

# Biodiversity Status in the Potential Conservation Corridors of the Kangchenjunga Landscape: a Distribution Model of Flagship and Indicator Species

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## Introduction

The Kangchenjunga landscape stretches from Nepal through India, China, and Bhutan and forms a part of a biodiversity hotspot of global importance (Sharma and Chettri 2005). The Kangchenjunga complex is outstanding in terms of both species' richness and the level of endemism. This landscape plays an important role in maintaining altitudinal connectivity between the habitat types that make up the larger Himalayan ecosystem (Wikramanayake et al. 2001). The inhabitant species of birds and mammals exhibit altitudinal seasonal migrations and depend on contiguous habitat for unhindered movement (Chettri et al. 2001). Habitat continuity and intactness are essential in order to maintain the integrity of biodiversity values

and their services to humanity. Conservation of biodiversity is contingent on maintaining the interconnectedness of the various types of ecosystems found in the region. Realising this, the World Wildlife Fund (WWF) Nepal Programme and the International Centre for Integrated Mountain Development (ICIMOD) carried out a regional consultation on conservation of the Kangchenjunga landscape in early 1997 in Kathmandu. The consultation arrived at a strong consensus that effective conservation of this important landscape was possible only through regional cooperation (Rastogi et al. 1997). This initiative was supported by various analyses and consultations, and the area was unanimously identified as one of the most critical biodiversity conservation areas in the eastern Himalayas (WWF and ICIMOD 2001). This was taken further by ICIMOD which advocated for regional cooperation for the entire landscape through participation of stakeholders, and for developing conservation corridors to promote conservation at the landscape level (Sharma and Chettri 2005).

## Biodiversity Overview

The Kangchenjunga landscape – a part of the eastern Himalaya – is actually a complex of 25 ecoregions with three distinct ecoregions, the eastern Himalayan broad-leaved and coniferous forests, the eastern Himalayan alpine meadows and the Terai-Duar savannas and grasslands (WWF and ICIMOD 2001). The eastern Himalayan broad-leaved and coniferous forests represent a band of temperate broad-leaved forest at 2,000 to 3,000m and are important both for their rich species' diversity and for their species' endemism. Four of the 125 mammalian species known to occur in this ecoregion are endemic (Table 1). Three of these species are also found in the adjacent ecoregions, but the Namdapha flying squirrel (*Biswamoyopterus biswasi*) is strictly endemic to this ecoregion with a range limited to the eastern Himalayan broad-leaved forests. Several threatened mammalian species, including the endangered tiger (*Panthera tigris*), red panda (*Ailurus fulgens*), takin (*Budorcas taxicolor*), and serow (*Capricornis sumatraensis*), and the vulnerable Vespertilionidae bat (*Myotis sicarius*), Assamese macaque (*Macaca assamensis*), stump-tailed macaque (*Macaca arctoides*), wild dog (*Cuon alpinus*), back-striped weasel (*Mustela strigidorsa*), clouded leopard (*Pardofelis nebulosa*), and Irrawaddy squirrel (*Callosciurus pygerythrus*) are found in this region (WWF and ICIMOD 2001). In addition, almost 500 bird species are found across the ecoregions of which eleven species are near-endemic, and one, the rufous-throated wren babbler, is strictly endemic, that is restricted to the eastern Himalayan broad-leaved forests (Table 2).

The bird assemblage also includes several threatened species of pheasants, tragopans, and hornbills that need mature forests and have low tolerance for disturbance. The presence of

**Table 1: Endemic and near-endemic mammalian species**

Common name	Species
Golden langur	<i>Semnopithecus geei</i>
Giant Flying Squirrel	<i>Petaurista magnificus</i>
Namdapha flying squirrel	<i>Biswamoyopterus biswasi</i> *
Brahma White-bellied Rat	<i>Niviventer brahma</i>

\* species' range limited to this ecoregion

species like the globally threatened rufous-necked hornbill (*Aceros nipalensis*) and Sclater's monal (*Lophophorus sclateri*), and the threatened white-bellied heron (*Ardea insignis*), Blyth's tragopan (*Tragopan blythii*), and Ward's trogon (*Harpactes wardi*), is an indicator of habitat integrity that deserves conservation (Stattersfield et al. 1998).

## Wetlands and Biodiversity

The whole of the Kangchenjunga landscape is rich in wetlands. Most of the wetlands lie at higher altitudes above 3000m and are as yet little explored for their values. The Lohnak Valley in north

Sikkim is one of the richest areas in Sikkim as far as Trans-Himalayan biodiversity is concerned (Lachungpa 1998). There is a good breeding population of ruddy shelduck (*Tadornana ferruginea*) and common redshank (*Tringa tetanus*). A small population of less than 10 black-necked cranes regularly visits the valley, although their numbers have dropped in recent years. The wetlands at lower altitudes (below 3000m) are home to the Eurasian otter (*Lutra lutra*), smooth coated otter (*L. perspicillata*), oriental small-clawed otter (*Aonyx cinerea*), and Himalayan salamander (*Tylotriton verrucosus*). The entire wetlands of this landscape are rich storehouses of wild genetic materials as well as an important flyway for migratory wild fowl.

## Protected Areas and Potential Conservation Corridors

The Kangchenjunga landscape is comprised of 14 protected areas of which six (Kangchenjunga Conservation Area (KCA), Khangchendzonga Biosphere Reserve (KBR), Singhalila National Park (SNP), Barsey Rhododendron Sanctuary (BRS), Pangolakha Wildlife Sanctuary (PWS), and Toorsa Strict Nature Reserve (TSNR)) have transboundary linkages cutting across parts of India, Nepal, and Bhutan. A portion of the complex lies within China but, for the purposes of this study, the area was excluded from the analysis. The protected areas included in the study are shown in Figure 1.

## Selection and Delineation of Potential Conservation Corridors

Fourteen species (Table 3) of mammals and eight species of *Rhododendron* (Table 4) were used as indicator species based on the criteria of rarity and value in order to identify potential corridors and assess their feasibility. Potential areas for connectivity were identified based on the habitat requirements of the selected mammalian and rhododendron species. The distribution

**Table 2: Endemic and near-endemic bird species**

Common name	Species
Chestnut-breasted partridge	<i>Arborophila mandellii</i>
Hoary-throated barwing	<i>Actinodura nipalensis</i>
Ludlow's fulvetta	<i>Alcippe ludlowi</i>
Rusty-bellied shortwing	<i>Brachypteryx hyperythra</i>
Elliot's laughing thrush	<i>Garrulax elliotii</i>
Grey-headed parrotbill	<i>Paradoxornis gularis</i>
Immaculate wren-babbler	<i>Pnoepyga immaculata</i>
Grey-crowned prinia	<i>Prinia cinereocapilla</i>
Mishmi wren-babbler	<i>Spelaeornis badeigularis</i>
Rufous-throated wren-babbler	<i>Spelaeornis caudatus</i> *
Snowy-throated babbler	<i>Stachyris oglei</i>
Spiny babbler	<i>Turdoides nipalensis</i>

\* species' range is limited to this ecoregion

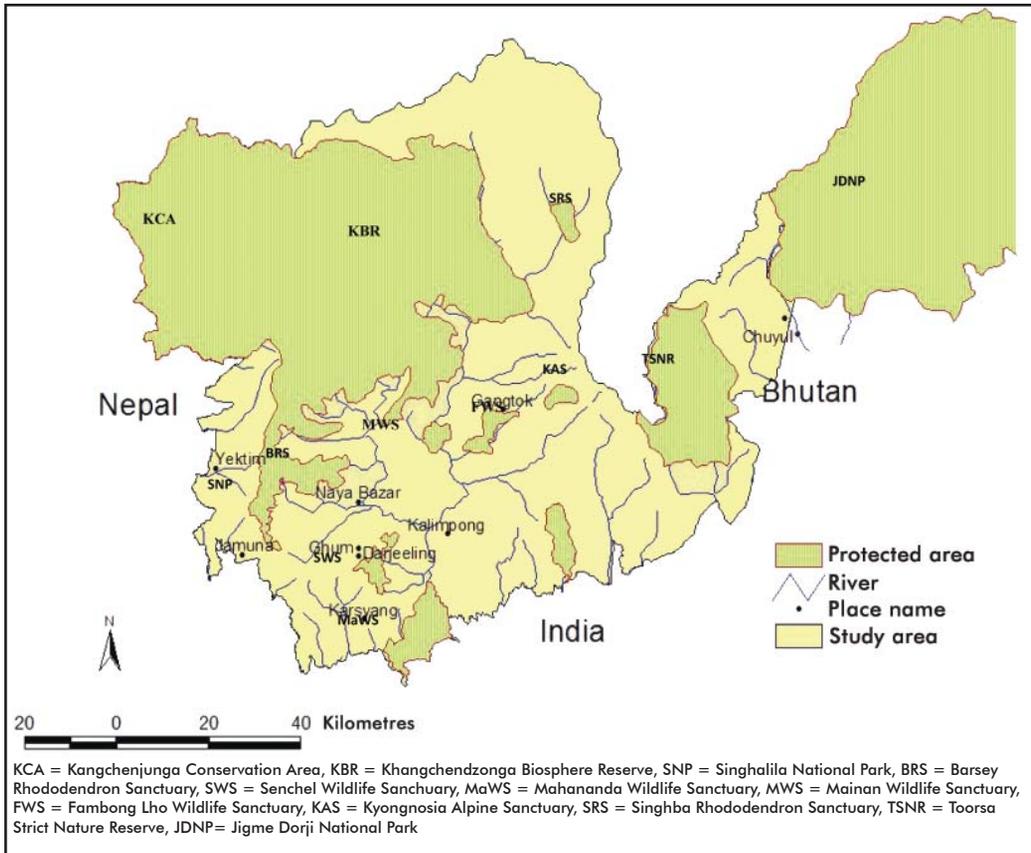


Figure 1: Protected areas in the Kangchenjunga conservation landscape (not including China)

**Table 3: Mammalian species used to identify potential corridors**

Common name	Species
Red panda	<i>Ailurus fulgens</i>
Wolf	<i>Canis lupus</i>
Takin	<i>Budorcas taxicolor taxicolor</i>
Serow	<i>Capricornis sumatraensis</i>
Blue sheep or Bharal	<i>Pseudois nayaur</i>
Snow leopard	<i>Uncia uncia</i>
Golden cat	<i>Felis temminckii temminckii</i>
Marbled cat	<i>Felis marmorata</i>
Leopard cat	<i>Felis bengalensis horsfieldi</i>
Brown bear	<i>Ursus arctos isabellina</i>
Himalayan black bear	<i>Ursus thibetanus</i>
Dhole	<i>Cuon alpinus primavus</i>
Musk deer	<i>Moshos charysogaster</i>
Clouded leopard	<i>Neofelis nebulosa</i>

**Table 4: Rare and endangered rhododendron species in the Sikkim Himalayas and their altitudinal distribution**

Species	Distribution range	Status <sup>a</sup>
<i>R. fulgens</i>	3,500-5,500	R
<i>R. leptocarpum</i>	2,500-4,000	E
<i>R. maddenii</i>	2,000-4,500	R
<i>R. niveum</i>	3,000-4,500	E
<i>R. pendulum</i>	3,000-4,500	R
<i>R. pumilum</i>	3,000-5,000	R
<i>R. sikkimense</i>	3,500-4,000	E
<i>R. wightii</i>	3,000-5,000	R

<sup>a</sup> R = Rare, E = Endangered

of the species was derived from previous reports and data of organisations such as the International Union for Conservation of Nature (IUCN), World Wild Fund for Nature (WWF), and World Conservation and Monitoring Centre (WCMC) of the United Nations Environment Programme (UNEP). The potential presence of each species was given a weighting of 1. Distribution maps were prepared for each of the fourteen mammalian species and then overlaid and the areas given a cumulative weighting for the species that could potentially be present in the area. A map showing the altitudinal species density of rhododendrons was prepared in a similar way. A final map was developed showing the potential conservation corridors for the Kangchenjunga landscape area with reference to the fourteen selected mammalian species and the altitudinal distribution of the eight rare and endangered species of Rhododendron (Figure 2).

### Species’ Distribution Model

A species’ distribution account was prepared for the selected mammalian species based on conservation status, habitats used, home range, and habitat availability in the Kangchenjunga landscape. Of the 14 species, six were vulnerable, three endangered, one near threatened, and four insufficiently known (IUCN 2004). Temperate montane and rugged alpine forests were the major habitats for many of these species.

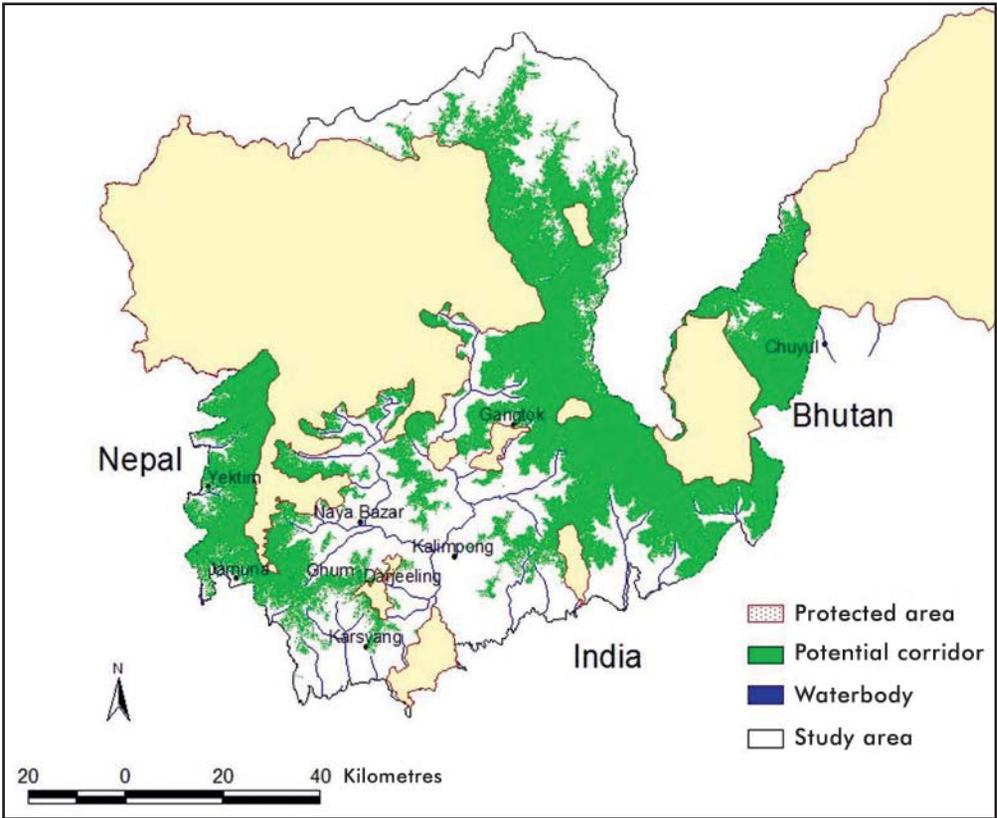


Figure 2: Potential corridor areas in the Kangchenjunga landscape based on the distribution pattern of indicator species

Land-cover analysis showed the potential habitat for the Asiatic black bear, clouded leopard, and dhole to be the region connecting the south of the Kangchenjunga Conservation Area (KCA) in Nepal along the Singhalila National Park and Sanchel Wildlife Sanctuary to the Mahananda Wildlife Sanctuary. The map shows, however, that these potential habitats have now mostly been converted into agricultural or cultivated lands.

The areas connecting the Singba Rhododendron Sanctuary to the Kyongnosla Alpine Sanctuary in the south and further towards the Toorsa Strict Nature Reserve appear to form a potential habitat for species such as the red panda, Tibetan wolf, takin, and blue sheep. The habitat range for the blue sheep, however, is mostly restricted to the alpine meadows in these potential corridors. Beside this, red panda, takin, brown bear, snow leopard, Tibetan wolf, and blue sheep seem to extend as far up as the Jigme Dorji National Park and cover adjoining areas extending to many protected areas such as Khangchendzonga Biosphere Reserve, Singba Rhododendron Sanctuary, Kyongnosla Alpine Sanctuary, and Toorsa Strict Nature Reserve. The potential habitat connectivity for serow and clouded leopard, marbled cat, leopard cat, golden cat, and dhole also lies along the surrounding areas of Singhalila National Park, Barsey Rhododendron Sanctuary, Sanchel Wildlife Sanctuary, Mahananda Wildlife Sanctuary, and Fambong Lho Wildlife Sanctuary.

## Conservation Options

The landscape is under immense pressure from human activities. There are options for addressing such prevailing issues through alternative and sustainable means of livelihoods for the local communities living in the Kangchenjunga landscape area. Tourism based on wildlife could be one means whereby revenue from wildlife tourism can be used for wildlife conservation: similarly, sustainable use of wildlife, including trout, pheasant, deer, and butterfly farming, looks promising. The introduction of trout farms in the region will allow an increase in economic activities and will ensure maintenance of the quality of water within small rivers. There is a tremendous potential for harvesting non-timber forest products (NTFP); e.g., beekeeping and cultivation of associated bee flora, extraction of plant oils, cultivation of herbs and medicinal plants, and cultivation and sale of ornamental plants, orchids, rhododendron species, and bamboo. For all of these options, new cooperatives need to be developed in the local communities so that provision is made for collection, marketing, and sale.

## Conclusion

The Kangchenjunga landscape, being located at the convergence of the Palaeartic and Oriental zoogeographical realms, is well known for its biodiversity, especially the presence of many critical wildlife species. The distribution patterns of some of the flagship mammalian species indicate that maintaining or establishing connectivity between isolated protected areas is the primary step towards long-term protection of such species. Among the potential corridors identified in the studies, the adjoining area along the Barsey Rhododendron Sanctuary (104 sq.km) in Sikkim and Singhalila National Park (76.8 sq.km) in Darjeeling, continuing up to the Mahananda Wildlife Sanctuary through to the Sanchel Wildlife Sanctuary area, is the most viable corridor area for the 14 mammals considered in this study. Moreover, Khangchendzonga

Biosphere Reserve, Singba Rhododendron Sanctuary, Kyongnosla Alpine Sanctuary, Toorsa Strict Nature Reserve, and Jigme Dorji National Park and their adjoining areas show great potential for developing conservation corridors. Biodiversity conservation at the landscape level, with definition and delineation of conservation corridors connecting the protected areas in the three countries, should be a priority for the conservation of biodiversity in this globally significant landscape.

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