Avian Diversity in the Himalayas

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Abstract

The Indian Himalayan mountain region is globally renowned for biological diversity. The Himalayan mountain system contributes 10% of the world bird's species and about 8% of the world's bird species breed in this region. However, bird species are not evenly distributed from East to West Himalayan region; various factors are responsible for bird's diversity gradient seen in this mountain chain. The present article is briefing on the bird's species diversity patterns in the Indian Himalayan region and is largely based on the work carried out under Wildlife Institute of India and University of Chicago collaborative research work titled 'Study of bird species numbers and densities in east and west Himalayas' and has already been published in many research papers.

Keywords: Diversity, bird species, indian himalayan region, distribution.

Introduction

The Indian region has one of the most diverse avifauna on earth, putting it on the top dozen countries in number of species reported from within their political boundaries. This amazing diversity is brought about primarily byits location at the merger of the Palearctic, Ethiopian and Oriental zoo-geographic realms and also by the diversity of climatic and physical features resulting in range of habitat types ranging from tropical desert to

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wet evergreen forests and from mangroves to alpine meadows. Over 1300 species of birds are reported from the Indian Subcontinent, constituting approximately 10% of the world's birds as per the leading databases of birds of the world (ebird, 2021; avibase, 2021).

Within the country, Himalayas are the most diverse region in avian diversity. Nearly 1000 species are known from the Himalayas making it a very diverse mountain range only second to the Andes. The high species diversity in the Himalayas is due to species turnover associated with elevational variation in habitat, as well as variation in species composition along the range (Martens and Eck 1995; Price et al. 2003). The uplift of the Himalayas may have created opportunities for both vicariant speciation within the range (Randi et al. 2000) as well as speciation in response to ecological diversification as in adaptive radiation (Richman and Price 1992; Price and Gross 2005). However, the Himalayan avifauna is predominantly composed of immigrants, from both the Palearctic and Oriental zoogeographical regions, with very little speciation in situ (Martens and Eck 1995).

Of the estimated 976 breeding land and freshwater species breeding on the Indian subcontinent, 783 breed along the Himalayas (about 8% of the world's bird species). 570 species can be found breeding in one 250 × 250 km area spanning the south-east Himalayas, a density only clearly exceeded in the Andes (Orme et al. 2005). However, the diversity of birds in Himalayas is not uniform along it's 2400 km length. Interestingly less than 50% that number breed in the north-west Himalayas. There is also a turnover of bird species as we move along the altitudinal gradient irrespective of the location, be it east or west. Here too, the diversity is not uniform, but shows varied patterns in east and west Himalayas (Figure 1).

Intrigued by these interesting patterns in the diversity gradients along the length and breadth of the Himalayas, a detailed collaborative research project was launched in 2006 involving the Wildlife Institute of India and University of Chicago, the USA. Renowned ornithologist Dr. Trevor D. Price led the research which continues even today. The Himalayas do have latitudinal orientation with the western Himalayas appreciably at higher latitude as compared to the Eastern Himalayas.

As a result, the theories on latitudinal gradients were used to set the hypothesis for this long term research. Causes of the latitudinal gradient in species diversity have been debated over more than 100 years. The two oldest hypotheses, considered to be the main alternatives are based on Ecology and Age or area.

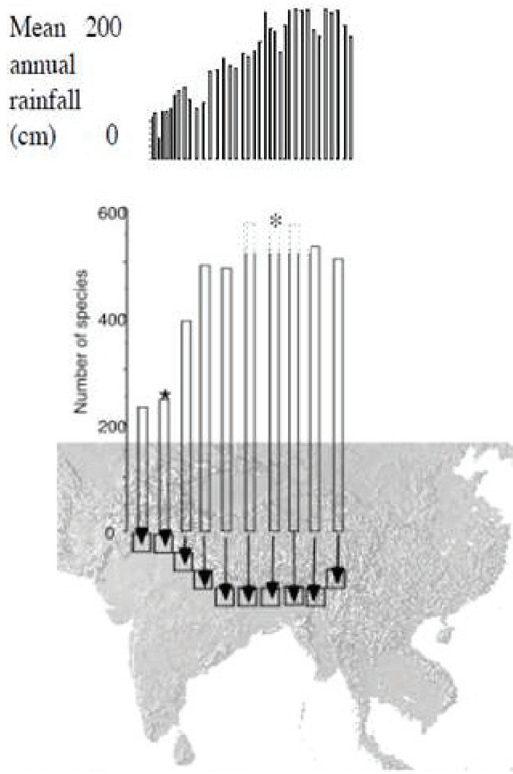

Figure 1 Number of bird species and mean annual rainfall along the Himalayas.

(1) Resource diversity generates increased numbers of species. Topography, which reflects habitat diversity, is an important additional predictor of bird species diversity in tropical regions.
(2) It takes time to evolve specific adaptations that can lead to exploitation of environments in more efficient ways, resulting in a build-up of species numbers.

Families and higher taxa of birds in the neotropics are on average older than they are in temperate regions.

Studying bird communities can be challenging as the quantification of abundance of multiple species in rich and dense forest can be very demanding.

Data Collection and Estimation

Spot mapping was used to assess the abundances which required high level of skills in bird identification mainly through auditory clues. Although the main focus of the field work was in East and West ends of the Himalayas, samples were also laid in other parts as well. In all 33, 5ha plots were laid out for spot mapping in different altitudes. Care was taken to select, near pristine areas to avoid the infuence of degradation owing to human pressures. Protected areas such as Eaglenest Wildlife Sanctuary, Pakke Tiger Reserve, Neora Valley National Park, Buxa Tiger Reserve, Chapramari Wildlife Sanctuary, Dachigam NP, Overa WLS, Ramnagar Rakha WLS, Rajaji National Park etc., were selected for the sample plots.

To get an understanding of altitudinal distribution of birds, altitudinal transects were walked where counts of singing males at every 50 m elevation along the transects to draw breeding altitudinal distribution.

200 random altitudes taken from altitudinal distribution of a species as in literature (Grimmett et al. 1999; Spierenburg 2005; Roberts 1991, 1992; Price et al. 2003) from South-east and climate records were taken from worldclim web site.

To relate the bird diversity the vegetation tree density, shrub, foliage height diversity was quantified from the 5-ha grids. Foliage height diversity was calculated using 30 points foliage touches.

The climate variables were also taken from worldclim data (Hijmans et al. 2005). The variables taken were maximum temperature, annual precipitation, temperature range and precipitation seasonality. Derived expected climatic niche in the west grid for species in the east from 200 climate records using the Maxent 3.3.3e. Relative probability of finding the species from East in West was calculated (Figure 1).

To quantify geographical distributions, we used the range maps in Rasmussen and Anderton (2005) and evaluated the ranges of all species in the focal groups across the whole Himalayas. All maps were scanned into shapefiles for use in ArcGis 9.3. From these files, bird numbers were computed across the Himalayas, as well as the latitudinal coordinates of range edges (Price et al. 2011).

Bird Species Distribution

Looking at the bird diversity across altitudes, a clear mid-elevational peak in the eastern Himalayas (having higher diversity) was seen, while a diffused

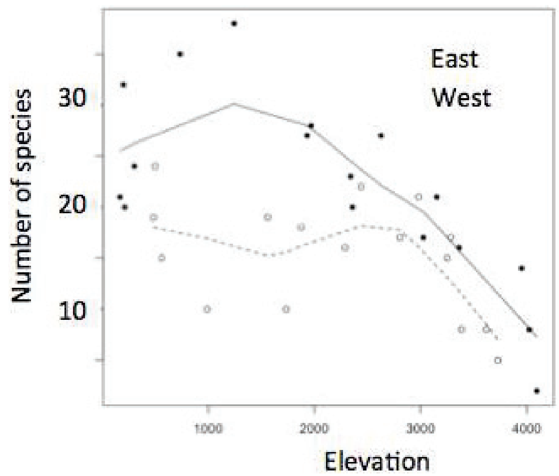

Figure 2 Bird species richness in East and West Himalayas with respict to altitude based on the field data. Price et al. (2011).

one in the west was observed. In the East, the peak was observed in the altitudinal interval 1000–1500 m while the diffused peak was seen between 2000–3000 m in the west (Figure 2).

The bird species richness was also plotted using the literature as mentioned above for a finer depiction of the above relationship. It is clearly seen that similar pattern was observed from this exercise as well (Figure 3).

At higher elevations, the number of species in both locations is similar, but at lower elevations, particularly between 1,000 and 2,000 m, many more species are present in the southeast. To see if climate governs this kind of pattern, two main drivers temperature variation and precipitaion was plotted for both East and West Himalayas as obtained from worldclim database. It was observed that at higher altitudes (above ca. 3000 m), both these climate variables converged for the two ends of the Himalayas as their differences narrowed down (Figure 4). Thus the species at higher altitudes extended their ranges from East to West as the climate they encountered did not vary much across the mountain range bringing in similarity in avifaunal assemblages. Therefore, climate tracking predicts that species found at higher altitudes in the southeast should extend their ranges to the northwest because the climatic zones they occupy also extend to the northwest and maximum difference in species numbers is observed below 2000 m asl.

The vegetation quantification also supports bird species distribution between eastern and western Himalayan region. It is also indicates that the

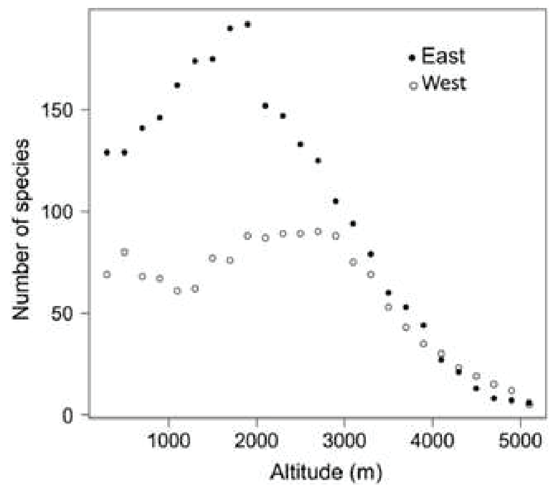

Figure 3 Number of species occurring as different altitude based on altitudinal distribution in available literature. Price et al. (2011).

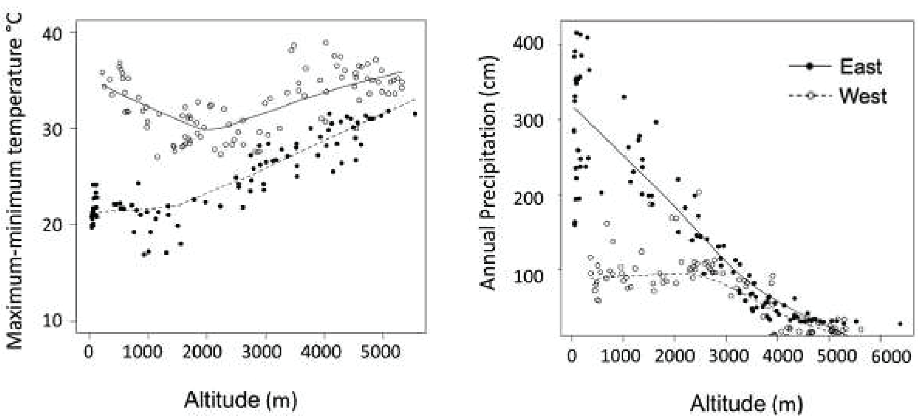

Figure 4 Comparison of precipitation and temperature variation between the southeastern and northwestern Himalayas. Price et al. (2011).

vegetation structure is not as diverse and density is not as dense in west as compared to the east and it may be suggested that the productivity of the forests is poorer in the western Himalayan region (Figure 5).

Total foliage is the total number of leaves estimated that would be touched along 30 vertical lines of sight above 0.2 m, randomly distributed across the

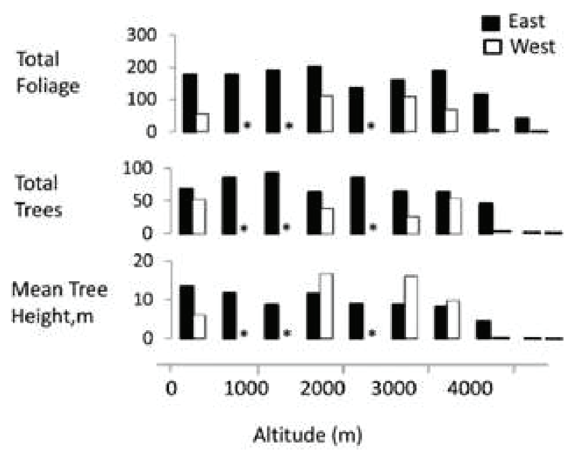

Figure 5 Major vegetation parameters measured in the sample plots from East and West Himalayas. Price et al. (2011).

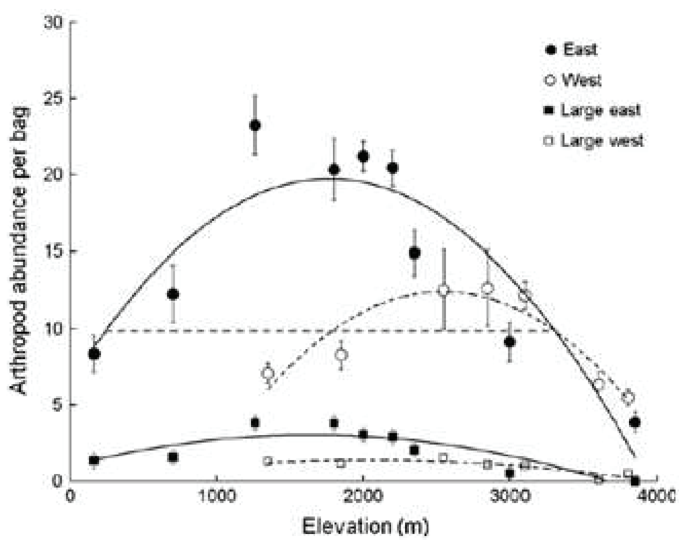

Figure 6 Arthropod abundance in East and West Himalayas based on bagging (Ghosh-Harihar et al 2014).

grid. Total tree is the number of trees 115-cm circumference at breast height within a 5-m radius of 15 points randomly distributed across the grid.

Further the quantification of arthropods on which more than half of the bird species depend for food, also led to similar results (Figure 6).

Thus in altitude below 3000 meters, the resource difference is large leading to stark differences in bird diversity between East and West Himalayas, while at higher altitudes (above 3000 m) it is similar. This led to a look at the forest and open habitat species as usually above 3000m the habitats are open and below are forested.

A total of 333 Forest Species were encountered in the Eastern Himalayan region while the number was as low as 138 in the Western part of the Himalayas. Thus, the forest bird species diversity was nearly 2.5 times higher in Eastern region. Open habitat species were slightly higher in the West (93) while only 76 were encountered in the East region. However, ninety one common forest species were found between the Eastern and Western Himalayan region. Smaller altitudinal ranges were seen in northwest even though same altitudinal mid-point was seen in both the ends. Total forty six avian species were recorded as across the range from eastern Himalayan to western part, however, the abundance was high (but significant) in northwest.

It appears that barriers in the tough mountain topography of Himalayas also played an important role in limiting the distribution of many Eastern Himalayan species.

To study this, limit of distribution ranges of east Himalayan birds were studied to see how far west they extended. As we traversed the Himalayas from east to west the distribution ranges of the east Himalayan birds ended at various distances from the east and these ended distribution ranges were plotted across the length of the Himalayas in Figure 7.

During cold periods (Pliestocene), the northwest was apparently dry, with much reduced forest cover. Many forest species with limited ranges are clearly derived from tropical clades and must have repeatedly suffered range contractions toward the southeast during cold, dry periods. As climate improved, some may have failed to cross various barriers, such as deep river gorges, and hence failed to colonize the northwest. A careful analysis of Figure 7 revealed that the dropping off of the bird distribution as one moved from east to west was not uniform but peaked at certain locations. These coincided with major Himalayan valleys which cut across the length of the Himalayas with few having their origin in trans-Himalayas such as Brahmaputra (Siang), Arun, Kali-Gandaki and Sutlej. Thus these deep valleys appear to have put a barrier to the spread of the eastern bird species to the west.

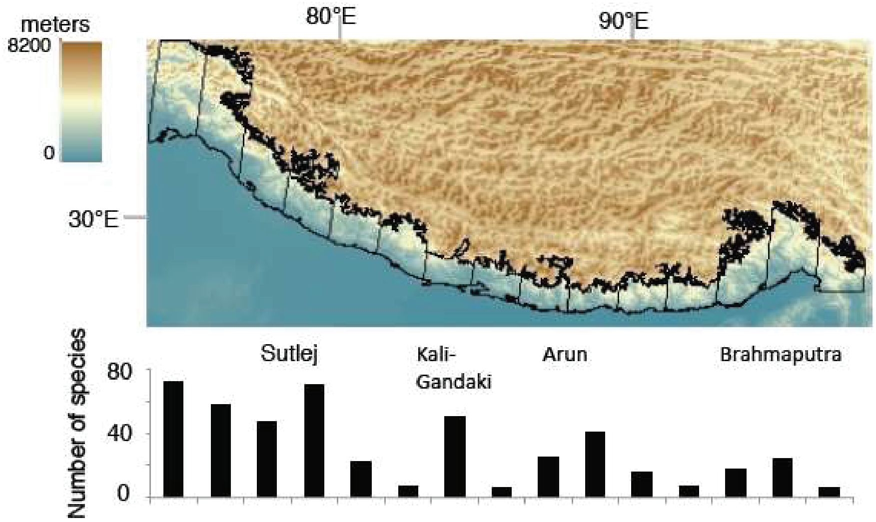

Figure 7 Number of East Himalayan species ending their distributional range at various sections of the Himalayas.

Conclusion

It is clear that climatic condition varies between lower altitudes of the Eastern and the Western part of the Himalayas. Climate-tracking is observed among species breeding at higher elevations in the east, though not to the extent predicted by climate model alone. Forest declines in quantity and foliage density reduces in the West, setting a lower carrying capacity. Far more forest species are found in the East and the gradient is reverse for open species though not as sharp. The mountain topography functions as barriers and plays a role to limits the forest bird distribution from the eastern Himalayan to western Himalaya.These factors set the western range limits of species and drive the observed bird diversity gradient.

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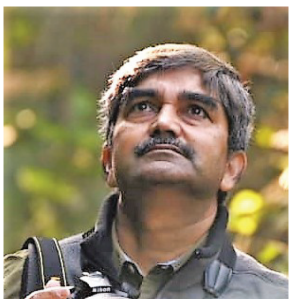
Biography



Dhananjai Mohan received his graduation degree in Electrical Engineering from Indian Institute of Technology (IIT), Kanpur in the year 1986. Later he joined the 1988 batch of Indian Forest Service and was allocated to the state of Uttar Pradesh and later on its split to the Himalayan state of Uttarakhand. He served as manager and management planner of protected areas in the Himalayan and terai regions of erstwhile Uttar Pradesh. He served as an Associate Professor in the Indira Gandhi National Forest Academy, Dehradun from 1998 to 2004 dealing with the subject of wildlife conservation and as a Professor in the Wildlife Institute of India, Dehradun from 2006 to 2013 where he led avifaunal research and collaborated with University of Chicago to conduct research on Himalayan bird diversity gradient. He did his Post-Graduate Diploma in Wildlife Management in the year 1992. He was awarded a Ph.D. degree on ‘Habitat selection of birds in New Forest, Dehradun, India’ by the Forest Research Institute Deemed University, Dehradun. He also served in the wildlife headquarters of Uttarakhand Forest department for over five years. Before taking over as Director Wildlife Institute of India, Dehradun in January 2020, he served as Principal Chief Conservator of Forests, Planning and Financial Management and Chairman State Biodiversity Board, in the state of Uttarakhand. He has written a book and contributed a book chapter and has many publications particularly on avifauna, his primary interest. Some of these were published in topmost international journals like Nature, Nature communication, American naturalist, Biology letters and Journal of Ornithology. Dr Mohan has been a passionate birdwatcher and naturalist for nearly four decades and has spanned the length and breadth of the country in pursuit of it.

Dr. Dhananjai is a fellow of Leadership for Environment and Development (LEAD), a programme initiated by the Rockefeller foundation. He has been a recipient of Dr Salim Ali fellowship of Ministry of Environment and Forests, Govt. of India in 2005. He served as a consultant to TERI and supervised a doctoral research and 10 M.Sc. dissertations in wildlife science and forestry.