

GALLIFORMES OF KHANGCHENDZONGA BIOSPHERE RESERVE, SIKKIM, INDIA

S. Sathyakumar, K. Poudyal, T. Bhattacharya and T. Bashir

ABSTRACT

We assessed the distribution and relative abundance of galliformes in Khangchendzonga Biosphere Reserve (BR), from February 2008 to April 2010. We sampled Prek *Chu* catchment (182 Km²) by using trail sampling (n=22) and camera trapping (n=27). Only trail sampling was used to survey the other watersheds of the BR. Through visual encounters and camera trap photos, we confirmed the presence of Blood pheasant (*Ithaganis creuntus*), Himalayan monal (*Lophophorus impejanus*), Satyr tragopan (*Tragopan satyra*), Snow partridge (*Lerwa lerwa*), Hill partridge (*Arborophila torqueola*) and Kalij pheasant (*Lophura leucomelanos*). Presence of Tibetan snowcock (*Tetraogallus tibetanus*) was confirmed through calls, droppings and marks at Lhonak valley, the northern trans-Himalayan part of BR. Snow partridge, Blood pheasant and Himalayan monal evidences were encountered in the subalpine and alpine habitats, whereas Satyr tragopan evidences were encountered in subalpine and temperate forests. Visual encounters of Kalij pheasant and Hill partridge were restricted to temperate zone only. Poaching and habitat degradation are threats to the galliformes species and their habitats.

KEYWORDS: *Galliformes, Khangchendzonga Biosphere Reserve, Habitat degradation*



The gregarious and well camouflaged Snow Partridges in the alpine rock and meadow habitats of Khangchendzonga National Park



The beautiful Blood Pheasant also the 'State Bird of Sikkim' is the most abundant pheasant in Khangchendzonga National Park

INTRODUCTION

Commonly referred to as the 'gallinaceous birds', Galliformes is a large and varied group of birds in the world comprising of 70 genera and 284 species (Keane *et al.* 2005). Five families come under the order Galliformes viz., Megapodidae (scrub fowls, bush turkeys, mallee fowl), Cracidae (guans, chachalacas, curassows), Numididae (Guineafowl), Odontophoridae (New World quails) and Phasianidae (grouse, turkeys, pheasants and partridges) (Dickinson 2003). These birds are well recognized for their ecological, socio-cultural, aesthetic and economic values, and have been an integral part of the people and their culture.

Of the 300 Galliformes species worldwide, 55 are found in south and central Asia and it is remarkable that India has 45 of these species. The Indian Galliformes fall under two main families: *Phasianidae*, which includes 44 species of Pheasants, Snowcocks, Spurfowls, Francolins, Partridges and Quails, and *Megapodiidae*, which is represented by a single species, the Nicobar Megapode. Of the 17 pheasants in India, 16 species occur in the Himalaya, except for the endemic Grey Junglefowl *Gallus sonneratii* that is confined to the Peninsular India. Of the 12 species that are listed as 'threatened' in India, five are pheasants (Sathyakumar & Sivakumar 2007).

Pheasants are the most charismatic of all the fauna found in the Himalayan landscape. Their high endemism and brightly coloured plumage makes them the most distinctive bird family of the Himalaya (Ali 1981). Of the 51 species of pheasants, 20 (39%) are endemic to the Himalaya, which include the genera of *Ithaginis* (blood pheasant), *Tragopan* (tragopans or horned pheasants), *Lophophorus* (monal pheasants), *Lophura* (kalij pheasant), *Pucrasia* (koklass pheasant), *Catreus* (cheer pheasant), *Crossoptilon* (eared pheasant) and *Polypectron* (peacock pheasant). The Indian Himalaya is home to 16 species of pheasants that form 94% of the total pheasant species (17) found in India. Five of the six species of pheasants that are threatened in India are found in Himalaya (Sathyakumar & Sivakumar 2007).

Tragopan (tragopans or horned pheasants), *Lophophorus* (monal pheasants), *Lophura* (kalij pheasant), *Pucrasia* (koklass pheasant), *Catreus* (cheer pheasant), *Crossoptilon* (eared pheasant) and *Polypectron* (peacock pheasant). The Indian Himalaya is home to 16 species of pheasants that form 94% of the total pheasant species (17) found in India. Five of the six species of pheasants that are threatened in India are found in Himalaya (Sathyakumar & Sivakumar 2007).

In terms of pheasants, eastern Himalaya is richer with 11 species as compared to eight in the western Himalaya. The eastern Himalaya also has more species exclusive to it whereas; four species, viz., Satyr Tragopan, Himalayan Monal, Kalij, and Red Junglefowl are common across the two regions. As far as Partridges, Quails and Francolins are concerned, five are exclusive to western Himalaya, while four are common across the entire Himalaya and only two species are exclusive to the eastern Himalaya (Sathyakumar & Sivakumar 2007)

Their role as prey-base for carnivorous birds and mammals provide a significant identity in the functioning of high altitude ecosystem (Johnsgard 1987). These species occupy various vegetation types and altitudinal gradients. The large size and heavily built plumage in these birds are possibly due to the physiological requirements to withstand the harsh climatic condition in high altitudes. During winter, when much of the ground is snow covered and resources are limited, they are forced to descend to lower elevations where they face density dependent and intra-specific competition, increased predation and threats from poaching.

Despite the state bird being a Galliformes (Blood Pheasant), till date there has been no systematic survey or population estimation of Galliformes. Seven species of Galliformes are found in Khangchendzonga BR out of which six are present in the study area (Plate 1). This study was primarily aimed to fill the above mentioned research gap and to prepare an inventory for galliformes of Khangchendzonga BR. In this chapter, we report the results of first such study on



The Himalayan Monal also known as the 'bird of nine colours' is a visual treat in the high altitude habitats of Khangchendzonga National Park



The scintillating Satyr Tragopan adds charm to the galliforme diversity of Khangchendzonga National Park



The Kalij Pheasant inhabits the mid and lower temperate forests of Khangchendzonga National Park and are found in large aggregations during winter



The Hill Partridge is more often heard than seen in the forested habitats of Khangchendzonga National Park

galliformes conducted in the Sikkim Himalaya. We described the distribution, conservation status and relative abundances of the galliformes found in the BR.

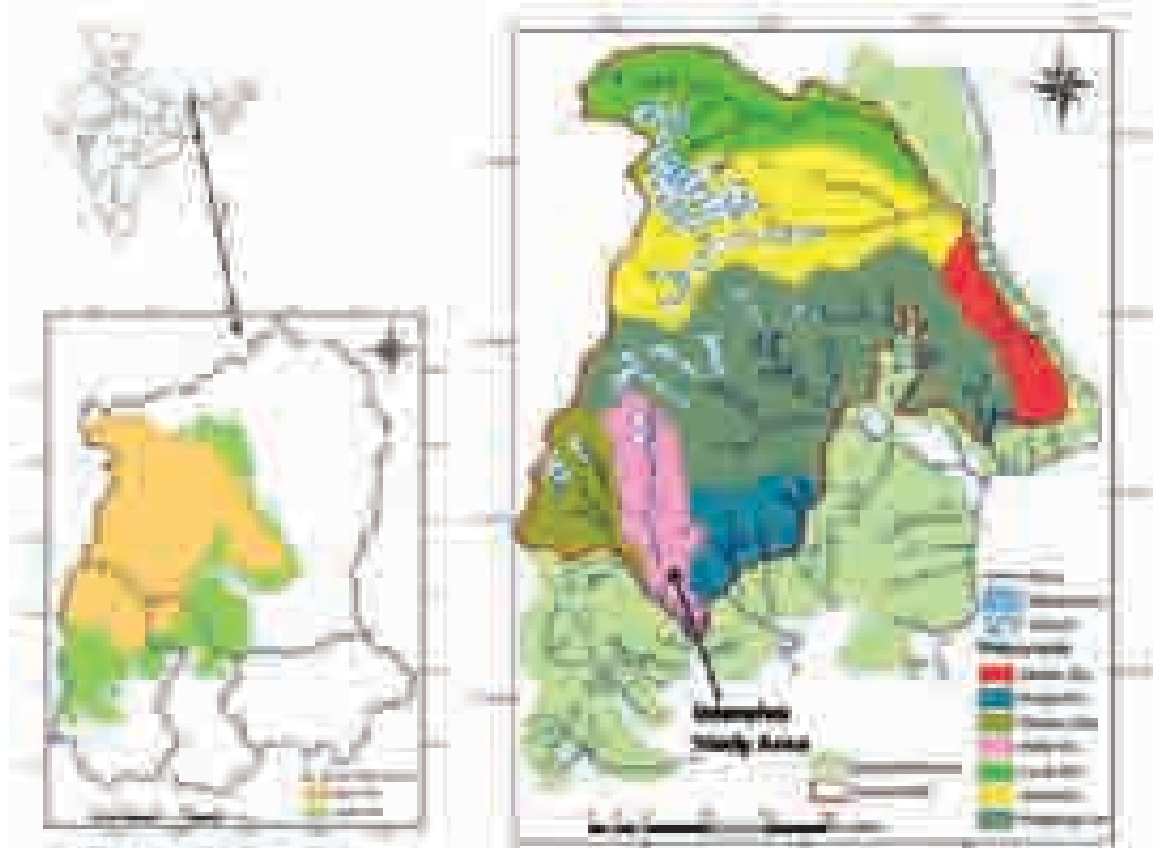
MATERIALS AND METHODS

Study area

The Khangchendzonga BR encompasses an area of 2,619.92 km² including the Khangchendzonga National Park (NP) (1,784 km²) and a buffer zone of about 836 km² (Tambe 2007). Located between 27° 30'-27° 55' N and 88° 02'-88° 37' E it is connected to the adjacent Khangchendzonga Conservation Area in eastern Nepal, Barsey and Maenam Wildlife Sanctuaries in Sikkim and Singalila BR in Darjeeling district of West Bengal, through a number of corridors (Tambe 2007). The area is classified as a biogeographic province 2C - Central Himalaya with the northern part included in biogeographic province 1B - Trans-Himalaya Tibetan Plateau (Rodgers *et al.* 2000). The varying elevation of 1,220 to 8,586 m within an aerial distance of just 42 km with about 90% area above 3000 m and 70% above 4000 m makes this park a unique natural heritage hotspot in the world.

The area of Khangchendzonga BR has been divided into seven watersheds or river subsystems (Fig 1) namely Lhonak (15%), Zemu (23%), Lachen (5%), Rangyong (36%), Rangit (6%), Prek (8%) and Churong (7%). In this study, Prek *chu* (27°21' - 27° 37'N, 88° 12' -88° 17'E) (*chu* = river) catchment area (182 km²) was selected as the intensive study area (Fig 2) because it represents all the habitat characteristics of Khangchendzonga BR (Sathyakumar *et al.* 2009), although surveys were also conducted in Lhonak, Zemu, Lachen and Churong watersheds. Its highest and lowest elevation being 6,691 m (summit of Pandim) and 1,200 m (Tambe 2007), the Prek *chu* watershed can be divided into six habitat classes, *viz.*, mixed sub-tropical (1%), mixed temperate (16%), sub-alpine (36%), alpine pastures (5%), rock and snow cover (41%) and water bodies (1%). The watershed has a typical oceanic climate with an average annual rainfall of around 2,230 mm (Tambe, 2007).

Figure 1 Location of Khangchendzonga Biosphere Reserve in Sikkim, India showing the different watersheds including Prek Chu catchment – the intensive Study Area



The study was conducted for a period of two years from April, 2008 to May, 2010. Due to the topography and remoteness of the area all field activities were carried out in the form of field expeditions i.e., camping in different areas of the Prek *chu* water shed. One field survey was usually of 7-8 days and all the sampling units were replicated and monitored after every 7-10 days.

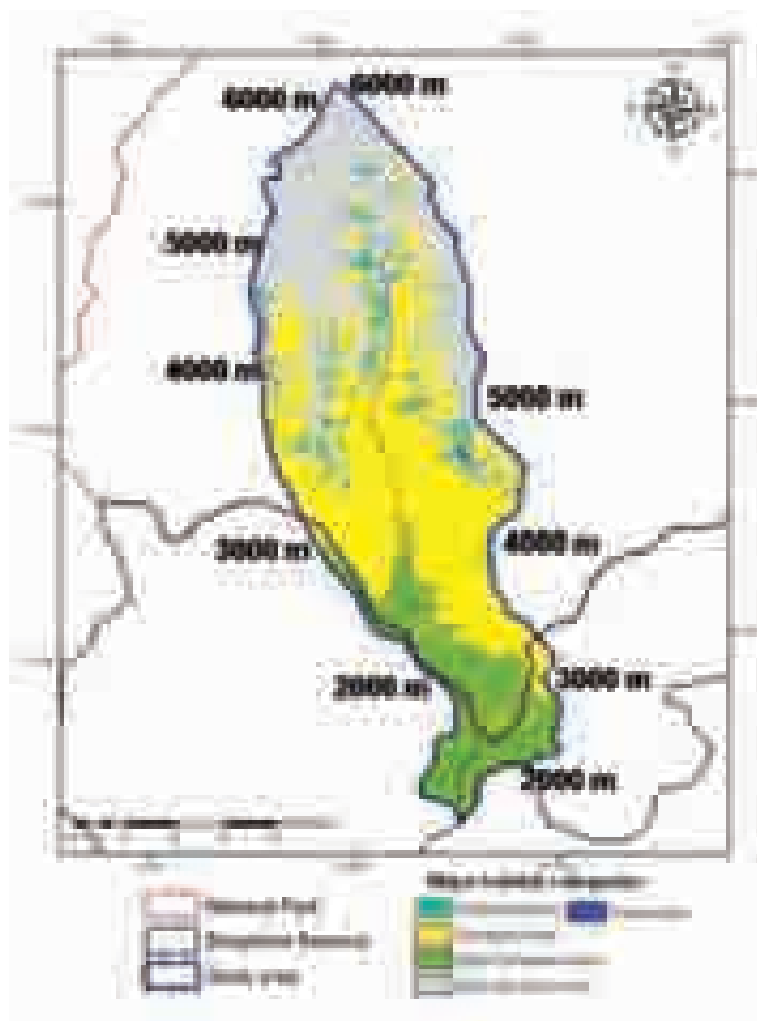
Reconnaissance surveys

In order to get a fair knowledge of the area exploration surveys were carried out in the early months of the study period in the five watersheds (Churong, Lachen, Zema, Lhonak and Prek) of the Khangchendzonga BR. This was followed by application of some conventional sampling methods for the assessment of galliformes (distribution and relative abundance) depending on the feasibility of the terrain.

Trail sampling

Trail sampling was used for detection of galliformes in different habitats of the study area. These trails were identified with slight modification from conventional transects (Burnham et al. 1981) for Himalayan terrain (Sathyakumar 1994). Trail sampling (n= 22; 1.5 to 7 km) within the intensive study area (Fig 3) was repeated (223

Figure 2 Major habitat categories and contours of Prek Chu Catchment, Khangchendzonga Biosphere Reserve, Sikkim, India

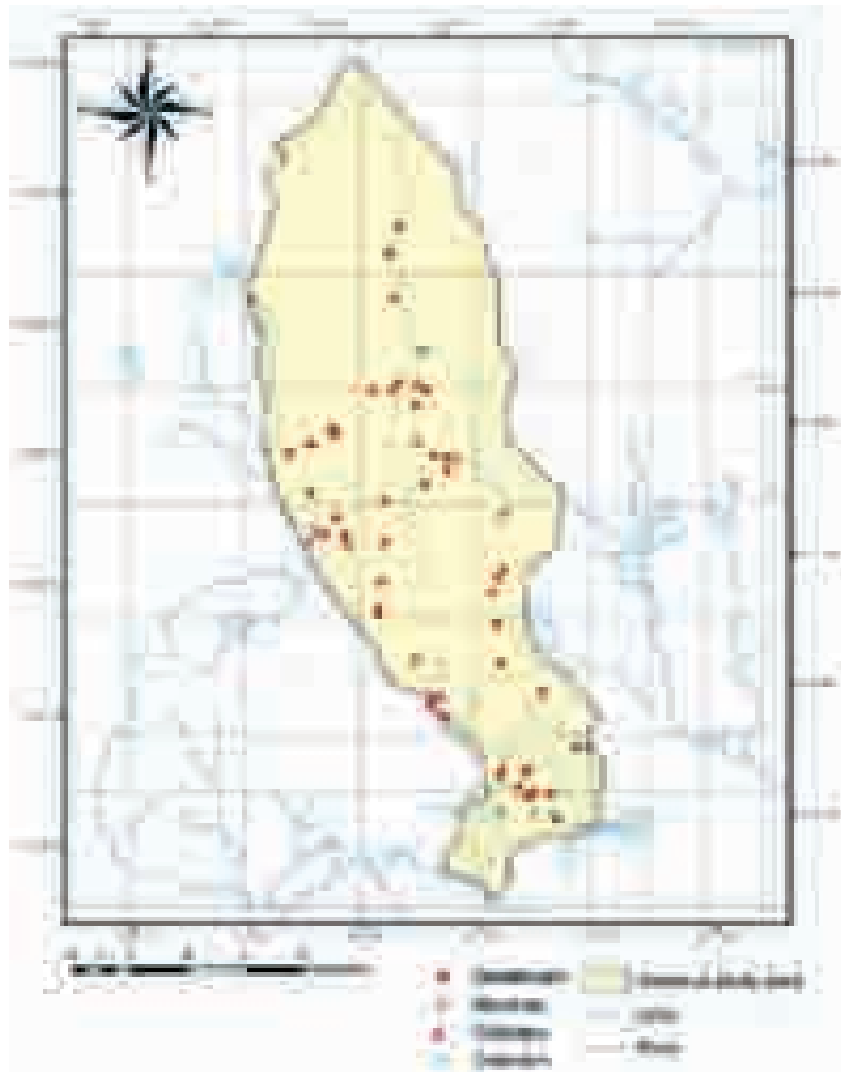


walks), and sign surveys were carried out once in a month for the intensive study area (25 surveys). Trail sampling and sign surveys were carried out once in each of the other four watersheds. Data obtained from the trail samplings were analysed in DISTANCE 5.0 (Thomas et al. 2002) to estimate the detection probability, density and effective strip width for a particular galliformes species.

Camera Trapping

Based on the knowledge acquired through reconnaissance surveys, as mentioned earlier Prek *chu* watershed was selected as the intensive study area for camera traps studies. For simplicity, the area was categorized into three different habitat zones, viz., temperate (1,200-3,000 m), sub-alpine (3,000-4,000 m) and alpine (above 4,000 m) and the camera traps were deployed corresponding to the area coverage of the zones and their accessibility. The study area was further divided into 2 km × 2 km sampling grids and cameras traps were placed along trails or paths that were actively used by study species

Figure 3 Map of Intensive study area showing Trails and locations of Camera traps in 2 km×2 km grids in Prek Chu Catchment, Khangchendzonga Biosphere Reserve, Sikkim, India



evident from their signs such as, tracks, digging signs, feaces and other signs, with at least one camera trapping unit covering each of the grids. Twenty seven cameras were deployed at 71 sites in 24 cells covering an area of 96 km² of accessible area in the study area (Fig 3). The camera trapping was done continuously in all the seasons using Deercam (2), Wildview (2), Stealthcam (18) and Moultrie (5) instruments. Monitoring of camera traps was done at least twice a month which included changing the batteries and memory card. Monitoring of cameras deployed in temperate zone were carried out from the base camp located at Yuksam (1,900 m), while for those deployed in subalpine were done from first (Tsoka, 3,000 m) and second (Dzongri, 3,950 m) advance camps and for cameras in alpine zone from third (Thansing, 4080 m) and fourth (Lampokhri, 4,200 m) advance camps, respectively The number of camera trap-days was calculated from the date of deployment till the date of retrieval (if the memory card was not full) or till the date of the final photo.

One major problem faced during this study was the lack of adequate data from direct evidences (visual encounters and camera trapping) for abundance estimation in order to overcome this problem the method of photographic rate was

used. Photographic rate is defined as the number of camera days (24 h) per study species (= 1 year old) photograph summed across all camera traps in the study (Carbone *et al.* 2001). Photo capture rate was calculated as the number of photographs of a species divided by the number of trap-days per site. Trap-days were computed as the number of 24-h periods from deployment of camera until the film was used up or the camera was retrieved. Instances where the same species were captured by the same camera more than once within 1 h were excluded from trap rate calculation (Bowkett *et al.* 2007). This was a compromise between scoring the same individual multiple times and missing individuals (Rovero *et al.* 2005) and is more conservative than other published studies (e.g. Kinnaird *et al.* 2003). Total camera trap days in the study period were 6,278 with 1,407 in temperate zone (26 sites), 3,061 in sub-alpine zone (20 sites) and 1,810 in alpine zone (25 sites), respectively.

Local interviews

In order to assess the awareness of local people regarding the galliformes diversity of the area and to verify it with camera trapping results (Can and Togan 2009), interviews and informal discussions were conducted in 15 villages viz., eight in Prek and Churong, six in Zema and Lachen and one in Lhonak watersheds. In Prek and Churong we sampled six villages at the border of the catchment and one each at the core and buffer zones. In the greater Himalayan zone of the northern part of Khangchendzonga BR i.e. Zema and Lachen, surveys were conducted in six bordering villages of the watersheds. In northern part (Lhonak), surveys were conducted in one village adjacent to the trans-Himalayan zone during which Dokpa Yak herders and Indo-Tibet Border Police personnel were also interviewed. In total, interviews and informal discussions were conducted with the heads of 72 households which included farmers, livestock herders, former hunters and trekking guides. The respondents were shown photographs and drawings of the mammal species provided in field guides (Ali and Ripley 1983) and their knowledge on species occurrence and natural history was recorded.

RESULTS AND DISCUSSION

Galliformes presence

Presence of six (6) species of galliformes was confirmed through visual encounters and camera trap photos from the intensive study area. Blood Pheasant was the most frequently seen pheasant during transect and trail sampling. Tibetan snowcock evidences (droppings and calls) were recorded from the trans-Himalayan zones of the National Park. Details of their confirmation are given in Table 1.

Detection probability, density and effective strip width of galliformes

Blood pheasant was the most sighted galliformes. It was sighted on 99 occasions (475 individuals) with aggregations of up to 75 individuals. Detection probability of blood pheasant was estimated as 0.29 (CV% 8.84). Overall density of Blood Pheasant in the study area was estimated as 13.64/ km². Himalayan Monal was sighted on 45 occasions (55 individuals) and its detection probability was 0.22 (CV % 4.94). Density estimated for monal was 1.38/km². Snow Partridge was sighted on 29 occasions (122 individuals), it was mostly found in groups ranging from 1 to 15. Its detection probability was 0.20 (CV% 17.5) and estimated density was 3.85/km². During the study period Kalij was sighted on 8 occasions (13 individual) and Hill Partridge was sighted on 9 occasions (18 individual) so density and detection probability estimation were not possible due to low sample sizes. There were 21 sightings of Satyr tragopan during the study period. Density estimated for tragopan was 1.02/km². Effective strip width was largest in case of snow partridge (20.16±3.58) followed by blood pheasant (18.9±1.67).

Photo capture rates of Galliformes

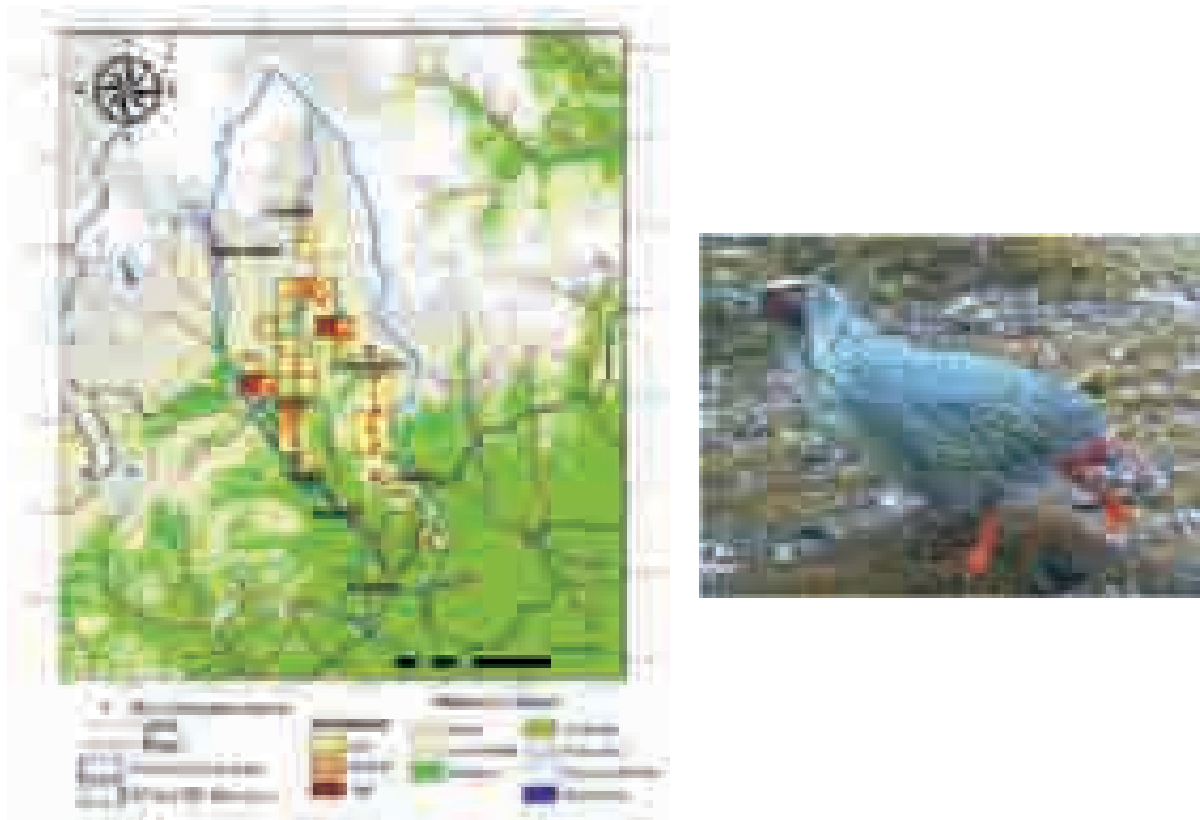
As per the results obtained from camera traps, the photo capture rate of blood pheasant was highest (3.43±1.28) followed by Himalayan monal (0.72±0.22), snow partridge (0.52±0.49) and satyr tragopan (0.51±0.27). In the temperate zone, photo capture rate of Kalij pheasant (0.54±0.23) and hill partridge (0.51± 0.24) were more or less similar. Species

wise account of galliformes of the intensive study area and their distribution inside the intensive study area are described below.

Blood pheasant: Distribution and Habitat

The Blood Pheasant (*Ithaginis cruentus*), is the only species in genus *Ithaginis* of the pheasant family. This relatively small, short-tailed pheasant is found in highland forest and scrub in Asia. Blood Pheasant is a resident and fairly common pheasant that is distributed in the Central and Eastern Himalaya (Sikkim and Arunachal Pradesh) with an altitudinal range of 3,200-4,700 m (Johnsgard 1987). As compared to other pheasants, the Blood Pheasant is found at higher elevations, even in winters. It is gregarious and keeps in coveys of five to ten birds, but sometimes 30 or more. Generally, tame and fearless, it is a swift and strong runner and usually runs uphill and flies downhill. The species is the most abundant among all the galliformes species in the study area, on the basis of direct sightings, indirect evidences of camera trap photo captures. The species mainly dwells the alpine areas but is also seen in the sub-alpine habitats of the area. The species is the state bird of Sikkim and found to occur in groups of up to 70 individuals. It was frequently found to occur in areas; Deorali (3,900 m), Lal jaithi (3,850 m), Chongrigang (4,150 m), Chamre (4,300 m), Kockchurong (3,700 m), Jamling (3,800 m), Ghunsa (3,100 m) (Fig 4).

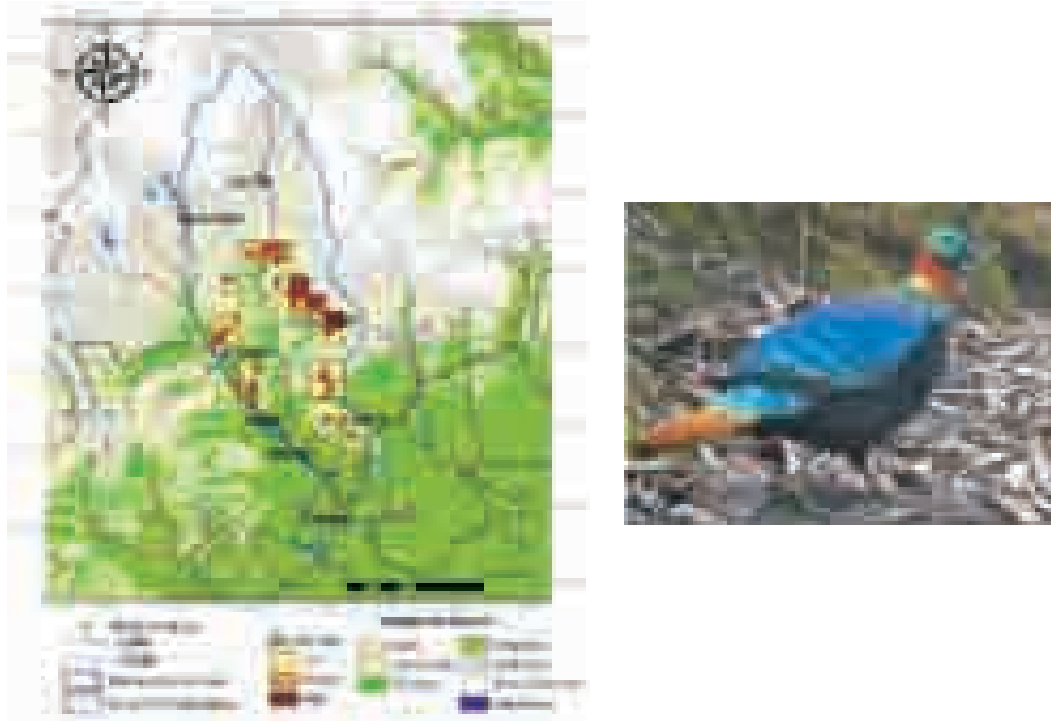
Figure 4: Distribution map and photo capture of Blood pheasant



Himalayan monal: Distribution and Habitat

The Himalayan Monal, *Lophophorus impejanus* also known as the Impeyan Pheasant or Danphe is a bird of genus *Lophophorus* of the Pheasant family, Phasianidae. It is a relatively large sized bird with reference to family Phasianidae. It occupies upper temperate oak-conifer forests interspersed with open grassy slopes, cliffs and alpine meadows between 2,400–4,500m, mostly concentrating in a narrow belt of 2,700–3,700 m. They seem to exhibit clear and fluctuating altitudinal migration reaching as low as 2,000 m in winter. In the study area, the species was the third most frequently sighted galliformes followed by blood pheasant and snow partridge. The species was also recorded in the camera traps. It inhabited the alpine and rocky areas mostly but during winter it was found to occur at lower elevations in the sub-alpine zone. The areas where monal were frequently encountered or recorded in camera traps were: Lampokhri (4,250 m), Neer pokhri (4,300 m), Chamre (4,350 m), Phedhi top (3,950 m), Ginghe (4,200), Ghunsa (3,100 m) (Fig 5).

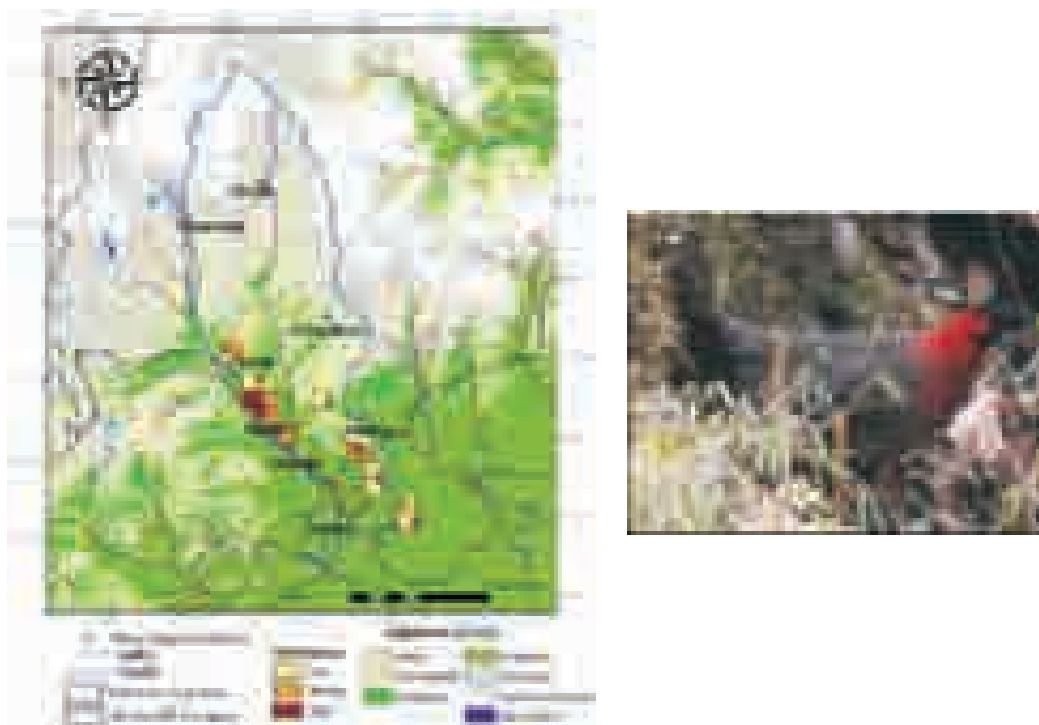
Figure 5 Distribution map and photo capture of Himalayan monal



Satyr Tragopan: Distribution and Habitat

The Satyr Tragopan (*Tragopan satyra*) also known as the Crimson Horned Pheasant is a pheasant found in the Himalayan reaches of India, China, Nepal and Bhutan. It is a resident and rare pheasant that is distributed in the western, central and eastern Himalaya (eastern Uttarakhand, northern West Bengal, Sikkim, and western Arunachal Pradesh). Its altitudinal range lies mostly between 2,400-4,500 m and it comes down to about 2,000 m in winter. The species is found to inhabit the sub-alpine habitats of the Biosphere Reserve. Although very less sighted the species generally lives in pairs and happens to be very shy to human interference. It occurred in the areas such as Ghunsa (3,100 m), Kasturi ridge (3,400 m), Kasturi (3,500 m), Phedang (3,750 m); as is evident from the distribution map of evidences in the study area (Fig 6).

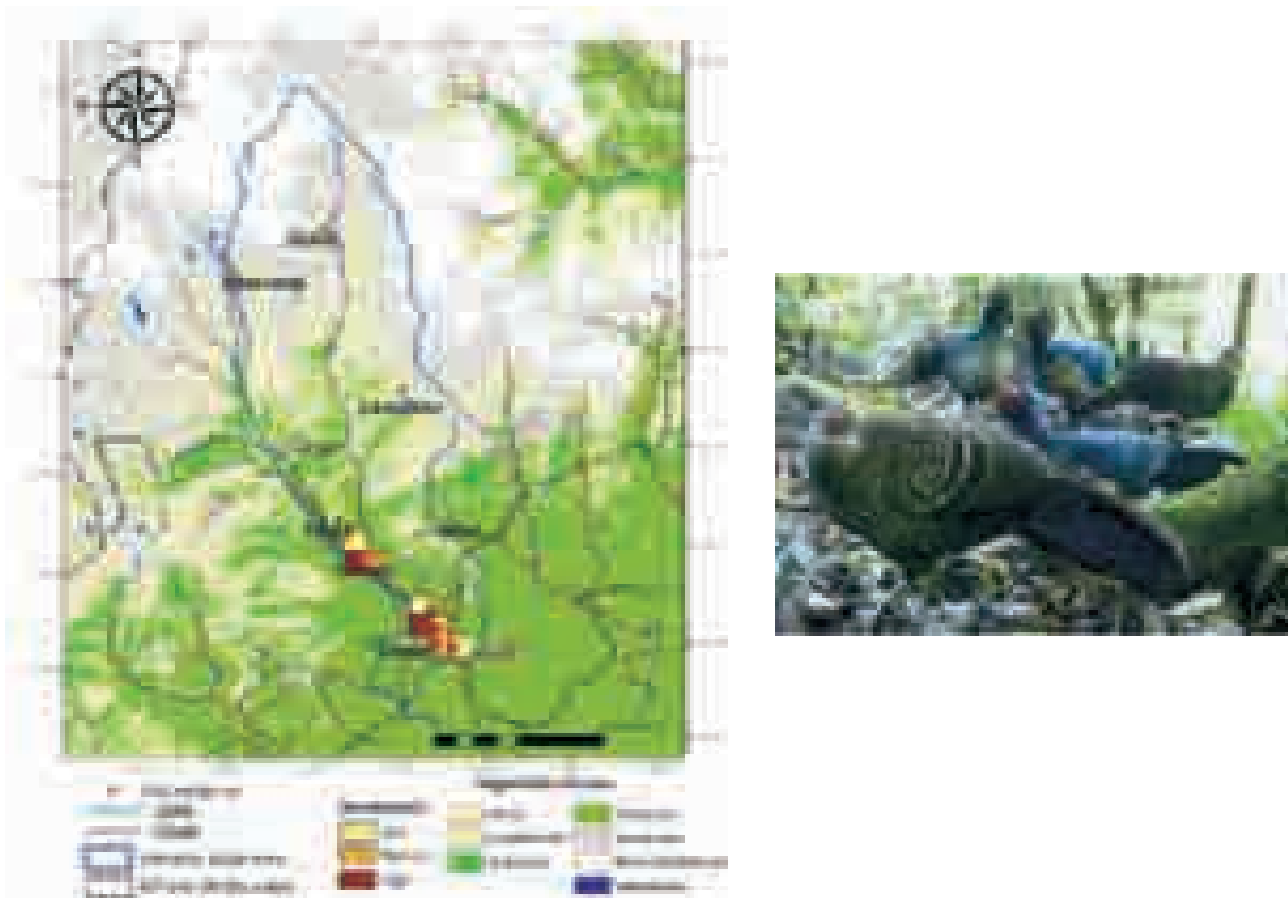
Figure 6 Distribution map and photo capture of satyr tragopan



Kalij Pheasant: Distribution and Abundance

The Kalij Pheasant (*Lophura leucomelanos*), is a pheasant found in forests and thickets, mainly in the Himalayan foothills, from the Indus River to western Thailand. The Kalij pheasant is distributed in the northwestern, western, central and eastern Himalayas (Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh and north west Bengal) usually < 2,700 m and in the hills of north east India (Assam, Meghalaya, Manipur, Mizoram, Nagaland & Tripura). It inhabits all types of forest with dense undergrowth and thickly overgrown steep gullies, usually not far from water (Sathyakumar & Kaul 2007). The species inhabits the temperate habitat of the study area. It has often been sighted mainly in groups. In the camera traps the species also occurs at places such as Yuksam (1,850 m), Dubdi (2,100 m), Quapani (2,050 m)(Fig 7), mainly in male-female groups with individuals ranging from 1-8.

Figure7 Distribution map and photo capture of Kalij pheasant



Snow partridge: Distribution and Habitat

The Snow Partridge (*Lerwa lerwa*) is widely distributed across the high-altitude Himalayan regions of India, Pakistan, Nepal and China. It is the only species within the genus. The species is found in alpine pastures and open hillside above the treeline. Snow partridge is found in the Himalaya from Jammu and Kashmir, Himachal Pradesh, Uttarakhand in the west to Sikkim and Arunachal Pradesh in the east. In summers, it is found between 4,000 and 5,000 m, but it comes down to 3,050 m in winters. It was found in pairs during spring and later in family groups of up to 30 birds. It found in pairs during spring and later in family groups of up to 30 birds. In the study area it was sighted in the groups of up to 15 individuals, mostly in the alpine zone. While in camera traps it occurred at few places in the *Krummholtz* zone. The areas where this species was either encountered or recorded in camera traps include: Lampokhri (4,250 m), Ginghe (4,280 m), Neer pokhri (4,350 m), Thangsing (4,050 m), Phedhi (3,950 m), although it occurred at Phedang (3,750 m) also in winters (Fig 8).

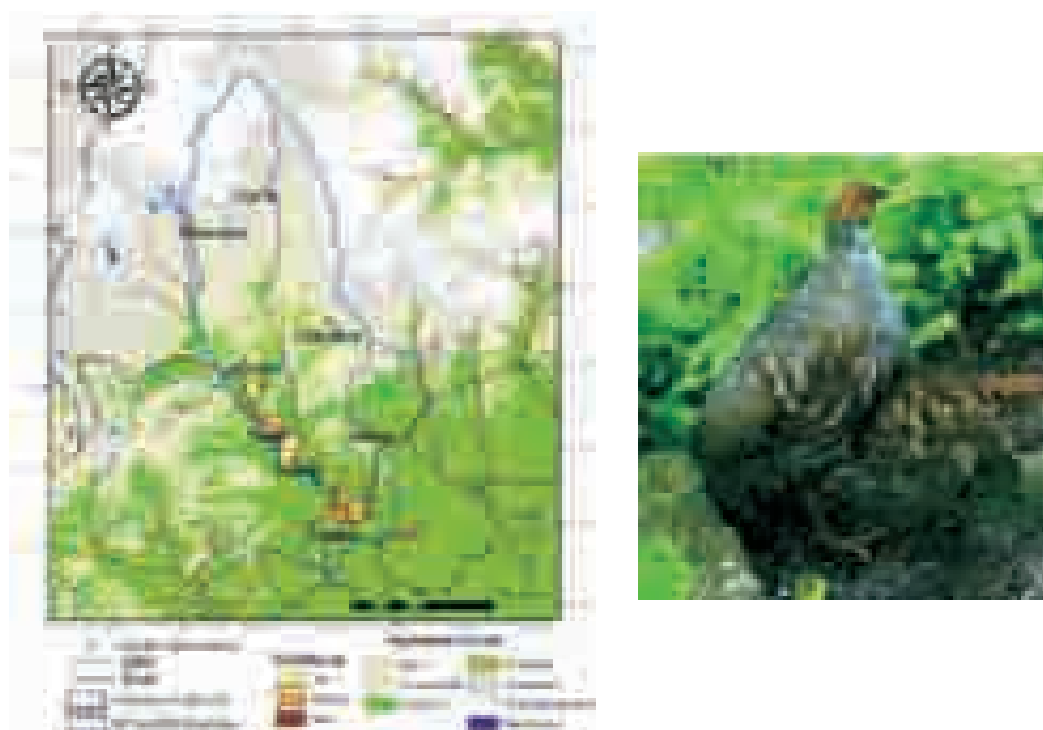
Figure 8 Distribution map and photo capture of snow partridge



Hill Partridge: Distribution and Abundance

The Hill Partridge (*Arborophila torqueola*) is a resident species and is distributed in Bhutan, China, India, Myanmar, Nepal, and Vietnam. Its natural habitats are subtropical or tropical moist lowland forests and subtropical or tropical moist montane forests. It is fairly common species found at an altitudinal range of 1,830-3,050 m. It is distributed from Himachal east to Arunachal Pradesh and north east India. Usually found in pairs but sometime gregarious, found in parties of five to ten birds outside the breeding season (Sathyakumar & Kalsi 2007). In the study area the species was found to occur in sub-alpine and temperate areas. It was mainly photo captured in Phedang (3,750 m), Ghunsa (3,100 m), Sachen (2,100 m), Quapani (2,050 m). A maximum group of seven individuals was recorded at Ghunsa (Fig 9).

Figure 9 Distribution map and photo capture of hill partridge



Management:

In the recent past, the Department and local communities have jointly demonstrated the success of the management interventions such as removing yak herders from the Khangchendzonga National Park (Tambe 2007). Such interventions have resulted in positive changes in the wildlife habitats and also in high encounters of wildlife including galliformes in the alpine areas of Dzungri and subalpine areas that were earlier highly used by yak herders. Such initiatives have to be maintained in order to ensure long term conservation goals of the people of Sikkim.

During our study, occasional instances of hunting mainly blood pheasant, Himalayan monal and Kalij pheasant were reported. We recorded a few instances of snares for galliformes in Khangchendzonga BR. Apart from these direct threats, there is still some presence of shepherd dogs and feral dogs inside the National Park and their frequent movements along with the tourists is a matter of concern for galliformes survival. As like the initiative taken by the management and the local communities, we propose that movement of dogs inside the National Park be avoided along with strict vigil during the peak tourist season and also regular monitoring of the galliformes habitats for regular removal of the snares. This will be another step towards ensuring conservation of galliformes by the local communities and the management.

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Table 1 Galliformes confirmed or reported in the Khangchendzonga Biosphere Reserve, Sikkim, with their IUCN Red List status, the type of evidence, their occurrence in the five watersheds

Species	Status ¹	Evidence ²	Occurrence in five watersheds ³				
			P	L	Z	C	La
Blood pheasant (<i>Ithaginis cruentus</i>)	LC	S, PC, LI	+		+	+	+
Himalayan Monal (<i>Lophophorus impejanus</i>)	LC	S, PC, LI	+	+	+	+	+
Satyr Tragopan (<i>Tragopan satyra</i>)	NT	S, PC, LI	+		+	+	+
Kalij Pheasant (<i>Lophura leucomelanos</i>)	LC	S, PC, LI	+		+	+	+
Hill Partridge (<i>Arborophila torqueola</i>)	LC	S, PC, LI	+		+	+	+
Snow Partridge (<i>Lerwa lerwa</i>)	LC	S, PC, LI	+	+	+	+	+
Tibetan snowcock (<i>Tetraogallus tibetanus</i>)	LC	Dr, C, LI		+			

¹IUCN-Red List status 2010: LC: Least Concern; Nt: near threatened

²S: Sighting, PC: Photo capture, C: Call, Dr: Droppings, LI: Local information

³P=Prek, L=Lhonak, Z=Zema, C=Churong, La=Lachen

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