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Avian Diversity and Effect of Anthropogenic Activities on Temperate Forests of Garhwal Himalaya, Uttarakhand, India

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Abstract: Present study deals with the avian diversity and effect of anthropogenic activities on temperate forests of district Pauri Garhwal, Uttarakhand, India lying between 29° 22', 29° 75' North and 78° 10', 78° 80' E above 1500 m altitude. The field study was conducted at four different sites namely-- Pauri, Khirsu, Adwani and Lansdowne from April 2015 to March 2017. Line transect method was used to record the avian diversity. During this study, a total of 88, 84, 81 and 78 species of birds were recorded at Pauri, Khirsu, Adwani and Lansdowne, respectively. The bird diversity measured by Shannon wiener diversity index was recorded as $H' = 3.35 \pm 0.06$ at Pauri, $H' = 3.30 \pm 0.06$ at Khirsu, $H' = 3.48 \pm 0.11$ at Adwani and $H' = 3.78 \pm 0.12$ at Lansdowne. The species richness of birds was recorded as 9.94 ± 3.74 at Pauri, 9.46 ± 3.05 at Khirsu, 9.43 ± 3.98 at Adwani and 9.54 ± 1.36 at Lansdowne. We assessed the detrimental effects of various anthropogenic activities like fire wood collection, timber extraction, over exploitation, forest fire, over hunting, road construction etc. on birds and their habitats. Birds are currently facing with increasing threats from these activities in their natural habitat such as degradation, loss of foraging, breeding sites, nesting sites to egg damage, roosting, nestling death or disruption of incubation. Therefore, the avian fauna is disappearing at an alarming rate and threatening the survival of ecology of the temperate forests.

Keywords: Avian fauna, Anthropogenic activities, Temperate forest, Pauri Garhwal

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Introduction

The temperate forests of Garhwal Himalaya are renowned for their high levels of species richness including birds and biodiversity that is arguably among the greatest in the world. These forests are one of the most diverse habitats on earth. They provide food, shelter and oxygen for all living creatures on the earth. But over the past century, the temperate forests have been suffering from exceptional rates of change as they are destroyed.

The increasing human population is dominated on the ecosystems, intensifying human land use and thus affecting the biodiversity (Foley, 2005; Patankar, 2021). Effects of these activities are manifested at all ecological scales, through local extirpations and global extinctions (Pimm *et al.*, 1995; Chapin *et al.*, 2000). Changes in landscape structure results in the habitat loss and fragmentation which in turn affect biodiversity

and ecosystem (Grimm *et al.*, 2008; Richard and Marek, 2021). The diversity of bird species is expected to vary with habitat type even at the smallest scales. Global increases in the extent of anthropogenic activities contribute to interest by wildlife managers and the public in managing to reduce harm to birds. Among all the living organisms on earth, birds are regarded as important indicators of environmental change. Even effects of aggregation and disruption to flight paths may ultimately reduce survival during migration by reducing energy stores and delaying arrival at breeding as well as wintering grounds. Many studies have demonstrated the importance of habitat heterogeneity in bird species richness and abundance (Datta, 2011). Few species specific studies are conducted in the study area particularly on Himalayan monal (Bisht *et al.*, 1989), Chukur partridge (Kukreti *et al.*, 2005), Cheer pheasant (Bisht *et al.*, 2005; Phurailatpam *et al.*, 2005), White crested Kalij (Kumar *et al.*, 2009), bird diversity of district Pauri Garhwal (Bhandari *et al.*, 2015) and bird fauna of temperate forests of district Pauri Garhwal (Sudesh *et al.*, 2015, 2016, 2019; Elmugheira *et al.*, 2021).

Present study deals with the avian diversity and effect of anthropogenic activities on temperate forests of district Pauri Garhwal, Uttarakhand, India.

Materials and Methods

The present study was conducted in district Pauri Garhwal which is a Western part of the Himalaya, situated between 29° 22'-29° 75' North and 78°, 10' to 78°, 80' East and 1500m asl. Four stands of temperate forests with average size 0.5 to 2.0 km² and constituted by *Quercus*, *Rhododendron*, *Myrica*, *Pyrus*, *Cedrus* etc. were selected at Pauri, Khirsu, Adwani and Lansdowne.

The field study was conducted from April 2015 to March 2017. Line transect method (Verner, 1985; Javed and Kaul, 2002), was used to record the birds diversity and species richness. During the morning hours (between 6:00AM to

10:00 AM) and in the evening hours (4:30 PM to 6:30 PM) each bird was recorded and further identified with the help of field binocular (2 x 40X), digital camera (21mp x 63X zoom) and pocket field guides (Kazmeirczak, 2000; Ali, 2002; Gremmitt *et al.*, 2011). The diversity index and species richness of birds was calculated by using Shannon wiener diversity index (1949) and Margalef index (1968). Field survey conducted during the harsh weather conditions and rainy seasons were not considered in the results. Along with information on birds, records were also maintained on the anthropogenic activities at the study area like percentage of deforestation (lopping, chopping of trees), incidence of forest fires, intruders-number of the people visiting forests for fuel and fodder collection, cattle grazing, hunting and fruit collectors at each site round the year.

Results and Discussion

A total of 152 species of birds belonging to 09 orders and 44 families were recorded during the study. The overall diversity index of birds in the temperate forests of Garhwal Himalaya was recorded as $H' = 3.46 \pm 0.10$ and species richness 10.01 ± 0.28 (Table 1).

Highest diversity index ($H' = 3.78 \pm 0.12$) was recorded at Lansdowne and the lowest was recorded at Khirsu ($H' = 3.30 \pm 0.06$). The highest species richness was recorded at Pauri (9.94 ± 3.74) and the lowest at Adwani (9.43 ± 3.98) (Table 1).

Further, the temperate forests of district Pauri Garhwal, Uttarakhand were found under high anthropogenic pressure as deforestation, intrusion by wood and grass collectors, cattle, hunters and incidence of forest fires were recorded. Deforestation (chopping and lopping of trees) were recorded at all sites. The highest percentage of deforestation was recorded at Khirsu ($32.92 \pm 3.40\%$), followed by Pauri (30.08 ± 3.38), Adwani (12.42 ± 3.63) and lowest at Lansdowne ($4.25 \pm 1.10\%$; Table 1, Fig. 1).

Table 1: Bird diversity of temperate forests of district Pauri Garhwal, Uttarakhand

S. No.	Sites	Line transect method	
		Diversity Index	Species Richness
1.	Pauri	3.35±0.06	9.94±3.74
2.	Khirsu	3.30±0.06	9.46±3.05
3.	Adwani	3.48±0.11	9.43±3.98
4.	Lansdowne	3.78±0.12	9.54±1.36
	Average	3.46±0.10	10.01±0.28

Fig. 1: Correlation between deforestation, diversity index and species richness of birds of the temperate forests of district Pauri Garhwal.

Fig. 2: Correlation between invaders, diversity index and species richness of birds of the temperate forests of district Pauri Garhwal.

The maximum human intrusion (visiting forests without any aim or picnic) was recorded in the month of June (19.11±9.81%) and lowest in the month of October (5.65±1.90%, Fig. 2).

The highest percentage of people visiting the forests for wood and grass collection was recorded in the month of December (27.75±14.91%) and the lowest percentage was recorded in the month

of October (4.56±2.68%, Fig. 3).

The cattle also use the temperate forests for grazing throughout the year during study period. Highest number of cattle in the forests was recorded in the month of November (23.57±13.74%) and lowest in the month of February (4.63±2.29%; Fig. 4).

Fig. 3: Correlation between wood and grass collectors, diversity index and species richness observed in temperate forests of district Pauri Garhwal.

Fig. 4: Correlation between domestic animals, diversity index and species richness observed in temperate forests of district Pauri Garhwal.

Fig. 5: Correlation between hunters, diversity index and species richness observed in temperate forests of district Pauri Garhwal.

Despite ban on the hunting under the Wildlife Protection Act (1972), hunters were also seen in the temperate forests. The highest percentage of hunters was recorded in the month of March (0.11 ± 0.11) and no hunting was recorded in the month of April, May, September and October (Fig. 5). The unusual forest fire was recorded

during the month of May and June (Figs. 6 A, B).

Therefore, the preliminary data on deforestation indicate that this is one of the reasons of decline of bird population in the area. Because bird diversity and species richness was less $H' = 3.30 \pm 0.06$, $H' = 3.35 \pm 0.06$ and $H' = 3.48 \pm 0.11$, respectively whereas

A

B

Figs. 6 A-B: Unusual forest fire in May (A) and June (B).

percentage of deforestation was higher as in Khirsu (32.9%), Pauri (30.08%) and Adwani (12.42%). On the other hand, the Lansdowne had low deforestation (<4.25%), the diversity and species richness of birds was high $H' = 3.78 \pm 0.12$ and 9.54, respectively. Therefore, results of the study also showed that the diversity index and species richness was high where anthropogenic activities were low and the diversity index and species richness was low having high anthropogenic pressure. Apart from these activities, virtually all the human activities can affect wildlife populations either positively or negatively. Such types of activities are likely to have adverse effects on bird's diversity and alter the physical environmental change and suitability of habitat for a species and also cause changes to an animal's behavior. In general, these are land use or management practices that change the trajectory of ecological succession, including altering the dominant plant communities and birds of that particular area. The ecological effects of these activities on birds and other faunal diversity are readily apparent and have been relatively well studied (Lichstein *et al.*, 2002). Although effects of the anthropogenic activities on biodiversity are typically of short duration, cumulatively they can effect wildlife populations adversely in both the short- and long-term (Holmes *et al.*, 1994; Johnson *et al.*, 2005).

Therefore, results of this study shows that the human activities that cause physical changes to birds including other faunal diversity, such as habitat destruction, deforestation, construction of building and roads, vegetation destruction, hunting, forest fire and overgrazing resulting from overuse of forest resources and wildlife related impacts are

harmful for the flora and fauna of that area. Many researchers pointed out that there will be decrease in the number of birds depending on increase in the anthropogenic activities in the area. Further, one of the most important thing observed in the study area was that the local people cut down the trees for their basic house hold purposes on daily bases. Therefore, the main reason of decline of bird population is deforestation and habitat loss because more than 70% human settlement exists in this area (Sudesh *et al.*, 2019).

Besides, people don't know that they lose animals to graze in the vicinity. The animals were found grazing nearby areas that also damage the surrounding vegetation of the region. Most of the birds live build their nests and derive their food from the trees but timber harvesting has altered the natural state of forest areas at an increasing rate. The bird communities are highly sensitive to changes in habitats by human disturbances (Pidgeon *et al.*, 2007) hence, they have been used effectively as bio-indicators in many ecosystems. But in the recent years invasion of alien vegetation (*Eupatorium*) is appearing as a new threat to the local biodiversity (Bisht *et al.*, 2012; Sekar, 2012).

Conclusion

The anthropogenic activities such as, deforestation, forest fire, hunting, use of chemicals in agriculture land and logging will affect adversely the biodiversity of birds at this region in the near future. Therefore, necessary and effective steps should be taken for environmental protection and conservation of birds including other fauna and flora to protect the bird diversity. So such type of increased activities should be

curbed in order to ensure future survival of avifaunal diversity of temperate forests of district Pauri Garhwal, India. There should be ban on these activities which are happening daily base in the study area and so that the biodiversity of this area can prove to be a blessing to the threatened species of bird of the temperate forest of the Garhwal, Himalaya.

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