Patch occupancy for cheer pheasant *Catreus wallichii* in the Great Himalayan National Park Conservation Area

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Abstract Cheer pheasant *Catreus wallichii* is considered Vulnerable to extinction as its population is fragmented and remaining habitats are contracting due to increasing anthropogenic pressure. However, there is a lack of information about the impact of human disturbance. We conducted field surveys during the spring season (April-May) in 2010, in the Great Himalayan National Park Conservation Area (GHNPCA). We used a detection – non-detection survey to estimate the occupancy probability of cheer pheasant. A total of 21 call count stations were monitored during the study. We modeled the response of cheer pheasant to the site parameters, elevation, vegetation and distance to human settlement. The null model $\psi(.),p(.)$ was the most parsimonious model. Both vegetation and distance models were found to be strong candidate models. The distance model suggested that the probability of cheer pheasant being present at a survey site increased with increasing distance from a human settlement. It indicates that cheer pheasant is sensitive to human disturbance. This study will further help the park managers to plan effectively for the conservation of cheer pheasant in the GHNPCA.

Keywords Occupancy modelling, call count, *Catreus wallichii*, cheer pheasant, density, Great Himalayan National Park Conservation Area

Introduction

Cheer pheasant *Catreus wallichii* is endemic to Western Himalaya. It is included in Schedule I of the Wildlife (Protection) Act of India, 1972 and is placed under the Endangered category in the Red data book of the Zoological Survey of India (ZSI, 2011). It is categorized as Vulnerable on the IUCN Red List (IUCN, 2011).

Catreus wallichii belongs to the order Galliformes and family Phasianidae. It is a medium sized bird (90–118 cm) weighing 1,250–1,700 g. It breeds during the spring season (late April-early June) (Ali & Ripley, 1983) and gives sporadic and irregular calls throughout the day especially during dawn.

It inhabits precipitous, often craggy hillsides with stunted trees and dissected by wooden ravines, scrub and grass cover, recently cleared areas with secondary growth. The main habitats of cheer pheasant are distributed through the southern foothills of the Himalayas, from Pakistan to Nepal, occurring in Northern Pakistan, Jammu and Kashmir, two states of India (Himachal Pradesh and Uttar Pradesh) and Nepal (Roberts, 1991; Kalsi, 1999). This species occurs over a rather wide altitudinal range in the Western Himalaya, and is particularly associated with steep slopes and scattered trees, especially where rocky crags are also present. Tall grasses, rather than heavily grazed grasslands are also preferred and in Himachal Pradesh, their altitudinal range varies from about 1200 m to 3000 m or from the subtropical pine forests to sub-alpine meadow zone (Gaston et al., 1981).

Cheer pheasant are thought to be positively influenced by human disturbance (Kaul, 1989; Garson et al., 1992; Ramesh, 1999). Its preferred habitat is a combination of low shrub cover, which is subject to regular browsing and cutting, with tall dense grass in spring. Its preference for early successional habitats, often created by traditional grass cutting and burning regimes, has led to an association with human settlements (BirdLife International, 2011). Indirect evidence is available regarding its presence in the Great Himalayan National Park Conservation Area (GHNPCA). However, our knowledge about its distribution in the GHNPCA is not well documented.

Here we addressed the probability of occurrence of cheer pheasant in the GHNPCA in relation to the distance to human habitation, vegetation and elevation. We assumed that the distance to human habitation was a proxy for the level of anthropogenic disturbance in accordance with Theobald et al., (1997). Given the commonly held view that human disturbance influences cheer pheasant positively, we expected that the probability of occupancy would be greater closer to human settlements. We also expected that cheer pheasant occupancy could be influenced by elevation, and its occupancy probability would increase at higher elevation. In addition, we examined the role of vegetation in determining occupancy of cheer pheasant.

Methods

Study Area

The GHNPCA study area was located within the Western Himalaya, in the Kullu District of Himachal Pradesh, ~45 km southeast of Kullu (31°38′28′′—31°54′58′′N and 77°20′11′′—77°45′ 00′′E). Study sites were on the Sainj Khad, Jiwa nal and Tirthan River (FIG. 1).

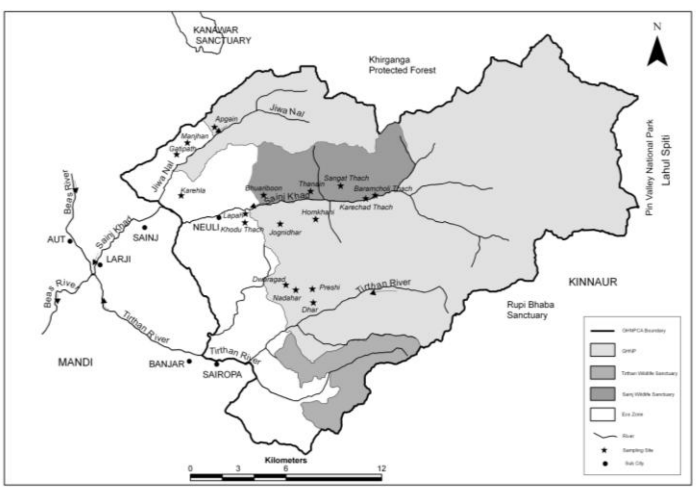

FIG. 1 Map showing sampling sites in the Great Himalayan National Park Conservation Area, Kullu, Himachal Pradesh, India (2010).

There is abundant subtropical, mixed broadleaf and coniferous forest vegetation in addition to large mountain meadows and pastures. The description of habitats of each sampled site are shown in Appendix 1. We classified each site as either woodland or grassland depending upon the predominant vegetation type. The area is a rich bio-diversity zone of the western Himalaya.

Bird Survey

Data were collected during April and May (breeding season) in 2010. We used detection – non-detection surveys (Rodgers, 1991; Sathyakumar et al., 2007; MacKenzie et al., 2006) to estimate cheer pheasant occupancy probability. We used calls to record its presence in 21 pre-existing call count stations located inside the GHNPCA (Appendix 1). We sampled only once a month due to difficult Himalayan terrain. 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 forest guards. We assumed each call station coincided with the home range of cheer pheasant.

Circular plots with a 300 m listening radii were fixed at each station and these were located more than 500 m away from each other to avoid a double count. The observers plotted the apparent position of all calling individuals on a data-recording sheet. This protocol has been used in many studies on Himalayan pheasants (e.g. Garson 1983; Kaul & Shakya, 2001; Jolli & Pandit, 2011). If no calls were heard, playback calls were played for 20 seconds only to elicit responses 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 our study area. We played calls with caution (<20 seconds duration) as repeated and longer duration of playback calls may interfere with breeding (Wildlife Surveys, 2012). Observations were taken for two hours after dawn. It was assumed that every observer identified the call of cheer pheasant correctly and that every bird was in pair providing characteristic calls used in the breeding season. Each call was recorded with respect to time and cardinal direction. Call count stations were selected and GPS readings of elevation, latitude and longitude were taken for each census point.

Data Analysis

We used patch occupancy models in PRESENCE version 2.2 (Hines 2006) to determine if the site parameters, elevation (meters above sea level) distance to the nearest village (km), and vegetation (woodland or grassland), affected the probability that cheer pheasant would be present at a survey point. The patch occupancy model assumes (1) that the focal species cannot colonise (or immigrate to) or go locally extinct at a site during the survey period, (2) species are not falsely detected, and (3) that detection at one site is independent of detection at other sites (Donovan and Hines 2007).

Patch occupancy models use the logit link and a maximum likelihood approach to estimate ψ, the probability of patch occupancy and p*i*, the probability of detecting the species of interest on survey *i* (given that it is present) as a function of site specific covariates. We used the global model: ψ (P*Grassland* + P*Elevation* + P*Distance*) p (Month), where p (Month) denotes the sampling co-variable survey month (April and May) and P denotes the site co-variables grassland (P*Grassland*), elevation (P*Elevation*) and distance to the nearest human habitation (P*Distance*).

Our candidate model set consisted of the global model and all combinations of the site characteristics and sample covariate (month) including p(.) where detection probability was assumed to be constant between the two sampling occasions.

The amount of over-dispersion in the data was examined by assessing the global model fit using 1000 parametric bootstraps (MacKenzie et al. 2006). We adjusted ĉ (1.9) to inflate standard errors as models were over-dispersed and we used the small-sized quasi-Akaike's criterion (QAICc) to rank models (Burnham & Anderson 2002; MacKenzie et al. 2006). QAICc is calculated as follows:

$$QAICc = -2 \log \text{Likelihood}/\hat{c} + 2K + 2K(K+1) / (n - K - 1)$$

Where *K* is the number of parameters in the model and *n* is the effective sample size. The determination of the effective sample size is conceptually difficult in patch occupancy modeling (MacKenzie et al. 2006). We used the number of sample sites as our effective sample size ensuring the maximum penalty in QAICc calculation. QAICc values are relative and therefore a more intuitive way to view them is as ΔQAICc. This was calculated as Q*AICci* – Q*AICcmin,* where the best ranked model is ΔQAICc = 0. These values allow models to be categorized as having substantial support (<2), less support (2-7), and no support (>10) (Burnham & Anderson 2002). We then calculated Akaike weights (*w*i) which approximated the probabilities that model *i* was the best model in the set (Burnham & Anderson 2002).

As a general rule of thumb, the confidence set of candidate models (analogous to a confidence interval for a mean estimate) include models with Akaike weights that are within 10% of the highest, which is comparable with the minimum cutoff point suggested by Royall (1997) as a general rule-of-thumb for evaluating strength of evidence.

The relative importance of individual parameters was examined using Akaike weights. Here the Akaike weights for each model that contains the parameters of interest are summed.

Results

The naïve estimate was found to be 0.722. The null model ψ(.),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 (Table 1).

The models ψ (Grassland), p(.) and ψ (Distance), p(.) were also found to be strong candidate models (ΔQAICc = <2.0; Table 1). We further checked the distance and grassland models to determine if they were good enough to be considered for explaining cheer pheasant occurrence. The Akiake weight wi for the distance model was found to be greater than 10% of the highest model (Royall, 1997) (FIG. 2). Thus, there is sufficient evidence to consider distance a plausible explanation for cheer occupancy.

The relative importance of grassland was 1.33 (0.3491/0.2607) times greater than distance, thus grassland was much more plausible given the data and candidate set. However, grassland and distance were both plausible explanations for cheer pheasant occupancy.

TABLE 1 Summary of probability of occupancy (ψ) and detection (p) model selection results for cheer pheasant in the Great Himalayan National Park Conservation Area. All models were adjusted for over-dispersion, ĉ = 1.7.

Model	QAICc	Δ QAICc	w_i	Likelihood	No. of Parameters	(-2*LogLikelihood)
psi(.),p(.)	15.99	0	0.4502	1	2	21.27
psi(Grass),p(.)	16.92	0.93	0.2828	0.6281	3	23.03
psi(Dist),p(.)	17.67	1.68	0.1944	0.4317	3	24.46
psi(.Grass+Dist),p(.)	19.82	3.83	0.0663	0.1473	4	23.01
psi(Grass),p(month)	26.41	10.42	0.0025	0.0055	3	41.05
psi(.Elevation),p(.)	27.19	11.2	0.0017	0.0037	3	42.54
psi(Dist),p(Month)	29.13	13.14	0.0006	0.0014	3	46.22
psi(.Elev),p(Month)	29.13	13.14	0.0006	0.0014	3	46.22
psi(Dist+Elev),p(.)	30.1	14.11	0.0004	0.0009	4	42.54
psi(Grass+Dist),p(month)	31.21	15.22	0.0002	0.0005	4	44.64
psi(Dist+Elev),p(Month)	32.04	16.05	0.0001	0.0003	4	46.22
psi(Grass+Distance+Elevation.),p(.)	33.47	17.48	0.0001	0.0002	5	42.54
psi(Grass+Dist+Elevation),p(.Month)	35.4	19.41	0	0.0001	5	46.22

w_i, AIC weight Model

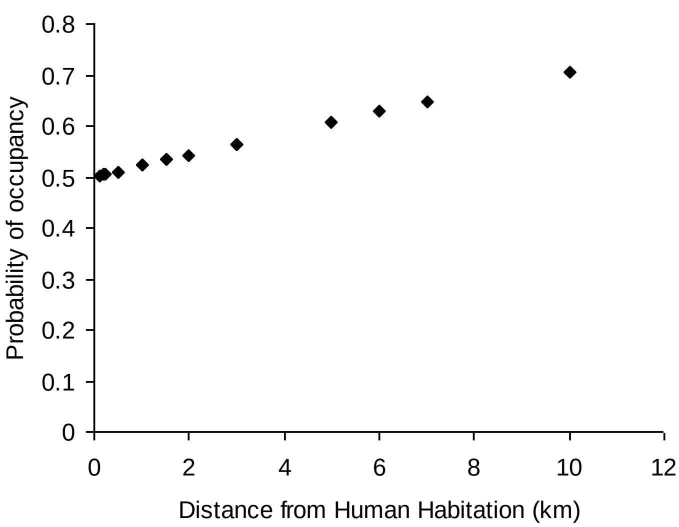

FIG 2. The probability of occupancy of cheer pheasant in the Great Himalayan National Park Conservation Area as a function of the distance to the nearest human habitation.

Discussion

The occurrence of cheer pheasant is best explained by the null model, which implies that its occurrence is independent of covariables (vegetation, elevation and distance to human settlement). Cheer pheasant is a grassland bird species therefore its occurrence is dependent on vegetation structure, which is supported by our vegetation model.

Previous work suggests that human disturbance is important for cheer pheasant survival (Kaul 1989, Birdlife International, 2011). However, it appears that although cheer pheasant can survive with high levels of disturbance 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.

There was no evidence that elevation made a difference to cheer pheasant probability of occupancy. This is different to what we thought could be a controlling factor in its distribution. The most plausible reason could be that the range of elevations surveyed may not be wide enough to find a pattern. Future surveys would need a larger altitudinal range to assess this aspect.

Cheer pheasant is easily detectable in its potential habitat sites. The results are encouraging, as its population appears to be intact in the GHNPCA. The GHNPCA is among the few available sites of cheer pheasant habitat. Therefore, it is of utmost importance to reclaim the degraded habitat of cheer pheasant (e.g. sowing local varieties of grass seeds) in its potential habitat. This may result in increase in occupancy of cheer pheasant especially in Jiwa and Sainj Valleys.

One of the main threats identified for this species appears to be its distribution in small isolated populations. Apart from this, activities like collection of medicinal plants, and 'Guchhi' (an edible mushroom) by local people is a source of income for them. Shepherds and local villagers used forest grassland for animal grazing in the GHNPCA, which they claim to be their birthright. Therefore, control and conservation of habitats is difficult in protected areas as native people historically depend on natural resources (Pandey & Wells, 1997).

As playback calls were not played at each site, one can argue that it could be a confounding factor in the methodology. It can influence the detection of cheer pheasant. Ideally, it should be used as a sampling covariate, to determine its influence on cheer pheasant occurrence probability. Due to the lack of available data on the use of playback calls, we cannot say much about this. However, this study has improved our understanding regarding cheer pheasant occurrence in the GHNPCA.

Native people often give good insight about cheer pheasant habitat locations, thus these upland villages can play a crucial role in its conservation. There is an urgent need for periodic environmental conservation awareness programmes with special emphasis on pheasant and nature conservation in these villages. The participation of local people in conservation initiatives can give excellent results (Waylen et al., 2010). A detailed study should be carried out in future to decipher the elevation distribution of cheer in the GHNPCA. Although the area is supporting cheer population at present, a proper conservation strategy addressing these impeding factors is needed to conserve this important species in the area for posterity.

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Appendix 1

Habitat description of call count stations monitored to estimate cheer pheasant patch occupancy in the Great Himalayan National Park Conservation Area

No.	Station	Longitude	Latitude	Height (m)	Nearest village	Distance from village (m or km)	Description
1	Chiari ri so	31º50'19"N	77º21'53.3"E	2671	Kunder	500 m	Open, Steep area with Scattered trees of Pinus wallichiana, Cedrus deodara, Rhododendron arboreum
2	Gatipat	31º49'47"N	77º20'57"E	2620	Kunder	1 km	Steep, grassy area dominated by scattered trees of Pinus wallichiana , Rhododendron arboreum,Hedichium spicatum
3	Shafadi	31º47'6.4"N	77º21'52.8"E	2453	Shafadi	1.5 km	Open Steep grassy area with scattered trees of Rhododendron arboreum, Quercus leucotrichophora and bushes
4	Chogad	31º49'20.3"N	77º20'30.5"E	1965	Mjahrma	3 km	Open, Steep area with patchy distribution of Pinus wallichiana, Cedrus deodara, Rhododendron arboreum
5	Chamandhar	31º50'02"N	77º21'02"E	2525	Kunder	1 km	Grassy steep area with scattered trees of Pinus wallichiana, Cedrus deodara,
6	Manjhan	31º50'36"N	77º21'51"E	2630	Manjhan	200 m	Mixed broadleaf and Coniferous forest interspersed with grassy slopes makes boundary between Ecozone andGHNP
7	Karaila	31º49'47"N	77º20'57"E	2430	Karaila	50 m	Upland village characterise by agriculture activity and high shrub density
8	Apgian	31º51'08"N	77º23'07"E	2750	Manjhan	8 km	Mixed broadleaf and Coniferous forest lies in GHNP
9	Dhar	30º40'29.6"N	77º28'52.4"E	2166	Dhar	2 km	Steep, grassy area with scattered trees of Pinus roxburghii, etc
10	Moringa	31º39'6.9"N	77º23'41"E	1826	Gaidhar	250 m	Steep, grassy area with scattered trees of Pinus roxburghii, Berberis aristata, Rosa macrophylla,Indigofera spp etc
11	Nadahar	31º39'05.1"N	77º25'015"E	2223	Nadahar	100 m	Steep, rocky and grassy area with scattered trees of Quercus leucothrichophora, Pinus wallichiana,Rhododendron arboreum,Rosa macrophylla, Indigofera spp.
12	Dwaragad	31º39'05.1"N	77º25'015"E	2223	Nadahar	200 m	Open, steep area with patchy distribution of Ban oak, Rhododendron arboreum, Toona serrata, Iris, Plectranthus rugosus, Rosa macrophylla
13	Preshi	31º39'9.2"N	77º27'17"E	2463	Bayati	500 m	Open steep area with scatterd trees of Rhododendron arboreum, Pinus wallichaina, Rhus cotinus, Indigofera sp

14	Brahmchuli	31º47'52.1"N	77º35'11.7"E	2988	Marour	10 km	Open grassy area with scattered trees of Pinus wallichiana,Berberis aristata,Indigodera sp
15	Karechad thach	31º47'42.2"N	77º34'15.4"E	2911	Marour	7 km	Grassy steep area with scattered trees of Pinus wallichiana, Indigofera spp,
16	Sangat Thach	31º47'37.2"N	77º32'18.3"E	2847	Marour	3 km	Open grassy area with scattered trees of Pinus wallichiana,Abies pindrow, Juglans regia,Rosa spp
17	Khodu thach	31º46'16.7"N	77º26'40.4"E	2544	Lapah	5 km	Steep grassy area with scattered trees of Quercus semicarpifolia,Abies pindrow and Picea smithiana
18	Homkhani	31º46'44.3"N	77º29'06.8"E	2840	Shakati	6 km	Open grassy area with Abies pindrow, Picea smithiana, Quercus semicarpifolia
19	Thanain	31º47'35"N	77º30'01.2"E	2544	Shakati	3km	open steep area with Quercus semicarpifolia, Jammu,Berberis spp, Princepia utilis.
20	Jognidhar	31º45'25.2"N	77º24'40.7"E	2976	Shakati	5km	Open,Steep grassy area with Pinus wallichiana,Abies pindrow and Picea smithiana
21	Buhariboon	31º47'08.2"N	77º25'54"E	2408	Majhan	1.5 km	Open grassy area with scattered trees of Pinus wallichiana, Alnus nitida, Prunus cerasoidis,Berberis sp, Princepia utilis