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Avian Species Distribution in Forest and Rural Habitat of Chamoli District of Uttarakhand, India

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ABSTRACT

The present study was made to understand the avian species distribution pattern along the elevational zone (300 m – 2,300 m asl) in forest and rural urban habitat of Chamoli District of Uttarakhand. The studies were conducted during January 2017 to December 2018. Total 120 species belonging to 41 families were recorded, results indicate the species distribution in terms of richness and diversity was not decline simultaneously along elevation. Non-parametric estimator Chao 1, Chao 2 and Jack-knife values were high at (1,500 m asl). It seems bulged shape at the mid elevation (1,500 m asl) along the elevation range. The present study provides a base line data to understand the species distribution pattern at local level. The presence of an endangered species (Egyptian vulture) and two threatened species (Alexandrine parakeet and river lapwing) in the study area suggests the need for the conservation efforts of avifauna and forest habitat in the study area.

Keywords Diversity, Richness, Chamoli, Avian species, Forest.

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INTRODUCTION

Biodiversity is not evenly distributional across the earth. It may be influence by biogeography (Karr 1976). Investigation of biodiversity distribution is a fundamental theme of ecology (Gaston 2000). In the last decade many ecologists (Cody 1974, Able and Noor 1976, Terborgh 1997, Rahbek 2005, Wu *et al.* 2010, Goncalves *et al.* 2017, Kawamura *et al.* 2019, He *et al*. 2019) have been focused on species distribution patterns along the elevation. On the other hand, the knowledge about the avian species distribution pattern along the elevation is ambiguous. The available knowledge on species distribution pattern shows peak at mid elevation zone about 49%, however 20% studies have shown species decline along the elevation and 24% indicates high richness at low elevation zones (Rahbek 1995, Rahbek 2005). Therefore, many studies have been attempted to understand the avian species distribution pattern in temperate regions (Rahbek 1997, Cueto and Casenave 1999, Lomolino 2001, Funnell and Parish 2011, Howard *et al.* 2015, Sabatini *et al.* 2018, Somveille *et al.* 2018). The avian diversity and composition shows rapid change along elevation gradient, particularly

in tropical and sub-tropical region (Terborgh 1997, Wu *et al*. 2010). Therefore, the contribution of this ecological theme from tropical and sub-tropical region is insufficient. The Indian Himalayan range is well recognized for its biological diversity and ecological values (Bhattacharya and Sathyakumar 2007). It also contains 27 important Bird Areas (IBAs) (Islam and Rahamani 2004). Some studies on avian species distribution patterns have been conducted in different area of Indian Himalayan regions such as, in Assam, North-East Himalaya (India) (Acharya *et al*. 2012); Eastern Himalaya (India, Nepal, Bhutan) (Kandel *et al*. 2018); Pauri District in Garhwal Himalaya (Naithani and Bhatt 2012); Nainital District in Kumaun Himalaya (Bhatt and Joshi 2011); Foot hill of Doon Valley (Joshi and Bhatt 2015); Sutlej basin western Himalaya, Himachal Pradesh (Santhakumar *et al.* 2018). The available information about avian species in the Himalayan region of Uttarakhand is based on checklist (Jerdon 1862-64, Hudson 1930, Osmaston 1935, Ali and Ripley 1998, Sultana and Khan 2000, Sultana *et al.* 2007, Mohan 1996, Mohan and Kumar 2010, Singh 2000, Sinha *et al*. 2019). In the light of the above background, it was decided to analysis the avian species distribution pattern along the elevational zones at local level in Chamoli District (foot hills of the Himalaya) of Uttarakhand.

MATERIALS AND METHODS

Study area

The survey was carried out between January 2017 to December 2018 at forest and rural urban habitat from 300 m to 2200 m asl elevation range in Chamoli District of Uttarakhand (Western Himalaya 29° N 79°E) (Fig. 1). The elevational ranges divided into major seven elevational zones with 300m interval (Table 1).

The temperature varies from 5°C in winter (December – February) to 32°C in summer months (April-July). The rainfall pattern in study area is monsoon dependent. Chamoli District receives the maximum rainfall in between July-September (Pandey *et al.*1994).

Bird survey

The bird survey was conducted in the elevational zones of forest and rural urban habitat of the study area. Fixed width line transect along with fixed radius point count method (Bibby *et al.* 2000) were used, to quantify the diversity indices in the forest and rural urban habitat of each elevation zone.

Total 504 transects (7 elevational zones X (3 transects forest habitat + 3 transects rural urban habitat) X 12 months) were studied in a year. The transects varied in length minimum 1000 mm and maximum 1500m, depending on accessibility. The survey was done between 06.00 – 11.00 h and 16.30 – 19.30 h in summer months (April-September) and between 08.00–11.30 h and 15.00 – 16.00 h in winter months (October - March). However, Survey was avoided during foggy weather and rainy days. About 10

Table 1. Physical characteristics of study area in different elevational zones in Chamoli District.

Elevation Zones Category	300m		600 m		900 m		1200 m		1500 m		1800 m		2200 m	
Habitats	Forest	Rural urban	Forest	Rural urban	Forest	Rural urban	Forest	Rural urban	Forest	Rural urban	Forest	Rural urban	Forest	Rural urban
Bird survey elevation range (m asl)	200-550		500-850		800-1050		1080-1350		1380-1650		1750-2100		2180-2280	
Average temp (Cº)	Min Max 18-35 (Cº)		Min Max 17-35 (Cº)		Min Max 19-35 (Cº)		Min Max 18-34 (Cº)		Min Max 15-25 (Cº)		Min Max 14-21 (Cº)		Min Max 13-21 (Cº)	
Forest type	Sub-tropical Forest		Sub-tropical Forest		Sub-tropical Forest		Pine mixed		Pine mixed		Mixed temperate		Mixed temperate Forest	

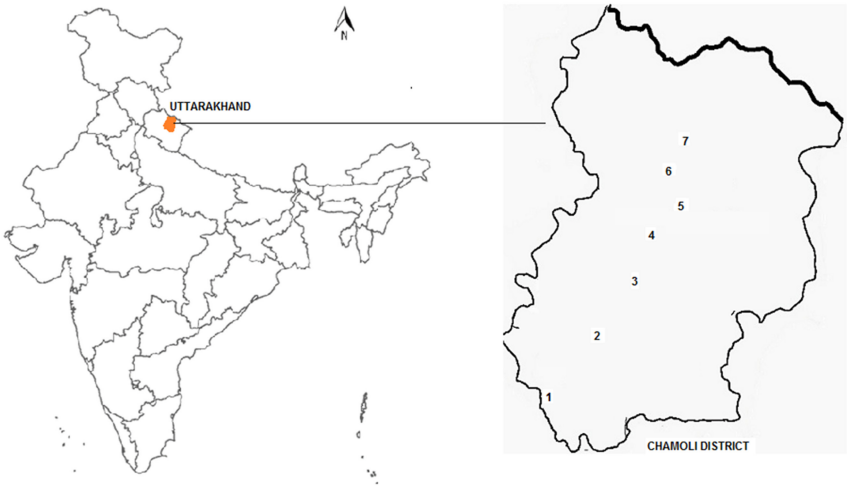

Fig. 1. Showing the avian survey points in the study area Chamoli district of Uttarakhand.

minutes stayed each point for bird count and took photographs of avian species as references.

Data analysis

Avian species diversity and richness were calculated by Shannon- Weavers formula (H'= - ∑pi (ln pi)) (Shannon and Weaver 1949) and Margalef's formula (SR = (S-1)/Log N) (Margalef 1951) respectively. We also used the non-parametric estimators of Chao I, Chao II and Jack-knife to explore the abundance and distribution of estimate species by using Estimate S (ver. 7.5) software (Colwell 2006). Similarity index dendogram was applied to understand the avian species distribution among the different elevation zone by the using Jaccard's similarity index (cluster analysis).

RESULTS

Total120 bird species belonging to 41 families were reported in forest and rural urban habitat of the study area (Annexure 1). Out of these, 10 species (8%) were exclusively found in rural urban area, 80 species (67%) were reported in exclusive forest habitat and 30 species (25%) shared both habitats in Chamoli. In addition, one endangered species (Egyptian vulture) and two threatened species (Alexandrine parakeet and river lapwing) recorded in the forest habitat.

The avian community distribution pattern along

Table 2. Avian species observation and diversity indices in different elevational zones of the study area.

	300 m	600 m	900 m	1200 m	1500 m	1800 m	2200 m
Avian species observed	28	26	29	24	32	17	12
Number of individual	211	205	209	194	214	186	123
Chao I	30	27	31	25	31	18	14
Chao II	32	30	33	27	33	20	16
Jackknife	34	32	35	30	35	22	18
Avian Diversity	2.75	2.78	2.89	2.98	3.25	2.56	2.38
Avian Richness	11.49	11.23	12.13	10.03	13.29	7.04	5.24
Number of point studied	25	25	23	25	25	20	20
Human disturbance	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

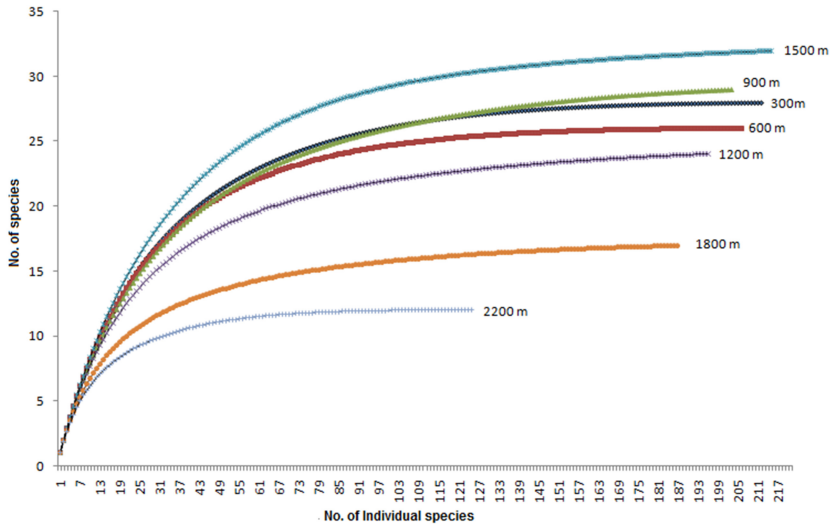

Fig. 2. Rarefaction curve between number of avion species and numbers on individuals among the elevational zones.

the elevation revealed that maximum avian diversity (H = 3.25) at 1500 m asl of both habitat of study area. The species distribution pattern it looks peaked at mid-range of the study area. Non-parametric estimators value (Chao I, Chao II and Jack-knife) also support the species richness and the numbers of species estimated at all the elevation zones were very close to the actual number of species observed (Table 2). Rarefaction curve between number of avian species and number of individuals also indicates maximum avian species and individuals present at midzone (1500m asl) of the study area (Fig. 2).

Among the total species, 30 species were shared in both forest and rural urban habitat of the study area, t-test analysis at equal variant indicates frequency distribution of species were significantly ($t = 2.01$, $df = 46$, $p = 0.05$) high at rural urban habitat of all the elevational zone.

Same as, nine species were shared in both the habitats of all elevational zones, out of these 4 species namely Himalayan Bulbul, Red vented Bulbul, Blue whistling Thrush and Grey tit were found significant high abundant at 1500 m asl elevational range and 3 species namely Common myna, House crow and Blue rock Pigeon abundance recorded significantly high at 300 m asl elevational zone. We compared similarity between avian community and elevation zones. Hierarchical cluster analysis indicates five clusters were formed at 0.74 similarity levels and shows the maximum avian species were similar between 600 m and 1500 m asl (Fig. 2) this may be influence by the ecotone in the study area.

DISCUSSION

The available variety of avian species in the presentstudy shows the Chamoli District is a harbor of diverse avian species. The presence of globally endangered vulture species, two threatened species in the forest habitat indicates, the vegetation structure at the study area supports to the diversity and abundance of such avian species.

In our study, the maximum avifauna diversity and abundance was recorded at mid elevational zone (1500 m asl) of the study range (300m asl to 2200 m asl), regarding the avian distribution along elevation zone indicates peaked (humped shape) at mid elevational zone of the study area. However, 49% studies on species distribution pattern along the elevation zones have been shown the highest species richness at mid elevation (Rahbek 1995, 2005). The results of present study on avian species distribution pattern also endorses the studies have been conducted

in temperate, tropical and subtropical forest region (Colwell and Lees 2000, Shiu and Lee 2003, Acharya *et al.* 2011, Joshi and Bhatt 2015, McCain 2009, Price *et al.* 2014, Pan *et al*. 2016, He *et al.* 2019).

The high abundance of four avian species (commonly shared in forest and rural urban habitat of all elevation) at mid elevation (1500 m asl) indicates that mid elevation range of the study area have ecotone area where the mix vegetation structure provides variety of food availability, good shelter and nesting sites. In the study, rich abundance of avifauna in rural urban habitat may be rich variety of food availability in rural urban as compared to forest habitat. However, avian species diversity and richness indicates positive correlation with the vegetation structure (Joshi 2011, Joshi *et al.* 2015) and mixed tree species, tall grass, bamboo vegetation and orchard habitat promote higher species richness (Tu *et al.* 2020). In addition, environmental factors including sampling, temperature, seasons, human disturbance and their combined effect also influence the species distribution along the elevation (McCain 2009, Goncalves *et al*. 2017, Kawamura *et al.* 2019). In some models, habitat loss and climate change have been introduced the bird extinction and distribution to higher altitudes (Peh 2007, Sekercioglu *et al.* 2012). There is an urgent need to understand the distribution pattern and the sensitivity of avian species in the Himalayan region.

The present study suggests that occurrence of an endangered species (Egyptian vulture) along with, two threatened species (Alexandrine parakeet and river lapwing) in the study area suggest the need for the conservation efforts of avifauna and forest habitat in the study area.

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