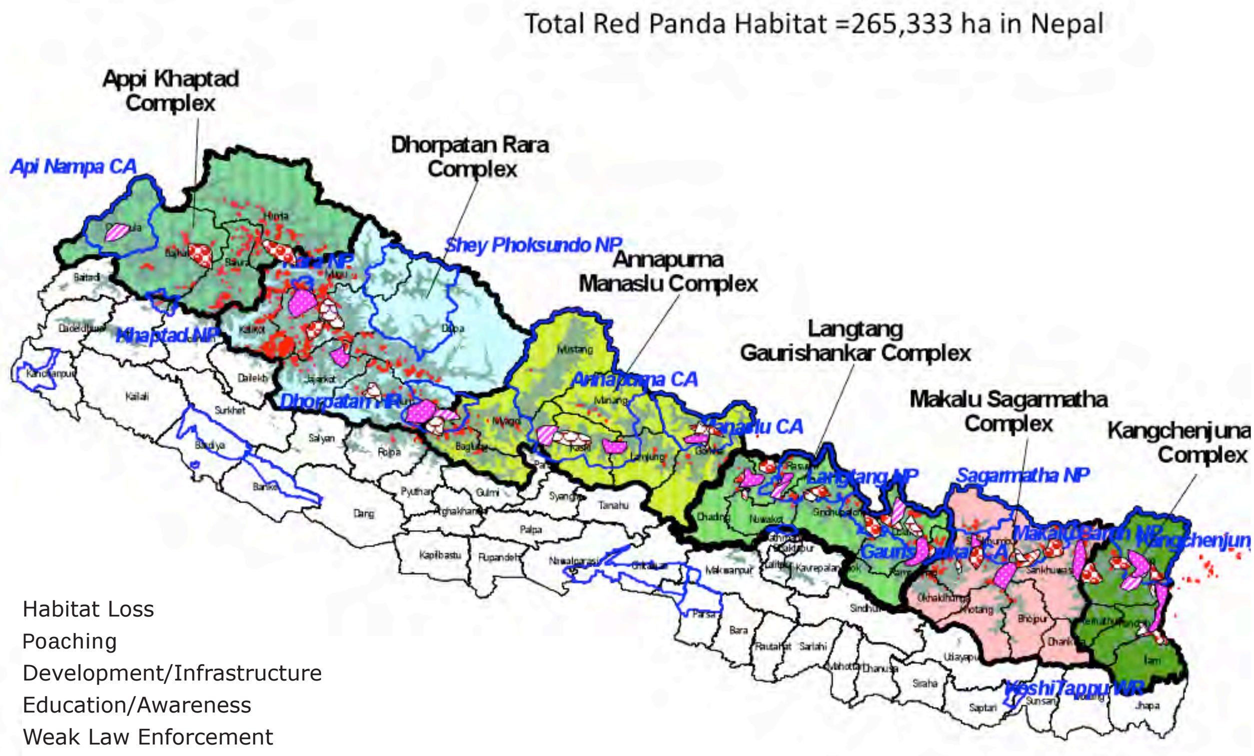
- Climate change
- Landslides/ floods
- Heavy snowfall/ rainfall
- Bamboo flowering - gregarious
- Disease outbreak

Changing pattern of climate such as unprecedented rainfall and snowfall have badly affected the livelihoods of the mountain communities. It has also impacted wildlife and habitats that thrive in the mountain ecosystem. Avalanches and landslides affect the Himalayan ecosystem.

Trans-boundary issues

- Poaching
- Illegal collection of NTFPs
- Trade in Red Panda body parts
- Movement of cattle herders/grazers during the breeding season

Illegal collection of NTFPs is commonly practiced within and outside of the PAs in Nepal. The disturbance created by collectors has a direct impact on the population of Red Panda and its movements. Similarly trans-boundary movement of cattle herders with large herds of livestock also affects Red Panda habitats such as in the recently declared Appi Nampa Conservation Area. In addition, there are certain transit points within protected areas where illegal trade occurs. Main identified transit points are: Olangchung gola and Yangma in Kanchanjanga CA, Taranga in Sagarmatha NP, Kimathanka and Hatthia in Makalu



Map 1: Six identified Red Panda conservation landscapes in Nepal with threat categories

Barun NP, Rashwagadhi in Langtang NP, Tatopani, Lamabagar in Gaurishankar CA and Hilsa in Rara NP.

All the above listed categories of threats were also listed against the following six different Red Panda conservation landscapes in Nepal (Map 1).

1. Kanchenjunga and Ilam Landscape Complex (KCA Ilam)—These landscapes cover 2,035 km^2 Kanchanjunga Conservation Area and some parts of Taplejung, Pacchthar and Illam districts above 2000 m of northeastern Nepal. It borders with Kanchanjunga National Park in Sikkim in India and Tibetan Plateau of the Tibetan Autonomous Region of China.

2. Makalu Sagarmatha Landscape Complex (SM)—Makalu Sagarmatha falls within the Mount Everest Ecosystem covering an area of 1,148 km^2 of Sagarmatha National Park (World Heritage Site) and 1,500 km^2 of Makalu Barun National Park and its buffer zone and district forest areas of Sankhuwashaba and Solukhumbu districts.

3. Langtang Gaurishankar Landscape Complex—It covers 2,187.5 km^2 of recently declared Gaurishankar Conservation Area and 1,710 km^2 of Langtang National Park and its buffer zone area. The area is heavily threatened from existing and upcoming hydropower construction.

4. Annapurna Manaslu Landscape Complex—It covers 7,629 km^2 of Annapurna Conservation Area and 1,663 km^2 of Manaslu Conservation Area. Both areas are managed by the National Trust for Nature Conservation through people participation. This landscape is one of the most diverse habitats of the flora and fauna in Nepal but the recent development of roads in Annapurna threatens its biodiversity and ecotourism potential. Similarly, heavy forest fire and timber logging threatens Manaslu Conservation Area.

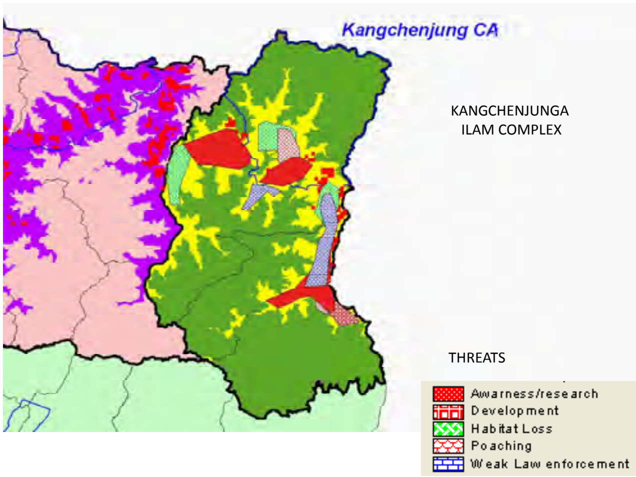
5. Dhorpatan Rara Landscape Complex—It covers 1,325 km^2 of Dhorpatan Hunting Reserve (only hunting reserve of Nepal) and 106 km^2 of Rara National Park and its adjoining areas of Myagdi, Dolpa , Baglung, Rukum, Jajarkot, Jumla, Kalikot and Mugu districts. The area is highly disturbed from livestock grazing and forest fires.

6. Appi Khaptad Landscape Complex—It covers 1,975 km^2 of recently declared Appi-Nampa Conservation Area and 225 km^2 of Khaptad National Park and its buffer zone. This area also includes parts of Bajura, Accham, Doti, Bajang, Darchula and Baitadhi districts. This area is highly degraded due to pressure from NTFP collection including *Cordyceps sinensis,* fire hazards and livestock grazing.

For each of these six landscapes, seven categories of threats were prioritized as below:

1. Kanchenjunga and Ilam Red Panda Landscape (Map 2)

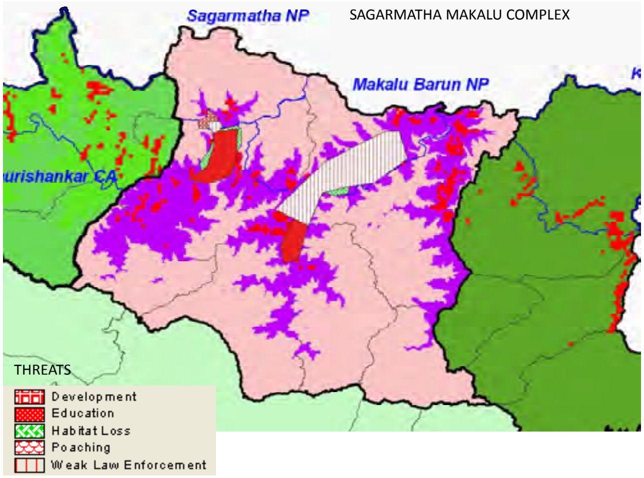
I. Habitat loss and degradation (forest fire, shifting cultivation, cattle grazing, transhumance pastorals, firewood collection)
II. Weak law enforcement
III. Poaching (accidental killing in traps, predation by domestic dog and disease transmission)
IV. Trans-boundary issues (poaching, illegal collection of NTFPs affecting Red Panda habitat, trade in body parts, movement of cattle herders/ grazing during Red Panda breeding season)
V. Inadequate awareness/ education/ research
VI. Developmental activities (unregulated tourism in Ilam area)
VII. Natural threats such as shifting of Red Panda habitats and bamboo die back from climate change.



Map 2: Kanchenjunga-Ilam Landscape Complex

2. Makalu-Sagarmatha Complex (Map 3)

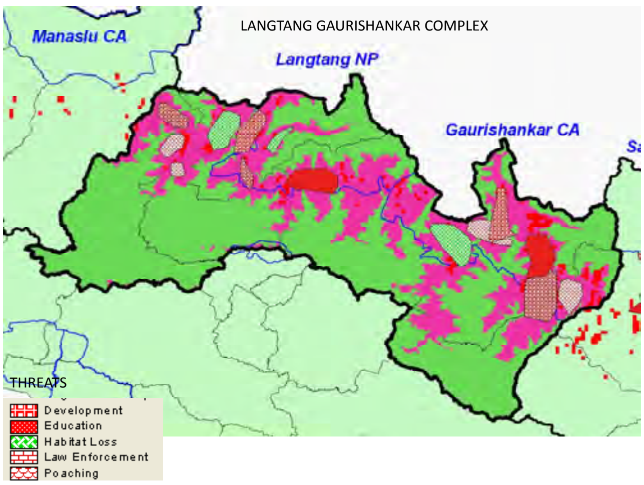
I. Weak law enforcement in Makalu area
II. Developmental activities (unregulated tourism in Sagarmatha area – hotels, resorts, lodges, camps, overcrowding, garbage)
III. Natural threats – Climate change - shifting of Red Panda habitat prominent in Sagarmatha area, bamboo die back.
IV. Poaching (trapping, predation by domestic dog and disease transmission, poaching in Makalu area)
V. Habitat loss and degradation (forest fire, shifting cultivation, cattle grazing, firewood collection, illegal logging, NTFP collection, *Cordyceps* collection)
VI. Trans-boundary issues (poaching, illegal collection of NTFPs affecting Red Panda habitat, trade in body parts, movement of cattle herders/ grazing during Red Panda breeding season)
VII. Inadequate awareness/ education/ research/ funding



Map 3 : Makalu-Sagarmatha Landscape Complex

3. Langtang-Gaurishankar complex (Map 4)

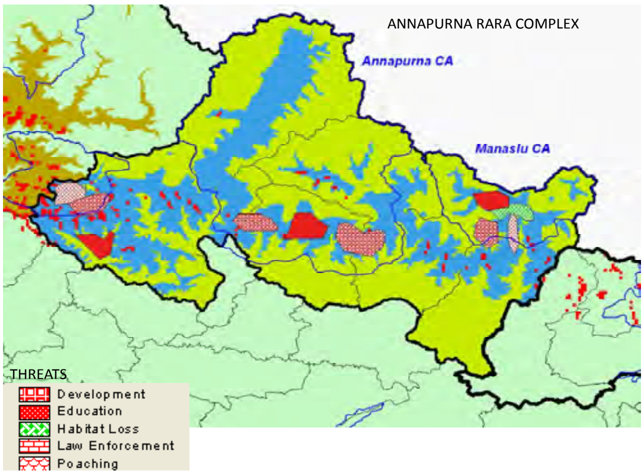
I. Habitat loss and degradation (cattle grazing, firewood collection, logging, invasive species, unregulated trails, forest fire)
II. Developmental activities (unregulated road construction by DDC/VDC, cheese factories, unregulated tourism, pilgrimage tourism resulting in overcrowding, garbage, lodges, proposed hydropower development)
III. Weak law enforcement in Gaurishankar area
IV. Poaching (trapping, predation by domestic dog and disease transmission, poaching in Gaurishankar area)
V. Trans-boundary issues (poaching, illegal collection of NTFPs affecting Red Panda habitat, trade in body parts, e.g. Tatopani and Rasuwagadhi transit points used for smuggling, movement of cattle herders/ grazing during breeding season)
VI. Inadequate awareness/ education/ research
VII. Natural threats – climate change-shifting of Red Panda habitat, bamboo die back



Map 4: Langtang-Gaurishankar Landscape Complex

4. Annapurna-Manaslu complex (Map 5)

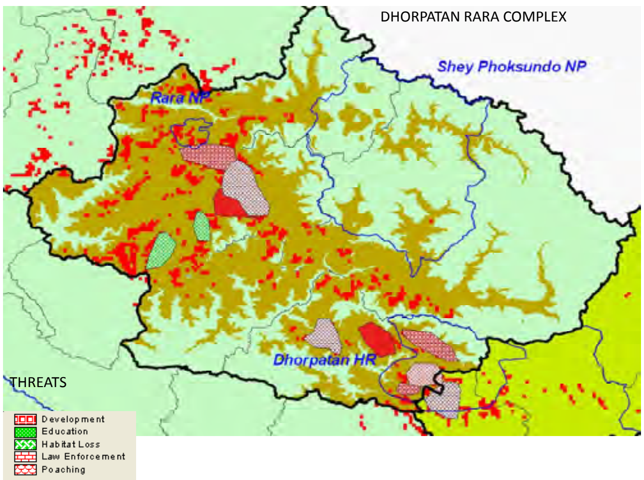
I. Habitat loss and degradation (forest fire, cattle grazing, tranhumance pastorals, firewood collection, logging, collection of NTFPs, bamboo shoots and *Cordyceps*)
II. Poaching (trapping, predation by domestic dog and disease transmission)
III. Developmental activities (road construction by DDC/VDC)
IV. Weak law enforcement
V. Inadequate awareness/ education/ research/ funding - Manaslu
VI. Natural threats –Climate change-shifting of Red Panda habitat, landslides, avalanches
VII. Trans-boundary issues (movement of cattle herders/ grazing, illegal logging and *Cordyceps* collection)



Map 5: Annapurna-Manaslu Landscape Complex

5. Dhorpatan-Rara complex (Map 6)

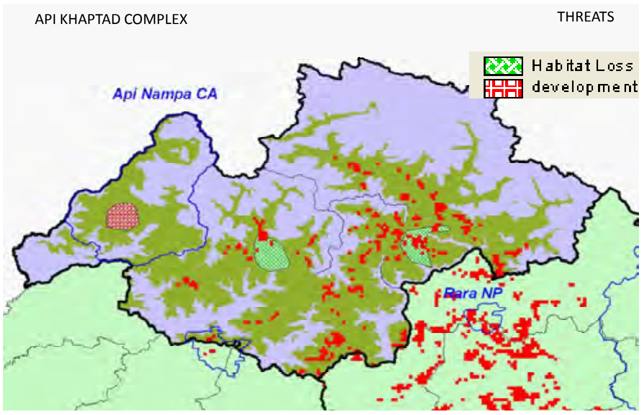
I. Weak law enforcement in Dhorpatan area
II. Habitat loss and degradation (forest fire, cattle grazing, transhumance (??) pastorals, firewood collection, collection of NTFPs, bamboo shoots and *Cordyceps*, encroachment for agricultural expansion)
III. Inadequate awareness/ education/ research/ funding
IV. Poaching (trapping, use of Red Panda as pets, body parts used for making hats, predation by domestic dog and disease transmission)
V. Developmental activities (road construction, hydropower)
VI. Natural threats – climate change- shifting of Red Panda habitat?



Map 6: Dhorpatan-Rara Landscape Complex

6. Appi-Khaptad complex (Map 7)

I. Weak law enforcement
II. Habitat loss and degradation (forest fire, cattle grazing, transhumance pastorals, collection of firewood, NTFPs, bamboo and *Cordyceps*, logging)
III. Poaching (trapping, use of Red Panda as pets, body parts used for making hats, predation by domestic dog and disease transmission)
IV. Trans-boundary issues (poaching, illegal collection of NTFPs affecting Red Panda habitat, trade in body parts, e.g. transit point at Tinkar, movement of cattle herders/ grazing)
V. Inadequate awareness/ education/ research/ funding
VI. Developmental activities (hydropower and road construction)
VII. Natural threats – climate change- shifting of Red Panda habitat?



Map 7: Appi-Khaptad Landscape Complex

Red Panda Darjeeling Zoo, West Bengal, India

Cause and effect - Chain of events

- Habitat reduction/ shrinkage/ isolation/ competition/ declining habitat quality/ fragmentation
- Shortage of food/ water/ cover
- Decrease in population/ inbreeding/ disease/ local extinction
- Forest regeneration adversely affected

Decrease in population/ inbreeding/ disease/ local extinction

- Habitat reduction/shrinkage/isolation/competition/declining habitat quality/fragmentation
- Shortage of food/water/cover
- Decrease in population/inbreeding/disease/local extinction

- Habitat reduction/shrinkage/isolation/competition/declining habitat quality/fragmentation
- Shortage of food/water/cover
- Decrease in population/inbreeding/disease/local extinction

- Lack of ecological data and information for conservation planning
- Hunting and poaching/illegal trade
- Poor management
- Cannot convince political decision makers
- Habitat reduction/shrinkage/isolation/competition/declining habitat quality/fragmentation
- Shortage of food/water/cover
- Decrease in population/inbreeding/disease/local extinction

- Hunting and illegal trade
- Poor coordination/collaboration
- Habitat reduction/shrinkage/isolation/competition/declining habitat quality/fragmentation
- Decrease in population/inbreeding/disease/local extinction

- Habitat reduction/shrinkage/isolation/competition/declining habitat quality/fragmentation
- Shortage of food/water/cover
- Decrease in population/inbreeding/disease/local extinction
- Other impacts???

4. Chain of Events

For each category of these seven threats, the following chains of events (cause and effect) were identified:

1. Habitat loss and degradation due to forest fire, shifting cultivation, cattle grazing, transhumance pastorals, firewood collection
2. Poaching (trapping, use of Red Panda as pets, Red Panda body parts used for making hats, predation by domestic dog and disease transmission)
3. Developmental activities (hydropower, road construction, factories, infrastructure)
4. Weak law enforcement due to political instability, political will, weak governance and inadequate resources
5. Inadequate awareness/education/research/funding
6. Trans-boundary issues (poaching, illegal collection and trade, e.g. Tatopani, Rasuwagadhi and Tinkar transit points used for smuggling, movement of cattle herders/grazing during breeding season)
7. Natural threats –Climate change- shifting of Red Panda habitat?

5. Mitigation measures

For each broad threat category, mitigation measures were proposed in two action strategies, which included current actions and future actions, detailed below:

5.1 Habitat loss and degradation- Forest Fire

Current actions
- Awareness program through radio, pamphlets, posters
- Fire fighting training for communities
- National fire fighting strategy
- Management plans – reflects forest fire fighting

Future actions
- Implementation of fire strategy
- Strengthen law enforcement for prevention of offences
- Forest fire alert and monitoring system
- Forest fire mapping/ zoning
- Forest fire volunteers
- Fire fighting equipment and gears
- Controlled burning
- Training community members in fire fighting
- Securing adequate funding
- Strengthen coordination/ collaboration between line agencies

5.2 Habitat loss and degradation- Shifting cultivation/encroachment:

Current actions
- General awareness
- Weak law enforcement
- Alternative cropping initiated

Future actions
- Improved law enforcement
- Promote Red Panda friendly alternative livelihoods (organic farming, agro forestry, horticulture, NTFPs, MAPS etc)

5.3 Habitat loss and degradation- overgrazing/cattle herders/dogs:

Current actions
- Weak rangeland management

Future actions
- Effective rangeland management using native species
- Controlled grazing based on zonation
- Alternative livelihoods
- Program to reduce livestock numbers especially unproductive breeds.
- Strengthen law enforcement
- Development of agri-silvipastoral system (integrated agriculture, pasture and agroforestry system).
- Vaccination/ health check up of dogs

5.4 Habitat loss and degradation- Firewood/timber/NTFPs:

Current actions
- Alternative energy pilots
- Improved cooking devices
- Agroforestry
- Community forestry
- Plantation

Future actions
- Strengthen use of alternative energy on a large scale (solar, micro hydro-electric plants, biogas)
- Improve law enforcement system
- Strengthen community stewardship in natural resources management
- Develop management system based on science
- Reward and punishment system both for communities and forest department
- NTFP cultivation on private land/community land/government land

5.5 Hunting/poaching

Current actions
- NPWC Act/ Forest Act 1993 is only protecting the Red Panda but not its habitat

- Inadequate capacity of forest guards
- Army is engaged
- Anti-poaching unit (community and PA)
- Informal anti-poaching unit
- Awareness program

Future actions
- Effective enforcement of NPWC Act/ Forest Act 1993 for protecting Red Panda habitat
- Improve law enforcement/ anti-poaching
- Strengthen cooperation and coordination between all stakeholders
- Trans-boundary cooperation for conserving Red Panda at a regional scale
- Strengthen awareness program

5.6 Developmental activities (Roads, Hydropower, Industry, Pesticides)

Current actions
- Environmental Impact Assessment (EIA), Initial Environmental Examination (IEE) and others

Future actions
- Appropriate EIA and IEE should be conducted and implemented
- Political willingness and support
- Alternative source of income generation system should be developed
- Encourage organic farming using cow-dung as a manure

5.7 Development Activities - Unregulated Tourism, Pilgrimage

Current actions
- Entry Permit
- Management zoning (restricted zone, facility zone, resource use zone)
- Garbage disposal system
- National Parks and Wildlife Conservation Act (NPWCA) 1973

Future actions
- Restricted entry permits in core zone (Red Panda zone)
- Restrict visitors during the breeding seasons
- Red Panda habitat management
- Proper disposal system should be developed outside the park
- Strict enforcement of NPWC Act-1973

5.8 Weak Law Enforcement and Policy Gap

Current actions
- NPWC Act-1973
- Himalayan National Parks Regulation-1979
- Conservation Area Management Regulation 1997
- Forest Act -1993
- Buffer Zone Management Regulation Act, 1996

Future actions
- Needs strict enforcement
- Needs allocation of enhance budget, manpower, capacity building and commitment
- Landscape Level Conservation Policy should be developed and implemented
- Identify unprotected RED PANDA habitat and make legal provision for the declaration of RED PANDA Community Conservation Area

5.9 Inadequate Awareness/Education/ Research/Funds

Current actions
- Public Awareness-Conservation education in schools, Green Force Clubs, Radio Program, Publication (posters, pamphlets, documentary) etc.

Future actions
- Continuation of awareness education with more effective measures
- Additional funding allocation
- Identify priority research topics and areas on Red Pandas
- Regular monitoring of its habitats
- Include Red Pandas in conservation education curriculum.
- Sensitize all stakeholders

5.10 Trans-boundary Issues

Current actions
- Trans-boundary agreement

Future actions
- Trans-boundary agreement should be implemented at PA levels
- Aware and trained custom officials to control illegal trafficking
- Depute trained manpower at transit point to control illegal trade
- Develop a tri-national ‘Project Red Panda’.

6. Prioritization of threats on the basis of severity:

After broad categorization, threats were further prioritized on the basis of severity as Severe (S), Medium (M) and Low (L) for the six Red Panda conservation complexes. The threats were also prioritized for the adjoining areas (unprotected habitats) of the all six complexes where Red Pandas have been sighted. The details of the severity of the threats are presented in a tabular form as Annexes 2.1-2.7.

7 Recommendations

Short term measures	Long term measures
6.1 Habitat loss and degradation	
Forest fire	
· Mapping and forest fire alert and monitoring system. · Awareness campaigning · Fire fighting equipment and gear · Fire hazard mitigation including controled burning · Identify forest fire volunteers · Training fire fighters including communities	· Sufficient funding · Strengthen coordination/collaboration · Endorse and implement fire strategy · Strengthen law enforcement and prevention of offences
· Shifting cultivation/encroachment /	
· Strict law enforcement · Clearing of encroachment · Awareness against shifting cultivation · Allocation of funds for alternative opportunities	· Improve legal provisions · Promote Red panda friendly alternative livelihoods (organic farming, agroforestry, horticulture, NTFPs, MAPS etc.)
· Overgrazing/cattle herders/dogs	
· Strengthen law enforcement · Controlled grazing based on zonation · Vaccination/health check up of dogs	· Effective rangeland management using native species · Alternative livelihoods · Program to reduce livestock numbers especially unproductive breed. · Development of agri-silvi-pastoral system (integrated agriculture, pasture and agro-forestry system).
· Firewood/timber/NTFPs	
· Improve law enforcement system · Strengthen use of alternative energy on a large scale (solar, micro hydel, biogas) · Reward and punishment system both for communities and forest department · Strengthen community stewardship in natural resources management	· Develop management system based on science · NTFP cultivation on private land/community land/government land

6.2 Hunting and Poaching

· Improve law enforcement · Strengthen awareness program · Establish effective community based anti-poaching program	· Strengthen cooperation and coordination · Trans-boundary cooperation

6.3 Development Activities - Unregulated Tourism, Pilgrimage

· Strict enforcement of NPWC Act-1973 · Restricted entry permits in core zone (Red Panda zone) · Restrict visitors during breeding seasons for Red Panda · Proper disposal system should be developed outside the park	· Red Panda Habitat Management

6.4 Weak Law Enforcement and Policy Gap

• Needs strict enforcement of existing laws • Needs allocation of enhanced budget, manpower, capacity building and commitment	• Identify unprotected Red Panda habitat and make legal provision for the declaration of Red panda Community Conservation Area. • Landscape Level Conservation Policy should be developed and implemented

6.5. Inadequate Awareness/Education/Research/Funds

· Inadequate Awareness/Education/Research/ Funds	• Regular monitoring of its habitats • Sensitize all stakeholders • Include Red Panda in Conservation Education Curriculum.

6.5. Trans-boundary Issues

· Depute trained manpower at transit point to control illegal trade · Aware and trained Custom Officials to control illegal trafficking	· Trans-boundary agreement should be implemented at PA levels · Develop tri-national 'Project Red Panda'.

8. Annexes


Red Panda mother and cub, Gorlitz Zoo, Germany. © Axel Gebauer

Annex 1: Group Members

1. Prof. Santosh Rayamajhi - Group leader
2. Dr. Jeewan Thapa – Recorder on flip chart
3. Ms. Sonam Choden - Recorder on computer
4. Sunil Shakya
5. Kamal Thapa
6. Bed Kumar Dhakal
7. Hari Prasad Sharma
8. Gokarna Jung Thapa
9. Bidur B Kuinkel
10. Dr. Naresh Subedi
11. Hari Bhadra Acharya
12. Madhu Chetri
13. Thakur Silwal
14. Fanindra R. Kharel
15. Dr. Awadhesh Kumar
16. Dr. Anwaruddin Choudhury
17. Dr. Dipankar Ghose

Annex 2: Prioritization of threats on the basis of severity for six Red Panda conservation complexes.

2.1 Habitat loss and degradation

	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
KCA-Illam	Forest Fire	Gybla, Hellok, Yamphudin-Deurali	S	Pathivara north, Chaba –Kalikhola vdc, Mamankha vdc, Kalpokhari-surumkhing	S	
KCA-Illam	Trans Humance Pastoralism	Harkete Danda, Tapethok	S	Taplejung,	M	
KCA-Illam				Panchthar	M	
KCA-Illam	Shifting cultivation	KCA	S	Taplejung,	S	
				Panchathar	M	
				Ilam	L	
KCA-Illam	Firewood collection for cooking and room heating	All part of KCA	L	Taplejung	M	
KCA-Illam				Panchathar	S	
KCA-Illam				Ilam	S	
S-M	Forest Fire	Sagarmatha	M	Sankhushawa	M	
S-M		Makalu	M	Solukhumbu	M	
S-M	Trans Humance Pastoralism	Sagarmatha	L	Sankhushawa	L	
S-M		Makalu	M	Solukhumbu	L	
S-M	Shifting cultivation	Sagarmatha	L	Sankhushawa	L	
S-M		Makalu		Solukhumbu	L	
S-M	Firewood collection for cooking and room heating	Sagarmatha	M	Sankhushawa	S	
S-M		Makalu	M	Solukhumbu	S	

	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
S-M	Timber logging	Sagarmatha	M	Sankhushawa	S	
S-M		Makalu	S	Solukhumbu	S	
S-M	NTFPs	Sagarmatha	M	Sankhushawa	M	
S-M		Makalu	S	Solukhumbu	M	
S-M	Encroachment	Sagarmatha	S	Sankhushawa	S	
S-M		Makalu	S	Solukhumbu	S	
L-G	Cattle grazing	Langtang	S	Dhading	S	
L-G		Gaurishankar	S			
L-G	Fire wood collection	Langtang	S	Dhading	M	
L-G		Gaurishankar	S			
L-G	Timber logging	Langtang	M	Dhading	M	
L-G		Gaurishankar	S			
L-G	Invasive species	Langtang	S	Dhading	L	
L-G		Gaurishankar	L			
L-G	Unregulated trails	Langtang	M	Dhading	L	
L-G		Gaurishankar	M			
L-G	Forest Fire	Langtang	M	Dhading	S	
L-G		Gaurishankar	S			
A-M	Forest fire	ACAP	M			
A-M		MCAP	M	Gorkha-Lamjung (Rubinala)	S	
A-M	Trans Humance Pastoralism	ACAP	M			
A-M		MCAP	S	Gorkha-Lamjung (Rubinala)	S	
A-M	Fire wood collection	ACAP	S			
A-M		MCAP	S	Gorkha-Lamjung (Rubinala)	S	
A-M	Timber logging	ACAP	M			
A-M		MCAP	S	Gorkha-Lamjung (Rubinala)	S	
A-M	NTFPs collection	ACAP	L			
A-M		MCAP	S	Gorkha-Lamjung (Rubinala)	S	
A-M	Bamboo Shoots collection	ACAP	S			
A-M		MCAP	L	Gorkha-Lamjung (Rubinala)	S	
D-Rara	Forest fire	Dhorpatan	S			Rukum, Jajarkot, Dolpa, Jumla, Kalikot, Bajura needs further investigation
D-Rara		Rara	M			
D-Rara	Trans Humance Pasatoralism	Dhorpatan	S			
D-Rara		Rara	S			
D-Rara	Fire Wood Collection	Dhorpatan	S			

	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
D-Rara		Rara	M			
D-Rara	NTFPs Collection	Dhorpatan	S			
D-Rara		Rara	M			
D-Rara	Bamboo Shoots Collection	Dhorpatan	S			
D-Rara						
D-Rara	Cordyceps Collection	Dhorpatan	S			
D-Rara						
Appi-K	Forest fire	Appi	S			Doti, Bajhang, Darchula, Baitadi needs further investigation
Appi-K		Khaptad	L			
Appi-K	Trans Humance Pastoralism	Appi	S			
Appi-K		Khaptad	S			
Appi-K	Fire Wood Collection	Appi	S			
Appi-K		Khaptad	M			
Appi-K	NTFPs Collection	Appi	S			
Appi-K		Khaptad	S			
Appi-K	Bamboo Shoots Collection	Appi	L			
Appi-K		Khaptad	L			
Appi-K	Cordyceps Collection	Appi	S			
Appi-K						

2.2 Poaching

	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
KCA-Ilam	Killing due to traps meant for other animals	KCA	S	Taplejung	S	
KCA-Ilam				Panchthar	S	
KCA-Ilam				Illam	M	
KCA-Ilam	Predation by domestic dogs	KCA	M	Taplejung,	M	
KCA-Ilam	Disease transmission	KCA		Taplejung		
KCA-Ilam				Panchthar		
KCA-Ilam				Illam		
S-M	Killing due to traps meant for other animals	Sagarmatha	M			
S-M		Makalu	S			

	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
S-M	Predation by domestic dogs	Sagarmatha	M			
S-M		Makalu	S			
S-M	Disease transmission	Sagarmatha	?			
S-M		Makalu	?			
L-G	Killing due to traps meant for other animals	Langthang	M			
L-G		Gaurishankar	S			
L-G	Predation by domestic dogs	Langthang	S			
L-G		Gaurishankar	S			
L-G	Disease transmission	Langthang	?			
L-G		Gaurishankar	?			
A-M	Killing due to traps meant for other animals	Annapurna	M			
A-M		Manaslu	M			
A-M	Predation by domestic dogs	Annapurna	M			
A-M		Manaslu	M			
A-M	Disease transmission	Annapurna	?			
A-M		Manaslu	?			
D-Rara	Killing due to traps meant for other animals	Dhorpatan	S			
D-Rara		Rara	M			
D-Rara	Predation by domestic dogs	Dhorpatan	S			
D-Rara		Rara	M			
D-Rara	Disease transmission	Dhorpatan	?			
D-Rara		Rara	?			
Appi-K	Killing due to traps meant for other animals	Appi	S			
Appi-K		Khaptad	M			
Appi-K	Predation by domestic dogs	Appi	S			
Appi-K		Khaptad	M			
Appi-K	Disease transmission	Appi	?			
Appi-K		Khaptad	?			

2.3 Developmental activities

Complex	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
KCA-Ilam	Unregulated tourism in Ilam area			Illam	L	
S-M	Unregulated tourism in Sagarmatha area –hotels, resorts, lodges, camps, overcrowding, garbage	Sagarmatha	S			
		Makalu	L			
L-G	Unregulated road construction by DDC/VDC, cheese factories, unregulated tourism, pilgrimage tourism -overcrowding, garbage, lodges, proposed hydropower development	Langthang	S			
L-G		Gaurishankar	S			
A-M	Road construction by DDC/ VDC	ACA	S			
A-M		MCA				
D-Rara	Road construction, hydropower	Dhorpatan	M			
D-Rara		Rara	L			
Appi-K	Road construction, hydropower	Appi	M			
Appi-K		Khaptad	M			

2.4 Weak Law Enforcement

	Complex	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat
1	KCA-Ilam	Weak law enforcement	KCA	S	Illam	S
2	S-M	Weak law enforcement	Sagarmatha	M	Solukhambu	S
		Weak law enforcement	Makalu	S	Sankshuwa	S
3	L-G	Weak law enforcement	Langthang	L	Dhading	S
		Weak law enforcement	Gaurushankar	S	UN	S
4	A-M	Weak law enforcement	ACA	L		
		Weak law enforcement	MCA	L	Gorkha, Lamjung (Rubhinala area)	S
5	D-Rara	Weak law enforcement	Dhorpatan	S	Rolpa (Jaljala)	S
		Weak law enforcement			Rukum	S
		Weak law enforcement	Rara	M	Mugu	S
6	Appi-K	Weak law enforcement	Khaptad	S	Ramaroshan (Accham)	S
		Weak law enforcement	Appi	S	Saipal-Bajang	S

S= Severe, M=Medium, L=Low

2.5 Education and Awareness

Complex	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
KCA-Ilam	Inadequate awareness/education	KCA	M	Taplejung, Illam, Pachthar	M	
KCA-Ilam	Research/funding	KCA	M	Taplejung, Illam, Pachthar	M	
S-M	Inadequate awareness/education	Sagarmatha	L			
S-M	Research/funding	Sagarmatha	M			
S-M	Inadequate awareness/education	Makalu	S			
S-M	Research/funding	Makalu	S			
L-G	Inadequate awareness/education	Langthang	L			
L-G	Research/funding	Langthang	M			
L-G	Inadequate awareness/education	Gaurishankar	S			
L-G	Research/funding	Gaurishankar	S			
A-M	Inadequate awareness/education	ACA	M			
A-M	Research/funding	ACA	L			
A-M	Inadequate awareness/education	MCA	M			
A-M	Research/funding	MCA	S			
D-Rara	Inadequate awareness/education	Dhorpatan	S			
D-Rara	Research/funding	Dhorpatan	S			
D-Rara	Inadequate awareness/education	Rara	S			
D-Rara	Research/funding	Rara	S			
Appi-K	Inadequate awareness/education	Appi	S			
Appi-K	Research/funding	Appi	S			
Appi-K	Inadequate awareness/education	Khaptad	S			
Appi-K	Research/funding	Khaptad	S			

2.6 Trans-boundary

Complex	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
KCA-Ilam	Poaching, illegal collection and trade, movement of cattle herders/grazing during breeding season	Olangchung gola	S	Kali Khola, Taplejung (Topke gola)	S	
KCA-Ilam		Yangma	S	Kal Pokhari, Gahairi Bas of Illam	S	
KCA-Ilam				Prambung, Pachthar	S	
S-M	Poaching, illegal collection and trade, movement of cattle herders/grazing during breeding season	Sagarmatha (Taranga)	M			
S-M		Makalu (Kimathanka, Hatthia)	S			
L-G	Poaching, illegal collection and trade, movement of cattle herders /grazing during breeding season	Langthang (Rashwagadhi)	S			

Complex	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
L-G		Gaurishankar (Tatopani, Lamabagar)	S			
A-M	Poaching, illegal collection and trade, movement of cattle herders/ grazing during breeding season	ACA (Koralla)	M			
A-M		MCA (Sama gaun)	S			
D-Rara	Poaching, illegal collection and trade, movement of cattle herders/ grazing during breeding season	Dhorpatan	S			
D-Rara		Rara	M	Humla (Hilsa)		
Appi-K	Poaching, illegal collection an trade d, movement of cattle herders/grazing during breeding season	Appi (Tinkar)	S			
Appi-K		Khaptad	M			

2.7 Education and Awareness

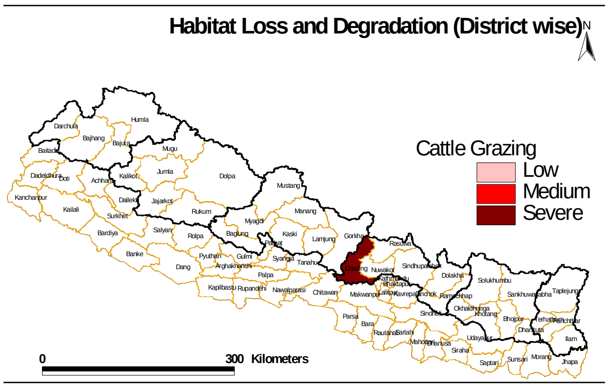
Complex	Threat category	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
KCA-Ilam	Inadequate awareness/education	KCA	M	Taplejung, Illam, Pachthar	M	
KCA-Ilam	Research/funding	KCA	M	Taplejung, Illam, Pachthar	M	
S-M	Inadequate awareness/education	Sagarmatha	L			
S-M	Research/funding	Sagarmatha	M			
S-M	Inadequate awareness/education	Makalu	S			
S-M	Research/funding	Makalu	S			
L-G	Inadequate awareness/education	Langthang	L			
L-G	Research/funding	Langthang	M			
L-G	Inadequate awareness/education	Gaurishankar	S			
L-G	Research/funding	Gaurishankar	S			
A-M	Inadequate awareness/education	ACA	M			
A-M	Research/funding	ACA	L			
A-M	Inadequate awareness/education	MCA	M			
A-M	Research/funding	MCA	S			
D-Rara	Inadequate awareness/education	Dhorpatan	S			
D-Rara	Research/funding	Dhorpatan	S			
D-Rara	Inadequate awareness/education	Rara	S			
D-Rara	Research/funding	Rara	S			
Appi-K	Inadequate awareness/education	Appi	S			
Appi-K	Research/funding	Appi	S			
Appi-K	Inadequate awareness/education	Khaptad	S			
Appi-K	Research/funding	Khaptad	S			

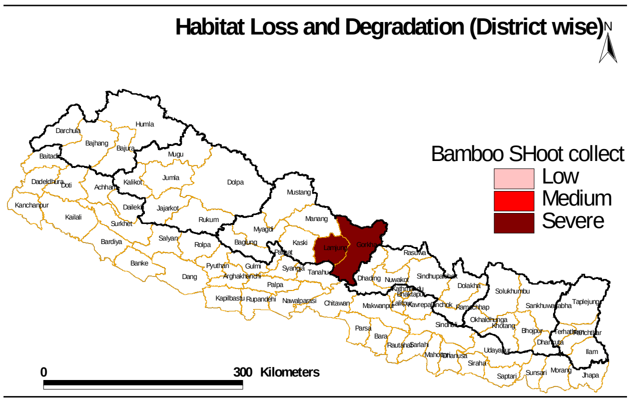
2.8 Natural Threats

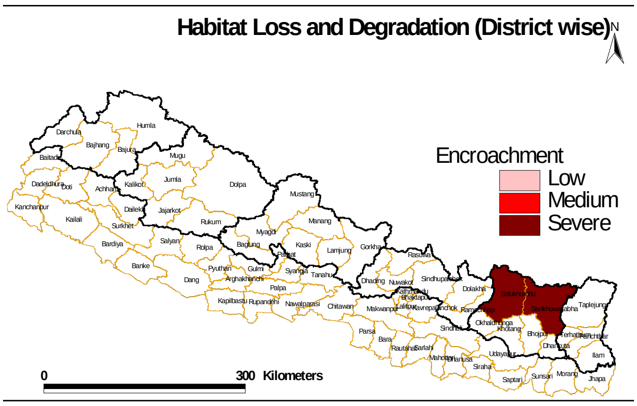
	Complex	PA Location	Level of threat	Outside PA Location	Level of threat	Remarks
1	Kanchanjunga-Ilam	Climate Change?	??	??	??	
2	Sagarmatha-Makalu	Climate Change?	??	??	??	
3	Langthang-Gaurishankar	Climate Change?	??	??	??	
4	ACA-MCA	Climate Change?	??	??	??	
5	Dhorpatan-Rara	Climate Change?	??	??	??	
6	Appinampa-Khaptad	Climate Change?	??	??	??	

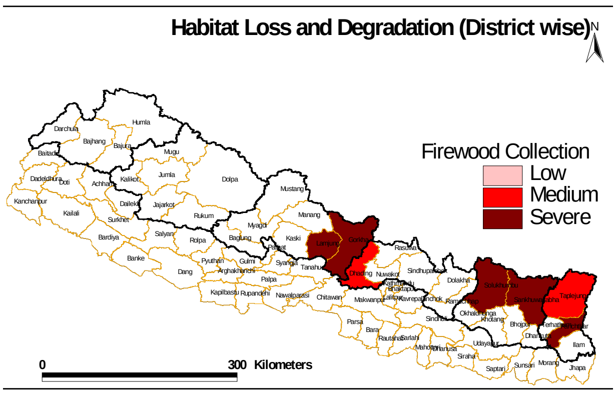
Annex 3: Reference map of threats - area wise (inside PA and outside PA)

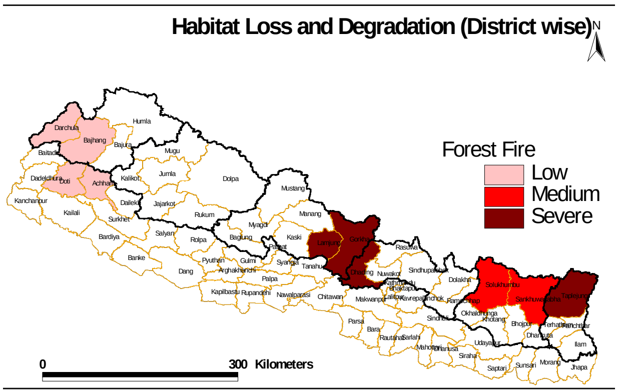
Habitat loss and degradation inside PA

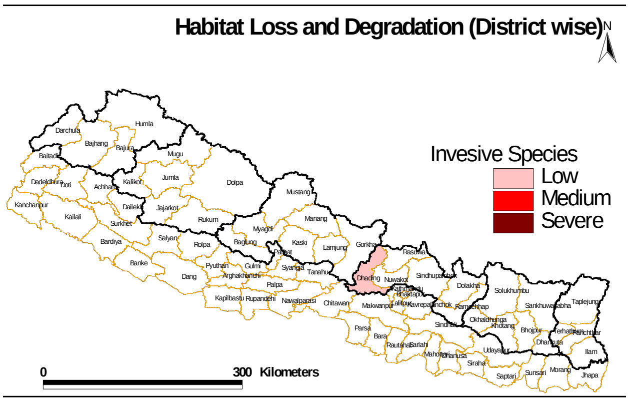


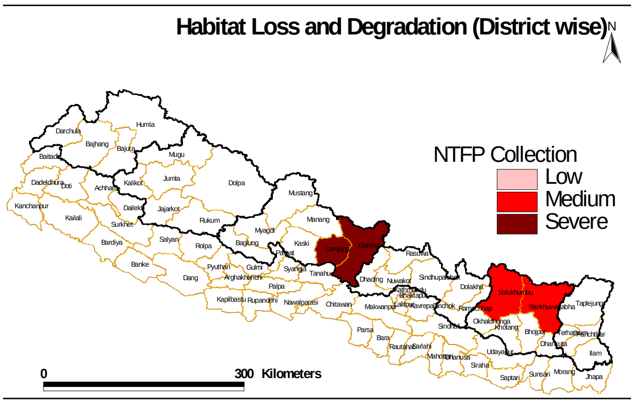


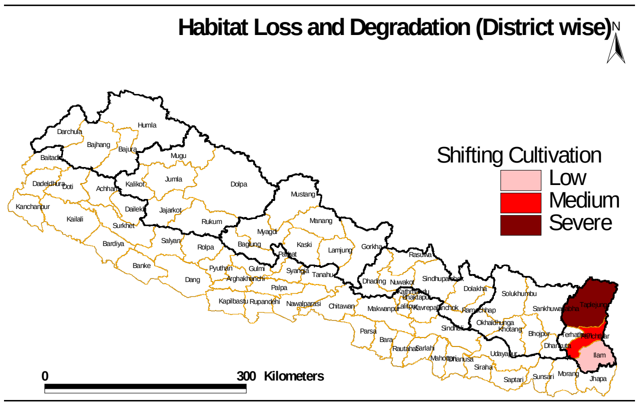


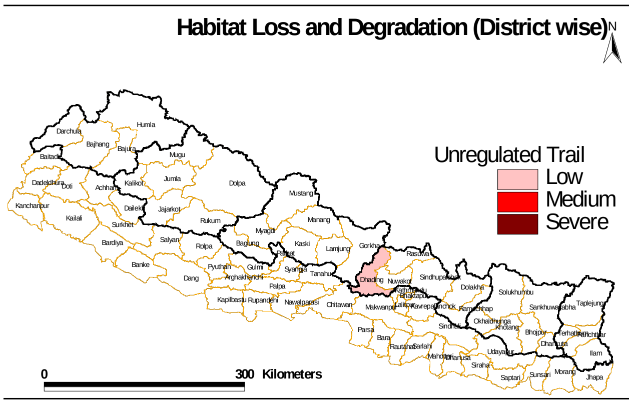


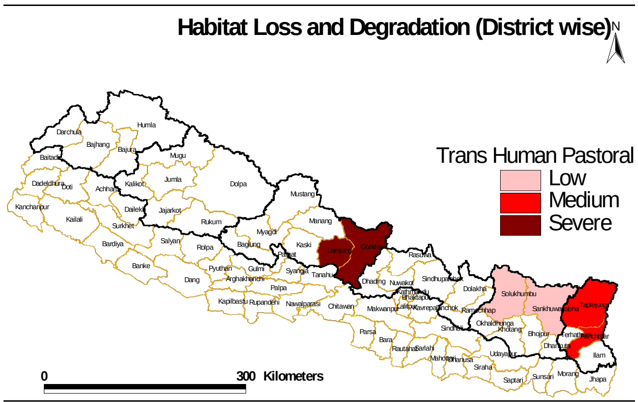


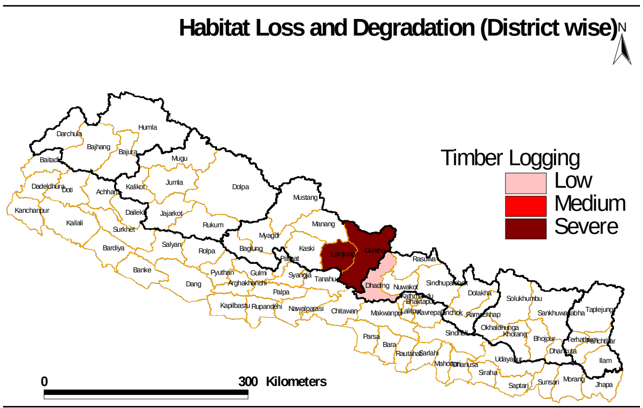




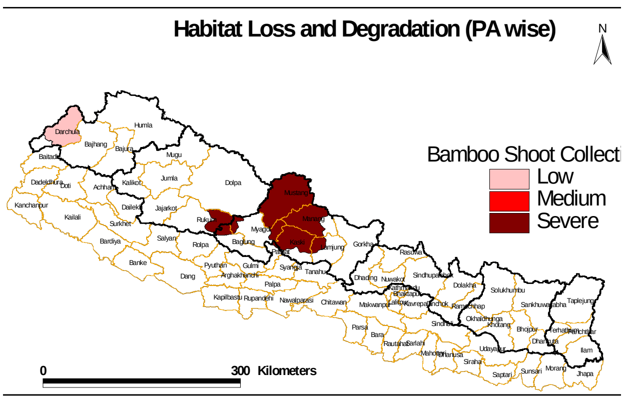


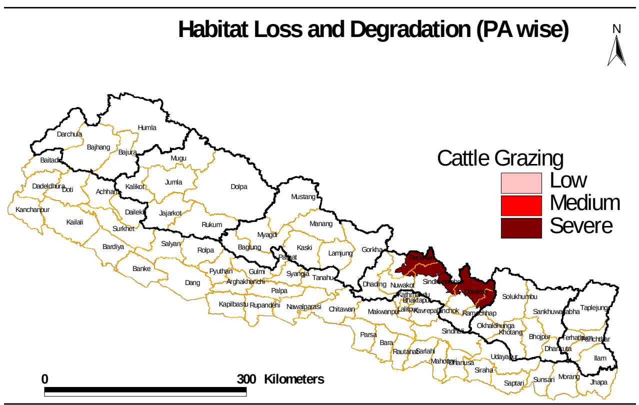


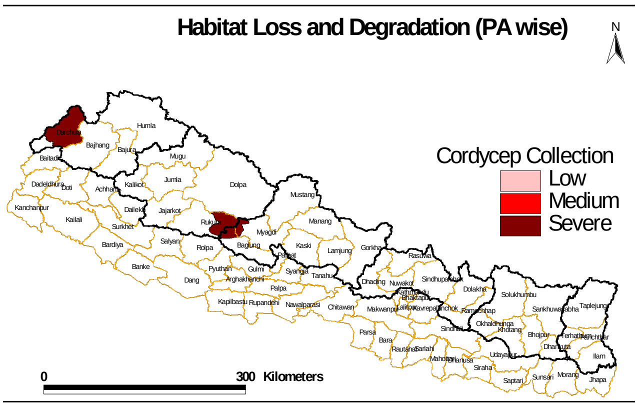


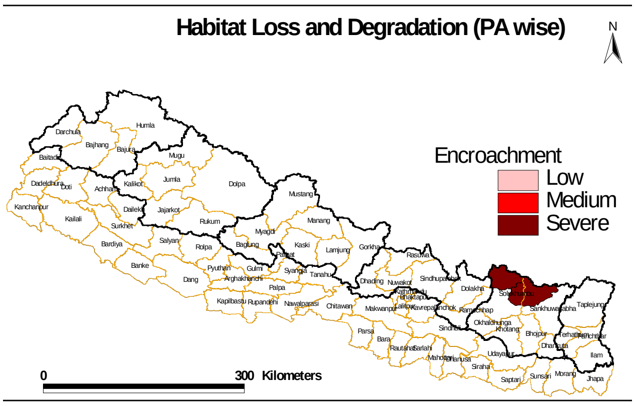


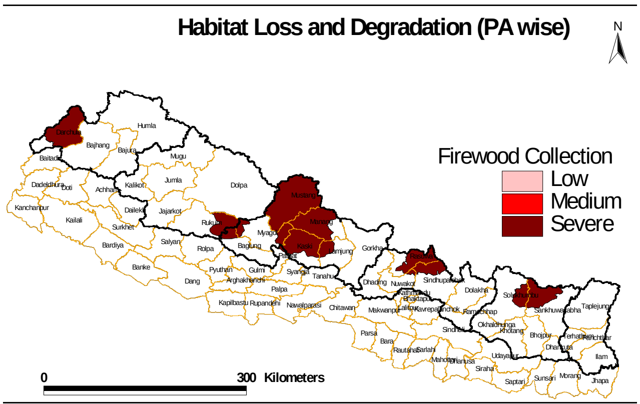
Habitat loss and degradation outside PA

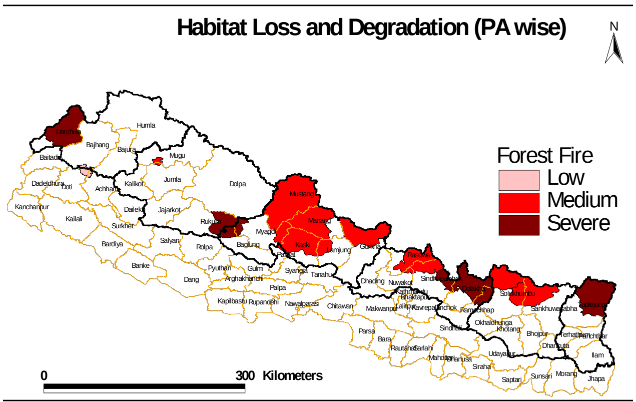


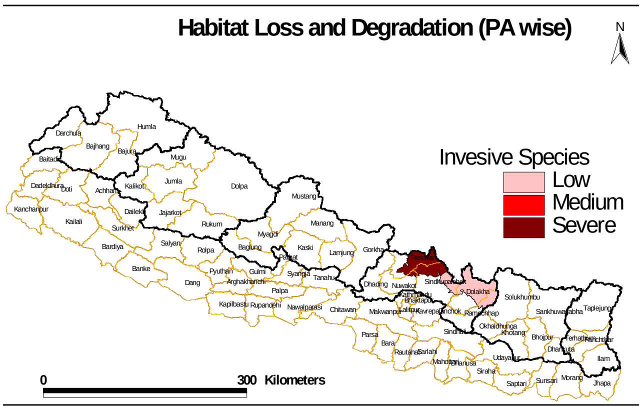


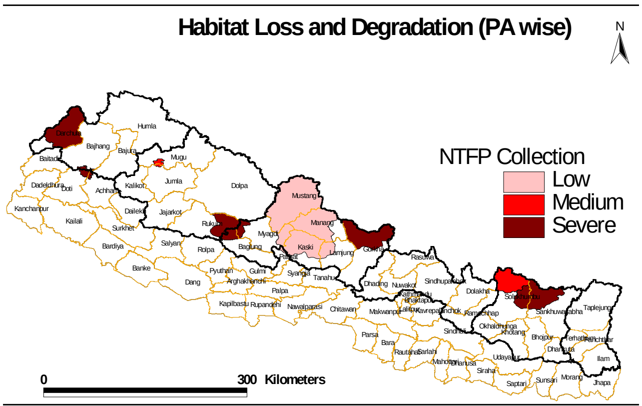

Habitat Loss and Degradation (PA wise)
N
Cordycep Collection
Low
Medium
Severe
0
300 Kilometers

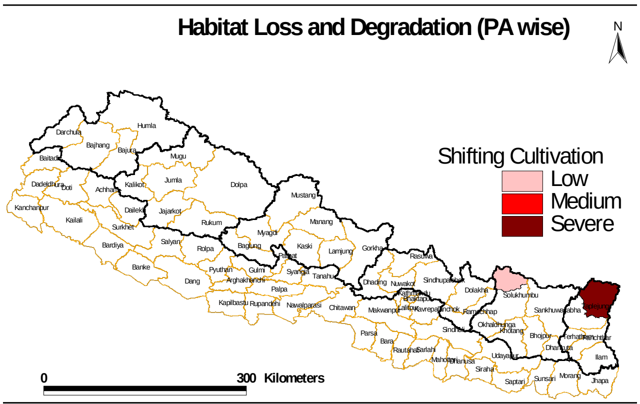

Habitat Loss and Degradation (PA wise)
N
Encroachment
Low
Medium
Severe
0
300 Kilometers

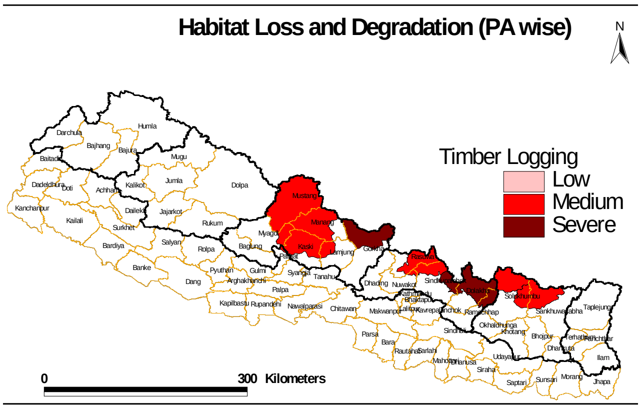

Habitat Loss and Degradation (PA wise)
N
Firewood Collection
Low
Medium
Severe
0
300 Kilometers

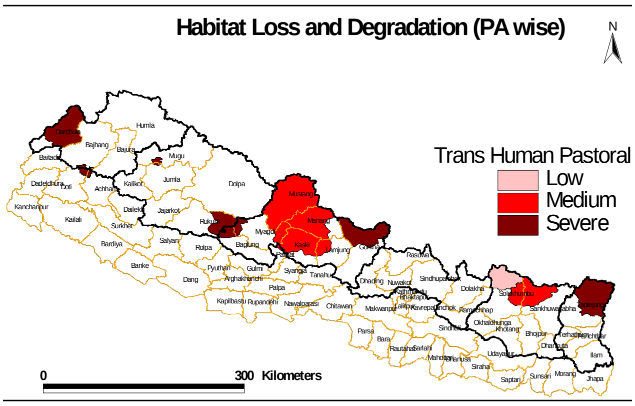

Habitat Loss and Degradation (PA wise)
N
Forest Fire
Low
Medium
Severe
0
300 Kilometers

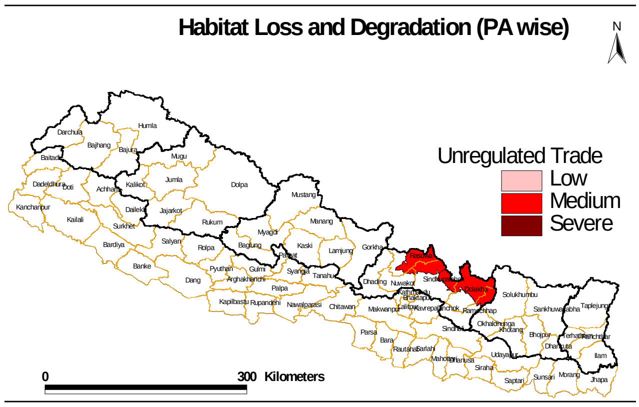

Habitat Loss and Degradation (PA wise)
N
Invesive Species
Low
Medium
Severe
0
300 Kilometers


Habitat Loss and Degradation (PA wise)
N
NTFP Collection
Low
Medium
Severe
0
300 Kilometers

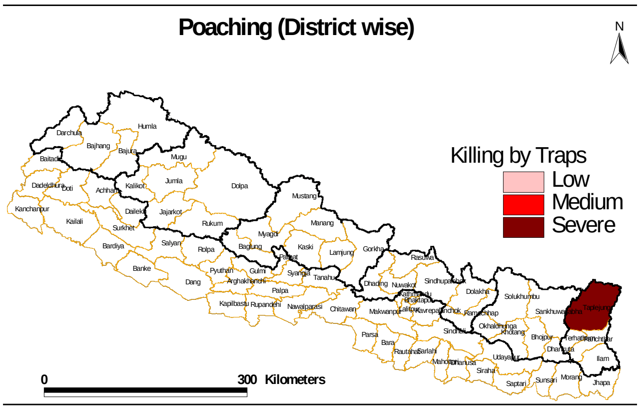

Habitat Loss and Degradation (PA wise)
N
Shifting Cultivation
Low
Medium
Severe
0
300 Kilometers

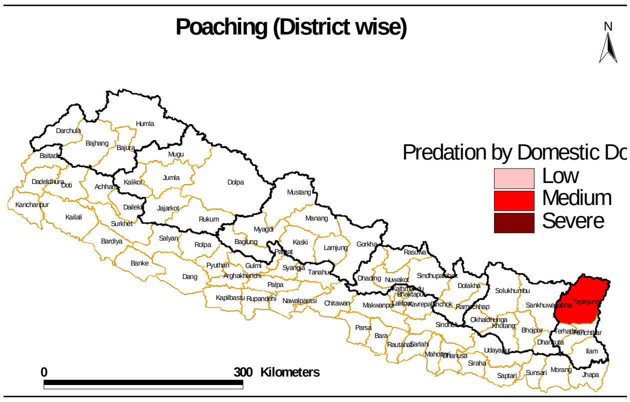

Habitat Loss and Degradation (PA wise)
N
Timber Logging
Low
Medium
Severe
0
300 Kilometers



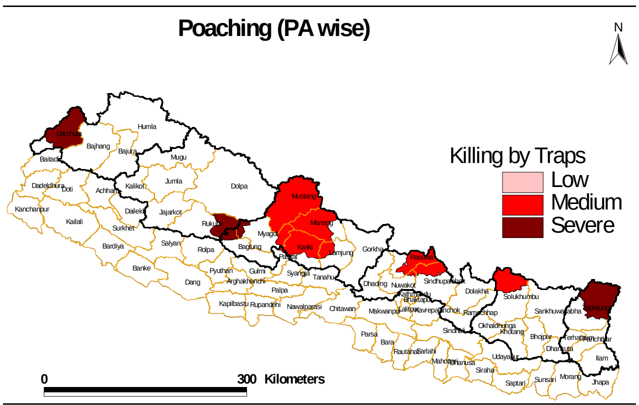


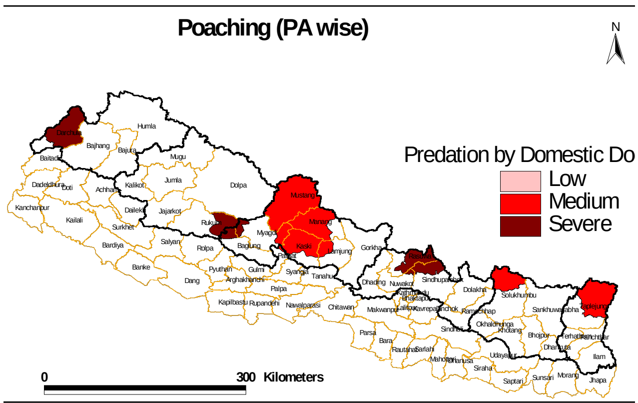
Poaching inside PA



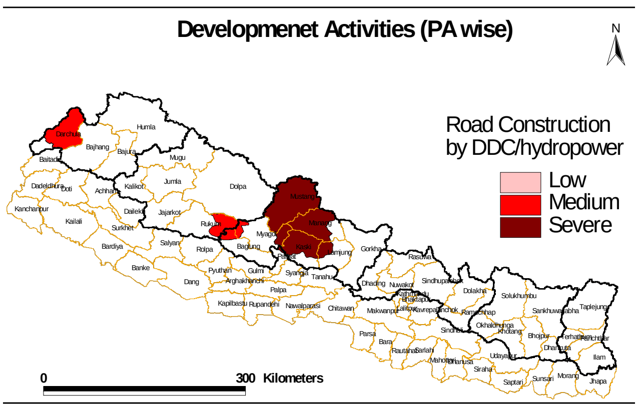


Poaching outside PA

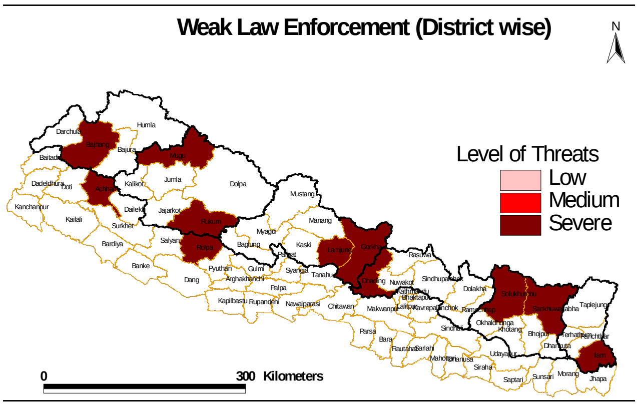




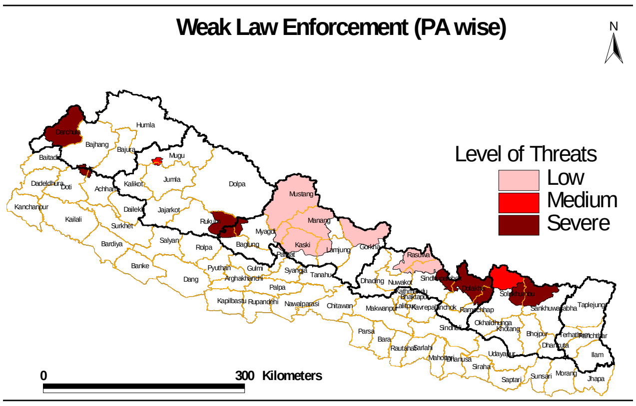
Development activities inside PA



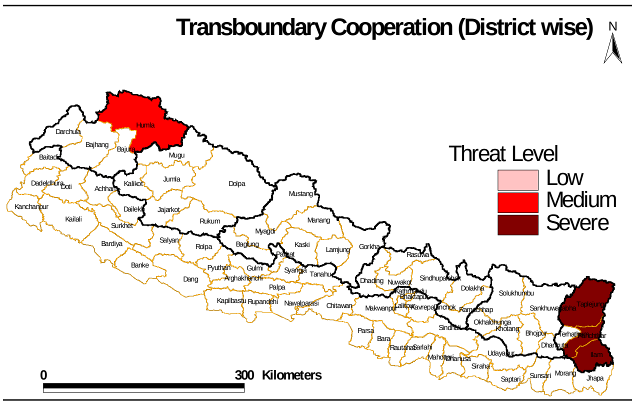
Enforcement activities inside PA

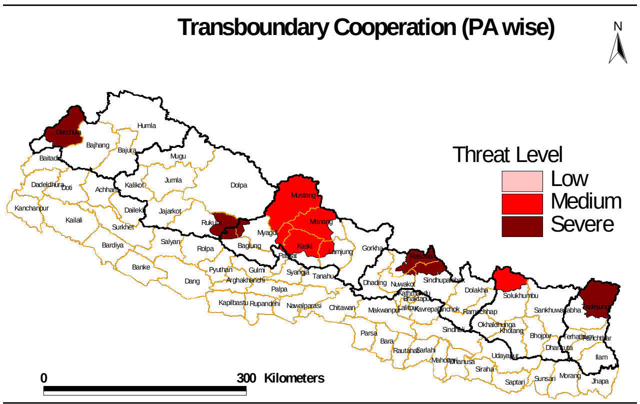


Enforcement activities outside PA



Trans-boundary inside PA





Red Panda Darjeeling Zoo, West Bengal, India. © Axel Gebauer

Mitigation of threats to Red Panda

	Issues/measures	Responsibility	Time line	Anticipated	Measurable products	Cost in NRs
1	**Habitat loss, degradation and fragmentation**					
1.1	Forest Fire					
	Short term					
	Endorse fire strategy	DOF/DNPWC	by 2011	Widely circulated to the concerned stakeholders	Fire strategy document , Annual reports, posters, pamphlets, Red Panda habitat well protected against fire, sighting of Red Panda increased, level of community awareness	400,000.00
	Mapping and forest fire alert and monitoring system	DOF/DNPWC/ NTNC/NGOs/ CBOs	by 2012	Prepared fire map		5,000,000.00
	Awareness campaigning	DOF/DNPWC/ NTNC/NGOs/ CBOs	on going	Awareness level raised by 70%		6,000,000.00
	Fire hazard mitigation including controlled burning, fireline, trial maintenance	DOF/DNPWC	by 2013	The fire incidence in Red Panda habitat decrease by 50%		20,000,000.00
	Identify forest fires volunteers	DOF/DNPWC	by 2012	Volunteer groups formed in each VDCs		2,000,000.00
	Training fire fighters including communities	DOF/DNPWC/ NTNC/NGOs/ CBOs	by 2012	Trained man power in community level		1,500,000.00
	Medium and Long Term					
	Sufficient funding for establishing fire fighting units with staffs and equipment	Govt/Donor	by 2016	Fire fighting unit in each sub population areas		10,000,000.00
	Strengthen coordination/ collaboration	DOF/DNPWC	on going	Effectiveness of activities increased		1,500,000.00
	Implementation of fire strategy	Govt/Donor	by 2015	Fire incidents decreased by 75%		20,000,000.00
	Strengthen law enforcement, prevention and offences	Govt	on going	Number of illegal activities decreased by 50%		-
1.2	Shifting cultivation/ encroachment					
	Short term					

	Issues/measures	Responsibility	Time line	Anticipated	Measurable products	Cost in NRs
	Strict law enforcement	Govt	ongoing	Cases of shifting cultivation decreased by 50%	Number of households practicing shifting cultivation, cases, Reports, Maps, supporting law notifiedin the gazette, number of households changing cropping pattern	2,000,000.00
	Clearing of encroachment	Govt	by 2013	Habitat restoration plan		
	Awareness against shifting cultivation	DOF/DNPWC/NTNC/NGOs/CBOs	on going	Encroachment incidences decreased by ca. 75 %		2,000,000.00
	Allocation of funds for alternative livelihood opportunities	Govt/Donor	by 2013	Functional cooperatives in each sub-population areas		4,500,000.00
	Amendement of existing laws	Govt.	by 2016	Law amended		500,000.00
	Promote Red Panda friendly alternative livelihoods (organic farming, agro forestry, horticulture, NTFPs, MAPS etc.)	DOF/DNPWC/NTNC/NGOs/CBOs	on going	Community participation in panda conservation increased		20,000,000.00
1.3	Overgrazing/cattle herders/dogs					
	Strengthen law enforcement	Govt.	on going	At least core habitats of Red Panda will be free of cattle, dog and cattle herders, effective patrolling, CBAPO mobilization	Principal habitat area strictly protected against grazing, Maps, reports, number of vaccinated dogs	40,000,000.00
	Controlled grazing based on zonation	Govt./ Community	by 2013	Zonation in all PAs completed		15,000,000.00
	Vaccination/health check up of dogs	DLSO/DNPWC/DOF/NGOs	by 2013	All dogs vaccinated in the peripheral area		3,000,000.00
	Effective rangeland management using native species	DNPWC/DOF/Community	by 2016	Habitat quality improved for panda	Habitat quality, number of cattle and herder decreased, number of herders adopting the alternative livelihood and feeding	3,500,000.00
	Alternative livelihoods	DOF/DNPWC/NTNC/NGOs/CBOs	by 2016	Atleast 50 % cattle herders shift in alternative livelihood and stall feeding		112,450,000.00
	Program to reduce livestock numbers especially unproductive breeds.	DLSO/DNPWC/DOF/NGOs	by 2015	Unproductive cattle number decreased by 50%		7,500,000.00

	Issues/measures	Responsibility	Time line	Anticipated	Measurable products	Cost in NRs
	Development of agri-silvi-pastoral system (integrated agriculture, pasture and agro-forestry system).	Agri dept/ DLSO/DNPWC/ DOF/CBOs/ NGOs	by 2015	At least one demo plot functional in each sub population sites		1,200,000.00
1.4	Firewood/timber/NTFPs					
	Improve law enforcement system	Govt.	by 2013	Number of collectors decreased by 25%	Number of HHs adopting alternative energy, NTFPs cultivation HH, plans and database, Monitoring reports, management documents	53,590,000.00
	Strengthen use of alternative energy on a large scale (solar, micro-hydro, LPG/biogas)	Govt./Donor	by 2013	At least 25 % households cadopt alternative energy		23,450,000.00
	Reward and punishment system both for communities and forest department	Govt.	by 2012	High morale of staff		,234,500.00
	Strengthen community stewardship in natural resources management	DOF/DNPWC/ NTNC/NGOs/ CBOs	by 2012	Increased community participation by 50%		2,350,000.00
	Develop management system based on science	DNPWC/DOF/ Donor/NGOs/ CBOs	by 2016	Scientific Red Panda monitoring system in place		23,456,000.00
	NTFP cultivation on private land/community land/government land	DNPWC/DOF/ NGOs/CBOs/ community	by 2016	Atleast 1000 HH cultivate NTFPs, 50 NTFP groups formed		12,459,000.00
1.5	Population Isolation due to fragmentation					
	Identiify subpopulations	GoN/MFSC/ Universities, Scientists, INGOs/NGOs, CBOs	by 2012	Census conducted	Census reports, other reports	50,000,000.00
	Initiate metapopulation management approach	GoN/MFSC/ Universities, Scientists, INGOs/NGOs, CBOs	by 2015	Program initiated with adequate trainings and resources	Annual reports, population evaluation reports	8,000,000,000.00
2	**Hunting/poaching**					
	Improve law enforcement	Govt.	by 2013	Poaching incidences reduced by 50 %	Annual reports, number of functional CBAPOs, number of poaching cases cases and number of trials	56,347,000.00
	Strengthen awareness program	DNPWC/DOF/ NGOs/CBOs	by 2012	Community based awareness activities launched by all		567,000.00
	Establish effective community based anti-poaching program	DNPWC/DOF/ NGOs/CBOs/ Community	by 2012	Functional CBAPOs in each subpopulation sites		567,899,000.00

	Issues/measures	Responsibility	Time line	Anticipated	Measurable products	Cost in NRs
	Strengthen cooperation and coordination	DNPWC/DOF/ NGOs/CBOs/ Community/Police/ Customs/ local government bodies	by 2014	regular meetings, workshops and sharing meeting and smooth law enforcement, stakeholders participation increased	Documents, reports, number of meetings, and trans-border illegal trade cases	230,000.00
	Trans-boundary cooperation	Government / Donor	by 2016	Periodic meetings in place, information exchanged, illegal trade decreased in border areas		7,890,000.00
3	**Developmental activities**					
3.1	Roads, Hydropower, Industry					
	Appropriate EIA and IEE should be strengthened	DNPWC/DOF/ MOE	by 2012	IEE, EIA mandatory, no mega development projects in core habitats	Zero mega projects in core habitats	345,600.00
	Political willingness and support	Government	by 2016	All parliament members will be aware about Red Panda conservation and support the conservation endeavors		15,678,000.00
3.2	Unregulated Tourism, Pilgrimage					
	Strict enforcement of NPWC Act-1973, Forest Act 1993 and other related acts & regulations	Government	by 2012	No tourist and pilgimage in the core habitat	Plans, cases, visitor trend, number of incinerators	450,000.00
	Restricted entry permits in core zone (Red Panda Zone)	Government / Community	by 2011	Controlled tourism in potential Red Panda habitat		127,800,000.00
	Restrict visitors during the breeding seasons	Government]/ Community	by 2011	Zero disturbance during breeding season		-
	Proper garbage disposal system should be developed	Government Community/ NGOs/CBOs/ Local govt. bodies	by 2011	Ecofriendly garbage disposal system in place		50,000,000.00
	Red Panda Habitat Management	DNPWC/DOF/ NGOs/CBOs/ Community/local government. bodies	by 2015	Habitat management plan prepared and endorsed	Management plan	8,500,000.00
4	**Weak Law Enforcement and Policy Gap**					
	Strict enforcement of existing laws	DNPWC/DOF	by 2011	No of illegal cases decreased by 50 %	Law enforcement status report, Community in action for panda conservation	89,340,000.00

	Issues/measures	Responsibility	Time line	Anticipated	Measurable products	Cost in NRs
	Allocation and enhance budget, manpower, capacity building and commitment	DNPWC/DOF/ NGOs/CBOs/local government . bodies/Donor	by 2013	Experience sharing Trainings, workshops and seminars		-
	Identify unprotected Red Panda habitat and make legal provision for the declaration of Red Panda Community Conservation Area.	DOF/Community/NGOs	by 2015	Community based panda conservation program launched		2,300,000.00
	Landscape Level Conservation Policy should be developed and implemented	DOF/DNPWC/ NGOs	by 2015	Provision of landscape conservation in act		-
5	**Inadequate Awareness/Education/Research/Funds**					
	Identify priority research topics and areas on RED PANDA	DOF/DNPWC/ NGOs/CBOs/local govt. bodies	by 2011	Research policy document prepared and endorsed	Reports, documents, school curriculum, number of eco-clubs, newspaper and other media	250,000.00
	Continuation of awareness education with more effective measures	DOF/DNPWC/ NGOs/CBOs/local govt. bodies	ongoing	Awareness level of all stakeholders raised by ca. 70%		-
	Additional funding allocation	DOF/DNPWC/ NGOs/Donor/ local government bodies	by 2012	Necessary additional funding secured		-
	Regular research and monitoring	DOF/DNPWC/ NGOs/Community/local government bodies	by 2014	Periodic M & E reports produced		35,000,000.00
	Sensitize all stakeholders	DOF/DNPWC/ NGOs/CBOs/local government . bodies	on going	Media coverage and sensitivity raised		40,000,000.00
	Include RED PANDA in Conservation Education Curriculum.	Government	by 2015	Curriculum endorsed		4,500,000.00
6	**Trans-boundary Issues**					
	Depute trained manpower at transit point to control illegal trade	government Govt.	by 2012	Position of one official in main transit	Number of trans-boundary meetings, reports, number of trainings	4,530,000.00
	Transboundary meetings and exchange visit	government Govt./Donor	by 2012	Information exchanged, Joint patrolling, Planning and coordination meeting conducted		1,000,000.00
	Aware and trained Custom Officials to control illegal trafficking	government Govt.	by 2012	Cases of illegal trafficking decreased by ca. 50 %		890,000.00
					Total NRS	9,458,106,100.00
					Total USD	131,362,584.72

Action Plan for 2011 to 2020

VIII. Vortex Modeling Working Group

***Modellers:* Kristin Leus and Sanjay Molur**

Vortex Simulation Model

Computer modeling is a valuable and versatile tool for quantitatively assessing risk of decline and extinction of wildlife populations, both free ranging and managed. Complex and interacting factors that influence population persistence and health can be explored, including natural and anthropogenic causes. Models can also be used to evaluate the effects of alternative management strategies to identify the most effective conservation actions for a population or species and to identify research needs. Such an evaluation of population persistence under current and varying conditions is commonly referred to as a population viability analysis (PVA).

The simulation software program *Vortex* (v9.99) was used to examine the viability of the Red Panda population in Nepal. *Vortex* is a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wild or captive small populations. *Vortex* models population dynamics as discrete sequential events that occur according to defined probabilities. The program begins by either creating individuals to form the starting population or importing individuals from a studbook database and then stepping through life cycle events (e.g., births, deaths, dispersal, catastrophic events), typically on an annual basis. Events such as breeding success, litter size, sex at birth, and survival are determined based upon designated probabilities that incorporate both demographic stochasticity and annual environmental variation. Consequently, each run (iteration) of the model gives a different result. By running the model hundreds of times, it is possible to examine the probable outcome and range of possibilities. For a more detailed explanation of *Vortex* and its use in population viability analysis, see Lacy (1993, 2000), Brook et al. (2000), and Miller and Lacy (2005).

Introduction

Hardly any life history parameters, population sizes and quantitative population trends required for entry into the Vortex model are known for wild Red Panda. The aim of the simulation model constructed for the Red Panda population of Nepal was therefore to create a baseline model based on the current best estimates for the various model parameters, that simulates a "best case scenario": a Red Panda population free from anthropogenic threats and catastrophes. Because of the large uncertainty in data entry values, the model will not be able to investigate the viability of specific Red Panda subpopulations in Nepal, under specific threat conditions or management scenarios. However, it can help to illustrate the extreme vulnerability of Red Panda subpopulations of the sizes identified by the Wild Population Working group, even without human caused threats acting upon them, and can thus help illustrate the extreme urgency for conservation actions to help protect the future of the Red Panda in Nepal. It also helps to illustrate a few basic principles in population biology for conservation.

Baseline Model Parameters

A baseline model was constructed with the aim to represent a Red Panda population in Nepal free of human caused threats. The input parameters were derived from previously published literature and reports and from discussions with the PHVA workshop participants, incorporating recently gathered unpublished information as well as general personal experience.

General Model Parameters

Number of iterations: 500
Number of years: 100 (or more than 20 generations)
Extinction definition: Only one sex remains
Number of populations: Single population

Reproductive Parameters

Mating system: Polygyny (short term)

Males appear to have larger territories than females and the territories of several males appear to board on/overlap with the territory of one female. In Singhalila National Park, Darjeeling, India, two males were seen courting one female (Sunita Pradhan pers. comm.). It is thought possible that one male mates with more than one female, but likely not very many. Pairings will change from year to year.

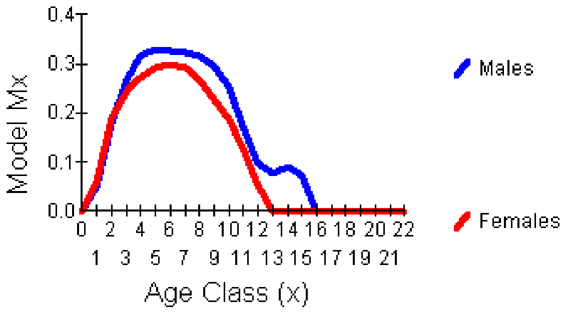
Reproductive lifespan: 10

Data from captive populations:

The European and North American subpopulations of *A.f. fulgens* in the international studbook for Red Panda (Glatston 2006) have large enough sample sizes for reliable life table calculations and yielded the following information:

European captive subpopulation of *A.f. fulgens* from 01 January 1984 – 31 December 2006:

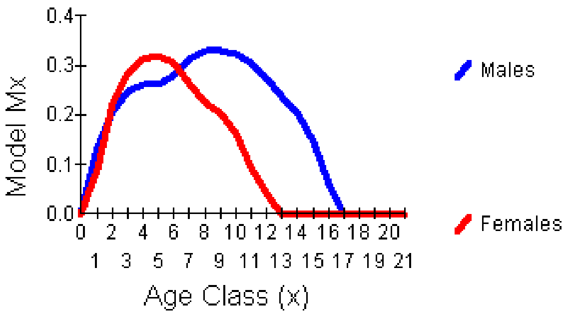
- Reproductive life span: Males: 1-15 years; Females: 1-12 years
- Age at first reproduction Females: median 2Y 11M 29D
- Age at first reproduction Males: median 3Y 1M 20D



Graph of age specific fecundity (Mx = average number of same sex offspring born to a parent of a specific age class):

North American captive subpopulation of *A.f. fulgens* from 01 January 1984 – 31 December 2006:

- Reproductive lifespan: Males: 1- 16 years, Females: 1-12 years
- Age at first reproduction Females: median 2Y 11M 12D
- Age at first reproduction Males: median 2Y 7M 27D



Graph of age specific fecundity (Mx = average number of same sex offspring born to a parent of a specific age class):

Data from literature
Young are said to attain adult size at approximately 12 months and to be sexually mature at approximately 18 months (Roberts, 1975, 1980, 1981) [quoted in Roberts & Gittleman 1984].

Summary
In captivity, the first age of reproduction is 1, but the median age of first reproduction is 2-3 years. Based on available information workshop participants felt that in the wild first age of reproduction is likely 2 years of age for both males and females. Both sexes have territories but there are no reports of active fighting between animals for territories. For this reason, the first age of reproduction was thought to be as young as 2 and there was felt to be no reason to think this is later for males than for females, because there is at yet no evidence for intra-male fighting for territories. The last age of reproduction in captivity appears to be about 12 years. It is thought that pandas in the wild do not live beyond their reproductive lifespan and that the latter is probably a bit shorter than in captivity – workshop participants agreed on 10 years.

Maximum number of young per year and litter size distribution: 3 (1: 40%, 2: 55%, 3: 5%)
In captivity, pandas have 1-4 cubs but a litter size of 4 is a very seldom occurrence (Glatston, 2006). It is thought that in the wild they will have 1-3 cubs and the frequency of these was based on results from the captive population in Europe and North America.

Captivity: *A.f. fulgens* populations in the period 01 January 1984 to 31 December 1996

Europe			North America		
Litter size	%	N	Litter size	%	N
1	39	197	1	32	101
2	59	274	2	56	177
3	5	26	3	11	34
4	1	3	4	1	2

Sex ratio at birth (in % males): 50%
In captivity the sex ratio at birth appears to be 50/50 (Glatston 2006) and there is currently no reason to assume this might be different in the wild.

Births in captivity: 01 January 1984 till 31 December 1996:

Region	Males.Females.Unknown Sex
Europe:	303.285.89
N. America:	189.208.55
India:	27. 27. 0

Percentage of adult females breeding per year: 80%

In captivity, during the period 01 January 1984 to 31 December 1996, the shortest interbirth intervals were (Glatston, 2006):
Europe:335 days
N. America: 340 days
India: 347 days

From the literature we learn that:
- In the wild, births occur in spring and summer, but mainly in June (Hodgson, 1847; Pocock, 1941; Wall, 1908) [quoted in Roberts & Gittleman 1984].
- Females that lose litters do not undergo a post-partum estrus. [captivity] [Roberts & Gittleman 1984]
- They seek mates from December to February, and the female gives birth to up to four cubs around four months later. The cubs stay with

their mother until she gives birth again the following year, when they venture out on their own (Holtcamp 2009)

The workshop participants therefore felt it is likely that females generally breed once a year. The percentage of females breeding per year was felt to be relatively high; there are no field data to support this but the workshop participants agreed on 80%.

Percentage males in the breeding pool: 91.5%
Although one male can mate with more than one female, it was felt that on average each male will have a very limited number of mates. It was felt that males on average might have 1.5 mates, which corresponds to 91.5% of males in the breeding pool.

Mortality Parameters

Age specific mortality rates:
There are no reliable age specific mortality data for wild Red Pandas. Based on experience in captivity combined with literature data from species that were felt to be possible model species (see below) the following mortality parameters were agreed upon:

Females:	0-1:	45(±5)
	1-2:	20(±5)
	2+:	15(±3)
Males:	0-1:	45(±5)
	1-2	20(±5)
	2+:	15(±3)

Data from captive populations
Age specific mortality rates (Qx = proportion of animals dying in a specific age class before being able to reach the next age) for captive *A.f. fulgens* in Europe (EEP) and N. America (SSP) (Glatston 2006) *[Data smoothed once, tails adjusted and sample size effects in higher age classes manually adjusted]*:

Age	Mortality			
	Males		Females	
	Qx EEP	Qx SSP	Qx EEP	Qx SSP
0	0.42	0.5	0.33	0.48
1	0.05	0.04	0.05	0.03
2	0.05	0.04	0.05	0.038
3	0.05	0.043	0.053	0.055
4	0.053	0.048	0.058	0.068
5	0.065	0.058	0.063	0.07
6	0.082	0.072	0.068	0.07
7	0.09	0.08	0.075	0.07
8	0.103	0.082	0.105	0.075
9	0.133	0.087	0.153	0.095
10	0.17	0.092	0.188	0.125
11	0.208	0.098	0.228	0.145
12	0.228	0.133	0.29	0.163
13	0.233	0.198	0.343	0.193
14	0.273	0.23	0.42	0.24
15	0.345	0.32	0.64	0.34
16	0.285	0.41	0.9	0.53
17	0.36	0.6	1	0.85
18	0.43	0.88	1	1
19	0.62	1	1	1
20	0.88	1	1	1
21	1	1	1	1

Data from literature:
Yonzon and Hunter (1991) report some mortality rates for a limited number of Red Panda in a heavily human disturbed area with a high level of predation by dogs and these rates are therefore not suitable for a baseline model free of anthropogenic threats: "Their fecundity is also limited (usually one cub/female/year and mortality of both cubs and adults is 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 (Yonzon and Hunter, in press). Most of the deaths from known causes (57%) were human-related; thus the presence of chauri, their herders and dogs was clearly detrimental to the pandas."
Data from other species:
It was felt that in terms of body size, lifespan and reproductive characteristics a small felid or raccoon could perhaps function as a model.

From: Miller et al. (2005) (based on new analyses by Aaron Haines (see also Haines et al. 2005, 2006)): Preliminary Population Viability Assessment for the Ocelot (*Leopardus pardalis*) in South Texas and Northern Tamaulipas.

Age Class	% Mortality (SD) (Road mortality excluded)	
	Females	Males
0-1	30.0 (6.0)	30.0 (6.0)
1-2	15.0 (3.0)	15.0 (3.0)
2-3	16.0 (4.0)	30.0 (6.0)
3-4	8.0 (2.0)	8.0 (2.0)
4+	8.0 (2.0)	8.0 (2.0)

From: Rees et al. (2008): Raccoon ecology database: A resource for population dynamics modeling and meta-analysis.

"Ontaria Rabies Model" (ORM) default values from Ontaria field data en range of values found for rural raccoons in the Racoon Ecology Database (REDB):

Parameter	ORM Default value	REDB
Year 0 male (female) mortality rate	0.5	Subadult: 0.4-0.51
Year 1 male (female) mortality rate	0.4	Adult: 0.3-0.9
Year 2 male (female) mortality rate	0.3	
Year 3 male (female) mortality rate	0.3	
Year 4 male (female) mortality rate	0.3	
Year 5 male (female) mortality rate	0.6	
Year 6 male (female) mortality rate	0.6	
Year 7 male (female) mortality rate	0.6	

Catastrophes:
Originally, large-scale bamboo flowering (followed by die off) were thought to potentially influence Red Panda carrying capacity or reproduction or survival. However, these events typically affect only one bamboo species per locality and the forests typically contain more than one species. The Red Panda might prefer one species over another but when forced can switch between species. Furthermore, the bamboo starts to shoot after about 1.5 year and it is the shoots the Red Panda eats. Any effect would therefore be short lived. Also, Red Panda are not obligate bamboo eaters and include many other food items in their diet.

According to the literature, large-scale die offs can affect 1,000-100,000 ha or 10-1000 km² (Keeley and Bond 1999). A recent large-scale die off in Arunachal Pradesh was thought to have affected at least 200 ha (or 2 km²). Assuming a Red Panda density of about 2.5/km², a population of 200 would live in an area of about 500 km². It was felt that most die offs in the region would affect areas considerably smaller than that (and would therefore not affect the whole population). For these reasons it was felt that bamboo flowering was not of sufficient consequence to Red Panda to be included in the model as a catastrophe (or in any other form). It was decided to create a baseline model without catastrophes.

Initial population size (N): 200

Inbreeding depression:
Because no information is available on the presence or absence or the way of manifestation of inbreeding depression in the Red Panda populations, and on how many lethal equivalents are present per diploid individual, inbreeding depression was included in the Vortex model with the default settings (Miller and Lacy 2005):

- Inbreeding depression is modelled as reduction in first year survival of inbred individuals
- The number of lethal equivalents (LE) sets the severity of the inbreeding depression. The default value in Vortex is 3.14 LE per diploid individual, based on a survey of 40 captive mammal populations
- The percentage of the genetic load due to recessive lethal alleles was set at 50%, derived from a number of well studied species

Results

1. Baseline scenario with carrying capacity (K) = 200:

The deterministic projections (assumes no stochastic fluctuations, no inbreeding depression, no limitation of mates, no harvest, and no supplementation) of the baseline model result in a population growth rate of 8.4% per year (r= 0.084), a generation growth rate (R0) of 1.488 and a generation time of 4.71 years for both males and females.

The stable age distribution associated with the model is as follows:

Age class	Females	Males
0	0.166	0.166
1	0.084	0.084
2	0.062	0.062
3	0.048	0.048
4	0.038	0.038
5	0.029	0.029
6	0.023	0.023
7	0.018	0.018
8	0.014	0.014
9	0.011	0.011
10	0.009	0.009

Ratio of adult (>= 2) males to adult (>= 2) females: 1.000

Stochastic projections for the baseline model result in a population with the following characteristics:

Probability of extinction: 0%
Stochastic growth rate (r): 0.07 (SD 0.09)
Proportion of gene diversity retained after 100 years: 0.9007 (SD 0.0220)
Mean population size after 100 years: 195.17 (SD 10.41)

2. Stochastic modelling results for the baseline scenario with varying values for Initial population size (N) and carrying capacity (K): N/K = 150, 100, 50, 20

Figure 1 indicates that with the current baseline input values (which exclude effects of human caused threats and catastrophes), populations of either 150 or 100 individuals have a 100% probability of survival after 100 years (or 0% probability of extinction). A population of 50 individuals has a slightly lower probability of survival (about 94%), whereas a population of only 20 individuals is almost guaranteed to go extinct – its probability of survival is only 11% and the median time to extinction is 57 years.

It would thus appear that populations as small as 50 individuals could still be relatively save from extinction. However, it is clear from the results of the Threats Working Group that the conditions of the baseline scenario (no human caused threats and no catastrophes) exist nowhere in the distribution area of the Red Panda in Nepal! Every known locality has a combination of several human caused threats acting on the populations and almost no natural population of any species anywhere on earth is free from catastrophes – in the case of the Red Panda forest fires are regular occurrences in the distribution area which can have varying degrees of effect on the suitability of the forest as Red Panda habitat. Because there was no reliable quantitative information available on the severity and effects of different threats and catastrophes, and because there was already a large uncertainty for the input values of the baseline scenario, it was not possible to model the effect of specific threats on specific populations. However, the following scenario was built to illustrate that even just one or two threats with a modest severity, can have a very large impact on the likely future of a Red Panda population that appeared to be relatively safe under the baseline scenario.

3. Comparing the effects of harvest or a reduction in carrying capacity on the outcome of a population with N and K = 150 individuals:

The Harvest scenario modelled assumed that one adult female and two cubs (one male and one female) would be "harvested" per year. This can be through poaching, or through added mortality from dogs etc.

The Harvest + Habitat scenario modelled the effect of harvest as described above + the effect of losing 1% of habitat (and therefore K) per year – a rate which, judging from the experiences of the workshop participants, appears modest.

The results in Figure 2 suggest that a population of 150 individuals is still relatively safe from extinction under the harvest scenario alone, whereas adding the habitat loss makes the population very vulnerable to extinction from about 50 years onwards (after 100 years the probability of survival would of course be 0% because there would be no habitat left at that time).

However, the relative safety of the population under the harvest scenario alone can be misleading if one does not take the percentage of gene diversity retained after 100 years into account: only 86.5% of the gene diversity of the starting population would be left at that time. This would equate to an average level of inbreeding of 13.5%, which is slightly higher than the equivalent level of half-sib matings (12.5%). Apart from causing a reduction in heterozygosity, inbreeding may cause decreased fitness in inbred individuals of naturally outbreeding species, a phenomenon which is called inbreeding

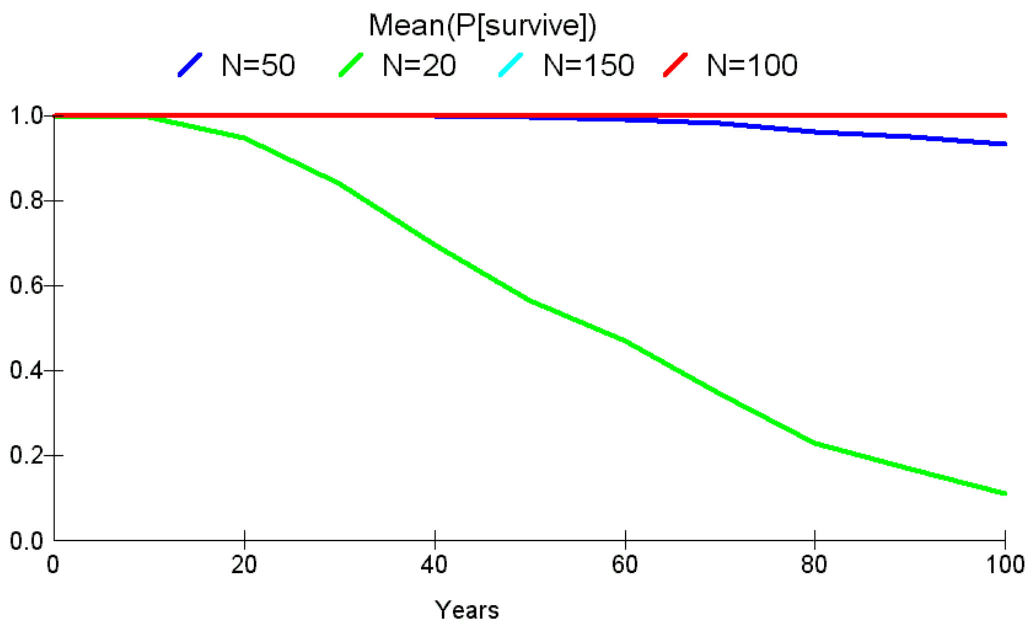


Figure 1.Average probability of survival over the course of 100 years for subpopulations with initial population sizes of either 20, 50, 100, or 150 individuals.

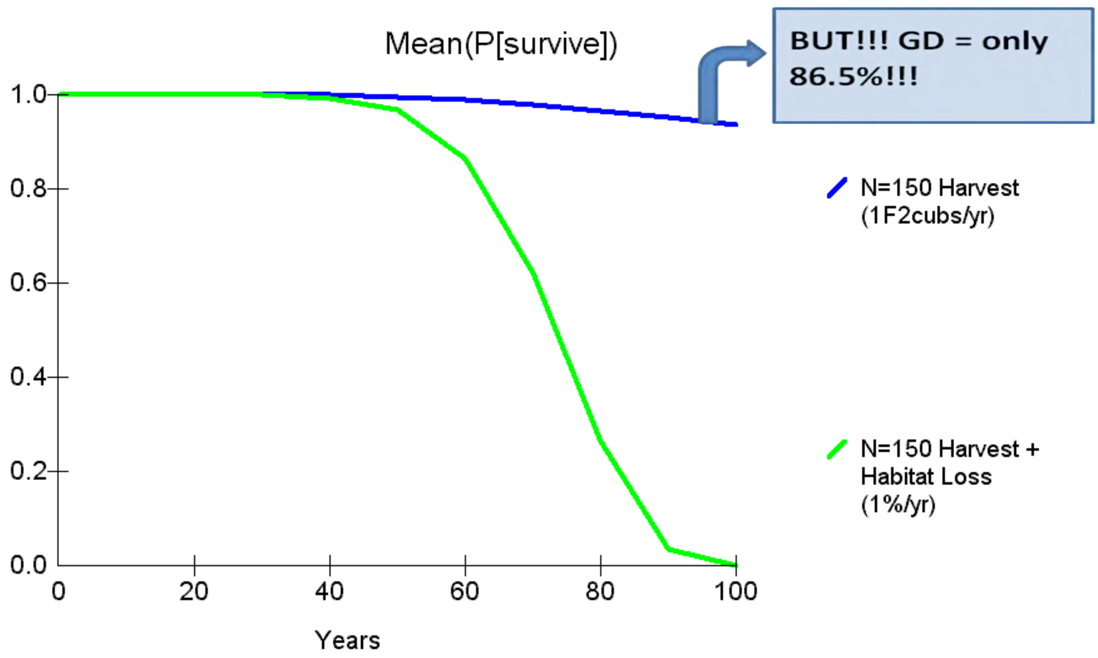


Figure 2. Average propability of survival over the course of 100 years for two populations with an initial starting size of 150 individuals, but whereby in one population one adult female and two cubs per year are harvested (blue line) whereas for the other population the same number and types of individuals are harvested but in addition, habitat is lost with 1% per year (green line).

depression (Frankham et al. 2002). The latter may express itself in many forms, some of which may not be immediately obvious unless one consciously sets out to investigate them, e.g. reduced juvenile survival, reduced adult survival, less successful mate acquisition, lower social dominance ranking of inbred individuals, reduced fertility, increased bilateral asymmetry, increased disease susceptibility etc. Inbreeding depression occurs more often than not and numerous wild populations have now been shown to suffer from inbreeding depression (Crnokrak and Roff 1999; Frankham et al. 2002; Frankham 2010). Inbred populations that appear to have healthy growth rates are not necessarily free from inbreeding depression, and inbred populations experiencing inbreeding depression are not guaranteed to go extinct. Furthermore, at low to moderate levels of inbreeding, inbreeding depression is usually low to moderate as well. However, there appears to be a threshold effect whereby there is a marked and incremental increase in risk of extinction due to inbreeding depression from intermediate levels of inbreeding onwards (Frankham 1995). Inbreeding effects also tend to be more severe in harsher environments. Populations that appeared fine may therefore start to struggle in times of increased stress from whatever source (Frankham 1995). Replicate populations of the same species, inbred to the same degree will show different degrees of inbreeding depression, possibly including no inbreeding depression or even increased fitness with inbreeding (e.g. Lacy et al. 1996), but the probability that inbreeding reduces fitness is higher than that it does not. Inbreeding depression therefore increases the probability of extinction, especially when populations remain small and moderate levels of inbreeding have been reached. Current scientific evidence suggests that, certainly when we deal with highly threatened populations, it would be foolish not to take the possible existence and effects of inbreeding depression into account (Frankham and Ralls 1998).

Ideally, for wild populations, one would strive for the retention of something in the order of 100-98% of gene diversity – so that 100-98% of the evolutionary potential can be retained, which this population would thus not be able to achieve on its own. It will be therefore be necessary to ensure that small populations (even those with 150 or 200 individuals) have connectivity to other populations so that the gene diversity in each subpopulation, and certainly at the level of the metapopulation can be kept sufficiently high. This concept is explored in the next scenario.

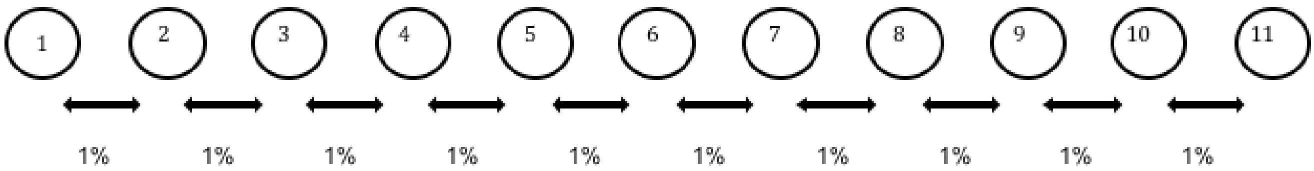
4. Dispersal between 11 subpopulations
Eleven subpopulations were created, each with an initial population size and carrying capacity of 20 individuals, and the same input parameters as the baseline scenario (please remember that these values do not include effects of human caused threats or catastrophes – all of the results described below will be worse if threats and catastrophes act on the population, as we know they do in real life). The model was run with a) no dispersal between the

subpopulations (so all subpopulations are completely isolated from each other), and b) a 1% annual probability of dispersal between the populations as follows:

Both males and females can disperse and for both sexes the age range of dispersing individuals is 2 to 10 years. The percentage survival of dispersing individuals is 75%.

Figure 3 shows the mean probability of survival for the metapopulation (of 11 subpopulations). This graph suggest that a metapopulation of subpopulations larger or equal to 50 individuals is save from extinction, regardless of whether or not there is dispersal between the subpopulations. However a metapopulation of subpopulations with a starting population size and carrying capacity of only 20 individuals has a higher risk of extinction, particularly after about 70 years, which is more pronounced for the scenario without dispersal than with dispersal. Furthermore when we look at Figure 4, which shows the mean population size of all populations (both those that went extinct and those that didn't), it becomes obvious that the population size of the metapopulation with starting subpopulations with a starting N of 20 keeps getting smaller. Indeed the mean stochastic growth rate (r) for the scenario with dispersal is 0.011 (SD 0.097) and without dispersal -0.001 (SD 0.111). Figure 5 indicates that even with dispersal between the subpopulations, each subpopulation has a very high risk of extinction within 100 years and this risk increases over the years. All this suggests that if we modelled a time period longer than 100 years the probability of extinction of this metapopulation will only increase until eventually all subpopulations and thus the metapopulation are extinct. Allowing dispersal between subpopulations that, each by themselves, have an extremely high risk of extinction therefore does not necessarily provide a solution, it merely buys a bit of time.

Figure 6 teaches us that the metapopulation of subpopulations with a starting population size of 50 retains about 96% of gene diversity after 100



Dispersal between 11 subpopulations

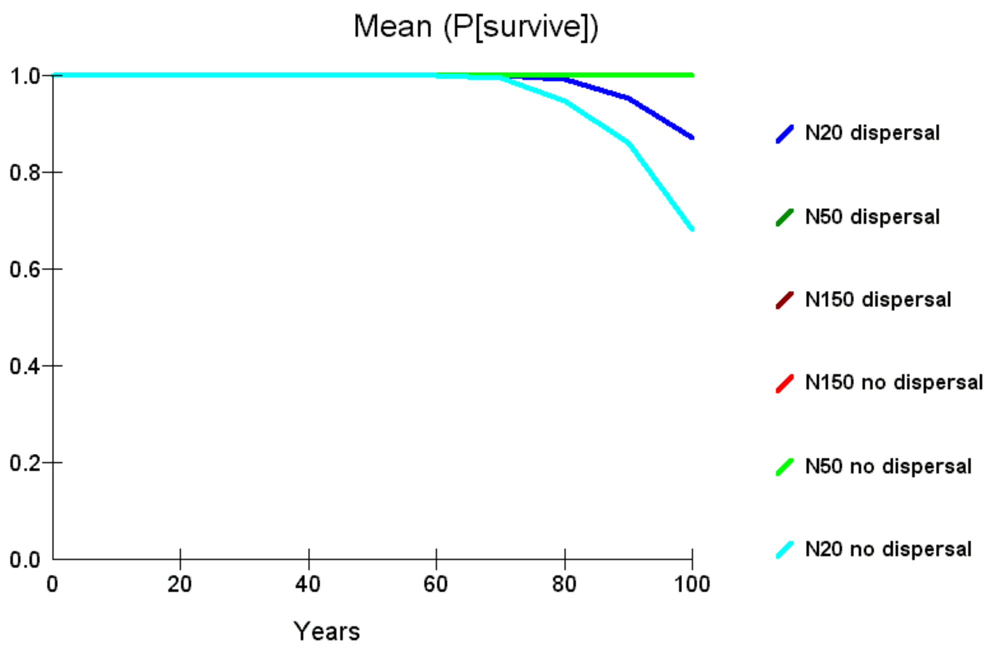


Figure 3 Average probability of survival for 6 metapopulations - 3 with and 3 without dispersal - each composed of 11 subpopulations and respectively with a starting population size of 20, 50 and 150 individuals. Dispersal was modelled with a 1% annual probability of dispersal between the populations as indicated in the schematic above.

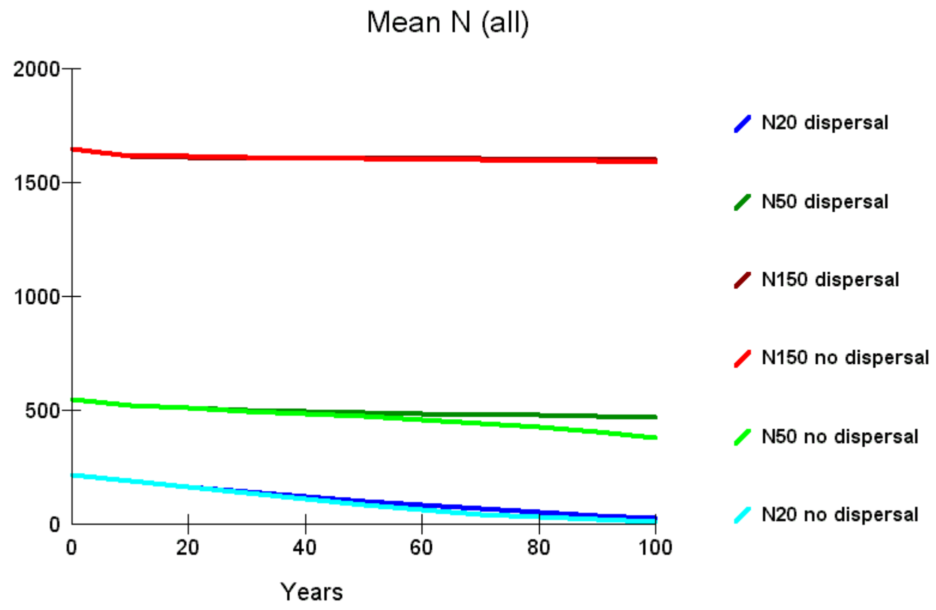


Figure 4 Mean population size of all populations (both those that went extinct and those that didn't) for 6 metapopulations - 3 with and 3 without dispersal - each composed of 11 subpopulations and respectively with a starting population size of 20, 50 and 150 individuals. Dispersal was modelled with a 1% annual probability of dispersal between the populations as indicated in the schematic above.

years, with or without dispersal. For N = 150 this climbs to about 98.8%. In this context it is worthwhile to point out that the "Wild Population Working Group" identified that the none of the subpopulations of Red Panda in Nepal has a "confirmed" size larger than 50 individuals and only two have a "possible" size larger than 150. Substantially larger populations are needed to guarantee not only the demographic but also genetic viability of the wild Red Panda population in Nepal.

Much more information needs to be collected on the size, location and dispersal rates between Red Panda subpopulations before plans to increase connectivity between these populations can be drawn up. If done without care and knowledge, linking subpopulations can have negative rather than positive effects on the survival chances of the metapopulation. Such plans should only be drawn up by specialists based on sound facts and science.

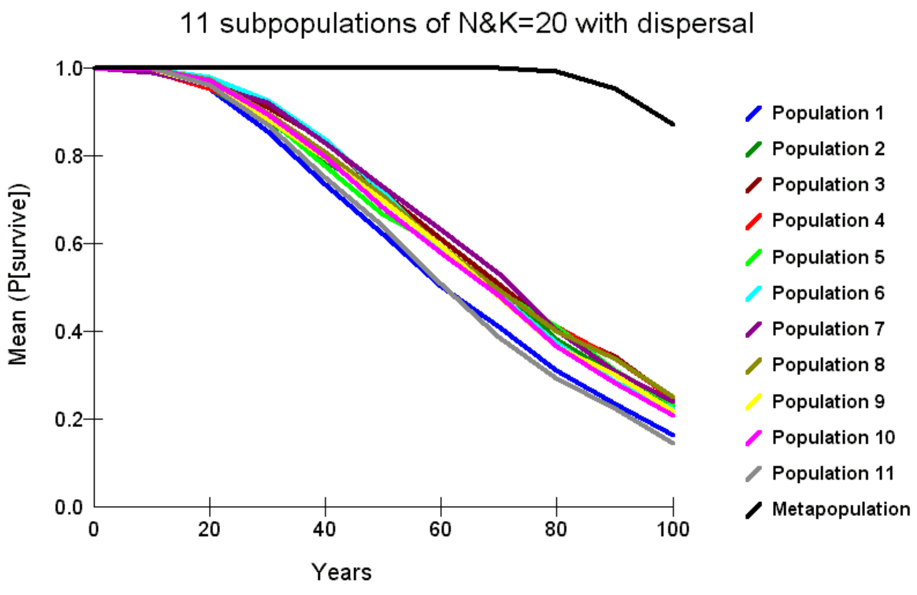


Figure 5 Average probability of survival over the course of 100 years for each of 11 subpopulations as well as the metapopulation, whereby each subpopulation had a starting population size and carrying capacity of 20 individuals and whereby dispersal between the subpopulation modelled with a 1% annual probability as indicated in the schematic above.

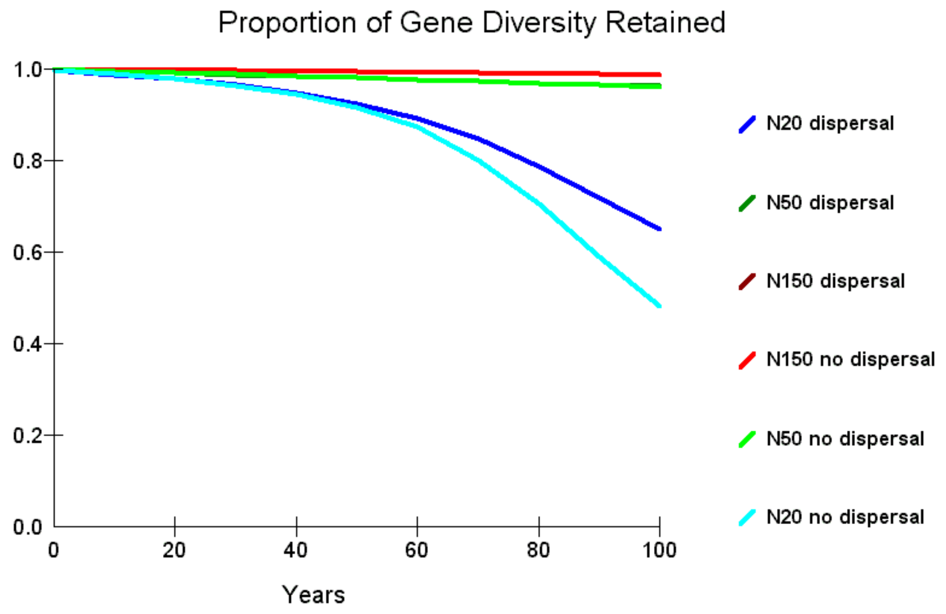


Figure 6 Proportion of Gene Diversity retainedat 100 years of populations with varying initial sizes and dispersal scenarios.

General conclusions

- Very small populations, ~20-50 Red Pandas, have a high probability of extinction **even without** additional, human caused, threats
- The majority of current subpopulations fall in this range
- Even larger populations will become extinct if human threats, such has hunting, predation by domestic dogs, habitat loss, fire etc. are not urgently addressed.
- Substantially larger populations are needed to guarantee not only the demographic but also genetic viability of the wild Red Panda population in Nepal.
- Organising dispersal opportunities between subpopulations that are so small that they each by themselves have a high probability of extinction are not efficient.
- Much more information needs to be collected on the size, location and dispersal rates between Red Panda subpopulations before plans to increase connectivity between these populations can be drawn up. If done without care and knowledge, linking subpopulations can have negative rather than positive effects on the survival chances of the metapopulation. Such plans should only be drawn up by specialists based on sound facts and science.

Recommendations

1. To avoid extinction of Red Pandas in Nepal in the short to midterm future, it is vital that:

- habitats between subpopulations are restored fully so that several subpopulations can expand their range and function as one large population;
- habitat fragments within each subpopulation are linked for safe panda movement, and
- human mitigated threats are immediately addressed.

2. To refine the projection of future trends in Red Panda populations in Nepal and evaluate the impact of alternative management strategies, it is vital that basic data on

- fertility and mortality
- numbers and distribution
- home range size and resource requirements of wild Red Panda are urgently collected

Red Panda youngster, Gorlitz Zoo, Germany. © Axel Gebauer

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Red Panda, Darjeeling Zoo, West Bengal, India. © Axel Gebauer

VIII. List of Participants and Sponsors

Mr. Pharindra Raj Kharel
Chief Conservation Officer
DNPWC, Kathmandu, Nepal
Phone: 4220912, 9741122875
fkharel@live.com

Dr. Narendra M.B. Pradhan
Chief Conservation Officer
DNPWC/CNP, Chitwan, Nepal
Phone: 9745012341, 9841473115
narendrapradhan@hotmail.com

Mr. Haribhadra Acharya
Management Officer
DNPWC, Kathmandu, Nepal
Phone: 4220912, 9849595260
hbacharya07@gmail.com

Dr. Maheshwar Dhakal
Ecologist
DNPWC, Kathmandu, Nepal
Phone: 4220912, 9849154767
maheshwar.dhakal@gmail.com

Mr. Bed Kumar Dhakal
Chief Conservation Officer
DNPWC/SNP, Sholukhumbu, Nepal
Phone: 9841461563
bedkumar@gmail.com

Mr. Sher Singh Thagunna
Chief Conservation Officer
DNPWC, Kathmandu, Nepal
Phone: 4220912, 9741142575
thagunnass@hotmail.com

Mr. Ram Chandra Kandel
Chief Conservation Officer
DNPWC/PWR, Parsa, Nepal
Phone: 9751003982
rckandel01yahoo.com

Mr. Ram Nandan Sah
Forest Product Officer
DoF, Kathmandu, Nepal
Phone: 9851071097
rayisasi2@hotmail.com

Mr. Hari B. Acharya
District Forest Officer
Ramechhap, Kathmandu
Phone: 048-690124, 9741030629
haribamsha1@yahoo.com

Dr. Shanta Raj Jnawali
Program Director
NTNC, Kathmandu, Nepal
Phone: 5526571, 9851036614
srjnawali@ntnc.org.np

Mr. Ram Chandra Nepal
Program Manager
NTNC, Kathmandu, Nepal
Phone: 5526571, 9849023780
rcnepal@ntnc.org.np

Ms. Sarita Jnawali
Program Manager
Central Zoo, Kathmandu, Nepal
Phone: 9851106793
saritajnawali@yahoo.com

Mr. Naresh Subedi
Office Incharge
BCC, Chitwan, Nepal
Phone: 056-560062, 9855056934
nareshsubedi@gmail.com

Mr. Baburam Lamichhane
Conservation Officer
BCC, Chitwan, Nepal
Phone: 056-560062, 9745009937
baburaml@gmail.com

Mr. Raj Kumar Gurung
Conservation Officer
ACAP, Kaski, Nepal
Phone: 061-622614, 9846051780
gurungkraj@yahoo.com

Mr. Bidur Kuikel
Conservation Officer
ACAP, Lamjung, Nepal
Phone: 993661307, 9841657423
bidurkuinkel@gmail.com

Mr. Madhu Chhetri
Office Incharge
MCAP, Manasalu, Nepal
Phone: 9856023385
mchetri@yahoo.com

Mr. Hemanta Kumar Yadav
Office Incharge
SCP, Suklaphanta, Nepal
Phone: 099-524703, 9858750129
yadavhemanta@gmail.com

Dr. Jeewan Thapa
Veterinary Officer
Central Zoo, Kathmandu, Nepal
Phone: 9841560312
jeewan@centralzoo.com.np

Mr. Manij Upadhyay
Program Officer
NTNC, Kathmandu, Nepal
Phone: 01-5526573, 9841519587
manij@ntnc.org.np

Dr. Rinjan Shrestha
Coordinator
WWF, Kathmandu, Nepal
Phone: 4434820, 9803030618
rinjan.shrestha@wwfnepal.org

Mr. Kamal Thapa
Research Officer
WWF, Kathmandu, Nepal
Phone: 4434820, 9741098912
kamal.thapa@wwfnepal.org

Mr. Gokarna J. Thapa
GIS Officer
WWF, Kathmandu, Nepal
Phone: 4434820, 9841329105
gokarna.thapa@wwfnepal.org

Prof. Karan Bahadur Shah
Professor
TU/Nature Hist. Museum, Kathmandu, Nepal
Phone: 9841615069
karan@htp.com.np

Dr. Mukesh Chalise
Associate Professor
TU/CDoZ, Kathmandu, Nepal
Phone: 5526893
mukesh57@hotmail.com

Mr. Hari Prasad Sharma
Lecturer
TU/CDoZ, Kathmandu, Nepal
Phone: 4336574, 9841437303
harisa@enet.com.np

Dr. Kadga Basnet
Professor
TU/CDoZ, Kathmandu, Nepal
Phone: 5528215, 9841399434
kbasnet@ntc.net.np

Dr. Santosh Rayamajhi
Ass. Professor
TU/Institute of Forestry, Pokhara, Nepal
Phone: 9840051018
srayamajhi2002@hotmail.com

Mr. Thakur Silwal
Teacher
TU/Institute of Forestry, Pokhara, Nepal
Phone: 061-430469, 9846059909
tsilwal2000@yahoo.com

Dr. Hem Sagar Baral
Chief Technical Advisor
Himalayan Nature, Kathmandu, Nepal
Phone: 01-4439042, 9851019751
hem.baral@gmail.com

Mr. Sunil Shakya
Program coordinator
RPN, Kathmandu, Nepal
Phone: 5552334, 9841091599
sunil@redpanda.org.np

Bibhushan Timsina
Director – Adm.& Comm
RPN, Kathmandu, Nepal
Phone: 5552334, 9721441816
bibhushan@redpanda.org.np

Mr. Bhagawan Raj Dahal
Contry Representative
RPN, Kathmandu, Nepal
Phone: 4419356, 9851061538
br_dahal@yahoo.com

Mr. Shyam Bajimaya
Wildlife Expert
Independent, Kathmandu, Nepal
Phone: 9841529927
sbajimaya@gmail.com

Mr. Arjun Thapa
Student
TU/CDoZ, Kathmandu, Nepal
Phone: 9841959828
thapa.nature@gmail.com

Dr. Axel Gebauer
Director
Zoo Goerlitz, Europe
Phone: 49-3581407400, 49-15153569961
a.gebauer@tierpark-goerlitz.de

Brian Williams
Executive Director
Red Panda Network, Western-USA Europe
Phone: 16502791650
brian.williams@redpandanetwork.org

Dr. Angela Glatston
Curator
Rotterdam Zoo
a.glatston@rotterdamzoo.nl

Kristin Leus
Program Officer
CBSG Europe, Belgium
kristin@cbsgeurope.eu

Sanjay Molur
Executive Director
Zoo Outreach Organization, India
herpinvert@gmail.com

Sally Walker
Director
Zoo Outreach Organization, India
sallyrwalker@zooreach.org

Jangchu Wangdi
Park Range Officer
Sakteng WL Sanctuary, Trashigang, Bhutan
jwangdi22@gmail.com

Namgay Dorji
Asst. Forester
Jigme Dorji N.P., Bhutan
ndorji83@yahoo.com

Sonam Choden
Sr. Forest Officer
Department of Forest, Bhutan
sonamchoden@yaoo.com

Awadhesh Kumar
Assistant Professor
NERIST, Nirjuli, Arunachal, India
Phone: 9436055347
tpileatus@gmail.com

Dr. Partha Sarathi Ghose
Sr. Project Officer
WWF- India, Sikkim, India
Phone: 91-3592-281927, 91-9775873293
ghose.ps1@gmail.com

Dr. Dipankar Ghose
Head- E. Himalaya Program
WWF-India, Delhi, India
Phone: 91-11-41504782, 91-9968661133
dghose@wwfindia.net

Anwaruddin Choudhury
Joint Secretary
Got. Of Assam, Tourism Department, Arunachal, India
Phone: 9435079376
acbadru56@gmail.com

Mr. Ramesh Pd Bhushal
Environmental Repoter
The Himalayan Times, Kathmandu, Nepal
Phone: 9841482978
toramesh25@gmail.com

Kasmira Kakati
Wildlife Biologist
Independent, India
kashmirak@hotmail.com

Inauguration Participants

Mr. Krishna Prasad Acharya
Joint Secretary
MoFSC, Kathmandu, Nepal

Mr. Ram Prasad Lamsal
Joint Secretary
MoFSC, Kathmandu, Nepal

Mr. Harihar Sigdel
Deputy Director General
DOF, Kathmandu, Nepal

Mr. Megh Bahadur Pandey
Deputy Director General
DNPWC, Kathmandu, Nepal
Phone: 4220912
pandey.megh@gmail.com

Mr. Top Bahadur Kattri
Chief
CSUWN

Dr. Prakesh Raut
Scientist
NAST, Kathmandu, Nepal

Mr. Judda Bahadur Gurung
Member Secretary
NTNC, Kathmandu, Nepal
Phone: 5526571, 9851036611
juddhagurung@ntnc.org.np

Mr. Ganga Jung Thapa
Executive Officer
NTNC, Kathmandu, Nepal

Dr. Siddhartha B. Bajracharya
Executive Officer
NTNC, Kathmandu, Nepal

Mr. Deepak K. Singh
Director-Administration
NTNC, Kathmandu, Nepal

Mr. Jitendra Raj Onta
Finance Director
NTNC, Kathmandu, Nepal

Mr. Hari Gopal Shrestha
Monitoring Officer
NTNC, Kathmandu, Nepal

Mr. Bidur Pokharel
Finance Officer
NTNC

Mr. Anil Manandhar
Country Representative
WWF, Kathmandu, Nepal

Dr. Ghana Shyam Gurung
Director
WWF, Kathmandu, Nepal

Mr. Shiva Raj Bhatta
Coordinator
WWF, Kathmandu, Nepal

Mr. Dilli Pandey
Journalist
ABC Television, Kathmandu, Nepal
Phone: 9841163657

Mr. Kiran KC
Program Officer
NTNC, Kathmandu, Nepal

Mr. Ratna Raj Timsina
Program Officer
NTNC, Kathmandu, Nepal

Mr. Achut Raj Panta
Officer
NTNC, Kathmandu, Nepal

Participants of Red Panda PHVA and SCS held at Nepal. ©NTNC