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Journal of Asia-Pacific Biodiversity

Original article

Avian species distribution along elevation at Doon Valley (foot hills of western Himalayas), Uttarakhand, and its association with vegetation structure

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ABSTRACT

We assessed a diverse avian population during February 2013 to February 2014 at Doon Valley forest. During the study period we recorded a total of 218 species (18,982 individuals) belonging to 50 families using line transect along with the fixed radius point count method in the study area. Avian species diversity, richness, and abundance showed a hump-shaped distribution pattern in the study range (325 −2300 m above sea level). The association of vegetation structure with avian community illustrates the significantly positive correlation with shrub diversity and density/ha along the elevation. The presence of new records (habitat area extension), endangered species, and two near-threatened species concerns the conservation of birds and forest habitat in this area.

Introduction

Biodiversity is not evenly distributed across the Earth. It may be influenced by geography (Karr 1976). In recent decades, the relationship between species community and elevation at global level has been an important theme in ecology. Many studies (Cody 1974; Able and Noor 1976; Rahbek 2005) have been conducted on avian species distribution patterns at regional level in temperate regions and in tropical/subtropical regions (Terborgh 1977; Brown and Gibson 1983; Wu and Yang 2010). Generally, the available knowledge about the avian species distribution pattern along an elevation is not clear approximately 49% of studies show peaked at mid elevation or humped shape patterns, 20% decrease and 24% high richness at low elevation respectively (Rahbek 1995, 2005). In general, forest provides a wide range of variation in bird habitat (Fuller 1995) and the important factors of this variation include vegetation structure (Cueto and de Casenave 1999; Holmes and Sherry 2001). The Indian Himalayan range is well recognized for its biological diversity and ecological value (Bhattacharya and Sathyakumar 2007). Only a few studies (Acharya et al 2011; Bhatt and Joshi 2011) have been conducted on avian species distribution and variation factors in the Himalayan region. By contrast in temperate regions, many studies have reported that productivity, forest structure, and vegetation cover influence the species distribution (McCoy 1990; Rahbek 1995; Waterhouse et al 2002). The Dehradun district is situated in the foothills of the western Himalayas. Knowledge of the avifauna of Doon Valley is based on only checklists (Osmaston 1935; Mohan 1992, 1997; Singh 2000), and the available information about avian species distribution along elevations is insufficient. An attempt was made to understand the avian species distribution pattern and variation factors (especially vegetation structure) along the elevation at the forest habitat (local level) of Doon Valley.

Material and methods

Study area

The present study was carried out at Doon Valley (29°55′ N to 30°30′ N, 77°35′ E to 78°24′ E) from 300 m to 2300 m above sea level elevation ranges in the Dehradun district of Uttarakhand, India (Figure 1). The elevation range was divided into three major elevation zones as follows: low zones (30°02′ N, 78°15′ E−30°20′ N,

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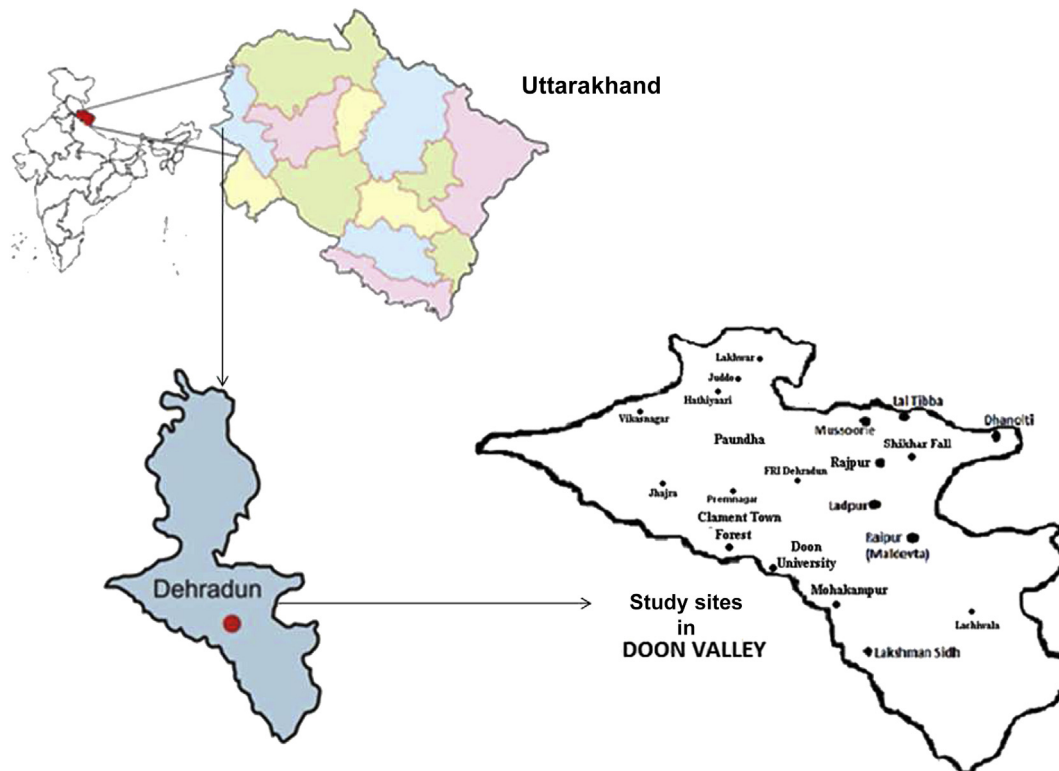
Figure 1. Different study sites in Doon Valley of the Dehradun district (Uttarakhand).

78°08′ E) from 300 m to 900 m above sea level, covering the Mohakampur, Laxman Siddh, Clementown, and Wild Life Institutes, dominated by the Sal (*Shorea robusta*), *Terminalia bellerica*, *Cedrela toona*, Shisam (*Dalbergia sissoo*), and *Butea monoserma* tree species; mid elevation zones (30°20′ N, 78°08′ E–30°25′ N, 78°04′ E) extending from 900 m to 1500 m above sea level and covering the Rajpur, Ladpur, Shikhar Falls, and Maldevta Forest areas, occupied by mixed vegetation, i.e., Dhola, Amla, Hared, Ghentela, Moist Sal (*Shorea robusta*), Shisam (*Dalbergia sissoo*) tree species, etc.; and high elevation zones (30°25′ N, 78°04′ E–30°27′ N, 78°06′ E) extending from 1500 m to 2300 m above sea level, namely the Lakhwar, Mussoorie, Lal Tibba, and Dhanaulty areas, which are dominated by Burans (*Rhododendron arboretum)*, Banj (*Quercus incana)*, *Quercus dilatata*, and Deodar (*Cedrus deodara)* trees.

The temperature varies from 10°C in winter (December–February) to 38°C in the summer months (April–July). The rainfall pattern in the study area is monsoon dependent. Dehradun receives the maximum rainfall between July and September (Pandey et al 1994).

Bird survey

The bird survey was conducted from February 2012 to February 2014 along the full elevation (300–2300m) range of Doon Valley. This range was divided into seven different elevation zones. Fixed-width line transect along with the fixed radius point count method (Bibby et al 2000) were used to quantify the diversity and abundance of avian species in each elevation zone of forest habitat. A total of 210 transects (7 elevation zones × 5 transects in each elevation zone × 12 months) were studied in 1 year and the same transects were revisited the following year. Transects varied in length from 700 m to 1000m, depending on vegetation and accessibility. The survey was carried out between 06.00–11.00 hours and 16.30–19.30 hours in the summer months (April–September) and between 07.00–11.30 hours and 15.00–16.00 hours in winter (October–March). Surveying was avoided during foggy weather and rainy days. Field guidebooks (Grimmett et al 2011; Kazmierczak and Perlo 2012) were used for bird species identification in all the elevation zones, and birds were observed for approximately 5 minutes at each point for bird count. No specimens were collected, however, most species were photographed for reference.

Vegetation sampling

The trees and shrubs were sampled in each studied elevation zone of Doon Valley forest area. The vegetation samples were collected along transects used for the avian survey. We placed 10 quadrats (10 m × 10 m) to estimate the tree inventory, and 5 m × 5 m quadrats were placed into the 10 m × 10-m tree quadrats to estimate the shrub density. Thus, in each elevation zone of bird survey transect we recorded the richness and density of the trees and shrubs.

Data analysis

The Shannon–Weaver formula [$H' = -\sum p_i (\ln p_i)$] was used to estimate the avian diversity and vegetation structure in the different elevation zones of Doon Valley (Shannon and Weaver 1949). The avian species richness, and tree and shrub richness were calculated using Margalef's formula [$SR = (S - 1) / \log N$] (Margalef 1951). The nonparametric estimators of Chao I, Chao II, and Jackknife were selected to explore the abundance and distribution of estimate species using Estimate S (ver. 7.5) software (Colwell 2005). Analysis of variance (1-way ANOVA) was applied to compare the avian species distribution among the elevation zones. Jaccard's similarity index (cluster analysis) with a single linkage