POPULATION STATUS, OCCUPANCY AND DISTRIBUTION MODELLING OF CHEER PHEASANT (*Catreus wallichii*) IN DHORPATAN HUNTING RESERVE, NEPAL

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Submitted To

Central Department of Zoology

Institute of Science and Technology

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Kirtipur, Kathmandu

8 June, 2015

DECLARATION

I hereby declare that this thesis entitled **"Population status, occupancy and distribution modelling of Cheer Pheasant (*Catreus wallichii*) in Dhorpatan Hunting Reserve, Nepal"** has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the authors or institutions.

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RECOMMENDATIONS

This is to recommend that the thesis entitled **"Population status, occupancy and distribution modelling of Cheer Pheasant (*Catreus wallichii*) in Dhorpatan Hunting Reserve, Nepal"** has been carried out by **Mr. Hari Basnet** for the partial fulfillment of **Master's Degree of Science in Zoology** with special paper **Ecology** and **Environment**. This is his original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions.

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CERTIFICATE OF ACCEPTANCE

This thesis work submitted by **Mr. Hari Basnet** entitled **"Population status, occupancy and distribution modeling of Cheer Pheasant (*Catreus wallichii*) in Dhorpatan Hunting Reserve, Nepal"** has been accepted as a partial fulfillment for the requirements of **Master's Degree of Science in Zoology** with special paper **Ecology and Environment**.

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LETTER OF APPROVAL

On the recommendation of supervisor "Dr. Tej Bahadur Thapa" this thesis submitted by Mr. Hari Basnet entitled **"Population status, occupancy and distribution modelling of Cheer Pheasant (*Catreus wallichii*) in Dhorpatan Hunting Reserve, Nepal"** is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for **Master's Degree of Science in Zoology** with special paper **Ecology and Environment.**

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ABSTRACT

The Cheer pheasant (*Catreus wallichii*) is a threatened species listed as vulnerable in IUCN Red list and legally protected by the Government of Nepal. The conservation of this species is of great importance worldwide and regular monitoring of its status and distribution are necessary. This study was done to assess the population status and estimate occupancy patterns in Dhorpatan Hunting Reserve, as well as to identify potentially suitable habitat of Cheer in Nepal. The study was conducted during the breeding season i.e. May and October 2013. Dawn call count method was used to obtain the population status; and detection and non-detection survey was done to estimate the occupancy of Cheer. The occupancy data was analyzed in the program PRESENCE. Habitat suitability was predicted throughout Nepal using a MaxEnt modeling approach, combining presence-only data. Population data revealed that Dhorpatan valley still supports significant population of Cheer with overall density of 7.08 pairs/ Km^2, but the population is in declining trend. Total population size of the species was found to be 143-156 pairs. Occupancy modeling revealed that the distance to water had greater weight in determining occupancy. Distribution modeling indicated smaller area (1.20%) was most suitable for the species occurrence in Nepal. Most of the habitat of Cheer is discontinuous mostly occurred in patchy habitat in the Western Nepal. Thus, Community based conservation program, regular monitoring, survey in potential habitat and its protection will be crucial to achieving the conservation goal.

Contents

LIST OF TABLES

Table **Title of Table**

LIST OF FIGURES

Figure **Title of Figure**

LIST OF ABBREVIATIONS

AIC	Akaike's Information Criterion
AUC	Area under Curve
BCN	Bird Conservation Nepal
DEM	Digital elevation Modelling
DHR	Dhorpatan Hunting Reserve
DNPWC	Department of National Park and Wildlife Reserve
EGV	Eco-geographical variables
GIS	Geographical Information System
GLM	Generalized Linear Models
GPS	Global Positioning System
GRASP	Generalized Regression Analysis and Spatial Prediction
IUCN	International Union for Conservation on Nature and Natural Resources
KCA	Kanchanjunga Conservation Area
RNP	Rara National Park
ROC	Receiver Operating Characteristics
SDM	Species Distribution Modelling
Sq. km.	Square kilometers
VDC	Village Development Committee
WPA	World Pheasant Association.

1 INTRODUCTION

1.1 Background

The Cheer pheasant (*Catreus wallichii*) (hereafter referred to as Cheer) is, a relict, monotypic species of the genera *Catreus* (Del Hoyo et al. 1994). The Cheer, belongs to the order Galliformes and family Phasianidae, is an endemic species of the Western Himalayas (Grimmett et al. 1998). This species is listed as Vulnerable category by IUCN (IUCN 2015, Birdlife international 2014) and the Government of Nepal listed it as protected in Nepal (HMGN 1973). The habitat of the Cheer is restricted within a narrow belt of the Himalayas which formerly ranged from Pakistan to the Kaligandaki River in western Nepal (Delacour 1977, Ali and Ripley 1998, Grimmett et al. 1998) (Figure 1.2). In Nepal, it is distributed in western Mountain extending from western boarder to the Kali-Gandaki River (Inskipp and Inskipp 1991) (Fig 2.1).

Cheer is lack of color and brilliance of most of the pheasants, with buffy grey plumage and long gray plumage and long grey crests. It has long, broadly barred tail, pronounced crest and red facial skin. Male is cleanlier and it is a medium sized bird among the Pheasants. Strongly marked than female with pronounced barring on mantle, unmarked neck and broader barring across tail (Grimmett et al. 2000). The male is 90-118 cm and female is 61-76 cm in length. Typical views are flying downhill, when buffs grey and brown coloration and long broadly banded tail are diagnostic. Juvenile is like female but lacks crest and is less heavily marked (Grimmett et. al. 1998). Voice of Cheer is loud chir-a-pir chir-a-pir chir chir-chirwa chirwa and high, piercing chewewoo notes, interspersed with short chut and harsh staccato notes (Birdlife international 2014).

The Cheer is monogamous and sociable species of bird commonly found in a flocks of 5-15 birds except in the breeding season (Finn 1902) or may be found in a flocks of half dozen or more, probably only the family party of the last hatching (Baker et al. 1918). Most calls are social in function rather than territorial signals, except during the breeding period at which the loud and intermittent calls are made by the males to protect their territories and to attract females (Mirza 1980). In April, particularly all appeared to in a pairs (Garson and Singh 1980) until the onset of winter when these family units combine

with other to form larger flocks (Kaul 1989). This species is thought to sit concealed during the day only emerging to forage in early morning or late afternoon (Murrday 1889) and is extremely skulking, tending to run away through undergrowth when disturbed rather a taking wing (Ali and Repley, 1998).

The Cheer is generally frequent in the outer hill ranges of the Himalayas, typically avoiding dense forest and favoring very precipitous terrain with scrub, tall grasses and stunted trees, particularly where interspersed with rocky crags (Garson et al. 1992). Nest scrape of Cheer is made on the ground by the female and this is usually concealed under overhanging vegetation in the shelter of rocks or bush, normally on the "broken" or precipitous ground (Baker 1921–1930, Ali and Ripley 1968–1998).

In India Cheer was found in Himachal Pardesh (Whistler 1926, Kalsi 1999), Uttarakhanda (Garson et al. 1992) and five other localities including Chail, Kandaghat, Dranghati, Nadar and Parshar (Gaston and Singh 1980). In Pakistan, it may now only persist in the Jhelum Valley, where it is declining and has apparently disappeared from some areas (Awan 2011). The most recent surveys found no evidence of it at Salkhala Game Reserve or Machiara National Park where it previously occurred (Awan et al.2012) (Fig. 1.1).

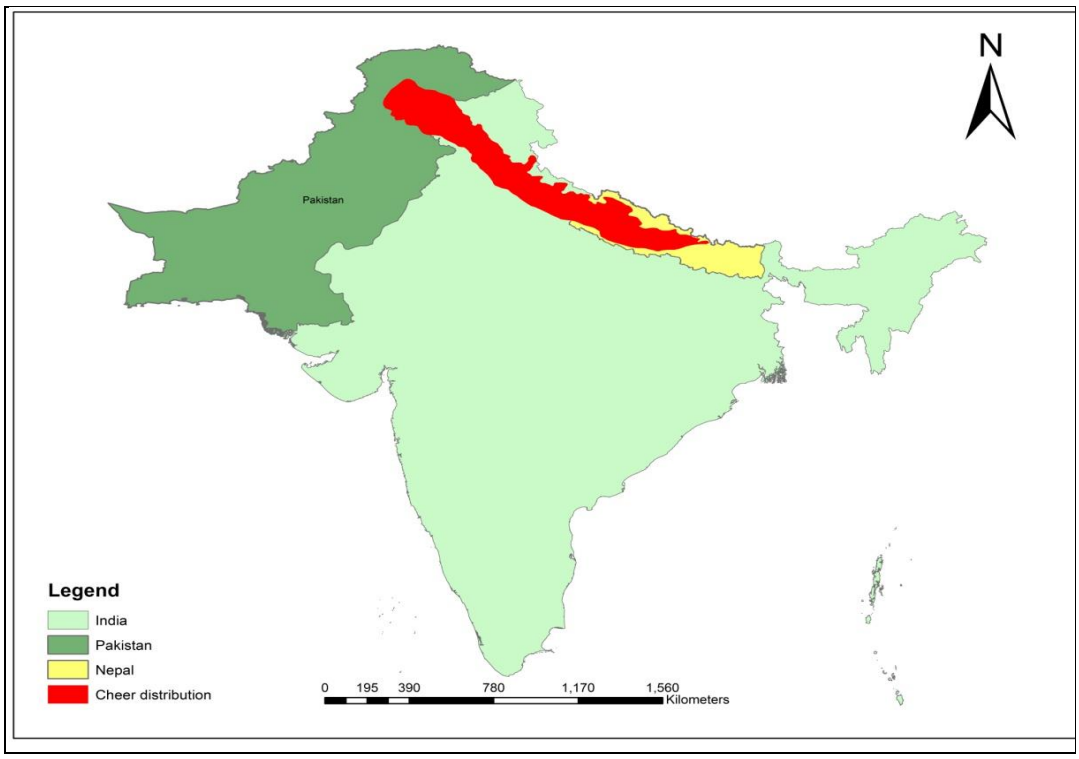


Fig. 1.1 Global distribution of Cheer Pheasant (Source: Birdlife International, 2014)

Important area for Cheer in Nepal and indeed within its entire global range is in and around Dhorpatan Hunting Reserve (DHR), local resident in the west and scarce elsewhere (Garson and Baral 2007). Their population has been known since the 1970s (Fleming et al. 1976) and Sherpas from Mountain Travel Ltd. subsequently reported Cheer from the valley east of Dhorpatan in 1976/77 (Singh et al. 2011). It was also reported in Bobang and Muri areas (Singh et al. 2006, Singh 2007, Singh et al. 2011), lower Kali Gandaki valley, Mustang (Acharya 2004) and Ghasa since 1982 (Inskipp and Inskipp 1991). Similarly, it was also recorded near Rara Lake in Rara National Park (Budhathapa 2007) and its buffer zone (Thakuri 2012). The species was reported by local people of Baitadi district from Kaphalpani and Dhaukudi VDCs although the first known record was from far west at Kasanidada of Kulau VDC (Budha 2006). In addition to this, locals of far west reported Cheer from the Tisimidad, Kanachaur VDC, Doti District; Dhapa VDC, Jumla district; Dhanaikot VDC, Mugu district , Basti, Balata, Kuntibandali and Bhairabsthan VDC in Achham District (Budha 2006) and Yalbang area and around Simikot in Humla District (Ghimirey 2011). Cheer was reported to be breeding in captivity in Dolpa District (Acharya 2006) (Fig1.2).

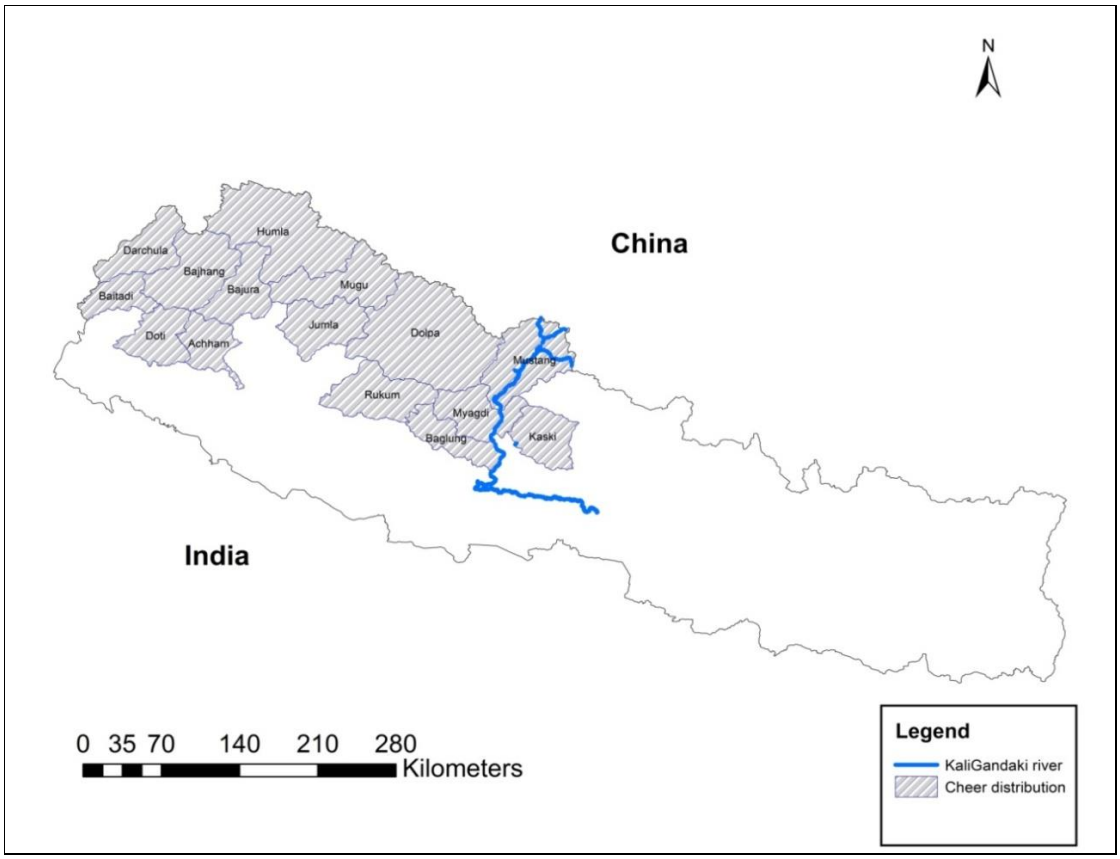


Fig. 1.2 Distribution of Cheer pheasant in Nepal.

1.2 Species Distribution Modelling and Conservation implication

Modeling of species distributions has become necessary in many aspects of biology, ecology and biogeography. Habitat suitability models could constitute a good tool for decision-making within the framework of applied biology (Garzon et al. 2006). They have mainly been used in strategies for conservation, planning and forest management. Species Distribution Modelling (SDM) estimates the actual or potential geographic distribution of a species (Pearson 2010) based on the environmental conditions of sites of known occurrence (Phillips et al. 2006). The SDM produce spatial predictions indicating the suitability of locations for a target species, community or biodiversity (Hirzel et al 2006*)*. Many different models are currently available. Among these, classical statistical models such as Linear Regression (Augustin et al. 2001), Generalized Linear Models (GLM) (Guisan et al. 1999), Generalized Additive Models (Seoane et al. 2004; Luoto et al., 2005) and Generalized Regression Analysis and Spatial Prediction (GRASP) (Lehmann et al. 2002) have been widely used. Among them SDM quantifies correlation between environmental factors and distribution of species (Miller 2010). Various group of algorithm like Ecological Niche Factor Analysis (Hirzel et al. 2002), Maximum Entropy (Phillips et al. 2006), Genetic algorithm (Stockwell and Peters 1999), Regression (Lehman et al. 2002, Elith et al. 2006) etc. are used to model potential habitat. As such, these models help estimate direct relationship between occurrence of the species and environment, they have found practical utility in protected area management, reintroduction and conservation ecology.

1.3 Rationale

Cheer pheasant's small population is naturally fragmented because it lives in small patches of successional grassland (Birdlife international 2014). Loss and degradation of the Cheer's specialized habitat, hunting and human disturbance in the Himalayan foothills are causing the decline of this species (Garson et al. 1992, Kasli 1998). It is the single species in the genera *Catreus* therefore, it deserves more importance as compared to the one which its genus contains several species (Gaston 1992). DHR is the only region in Nepal supporting an apparently stable and viable population of Cheer pheasant and it is crucial to monitor the population regularly (Singh et al. 2011). The protection of this

vulnerable species is of great importance worldwide and regular monitoring of its status and distribution are necessary for measuring the management quality and quantity of ongoing activities. Some recent information puts their population size at a lower level than was previously estimated (Birdlife international 2014). There wasn't any further study in the valley after the study done by Subedi (2003) so updated information on Cheer is much needed to reveal the current status of the species.

This study also provides the baseline data on occupancy of Cheer in DHR. Cheer pheasant are thought to be positively influenced by human disturbance (Kaul, 1989; Garson et al. 1992; Ramesh, 1999) but there is lack of information about the combine association with water sources and human settlement. Thus, the probability of occurrence of Cheer in the Dhorpatan valley in relation to the distance to human settlement and water sources was assessed during this survey. Furthermore, response of Cheer to the site parameters, grazing intensity and elevation was also modeled. This study also provides the first detailed map of Cheer pheasant habitat suitability throughout Nepal which provides the cornerstone for future designing of management actions for long run survival and conservation of this endangered species.

1.4 Objectives

The main objective was to assess the population status, occupancy of Cheer pheasant and its potential habitat distribution. The specific objectives were to:

- Determine population status of Cheer pheasant in the Dhorpatan Valley of DHR.
- Estimate occupancy patterns and important covariates affecting occupancy of Cheer pheasants in Dhorpatan Valley, and
- Identify potentially suitable habitat of Cheer in Nepal.

1.5 Limitations of the Study

- Due to logistic and resource limitations all the calling stations were surveyed only three consecutive mornings and this study covers 13 calling stations previously surveyed by the researcher.
- Survey was restricted to the Dhorpatan valley of DHR and due to difficult geographical location all the indirect survey couldn't be record fully and transect walk was done as much as possible.
- To prepare species distribution modeling only 39 presence points of Cheer is collected from current study and different literature.

2 LITERATURE REVIEW

2.1 Population Status and Distribution in Nepal

The first survey on in Dhorpatan valley estimated about 50 to 100 individuals of Cheer (Lelliott 1981). Fleming et al. (1976) and Roberts (1980) have also reported an unspecified number of Cheer in Dhorpatan area. The Dhorpatan valley was found to support an estimated Cheer population of between 179 and 229 pairs (Singh et al. 2011). A survey in 2006 in the DHR buffer zone was estimated 148-188 pairs of Cheer (Singh et al. 2006, Singh et al. 2011). In total the Dhorpatan area had an estimated Cheer population of 327-417 pairs and the population densities were the highest recorded in Nepal 7.5-9 pairs per km^2 (Singh et al. 2011).

In the lower Kali Gandaki valley the population of Cheer was estimated to be 85-111 pairs in June 2004 (Acharya 2004) and 20-97 pairs in June 2006, a marginal decline, but considered statistically insignificant (Acharya et al. 2006). A June 2009 survey of the valley estimated a population of 25-37 pairs, a marginal decline by more than 54% and a low population density of 1 pair per km^2 but statistically adjustments suggesting that Cheer still survives in good numbers in the lower Kali Gandaki valley (Subedi 2009, Subedi 2013). In Rara National Park (RNP), 2005 survey estimate the Cheer population 9.48 to 14.22 pairs and a low population density of 2 pairs per km^2 (Budhathapa 2006, Singh 2009). In 2009 only 2 calling birds were recorded in RNP buffer zone (Singh 2009b, Singh and KC 2008). However Thakuri (2012) survey in a different area of the buffer zone to the north located 33 calling birds. In Jumla it was common in 1972, but only one call was reported by Roberts (1980). The species was regularly recorded at Ghasa of Mustang district since 1982. A maximum of seven calling birds recorded in 1992 and in January 1998, six to ten birds reported above Ghasa. Four calling birds recorded from the Kumai in 1995 (BirdLife international 2014).

In India it has also declined, Based on surveys in 1979-1980 population of Cheer in Himachal Pradesh estimated 1,000 pairs (Birdlife international 2015). But now known population of Cheer confined Himachal Pradesh and Uttarakhand (BirdLife international 2014). In one small wildlife sanctuary (Chail), a spring population density of 6-7 pairs /km^2 was estimated (Gaston and Singh 1980, Garson 1983). The area in and around Majathal Wildlife Sanctuary (MWS) was found to support an estimated densities of 24

pairs/km^2 in 1983 (Birdlife international, 2015). Recent, a density estimates (2008- 2009) revealed a density of 4-5 pairs/km^2 (Birdlife international, 2015). In Palla Game reserve the density indices at the various areas showed the maximum of 2.40 km^2 at Tranger and minimum of 1.33 km^2 at Ban (Khan et al. 2006).

2.2 Occupancy patterns of Cheer pheasants

Detection/non-detection surveys in site occupancy modeling have been used in numerous species monitoring programmes worldwide. Site occupancy model (MacKenzie et al. 2002) was used by the different researchers to carry out the site occupancy of the species and analyzed to find out the habitat suitability based on these covariates. The patch occupancy model assumes that: (1) the focal species cannot colonize (or immigrate to) or go locally extinct at a site during the survey period, (2) species are not falsely detected, and (3) the detection at one site is independent of detection at other sites (Donovan and Hines 2007). Jolly et al. (2011) reported that the occurrence of Cheer is independent of covariates like vegetation, elevation and the probability of Cheer pheasant being present at a survey site increased with increasing distance from a human settlement. Densities of Cheer were negatively correlated with tree crown cover and there was no significant correlation with grass cover or measures of grazing pressure (Singh et al. 2011). Cheer pheasant is easily detectable in its habitats The human disturbance is important for Cheer pheasant survival indicate Cheer can survive in high level of disturbance (Kaul 1989, Birdlife International 2014) but in contradiction Jolly et al. (2011) result suggest that a decrease in the level of disturbance appears to increase the probability that a Cheer is present at a site. Thus, Cheer pheasant responded negatively to human disturbance (Jolly et al. 2011).

Very few studies have been conducted on Cheer Pheasant so far in Nepal. Kandel (2013) reported that probability of occupancy is higher at grassland areas. He further reported that level of disturbance as a site specific covariate which indicate occupancy is dependent on the low level of disturbance considering disturbance level in terms of human impacts and grazing intensity which had also been supported by (Kaul 1989, Birdlife International 2014).

2.3 Species Distribution Modeling

The availability of detailed environmental data, together with inexpensive and powerful computer programs, has fueled a rapid increase in predictive modeling of species environmental requirements and geographic distributions (Phillips et al. 2006). Species Distribution Modeling (SDM) estimates the actual or potential geographic distribution of a species (Pearson 2010) based on the environmental conditions of sites of known occurrence (Phillips et al. 2006). For most rare species, surveys are undertaken in areas of the most suitable habitat to maximize the likelihood of detection. One approach to identifying such habitat is to generate Species Distribution Models (e.g. Guisan and Zimmermann 2000, Boitani et al. 2011). The potential distribution of the Cheer pheasant is generating a climatic and topographic model using maximum entropy (MaxEnt) Species Distribution Modeling software (Phillips et al.2006, Phillips and Dudík 2008). MaxEnt is a general-purpose method for making predictions or inferences from incomplete information MaxEnt has been found to perform well against other distribution models (Elith and Graham 2009) and produces models that have particularly high accuracy in the case of species with small sample sizes and restricted geographic locations.

Phillips et al. (2006) compared Maximum Entropy (Program MaxEnt) and Genetic Algorithm (Program GARP), and concluded that both approaches provided reasonable estimates species range, MaxEnt presenting higher discrimination over GARP. Similarly Elith et al. (2006) compared 16 types of modeling method over large region and species, and concluded that MaxEnt was ranked better over other methods for distribution modeling. Hernandez et al. (2006) compared four modeling methods for their efficiency to correctly predict distribution range for small sample size as low as five where MaxEnt outperformed other methods. Kumar and Stohlgren (2009) used MaxEnt for determining potential suitable habitat for a threatened tree species with small samples and obtained low omission rate and statistically significant result.

3 MATERIALS AND METHODS

3.1 Study area

Dhorpatan Hunting Reserve (DHR) (Fig. 3.1) is situated in the Himalayan ecological zone of mid-western Nepal occupying an area of 1,325 Km^2 in Rukum, Baglung and Myagdi districts of Nepal (DNPWC 2006). This study was conducted in the Phagune and Surtibang. Phangune (28^0 29' 46" N and 83^0 04' 45" E) and Surtibhag (28^0 30' 6" N and 83^0 01' 18" E) areas located in the Dhorpatan valley, inside DHR (82^0 15′ E to 83^0 15′ E 28^0 27′ 30′ N to 28^0 50′ N) and these areas constitute most part of Dhorpatan valley (Singh et al. 2011).

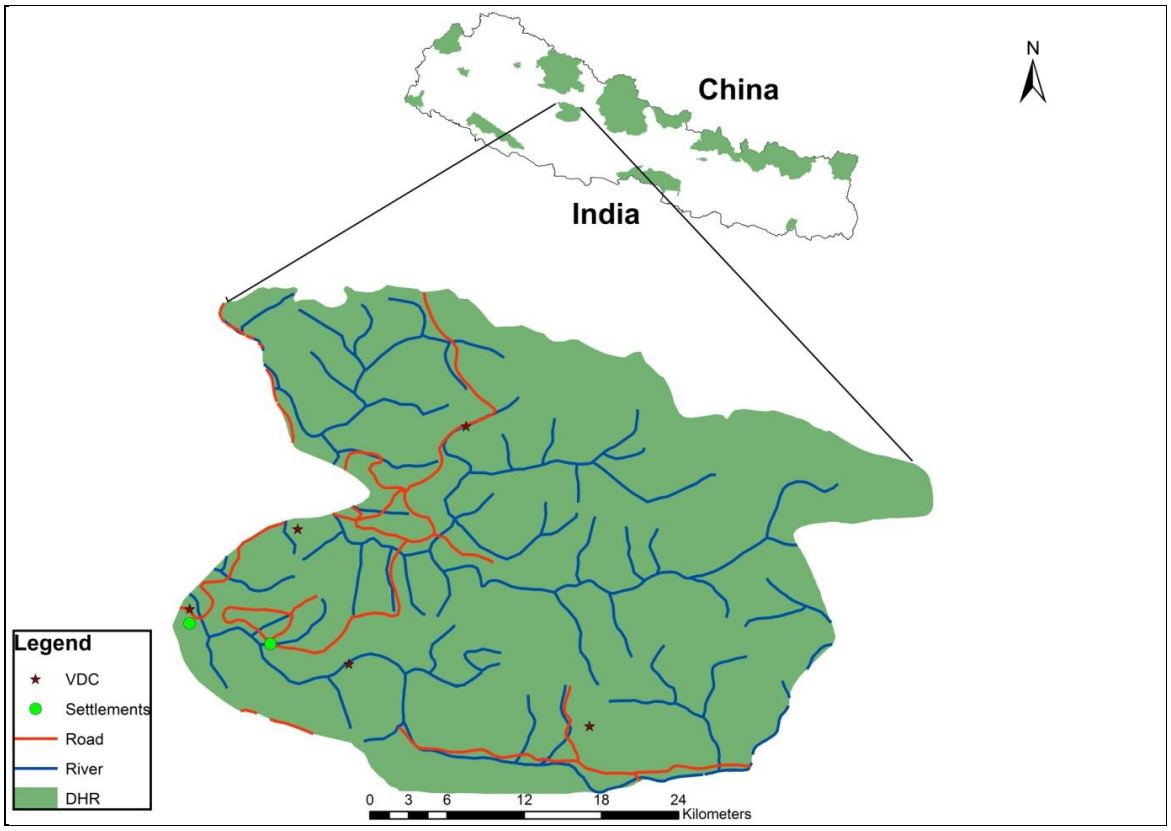


Fig. 3.1 Map of the Study area.

3.1.1 Climate

Climate of the DHR is dry and cold in the winter (Nov- Feb) and precipitates in the summer from mid-May to August. The climatic variation is high because of the varied

topography and elevation. Every year maximum rainfall occurred in July and August (Figure 3.2).The highest rainfall occurred in 2013 with 229.31mm and lowest rainfall in 2004 with 142.7mm. The average rainfall from 2003 to 2013 was 181.23 mm.

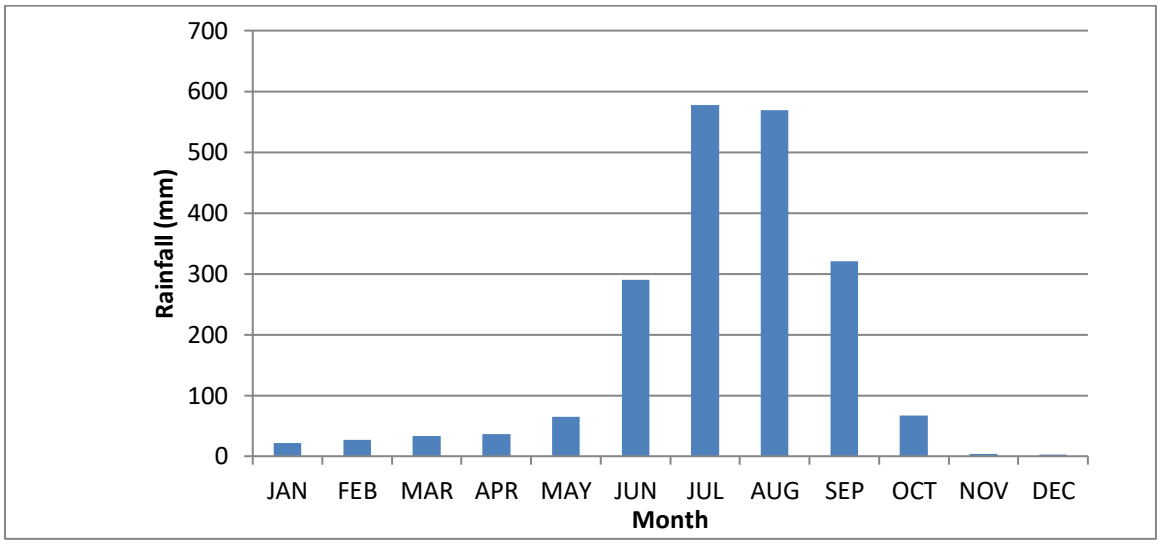


Fig. 3.2: Average rainfall of Dhorpatan Hunting Reserve (Gurjakhani station), Nepal (2003-2013). (Data Source: DHM/GOVN)

DHR is characterized by alpine, sub-alpine and high temperate climates. Summer is moderate hot and dry. It starts from third week of February and lasts up to second week of June. The Annual average maximum temperature in eight years (2003-2011) showed that Recorded June was the hottest month of the year with mean maximum temperature 21.47 ºC (Fig 3.3). After monsoon season cold winter season starts and temperature decreases continuously. Winter is severe with temperature below freezing point and frequent snowfall above 2,500 m altitude. Occasional heavy snowfall closes the trails for several days and snow avalanches frequently pose threats to local people, livestock and wildlife. January is the coldest month of the year with average minimum temperature recorded from 2003 to 2011 was -1.17ºC (Fig 3.3).

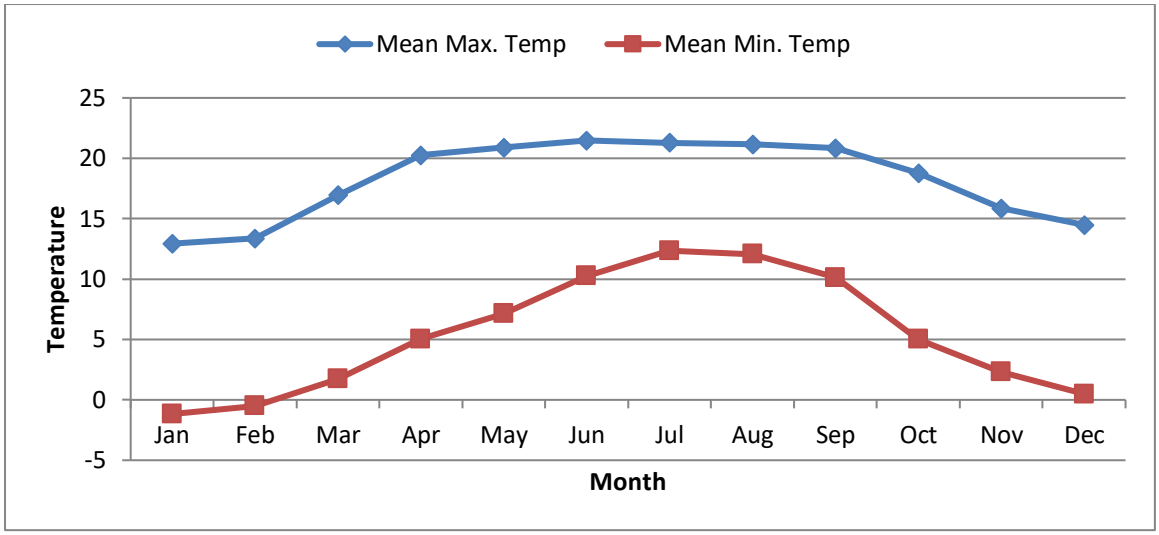


Fig. 3.3 Average maximum and minimum temperature of Dhorpatan Hunting reserve (Gurjakhani Station), Nepal (2003-2011). (Source: DHM/GOVN)

3.1.2 Forests

There are fourteen type of forest ecosystem and ten types of vegetation in DHR (Bhuju et al. 2007). The forest of DHR broadly consists of Pine-juniper forest, with fir and rhododendron on the upper slopes (Dobremez and Jeest 1971). Progressing downwards down the valley other coniferous species such as cedar, spruce and cypress are evident; while on the lower slopes broadleaves species such as oak, maple and rhododendron predominate (Lelliott 1981).

3.1.3 Flora and Fauna

The reserve is characterized by alpine, sub-alpine and high temperate vegetation. This reserve has one of the highest numbers of endemic plants (36 species) indicating its biological significance (Kandel 2000). Fifty eight vascular plants have been recorded as present in the reserve. Phagune and Surtibang broadly consist of pine-juniper forest with *Abies spectabilis* and Rhododendron spp. on the upper slopes. Progressing westwards down the valley, other coniferous species such as cedar (*Toona* sp.), spruce (*Picea* sp.) and Himalayan cypress (*Cupressus* sp.) are evident. On the lower slopes broadleaved species such as *Quercus* spp. Maple (*Acer* sp.) and Rhododendron spp. are dominate (Lelliott 1981).

The numbers of faunal species found in the reserve include 18 mammals, 167 birds and two herpetofauna (Bhuju et al 2007). The reserve is prime habitat for rare and endangered mammals such as Snow leopard (*Uncia uncia*) Musk deer (*Moschus chrysogastur*), Red panda (*Ailurus fulgens*), Dhole (*Cuon alpinus*). Other animals are Himalayan Serow (*Capricornis sumatraensis*), Ghoral (*Nemorhaedus goral*), Barking deer *(Muntiacus vaginalis*), Himalayan Tahr (*Hemitragus jemlahicus*), Blue sheep (*Pseudois nayaur*), Asiatic black bear (*Ursus thibetanus*), Leopard (*Panthera pardus*), Grey Wolf (*Canis lupus),* Wild boar (*Sus scrofa),* Red fox (*Valpes vulpes*), Mouse hare (*Ochotona roylei*) (Aryal and Kreigenhofer 2009) and symbolic avifauna including Cheer pheasant (*Catreus wallichii*), Koklass pheasant (Pucrasia microlopha) and Himalayan Monal (*Lopophorus impejanus)* recorded in DHR (Bhuju et al. 2007).

3.1.4 Socio-economic

The major ethnic groups of the users of the reserve are Magar, Brahmin, Chhetri, Kami, Damai, Thakali, etc. The ethnic groups of the reserve are famed as Nauthar such as Adai, Bhandari, Chhotabhandari, Mateadai, Kather, Kayat, Khadka, Kumai, and Thapa as well as Tibetan descent. The major occupations of the local people are livestock rearing, farming and forest products collection. The major livestock are goat, sheep, cow, ox, buffalo and horse etc. Livelihood of the local people around DHR and its catchment area is versatile. Most of the people do migratory settlement due to climatic conditions and resources availability. They do descend down during winter and ascend up during summer. Both the purposes are related to storing forage and feeding their livestock and to sustain there in the reserve area. They do their household work and storing cereal crops (Oat, Potato) during September-November (Yadav 2007).

3.2 Bird survey techniques

3.2.1 Research design

Topographic map of the study area was studied briefly and tentative design was made before the preliminary survey. A preliminary survey was carried out to find out same call count station which were used in the earlier survey conducted in 2003 and call count stations were fixed during this survey. The survey was done in breeding season i.e. May

and October 2013. Thirteen calling points were those already surveyed by previous researcher and one new calling site was selected for the survey.

3.2.2 Preliminary survey

The survey was done in breeding season i.e. May and October 2013. A preliminary survey was carried out to locate call count station which were used for previous survey conducted in 2003. Further, potential locations for the Cheer were identified through communication with reserve staff, BCN officers, livestock herders, and local knowledgeable person and through review of secondary data. One new calling point and thirteen previously surveyed points were selected for monitoring the population of Cheer pheasant in the Dhorpatan valley. All possible sites were surveyed for the verification of the Cheer habitats.

3.2.3 Population Estimation

Population status of Cheer in the DHR was estimated through the use of dawn call count method. The call count is only reliable method for estimation of pheasant population (Gaston et al. 1981) and was widely used in many studies on Himalayan pheasant species (*e.g.* Gaston and Singh 1980, Yonzon 1987, Garson 1983, Picozzi 1984, Duke 1990, Howman and Garson 1993, Khaling *et al*. 1998, Baral et al 2001, Mahato *et al* 2006). Both male and female Cheers are vocal, giving loud calls in the morning and evening (Young et al. 1987). They are very vocal during the breeding season (April – June) and in autumn (October – November) (Ali and Ripley 1998). Counts were made 30 minutes before sunrise in the morning as suggested by Young et al. (1987) and 58 minutes after the sunset (Singh et al. 2011). Circular plots with a 300 m listening radii were fixed at each station (Fig 3.4) and these were located more than 800 m apart from each other to avoid a double count (Subedi 2003).

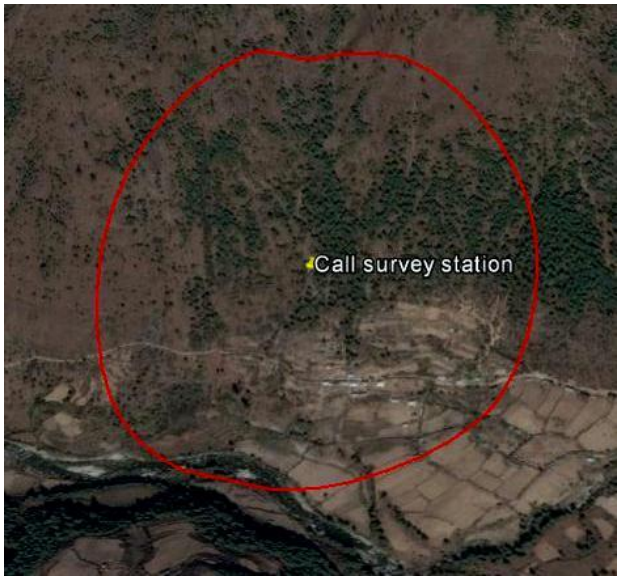


Fig. 3.4 Showing 300m buffer circle in call count station of Khudi area.

The Calling bouts were precisely timed and Cheer call count sheet developed by Gaston (1983) with some modification was used to record data (Annex 5). Their compass direction and estimated distance from the station was also marked on the sheet as to avoid double counts and also to estimate the abundance. Some of the points of the calling sites previously used by researchers were changed due to difficulty to listen the calls from surrounding hills. The effective sampling area of this survey was 21 Km^2 (Subedi 2003). Altogether 42 man work day were spent in the field and 14 points were surveyed which included six points surveyed by Lelliot (1981), 13 calling sites surveyed by Subedi (2003) and one new site was selected. Among these 14 points, six points were located in Surtibang block and eight points in Fagune block (Fig. 3.5).

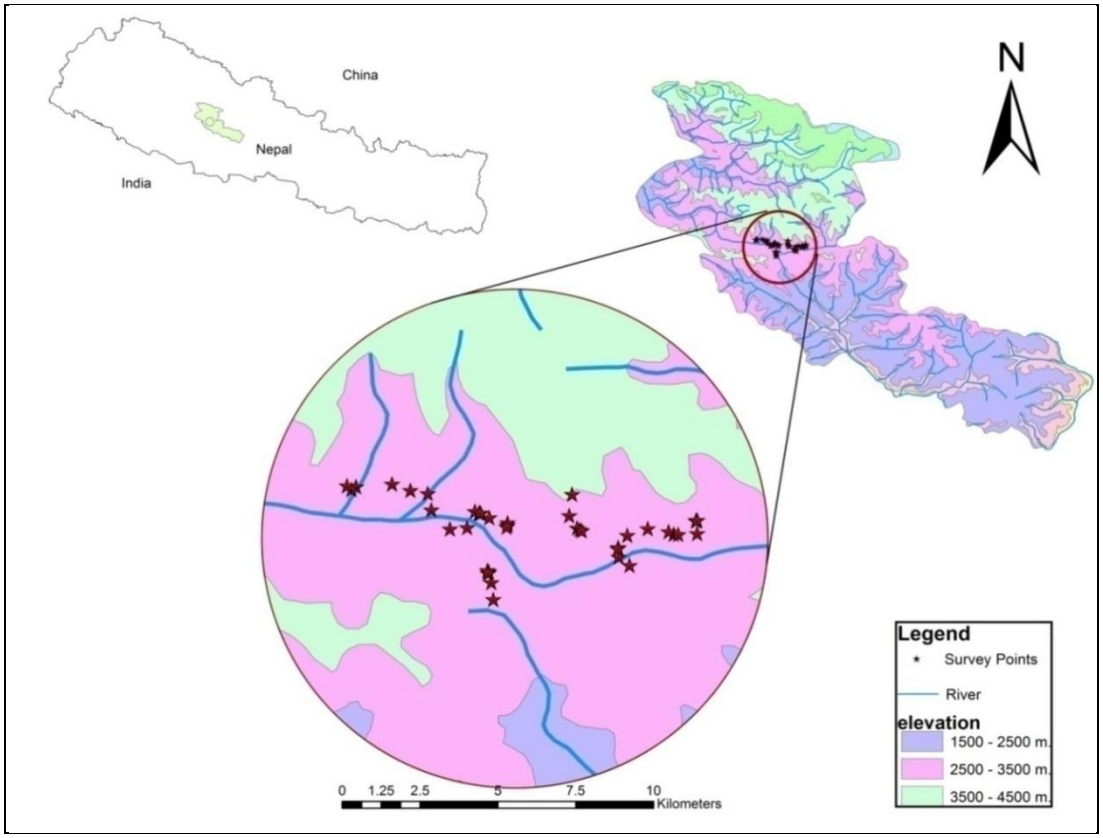


Fig. 3.5 Map of Dhorpatan valley showing the Call count stations along the each site of Uttarganga River.

3.2.4 Occupancy survey

Data were collected during May (breeding season) in 2012. Detection – non-detection surveys (Roberts, 1991; Sathyakumar et al., 2007; MacKenzie et al., 2006) was used to estimate Cheer pheasant occupancy probability. Calls were used to record its presence in 14 call count stations. Indirect evidences i.e. droppings, clutching, ground scratching; footprints were also collected as indicators of the presence of Cheer GPS readings of elevation, latitude and longitude, slope and aspect of conformed call of Cheer and potential habitat were recorded. These call count stations were selected based on the presence of Cheer pheasant at these stations in the past and also from interviews with local shepherds and discussion with park staffs. Each call was assumed to be coincided with the home range of Cheer pheasant. Playback calls are quite useful in presence-absence surveys particularly in difficult terrain (Garson 1998; Awan et al. 2004) such as that in Dhorpatan valley. Mp4 player was used for playback call of Cheer pheasant which was downloaded from xerocanto.com. If no calls were heard, playback call was played for 20 seconds only to elicit responses of Cheer pheasant. Response of Cheer pheasant to

the site parameters, water sources, distance to human settlement, grazing intensity and elevation was recorded.

3.2.5 Species Distribution Modeling

Cheer pheasant presence locations were collected through extensive survey in the study area. Presence data also collected from literature covering most of the important survey done in Nepal from Kaligandaki River in the east to the western border of the country. A total of 39 geo-referenced presence points were available. Environmental variables included 22 variables likely to affect distribution of the species. Of these variables 19 Bioclimatic were generated by Worldclim (Hijmann et al. 2005 (www.worldclim.org)), land cover on Globcover-Ionia (ESA 2008) (http://ionia1.esrin.esa.int/). Similarly, Digital Elevation Model (DEM) was downloaded (Jarvis et al. 2004) with a 30 m resolution and masked it with the country boundary. DEM was used to prepare an aspect map and slope map in ArcGIS 10. These data were formatted by ArcGIS 10. Program MaxEnt which uses Maximum Entropy Algorithm for modeling distribution was used for data analysis.
These randomly generated points were recorded in file type as required by the software (.csv). Similarly, 19 environmental layers in raster format were also extracted from the country's shape files, resampled whenever necessary and converted to the format required which was finally imported to the software. The model was then run using default auto features (linear and quadratic). Regularization multiplier value was taken as 1.

3.3 Data analysis

Data collected during this field survey was analyzed using following statistical tool:

3.3.1 Descriptive statistics

The descriptive analysis was done to represent the collected data for further interpretation. Pooled mean and pooled variance was estimated to represent the overall status of abundance of the species since the sampling unit consists of both replicated and repeated measures (Poudyal 2008).

$$\bar{\bar{x}} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2 + n_3\bar{x}_3 + \ldots\ldots\ldots\ldots\ldots + n_N\bar{x}_N}{n_1 + n_2 + n_3 + \ldots\ldots\ldots\ldots\ldots + n_N - N}$$

$$\sigma = \sqrt{\frac{\Sigma(x-\bar{x})^2}{N}}$$

Where,

n =Number of repeated measures in each station

$\bar{x}$ = Mean of each plot

$\bar{\bar{x}}$ = pooled mean or mean of the mean

σ = Standard deviation

3.3.1.1 Detection rate or encounter rate:

Detection rate or encounter rate of Cheer pheasant was calculated by summing the total number of recorded bird in transect and then dividing it by the total number of survey days (Subedi 2003).

$$\text{Entire detection rate} = \frac{\Sigma \text{ x (total no. of particular species recorded during the survey}}{\text{Total number of survey days}}$$

3.3.1.2 Breeding population Estimation (BPE)

The survey was conducted during breeding season so multiplying the number of calling sites detected before sunrise by factors of 0.75, because this produces the best available estimate of breeding population within the survey area (Young et al. 1987).

BPE= $\Sigma\bar{x}$ x 0.75

Where $\Sigma\bar{x}$ = Total mean of the study area.

3.3.1.3 Mean population density

The mean population density was estimated based on taking the mean number of calling birds divided by the total area covered in each station. The mean was a pooled mean estimate based on the formula given below. That estimate was then extrapolated for the entire population assuming that sex ratio of the species is 1:1(Subedi, 2003).

$$\text{Mean population density} = \frac{\text{mean number of calling birds in an area.}}{\text{Total area covered in each station.}}$$

3.4 Occupancy

Occupancy models in PRESENCE version 5.6 (Hines 2006) was used to determine if the site parameters, distance to the nearest village (m), and water sources, grazing intensity and elevation affected the probability that Cheer would be present at a survey point. Single species-single season occupancy model was used to estimate occupancy (Mackenzie et al. 2002, 2006) using method of maximum likelihood. Multiple models were run and the models were ranked and model weights calculated using Akaike's Information Criterion (AIC) (Burnham and Anderson, 2002). In a model set, the AIC weights sum to one for all members, and the weights represent measure of the appropriateness of a given model relative to other models in the model set.

3.5 Species distribution mapping

MaxEnt is a general-purpose algorithm for estimating a target probability distribution by finding the probability distribution of maximum entropy (i.e, closest to uniform) (Phillips et al., 2006). The algorithm was chosen for use in this study because it (1) has performed well when compared with other novel methods (Elith et al., 2006; Gibson et al., 2007; Pearson et al., 2007; Hernandez et al., 2008), (2) does not require absence data, and (3) allows for the incorporation of categorical information (that is, landcover). MaxEnt software v3.3.was used to prepare species distribution map. After the interpretation of data the output was classified into four habitat suitability categories as "Unsuitable or Poorly Suitable" (0-0.09), "Low" (0.1-0.39), "Medium" (0.4-0.59) and "High" (0.6-1) (Kumar and Stohlgren 2009). The Extent of Occupancy (EOO) as defined by IUCN (2001) was calculated using a threshold value of 0.5; above which the species is more likely to be present (Li et al. 1997, Manel et al. 1999). Areas for these parameters were calculated using Arc GIS 10.

4 RESULTS

4.1 Population status

A maximum of 32 calling Cheers were recorded during the study. Mean call records in the study area was 28 birds. The total number of breeding population was estimated to be 21. During the survey, five individuals of Cheer were seen in different stations. Detection rate for the entire population was estimated to be 0.42 birds/ station i.e. 1.49 birds/Km^2 .The highest number of Cheer call was recorded from Pakhathar, minimum number at station Nabithumko and none in station Gadikhola, Kandedanda and LumbaKharka (Fig. 4.1).

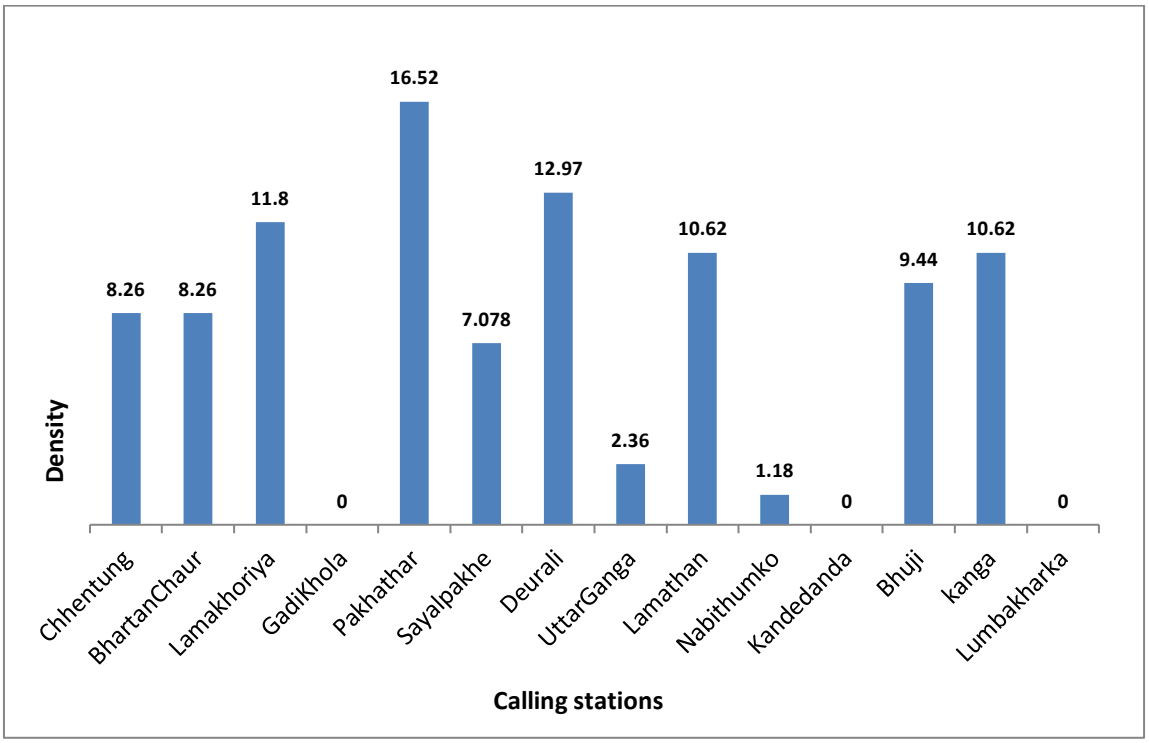
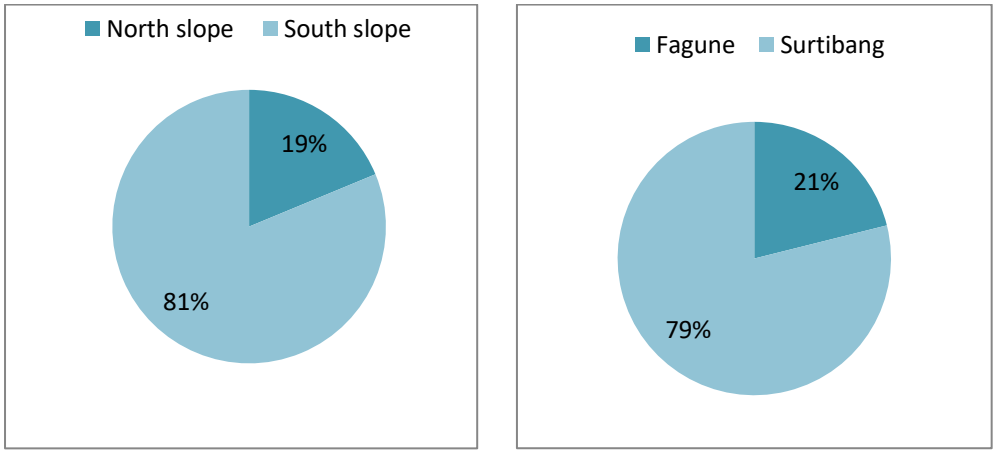


Fig. 4.1 Density of Cheer populations in each station

Based on the pooled mean and sampling radius of 300m, the mean population density of the species was 7.08 birds/km^2 and population density, at 95% confidence limit ranged between 6.79 birds/km^2 and 7.37 birds/km^2. The extrapolated total population size of the species was found to be 143-156 pairs.

The mean population density of the species in Surtibang block was 2.76 birds/km^2 whereas that of Fagune block was 10.32 birds/km^2 (Fig 4.1b). Out of 32 calling birds, 6 birds were heard in north facing slope whereas 26 birds heard in south facing slope (Fig 4.1a).



(a) **(b)**

Fig. 4.1 Percentage of Cheer density by slope (a) and by block (b)

4.1.1 Duration of call/ calling time

During the survey call of Cheer was found variable. Cheer call was heard early in the morning between 04.38 hr to 05.23 hr but birds gave call at 04.26 hr near Chhentung sites, another call recorded at 07.07 hours on the way to Lamakhoriya while returning from Chhentung calling station. One unusual call was recorded at the height of 3457 meter at 12:26 hr in Kanga area (Bokat site) but a single burst of calling couldn't be confirmed clearly. In most of the cases calling heard lasting less than 10 second but in some calling station continuous calling of Cheers was recorded lasting for more than 15 minutes.

4.2 Occupancy estimation

Eleven final models were run to estimate occupancy and detection probability of the Cheer. The naive occupancy estimate was found to be 0.7857. The null model psi(.), p(.) performed poorly as can be seen from the summary statistics ranked according to AIC value. The model psi(DW), p(.) had the highest level of support (ΔQAICc = <2.0) with highest weight (*wi*) which suggests that it was the best model in the set. The models

p(DW,ELEV), p(.) and psi(DW,DS),p(.) were also found to be strong candidates models (ΔAIC = <2.0) (Table 2). Top ranking model considered distance to water as most important covariate to determine the occupancy of the Cheer. Top ranked model showed a negative association (β=-1.99) for occupancy of the species and the distance to the water.

Table 1: Summary of probability of occupancy (psi) and detection (.) model selection results for Cheer pheasant in the Dhorpatan Valley.

Models	AIC	deltaAIC	AIC wgt	no.Par.
psi(DW),p(.)	33.61	0	0.4392	3
psi(DW,ELEV),p(.)	35.25	1.64	0.1934	4
psi(DW,DS),p(.)	35.58	1.97	0.164	4
psi(DW,DS,ELEV,GI),p(.)	36.11	2.5	0.1258	8
psi(.),p(.)	38.64	5.03	0.0355	2
psi(DS),p(.)	40.44	6.83	0.0144	3
psi(ELEV),p(.)	40.62	7.01	0.0132	3
psi(GI),p(.)	42.29	8.68	0.0057	5
psi(DS,ELEV),p(.)	42.41	8.8	0.0054	4
psi(DS,GI),p(.)	43.63	10.02	0.0029	6
psi(ELEV,GI),p(.)	48.26	14.65	0.0003	8

Codes: Occupancy rates (psi), Detection probability (p), Relative difference in AIC values compared to top ranked model (deltaAIC), AIC model weights (AIC wgt), Number of parameter (no. par), Constant (.), Distance to water (DW), Elevation (ELEV), Distance to settlements (DS), Grazing intensity (GI).

4.2.1 Covariates Weight

Distance to water showed greater weight (79.6%) in determining occupancy of the species for top models and 90% for all sets of model. Similarly, elevation also showed 19% in determining the occupancy of the species for the top models and 32.45% for all sets of models. Distance to water showed 16.40% in top model and 31.50% for all model grazing intensity didn't contribute on top model although 13.4% contribution on determining occupancy of the species for all set model (Table 2).

Table 2: Support for each covariate in top and all models.

	Distance to water	Elevation	Distance to Settlement	Grazing intensity
Top set	79.60%	19%	16.40%	-
All set	90%	32.45%	31.25%	13.47%

4.3 Habitat Suitability Distribution

Potentially suitable habitat for the species in Nepal was predicted with available data and Eco-geographical variables (EGVs). The omission rate is calculated both on the training presence records, and (if test data are used) on the test records. The graph plotted against specific threshold and omission (Fig. 4.4) showed a closer agreement with expected value for any threshold explaining the model fit.

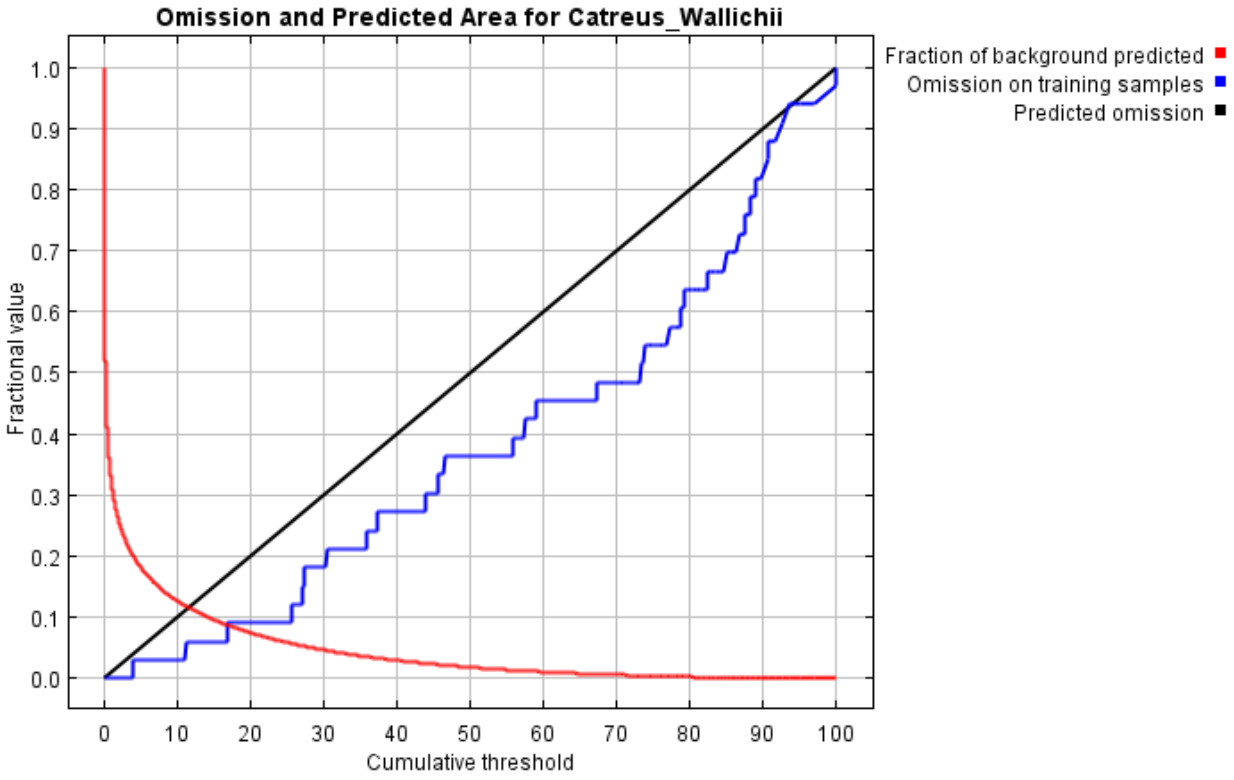


Fig. 4.4 AUC value for test and training data

For Area under Curve (AUC) under ROC (Receiver Operating Characteristics), sensitivity and 1-specificity were plotted against each other to assess the omission rate to

predicted fractional area. Curves for both training (AUC=0.975) and test (AUC=0.5) (Fig. 4.5) reported model fit.

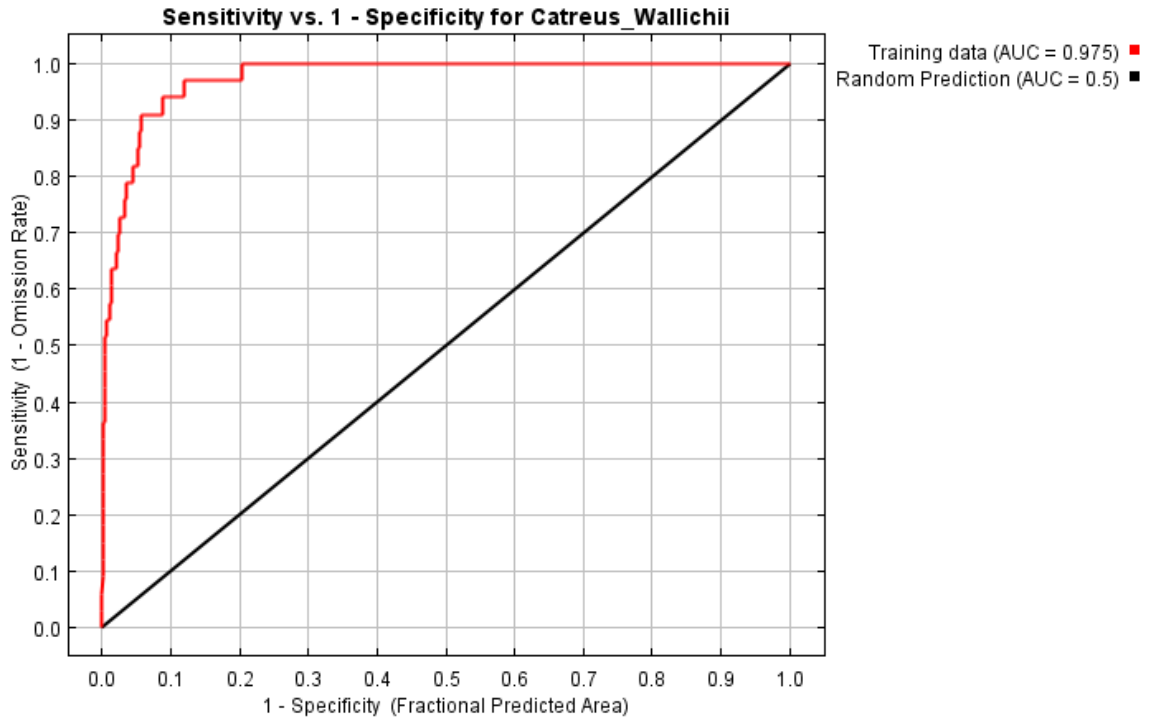


Fig.4.5 AUC value for test and training data.

The distribution of the Cheer in hilly and mountain region of Nepal was discontinuous. Hilly region of western, mid-western and far-western region covered mostly of highly suitable habitat. This consists of protected areas *viz.* Annapurna Conservation Area, Dhorpatan Hunting Reserve, Rara National Park, Shey-phoskundo National Park and Apinampa Conservation Area and moderate probable suitable habitat in Khaptad National Park. The modeling also predicts the patchy habitat occurred outside the protected areas. Some of the district like Baglung, Myagdi, Dolpa, Mustang Rukum, Mugu, Bajura, Jajarkot, Jumla, Kalikot, Humla, Kaski and Taplejung showed high and moderate probable areas. District like Dadeldhura, Darchula, Bajhang, Doti, Dadeldhura, Achham, Dailekh, Rolpa and Manang showed traces of high and moderate probable areas. Naturally fragmented small patches of highly suitable region were found in the eastern Nepal *i.e.* Kanchanjunga Conservation Area (KCA). Area between KCA and Kaligandai River basin showed unsuitability with some low suitable area in Kathmandu valley (Fig. 4.6).

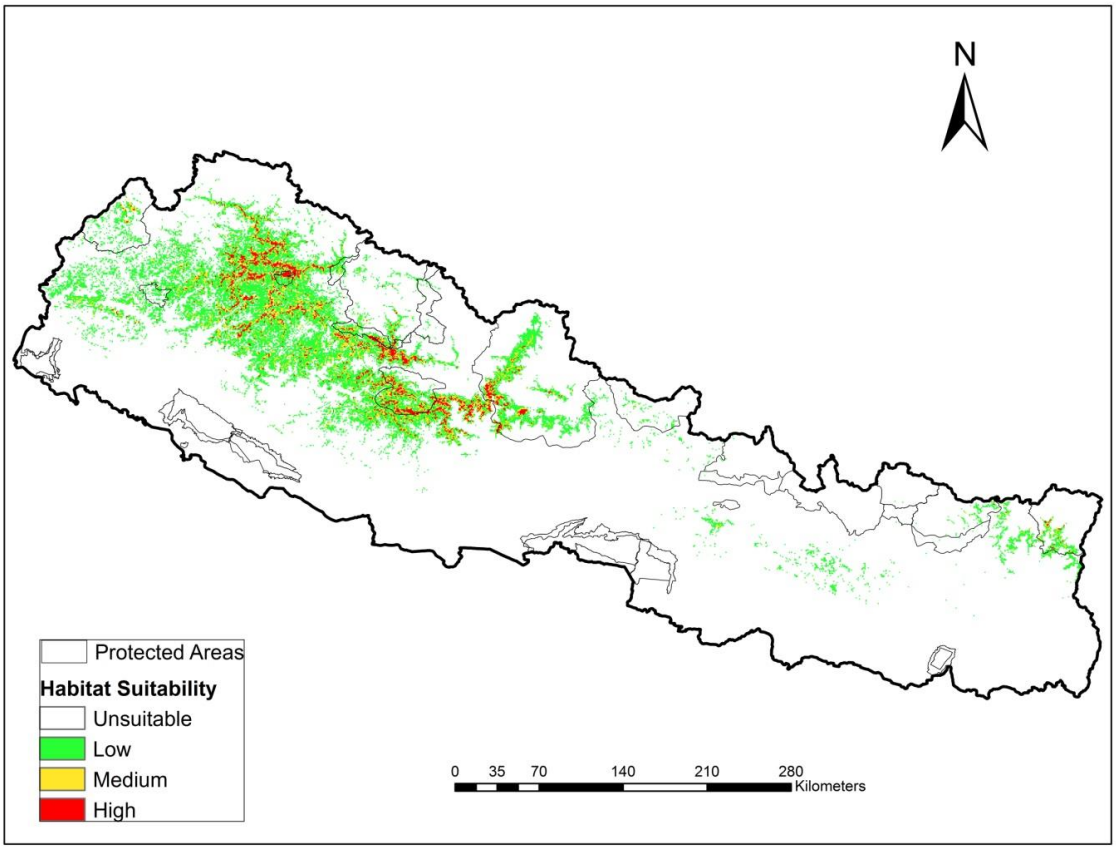


Fig. 4.6 Distribution of suitable habitats for Cheer pheasant in Nepal.

The highly suitable, moderately suitable, poorly suitable and unsuitable areas were approximately 1769Km^2, 3253 km^2, 15660 km^2 and 126458 Km^2 respectively.

Table 3: Percent Contribution of Environmental Variables in Distribution Modeling.

Environmental Variable	Percent contribution	Permutation importance
Altitude	23.9	0
bio19	20.4	16.4
Land-cover	12.7	10.4
bio11	10	0
bio3	8.9	9.4
bio14	8.4	12.6
bio6	4	28.5
Aspect	3.1	5.1
Slope	1.7	1.4
bio13	1.5	0
bio16	1.4	5.7
bio15	1.2	1
bio12	1.1	2.9
bio18	0.8	4.9
bio1	0.7	0
bio4	0.1	0

(bio19= Precipitation of Coldest Quarter, bio11= Mean Temperature of Coldest Quarter, bio3= Isothermality (P2/P7)*(100), bio14= Precipitation of Driest Month bio6=Min Temperature of Coldest Month, bio13 =Precipitation of Wettest Month, bio16 =Precipitation of Wettest Quarter, bio15 =Precipitation of Seasonality, bio12 =Annual Precipitation, bio18 =Precipitation of Warmest Quarter, bio1 = Annual Mean Temperature, bio4 =Temperature Seasonality)

5 DISCUSSION

5.1 Population status

Results of this study revealed that the overall density of Cheer is 7.08 pairs/ km^2 in the Dhorpatan valley. This estimate is lower than the Cheer density estimated in 2003 for Dhorpatan valley 10.75 birds/km^2 (Singh et al. 2011). Comparable density is reported from Bobang (8pairs/km^2) and Muri (7.5 pairs/km^2) in the Buffer Zone (Singh et al. 2011). Cheer density is estimated to be 2 pairs/ km^2 in Rara National Park (Singh, 2009) and 4 pairs/ km^2 (Acharya, 2004) and later Subedi (2009) reported 1 pair/ km^2 in Kaligandaki Valley of Annapurna Conservation Area. Comparing previous Cheer survey of Nepal, due to more potential suitable area Dhorpatan valley still supports the highest known population of Cheer.

Comparing 13 call count stations with Subedi, 2003 overall population density is estimated to be 10.75 birds/ km^2 whereas this study revealed only 6.81 birds/km^{2}in population density in the Dhorpatan valley. Current study of Cheer in Dhoraptan Valley showed evidence of significant decline (36.7%) in their population and even disappearance from some previously recorded sites. Main reason behind the decline is due to snaring, hunting, over grazing and habitat destruction. Decline of Cheer population is also recorded from different location, marginal decline of Cheer also observed in Dhorpatan valley (Subedi 2003), RNP (Subedi 2009) and decline in number in Ghasa area (BirdLife International, 2015). Decline of Cheer population also recorded in Jhelum valley (Awan 2011), Himachal Pradesh (Birdlife international 2015), Majathal Wildlife Sanctuary (Subedi 2003) and even disappeared from Salkhala Game Reserve (Awan et al. 2012). In Dhorpatan valley, the major population decline in all survey plots except Kanga, Bhuji and Uttarganga where population density is slightly increased. Significant population decline has been observed in Kandedanda area where a population density of 18.4 per km^2 is estimated in 2003 but no calls has been heard from same call survey point and Lamathan where 17.69 birds/km^2 were recorded now it estimated only 1.18 birds/km^2. Similarly, a decline of around 50% has been recorded from Chhentung and Bartanchaur area (Fig. 5.1).

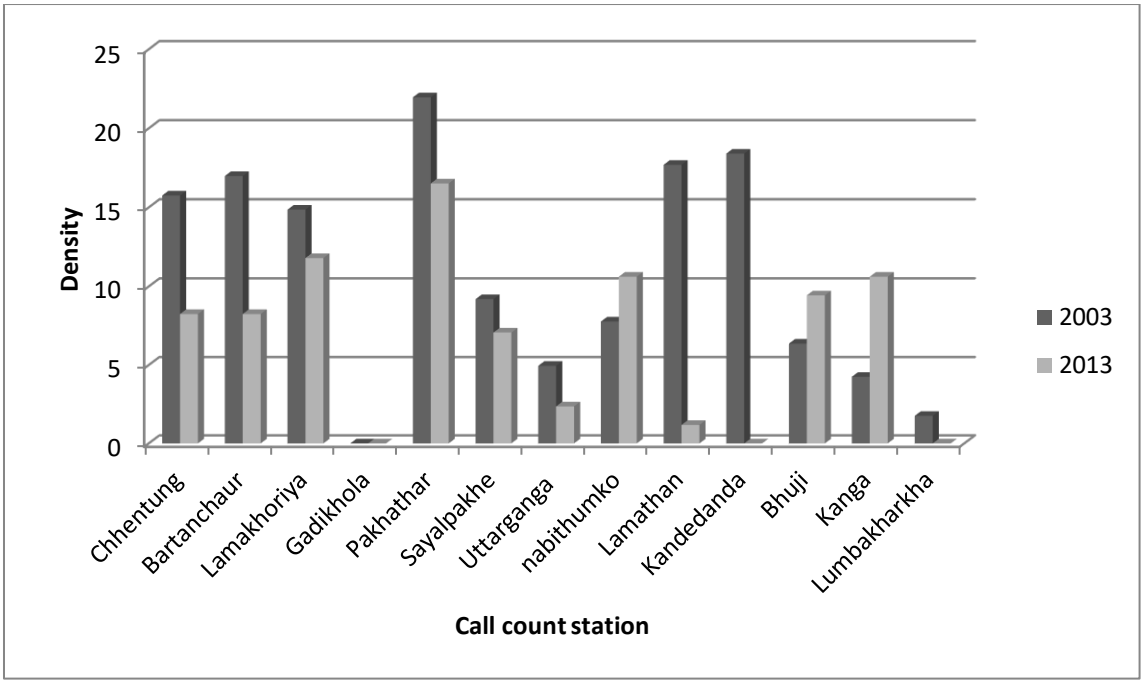


Fig. 5.1 Comparing the Cheer density between 2003 and 2013.

Out of the 32 Cheer calls, 6 were heard in north facing slope whereas 26 call heard in south facing slope indicating south facing slope support more suitable habitat of Cheer in Dhorpatan valley. The south facing slope characterized by sunny area mixed with most of the grassland, shrubs and sparse trees, scattered tree and grassland, sometimes broken rocks are the area (Subedi, 2003) which was also observed in Kanshian valley (Zaman 2008).

Ali & Ripley (1983) reported that Cheer gives sporadic and irregular calls throughout the day especially during dawn and our survey also confirmed that it gives call during the morning between 0438hr to 0523hr and sometime even heard in late morning, mid day which is also reported by previous researches working on Cheer. From the timing of Cheer calling it can be said that down call counting method is best method of surveying the Himalayan pheasant's species.

5.2 Occupancy

Occupancy modelling revealed that, the Cheer primarily associated with water and increases in occupancy as distance to water increases, but Singh et al. (2011) in Dhorpatan valley reported there is no evidence of correlation between the presence of Cheer and distance to water. Result of the study clearly revealed that the occurrence of Cheer was independent of elevation which has been also supported result of Jolly et al. (2012) in Great Himalayan National Park Conservation Area (GHNPCA). This could be due to the range of elevations surveyed may not be wide enough to find a patterns. However, the human disturbance (distance to human settlement) and grazing intensity were not important covariate to determine the occupancy of Cheer in the Dhorpatan valley. The result was consistent with the result of Singh et al. (2011) in the Dhorpatan valley but difference with Kaul (1989) and Jolly et al. (2011). The study shows that distance to settlement and distance to water additive model has greater weight to explain occupancy of Cheer in study area but both variables were not used in other studies. These studies (Kaul 1989, Jolly et al. 2011) alternatively showed greater importance to the variables used in the corresponding study unaware other fact that these variables may have additive response to Cheer occupancy. Due to small study area and difficult geographical location, livestock grazed per unit area was not fully recorded so the result may be difference with the other studies.

5.3 Habitat Suitability Distribution

The Habitat Suitability Model (HSM) predicted habitat of Cheer at a landscape level. The highly suitable area of Cheer was only 1.20 % of the total area of Nepal. The map also clearly showed that western Nepal support potential habitats of Cheer pheasant. It is almost restricted to the Kaligandaki river basin of Nepal which is also supported by Inskipp and Inskipp (1991). Species distribution model showed that some of district like Kalikot, Jajarkot, Rolpa, Manang and Dailekh, where Cheer has not been recorded yet, are highly suitable habitat for Cheer. This is also supported by the Birdlife international (2014) facts that in some part of western Nepal Cheer has been identified but not studied yet. The model sufficiently predicts DHR is most important area of Cheer which is supported by the Garson and Baral 2007. Study further suggest that RNP along with

southern part of Dolpa and Humla district and northern part of Bajura district are also found as important Cheer areas in Nepal. The model also predicted the distribution of the species in eastern region i.e. Kanchanjunga Conservation Area (KCA) (Fig. 5.2). Good quality of Pheasant habitat was observed in several forests in KCA (Inskipp et al. 2008). Although potential suitable area as predicted by the MaxEnt model in KCA but very less area is available for the population persistence so colonization within these areas is minimal. Some area of Kathmandu valley also showed the poorly suitable area. The main reason for the prediction may be due the similar altitude, precipitation and land cover (Table 3). The present study suggested that in Nepal 23 district are suitable for the species. All hilly and mountainous protected area west to Kaligandaki River is suitable habitat of Cheer in Nepal.

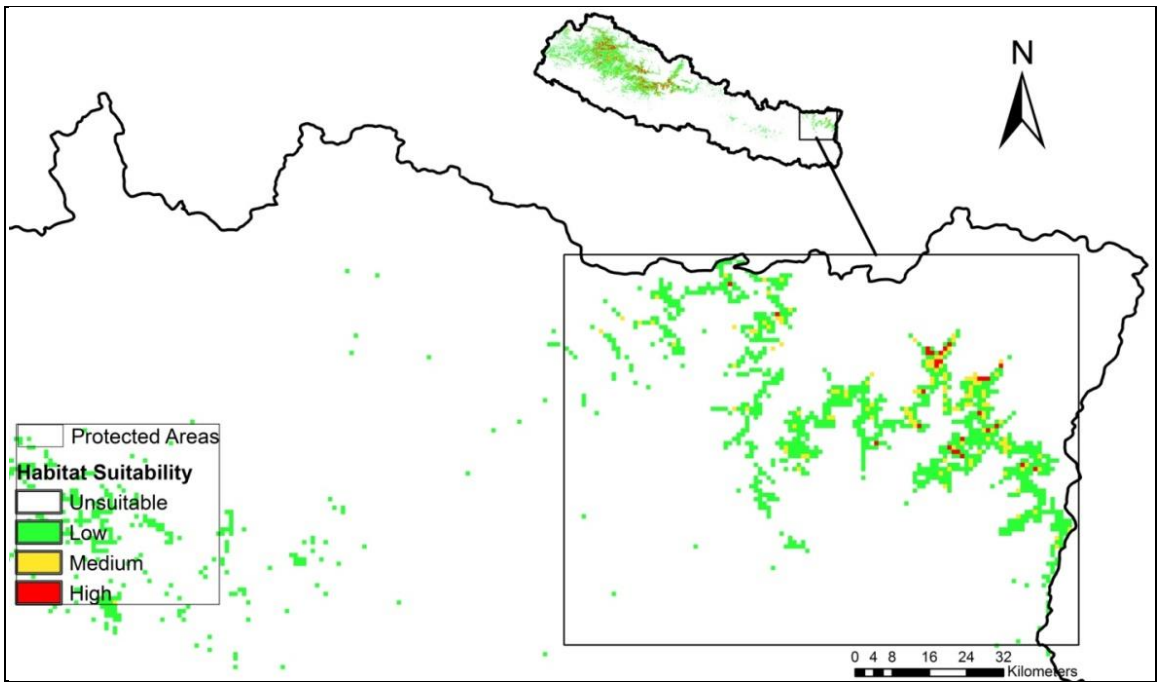


Fig. 5.2 Species distribution modeling predicting the Eastern distribution of Cheer pheasant.

6 CONCLUSION AND RECOMMENDATION

Significant decline in Cheer density was observed in Dhorpatan Valley. Despite of the considerable decline in Cheer density, Dhorpatan valley still supports good number of Cheer. South facing slope and Fagune block are more potential area for the Cheer in the Dhorpatan valley.

Occupancy of the Cheer pheasant was determined principally by distance to water in the study area. Significant AIC weight of interaction between distance to water and elevation; distance to water and distance to settlement was found.

This study provided the first detailed map of Cheer pheasant habitat suitability throughout Nepal. An easy-to-interpret output that provided potential distribution of the species in Nepal for a poorly studies species was prepared which indicated very few suitable habitats of total area for the species occurrence in Nepal. Twenty-three districts have potential suitable habitat for the Cheer mostly occurring in patchy habitat of western region.

Based on this study, important recommendations for the conservation of Cheer are as follows:

- Dhorpatan valley is one of the important areas for Cheer conservation so, regular monitoring the population will be crucial to achieving the conservation goal with protection from hunting and overgrazing, reinstatement of guard posts and patrolling of Cheer habitat.
- Scientific study should be done on habitat use, fires, grazing intensity and hunting pressure on Cheer habitats and various ecology of Cheer. Research should be conducted on the causes of decline of Cheer so that actual causes can be addressed properly. Species need to be uplisted to Endangered categories due recent decline within suitable habitat, hunting, snaring pressure and small fragmented habitat suggested by species distribution modeling.

- Potential areas should be surveyed to verify its presence. The modeling shows highly potential area in eastern Nepal so survey of Cheer is recommended in Eastern Nepal as no survey have been carried out to date and

- Conservation awareness education should be done for park staffs, local people and Sheppard's. Community based conservation program outside the protected area within predicted range will promote connectivity among suitable patches.

REFERENCES

Acharya, R. 2004. Survey of Cheer Pheasant in Lower Kaligandaki Valley, Mustang Nepal. A final report submitted to King Mahendra Trust for Nature Conservation (KMTNC), Annapurna Conservation Project, World Pheasant Association, UK and School of Environmental Science and Sustainable Development, Nepal.

Acharya, R. 2006. Does Cheer Pheasant *Catreus wallichii* exist east of Kaligandaki Valley, Nepal? Danphe **15**: 7-8.

Acharya, R., Thapa, S. and Ghimire, Y. 2006. Monitoring of Cheer pheasant *Catreus wallichii* in Lower Kaligandaki Valley, Mustang, Nepal. Unpublished Report submitted to Annapurna Conservation Area Project, Pokhara, Nepal.

Ali, S. and S.D. Ripley, 1968-1998. Handbook of the Birds of India and Pakistan. Bombay: Oxford University Press.

Augustin, N.H., Cummins, R.P. and French, D.D. 2001. Exploring vegetation dynamics using logistic regression and multinomial logit model. Journal of Application Ecology **38:** 991–110.3

Awan, M. N. 2011. Monitoring and conservation of Cheer Pheasant in Jhelum Catchments, Pakistan. Unpublished final report submitted to the Rufford Small Grants Foundation, UK.

Awan, M. N., Ali, H. and Lee, D. C. 2012. An annotated checklist of birds and conservation issues in Salkhala Game Reserve, an isolated Important Bird Area in Azad Kashmir, Pakistan. Forktail **28**: 38-43.

Awan, M. S., Khan, A. A., Ahmed, K. B., Qureshi, M. A. and Dar, N. I. 2004. First Breeding and Nidification record of Cheer pheasant *Catreus wallichii* in Jhelum Valley, Muzaffarabad, Azad Kashmir, Pakistan. Journal of Biological Sciences **4**: 304-308.

Baker, E.C.S., 1921-1930. Fauna of Britich India, Birds. Game birds of India, Burma and Ceylon. London: John Bell annd Edn. And Vols. Taylor and Francis, London.

Baral, H. S., Gurung, P. C., Kaul, R. and Ramesh, K. 2001. Santel Galliformes survey: a possible extension of Pipar Pheasant Reserve, Annapurna Conservation Area, central

Nepal. Report to the World Pheasant Association (UK) and Annapurna Conservation Area Project (Nepal). Unpublished. 22pp.

Bhuju, U.R., Sakya, P. R., Basnet, T. B. and Shrestha, S. 2007. Nepal Biodiversity Resource Book- Protected Areas, Ramsar Sites, and World Heritage Sites, ICIMOD; MoEST-GoN, Kathmandu, Nepal, 128 pp.

BirdLife International 2014. Species factsheet: *Catreus wallichii*. Downloaded from http://www.birdlife.org on 28/12/2014.

BirdLife International 2015. Species factsheet: *Catreus wallichii*. Downloaded from http://www.birdlife.org on 17/01/2015.

Boitani , L. , Maiorano , L. , Baisero , D. , Falcucci , A. , Visconti , P. and Rondinini , C . 2011. What spatial data do we need to develop global mammal conservation strategies? Phil. Trans. R Soc. B-Biological Science **366**: 2623 – 2632 .

Budha, P. B. 2006. The Cheer Pheasant *Catreus wallichii* (Hardwicke, 1827) and indigenous hunting techniques in mid and far west Nepal. Danphe **15**: 2-3.

Budhathapa, B. 2006. Status and distribution of Cheer Pheasant *Catreus wallichii* in Rara National Park. Report to World Pheasant Association, UK and Oriental Bird Club, UK. Unpublished.

Budhathapa, B. 2007. Status and distribution of Cheer Pheasant *Catreus wallichii* in Rara National Park. Report to World Pheasant Association, UK and Oriental Bird Club, UK. Unpublished. 20 pp.

Burnham, K. P. And Anderson, D.R. 2002. Model selection and inference: a practical information theoretic approach. Springer, New York, United States of America.

Del Hoyo, J., Elliott, A. and Sargatak, J. (eds.) 1994. Handbook of the Birds of the World. Vol.2. New World Vulture to Guineafowl. Barcelona: Lynx Edicions.

Delacour, J. 1977. The Pheasants of the World. Second Edition, Spur, Liss.

DNPWC 2006. Brochure of Dhorpatan Hunting Reserve. Babarmahal Kathmandu: Department of National Park and Wildlife Conservation (DNPWC).

Dobremez and Jeest 1971. Carte ecologique du Nepal, Region Annapurna- Dhaulagiri 1:250,000. Doc. Carte Veg. Alpes IX: 147-190.

Donovan, T.M. And Hines, J. 2007. Exercises in occupancy modeling and estimation. http://www.uvm.edu/envnr/vtcfwru/spreadshe ets/occupancy.htm.

Duke, G. 1990. Using call counts to compare western tragopan populations in Pakistan's Himalaya. In Pheasants in Asia 1989 (eds D.A. Hill, P.J. Garson, and D. Jenkins), pp. 116-123. World Pheasant Association, Reading, U.K.

Elith J., Graham C. H., Anderson R. P., Dudik M., Ferrier S., Guisan A., et al. 2006. Novel methods improve prediction of species' distributions from occurrence data. Ecography **29**: 129-151.

European Space Agency, 2008. GlobCover Land Cover v2 2008 database. European Space Agency GlobCover Project, led by MEDIAS-France. http://ionia1.esrin.esa.int/index.asp accessed on 28 January 2015.

Finn, F., 1902. Indian Pheasants and their Allies. Ind. For., **28**: 221-230

Fleming, R. L. Sr 1976. May trek to the Annapurna Range. Nepal Nature Conservation Society Newsletter No. 32, August 1976.

Garson, P and Baral, H. S. 2007. Cheer Pheasant conservation summit in Kathmandu. Danphe 16(1): 24-25. http://www.birdlifenepal.org/publication.php

Garson, P. 1998. Conservation of Galliformes in Great Himalayan National Park: A review of monitoring and research activity, Final Report: Forestry Research Education and Extension Project - Great Himalayan National Park. Wildlife Institute of India, Dehradun. http://www2.wii.gov.in/envis/ghnpr eports/6_28_garson.pdf.

Garson, P.J. 1983. The Cheer pheasant *Catreus wallichii* in Himachal Pradesh, western Himalayas: an update. Journal of the World Pheasant Association **8:** 29-39.

Garson, P.J., L. Young and R. Kaul, 1992. Ecology and conservation of the Cheer pheasant *Catreus wallichii*: Studies in the wild and the progress of a reintroduction project. Biological Conservation. **59**: 25-35.

Garzon, M. B., Blazek, R., Neteler, M., Dios, R.S., Ollero,H.S. and Furlanello, C. 2006. Predicting habitat suitability with machine learning models: The potential area of Pinus sylvestris L. in the Iberian Peninsula. Ecological modelling 197: 383–393

Gaston, A. J., and J. Singh. 1980. The status of the Cheer Pheasant *Catreus wallichii* in the Chail Wildlife Sanctuary, Himachal Pradesh. Journal of World Pheasant Association **5**: 68-73.

Gaston, A.J. and Garson, P.J. 1992. A re-appraisal of Great Himalayan National Park. Report of Himachal Wildlife Project-III.

Gaston, A.J. and J. Singh, 1980. The status of the Cheer Pheasant *Catreus wallichii* in the chail wildlife sanctuary, himachal ehavio. World Pheasant Association Journal **5**: 68-73.

Gaston, A.J., Hunter, M.I. and Garson, P.J. 1981. The Wildlife of Himanchal Pradesh,Western Himalayas. U. Marine School of Forest Res. Tech., Note, 82: 159.

Ghimirey, Y. 2011. Birds recorded in Humla District in December 2011. Unpublished report summited to World Pheasant Association.U.K.

Gibson, L. Barrett, B. and Burbidge, A. 2007. Dealing with uncertain absences in habitat modeling: a case study of a rare ground-dwelling parrot. Diversity and Distribution. **13**: 704-713.

Grimmett, R, C. Inskipp and T.Inskipp. 2000. Birds of Nepal. Prakash Books Depots, New Delhi, India.

Grimmett, R., Inskipp, C. and Iinskipp, T. 1998. Birds of the Indian Subcontinent. London: Christopher Helm.

Guisan, A. and Zimmermann, N. E. 2000. Predictive habitat distribution models in ecology. Ecological Modelling, **135**(2–3):147−186.

Guisan, A., Weiss, S.B., Weiss, A.D., 1999. GLM versus CCA spatial modeling of plant species distribution. Plant Ecology **143**: 107–122.

Hernandez P.A., Franke, I., Herzog, .S.K, Pacheco, V., Paniagua, L., Quintana, H.L., Soto, A., Swenson, J.J., Tovar, C., Valqui, T.H., Vargas, J. and Young, B.E. 2008.

Predicting species distributions in poorly-studied landscapes. Biodiversity Conservation. **17**: 1353-1366.

Hernandez, P. A., Graham, C. H., Master, L. L. and Albert D. L. 2006. The effect of sample size and species characteristics on performance of different species distribution modelling methods. Ecography **29**: 773-785.

Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G. and Jarvis, A. 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology **25**: 1965-1978. http:/ www.worldclim.org. Accessed on 15 January 2015.

Hines, J. E. 2006. PRESENCE v2.2 software to estimate patch occupancy and related parameters. USGS-PWRC. http://www.mbrpwrc.usgs.gov/software/presence.html.

Hirzel, A.H., Hausser J., Chessel D. and Perrin N. 2002. Ecological-niche factor analysis: How to compute habitat-suitability map without absence data. Ecology **83**: 2027-2036.

Hirzel, A.H., Lay, G.L., Helfer, V., Randin and Guisan, G. 2006. Evaluating the ability of habitat suitability models to predict species presences. Ecological modelling **199**: 142–152.

HMG/N 1973. The National Park and Wildlife Conservation Act 2029. Nepal Gazette 2029/11/28 as amended in 1974, 1982, 1989 and 1973. Kathmandu, Nepal: Ministry of Law and Justice, HMGN.

Howman, S. & Garson, P.J. 1993. Pheasant survey at Pipar Nepal (1979-91). Abstract in Pheasants in Asia 1992 (ed D. Jenkins). World Pheasant Association. Reading. UK.

Inskipp, C. and Inskipp, T. 1991. A guide to birds of Nepal. Second Edition. London: Christopher Helm.

Inskipp, C., Inskipp, T. Winspear, R., Collin, P., Robin, A., Thakuri, J. and Pandey, M. 2008. Survey of Kanchanjunga conservation area, April 2008. Kathmandu, Nepal and Sandy, UK. Bird Conservation Nepal and Royal Society for protections of Birds.

IUCN Red List of Threatened Species. Ver 2009.1. www.iucnredlist.org. (Downloaded on 26 December 2014).

IUCN, 2001. IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission, IUCN, Gland and Cambridge.

Jarvis, A., H.I. Reuter, A. Nelson, E. Guevara, 2008, Hole-filled SRTM for the globe Version 4, available from the CGIAR-CSI SRTM 90m Database (http://srtm.csi.cgiar.org).

Jolli, V., A. Srivastav, and S. Thakur 2011. Patch occupancy for Cheer pheasant *Catreus wallichii* in the Great Himalayan National Park Conservation Area. International Journal of Galliformes Conservation **2**: 74–81.

Kalsi, R.S. 1999. Status and habitat of Cheer pheasant *Catreus wallichii* in Himachal Pradesh. World Pheasant Association, South Asia Regional Office, New Delhi.

Kandel, K. 2013. Distribution and Occupancy modelling of globally threatened Cheer pheasant *Catreus wallichhi* in Western Nepal: Implications for strategic conservation planning. Report submitted to the Rufford Foundation. Unpublished.

Kandel, R. 2000. Status Paper of Dhorpatan Hunting Reserve. In Camile, R., Basnet, K., SAH, J.P. and RAUT, Y. (Eds.) Grassland Ecology and Management in Protected Areas of Nepal. pp. 137-145.Kathmandu: DNPWC, ICIMOD and WWF-Nepal.

Kaul, R. 1989. Ecology of the Cheer pheasant *Catreus wallichii* in Kumaon Himalaya. Unpublished Ph.D. thesis. University of Kashmir, Srinagar.

Kaul, R. and S, Shakya. 1998. A wildlife survey of the pipar sanctuary, Central Nepal, 28 April- 5 May 1998. Unpublished report to World Pheasant Association, Reading, UK.

Khaling, S., Kaul, R. and Saha, G.K. 1998. Survey of the *Tragopan satyra* in the Singhalila National Park, Darjeeling, India using spring call counts. Bird Conservation International **9**: 361-371.

Khan A.S., Awan M.S., Ahmad K.B., Dar I.D. 2006. Distribution and population status of Cheer Pheasant *Catreus wallichii* in Phalla Game Reserve, District Bagh, Azad Kashmir, and Kashmir, Pakistan. Pakistan Journal of Biological Sciences **9**: 810-815.

Kumar, S. and Stohlgren, T.J. 2009. MaxEnt modeling for predicting suitable habitat for threatened and endangered tree Canocomyrica monticola in New Caledonia. Journal of Ecology and Natural Environment **1**: 94-98.

Lehman, A., Overton, J.M. and Leathwick, J. R. 2002. GRASP: generalized regression analysis and spatial prediction. Ecological Modelling **157**: 189-207.

Lelliott, A.D. 1981. Survey of Cheer pheasant near Dhorpatan west Nepal 1981 In C.D.W. SAVAGE and M.W. RIDLEY (eds.) Pheasants in Asia 1982. pp. 58-61.

Li, W., Wang, Z., Ma, Z. and Tang, H., 1997. A regression model for the spatial distribution of red-crown crane in Yancheng Biosphere Reserve, China. Ecological Modelling **103**: 115–121.

Luoto, M., Poyry, J., Heikkinen, R.K., Saarinen, K., 2005. Uncertainty of bioclimate envelope models based on the geographical distribution of species. Global Ecology Biogeography **14**: 575–584.

MacKenzie, D. I., J. D. Nichols, G. B. Lachman, S. Droege, J. A. Royle, and C. A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology **83**: 2248–2255.

Mackenzie, D. I., Nichols, D. J., Royle, J. A., Pollock, K. H., Bailey, L. L. And Hines, J. E. 2006. Occupancy estimation and modeling. Academic Press, Burlington, United States of America.

Mahato, N.K., Poudyal, L.P., Subedi, P. and Singh, P.B. 2006. 2005 spring survey of Galliformes in the Pipar Reserve and of Santel, Annapurna Conservation Area, Central Nepal: a World Pheasant Association Report. World Pheasant Association, Fordingbridge, UK.

Manel, S., Dias, J.M., Buckton, S.T. and Ormerod, S.J. 1999. Alternative methods for predicting species distributions: an illustration with Himalayan river birds. Journal of Applied Ecology **36**: 734–747.

Miller, J. 2010. Species distribution modelling. Geography Compass **4**: 490-509.

Mirza, Z.B., 1980. Status of the Pheasants in Pakistan. In: Pheasants in Asia 1979, Savage, C. (Ed.). World Pheasant Association, Exning Road, UK., pp: 27-28.

Murray, J.A., 1889. The Edible and Game Birds of British India with its Dependencies and Ceylon. Trubner, London.

Pearson RG, Raxworthy CJ, Nakamura M. and Peterson, A.T. 2007. Predicting species distributions from small numbers of occurrence records: a test case using cryptic geckos in Madagascar. Journal Biogeogrography **34**: 102-117.

Pearson, R.G. 2010. Species' Distribution Modeling for Conservation Educators and Practitioners. Lessons in Conservation **3**: 54-89.

Phillips SJ, Anderson RP, Schapire RE 2006. Maximum entropy modeling of species geographic distributions. Ecological Modeling **190**: 231-259.

Phillips SJ, Dudik M 2008. Modeling of species distributions with MaxEnt: new extensions and a comprehensive evaluation. Ecography **31**: 161-175.

Picozzi, N. 1984. An ecological survey of a proposed reserve for Himalayan pheasants at Pipar, Nepal in November 1983. A report to the World Pheasant Association (UK). Unpublished.

Poudyal, L.P. 2008. Distribution and Habitat Use of Pheasants in the Headwater Forests of Setikhola, Annapurna Conservation Area, Nepal. Master's Thesis to the Tribhuvan University-Institute of Forestry, Nepal.

Ramesh, K., Sathyakumar, S and Rawat, G. S. 1999. Ecology and conservation status of pheasants of the Great Himalayan National Park, Western Himalaya. Report submitted to Wildlife Institute of India pp 85.

Roberts, J. O. M. 1980. Nepal (2) status of the pheasants of Nepal. Pp. 22-26 in C. Savage, ed., Pheasants in Asia 1979. Exning, U.K.: World Pheasant Association.

Roberts, T.J. 1991.A supplementary note in Khar Pakistan. Oriental Bird Club Bull **14**: 35-37

Sathyakumar, K., Kaul, R. and Kalsi, R. 2007. Techniques for monitoring Galliformes in India. Galliformes of India **10**: 177-179.

Seoane, J., Vinuela, J., D´ıaz-Delgado, R., Bustamante, J., 2004. The effects of land use and climate on red kite distribution in the Iberian peninsula. Biological Conservation **11**: 401–414

Singh, P. B. 2007. Survey of Cheer Pheasant *Catreus wallichii* in and around Dhorpatan Hunting Reserve, western Nepal. Birding ASIA 8: 7.

Singh, P. B. 2009. Cheer Pheasant in peril in Rara National Park, Nepal. World Pheasant Association News: 4.

Singh, P. B. 2009b. Cheer pheasant in peril in Rara National Park, Nepal. The International Newsletter of World Pheasant Association 83. Fordingbridge, UK: World Pheasant Association.

Singh, P. B. and K. C., S. 2008. Study on Cheer Pheasant *Catreus wallichii* in Botamalika grassland, Rara National Park and Buffer Zone, Mid-Western Nepal, April-September 2008. Report to Pheasant Specialist Group UK, World Pheasant Association and Oriental Bird Club. Unpublished. 35 pp.

Singh, P. B., Paudel, L., and Sharma, S. 2006. Survey of Cheer pheasant *Catreus wallichii* in and around Dhorpatan Hunting Reserve, Western Nepal.

Singh, P. B., Subedi, P., Garson, P. J. and Poudyal, L. 2011. Status, habitat use and threats of Cheer pheasant *Catreus wallichii* in and around Dhorpatan Hunting Reserve, Nepal International Journal of Galliformes Conservation **2**: 22-30.

Stockwell, D.R.B. and Peters D.P. 1999. The GARP modelling system: Problems and solutions to automated spatial prediction. International Journal of Geographical Information Systems 13: 143-158.

Subedi, P. 2003. Status and Distribution of Cheer pheasant *Catreus wallichii* in Dhorpatan Hunting Reserve, Nepal. Unpublished research report submitted to Institute of Forestry, Pokhara for the partial fulfilment of the requirement of B.Sc Forestry Degree.

Subedi, P. 2009. Monitoring of Cheer Pheasant (*Catreus wallichii)*Conservation/Annapurna Conservation Area Project Unit Conservation Office, Jomson, Nepal. Unpublished. 34pp.) in Kaligandaki river valley, Mustang District, Nepal. A report to National Trust for Nature.

Subedi, P. 2013. Struggling Cheer Pheasant: a re-visit survey in the Kaligandaki valley, Nepal. Ibisbill **2**: 66-74.

Thakuri, J. J. 2012. Cheer Pheasant report, Rara National Park buffer zone April-May 2012. Preliminary report submitted to the Rufford Foundation. Unpublished.

Thakuri, J. J. and Prajapati, A. 2012. An ornithological survey of Api Nampa Conservation Area, Nepal. Report submitted to Api Nampa Conservation Area, Darchula, Nepal. 40 pp.

Whistler, H., 1926. Birds of the Kangra District. Ibis, **12**: 521-581

Yadav, B.P. 2007. An Assessment of Asiatic Black Bear (Ursus Thibetanus) – Human Conflicts at Dhorpartan Hunting Reserve, Nepal. Unpublished Report submitted to Rufford foundation U.K.

Yonzon, P.B. 1987. Nepal-Himalaya pheasant surveys at Pipar, Machhapuchare. In Pheasants in Asia 1982.(eds C.D.W. SAVAGE and M.W. RIDLEY), PP. 55-57. World Pheasant Association, Reading, UK.

Young, L., Garson, P.J. and Kaul, R. 1987. Calling behaviour and social organization in the Cheer pheasant: Implications for survey technique. Journal of World Pheasant Association. **12**: 30-43.

APPENDICES

1. Maximum numbers, standard deviation, mean density of Cheer in each call survey station.

S.N	Name of Station	Repd. time	Day 1	Day 2	Day 3	Max. call heard	Cheer seen	Mean	SD	mean density/km^2
1	Chhentung	3	2	3	2	3	0	2.33	0.57	8.25
2	BhartanChaur	3	1	3	3	3	1	2.33	1.15	8.25
3	Lamakhoriya	3	3	3	4	4	0	3.33	0.57	11.79
4	GadiKhola	3	0	0	0	0	0	0	0	0
5	Pakhathar	3	5	4	5	5	2	4.66	0.57	16.51
6	Sayalpakhe	3	2	2	2	2	0	2	0	7.077
7	Deurali	3	4	3	4	4	0	3.66	0.57	12.97
8	UttarGanga	3	0	1	1	1	0	0.66	0.57	2.35
9	Lamathan	3	3	3	3	3	0	3	0	10.61
10	Nabithumko	3	1	0	0	1	0	0.33	0.57	1.17
11	Kandedanda	3	0	0	0	0	0	0	0	0
12	Bhuji	3	3	2	3	3	2	2.66	0.57	9.43
13	Kanga	3	3	3	3	3	0	3	0	10.61
14	Lumbakharka	3	0	0	0	0	0	0	0	0
		42				35		28	5.19	

2. Comparison of mean Cheer heard in six calling station on three survey period in Dhorpatan Valley.

Name of station	1981		2003		2013	
	No of Cheer heard	No. of Cheer seen	No of Cheer heard	No. of Cheer seen	No of Cheer heard	No. of Cheer seen
Sayalpakhe	7	4	5	0	2	0
Nabi Thumko	11	7	5	0	1	0
Kande Danda	5	2	7	2	0	0
Lamathan	8	2	7	0	3	0
Lumbakharka	0	0	0	0	0	0
Kanga	0	0	2	0	3	0
Dhankali	1	0	0	0		
Dija Lumba	0	0	0	0		

3. Distance between water sources and human settlement from the survey point.

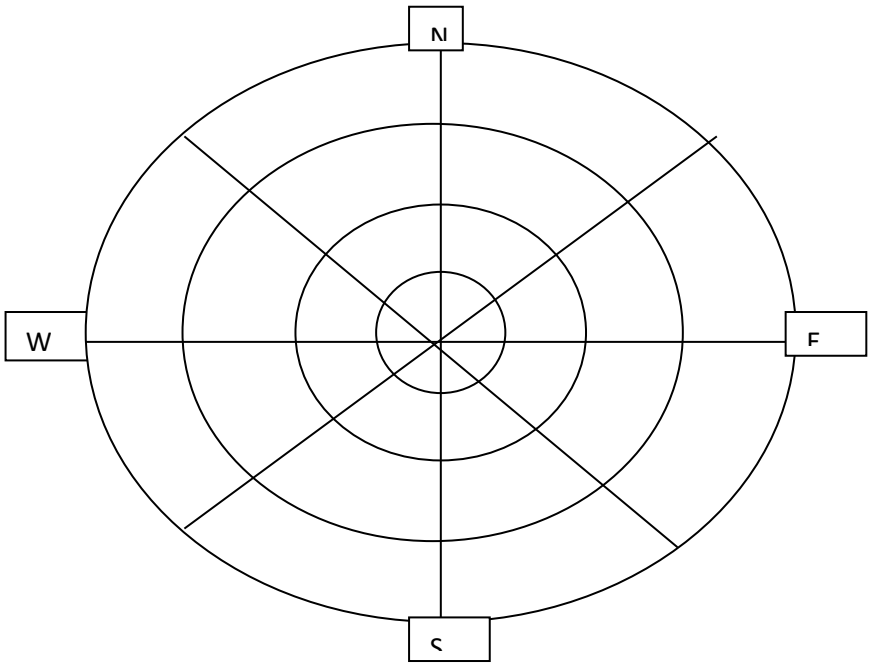
Name of Station	Water source (Meter)	Human settlement (Meter)
Chhentung	58	213
Bhartan Chaur	125	395
Lamakhoriya	151	618
Gadi Khola	632	238
Pakhathar	65	790
Sayalpakhe	142	316
Deurali	184	562
Uttar Ganga	101	101
Lamathan	530	145
Nabithumko	153	124
Kandedanda	286	216
Bhuji	248	675
Kanga	61	155
Lumbakharka	629	892

4. Data Sheet for the occupancy survey

Station no	Name of Station	Site specific covariates					Time specific covariates		Human Disturbance covariates				
		water sources	Habitat type	elevation	slope	aspect	Weather	Time	Snaring	Poaching	Grazing	Forest fire	Human settlements

5. Dawn call counts census data sheet.

Dawn Call counts Census Method in Dhorpatan hunting reserve



Birds	Calling time1	Calling time 2	Calling time 3	Calling time 4	Minimum Call duration	Maximum call duration
C1						
C2						
C3						
C4						

Date:

Observers Name:

Name of Location:

Site/Point no:

Starting time:

Starting Temperature:

Finishing time:

End Temperature:

Time of sunrise:

Air velocity:

Weather: cloudy/rainy/windy

Time of first call:

Time of last call:

Position:

Altitude:

PHOTOPLATES

a) Call count stations

b) During the call count survey and discussion with the local people in Dhorpatan valley.

c) Some of the threats of Cheer in the Dhorpatan valley.

d) Some of the sign of Cheer pheasant with mammals and birds of Dhorpatan Valley.