

Research Article

**BIRD COMMUNITIES STRUCTURE ALONG WITH SPECIES
DIVERSITY, RELATIVE ABUNDANCE AND HABITAT USE OF
TEHSIL UDHAMPUR, JAMMU AND KASHMIR, INDIA**

Rajan Singh^{*}, Kapil Dev, Deep Novel Kour, and D.N. Sahi

P.G. Department of Zoology, University of Jammu,
Jammu-180 006, Jammu and Kashmir, India

Article History: Received 3rd December 2013; Accepted 13th January 2014; Published online 3rd February 2014

ABSTRACT

The present study dealt with the diversity, Resident/Migratory status, abundance, diversity indices and habitat used by the bird communities within five different habitats Cultivated Area (CA), Coniferous Forests (CF), Mixed Deciduous Forests (MDF) scrubby areas (SA) and Urban Areas (UA) of Tehsil Udhampur of Jammu and Kashmir. Udhampur town is located in Lesser Himalayas and upper Shiwalik of Jammu and Kashmir and has lies between 32° 55' 08" N and 75° 07' 52" E and elevation is 745 m from mean sea level. The data was collected from twenty four transects made during April 2011 to April 2012. A total of 3884 birds were counted belonging to 66 species, 11 orders and 27 families with annual abundance 946, 287, 928, 819 and 904 at CA, CF, MDF, SA and UA respectively. Mixed Deciduous forests were found to support maximum number of bird species (58) because of food and nesting sites availability. Order Passeriformes dominated among the four bird communities with 37 species. Shannon weaver index, Marglef richness Index and Reciprocal Simpson Index were found maximum at Mixed Deciduous Forest (MDE). Simpson diversity index was found maximum at urban areas. Cultivated area and Scrubby Area were found more similar with highest value of Sorenson's Quotient of similarity (Q/S) (86.95%). The dominant species of CA, MDF, CF, SA and UA were House Sparrow, White-rumped Vulture, White-Cheeked Bulbul, Indian Blue Rock Pigeon and Common Myna respectively. 80.33 % of species were resident, 3.03% were winter migrant and 13.63% were summer migrant. Of the total 66 species reported, 51.51% were insectivorous, 22.72% carnivorous, 12.12% grainivorous, 7.5% omnivorous, 4.5% frugivorous and 1.5% bark feeders.

KEYWORDS: Udhampur, avifauna diversity, mixed deciduous forests, scrubby area, Jammu and Kashmir.

INTRODUCTION

Indian subcontinent is known for diverse and rich bird species whose taxonomy, distribution and their general habitat characteristics are well documented in India (Jerdon, 1862-1964; Bates and Lowther, 1952; Ali and Ripley, 1983). Bird community evaluation has become an important tool in biodiversity conservation and for identifying conservation actions in areas of high human pressure (Kremen, 1992; Safiq *et al.*, 1997). Bird communities have been studied fairly well both in temperate and tropical forests

(Blake, 2007; Latta *et al.*, 2003; Mac Arthur and Mac Arthur, 1961; Terborgh *et al.*, 1990; Thiollay, 1994; Wiens, 1989; Willson and Comet, 1996). However, only a very little is known about bird community structure and their dynamics in India (Daniels, 1989; Khan *et al.*, 1993; Khan *et al.*, 2012; Johnsingh and Joshua, 1994; Javed, 1996; Safiq *et al.*, 1997; Price *et al.*, 2003; Sultana and Khan, 1999 and 2000; Sultana *et al.*, 2007; Acharya, 2008; Chettri *et al.*, 2001; Raman *et al.*, 1998, Jayson and Mathews, 2002; Das, 2008; Singh *et al.*, 2013a). Large scale habitat changes are occurring

*Corresponding author e-mail: rsthakurlibra@gmail.com

globally for fulfilling human needs that have caused habitat destruction, fragmentation and degradation, necessitating assessment on the impacts of such change on birds (Khan *et al.*, 1993). Understanding the diversity and structure of bird communities is essential to delineate the importance of regional or local landscapes for avian conservation (Kattan and Franco, 2004). Determinations of bird population in various habitats are central to understanding the community structure and niche relationships, as well as for intelligent management of

populations. Moreover seasonal monitoring is equally important to trace the dynamic movement of birds in such habitats (Green and Catterall, 1998).

MATERIALS AND METHOD

Study area

The study was carried out from April 2011 to April 2012. The present study was conducted at Tehsil Udhampur of District Udhampur of Jammu and Kashmir, which is a part of the Northwest Lower Himalayas (Figure 1).

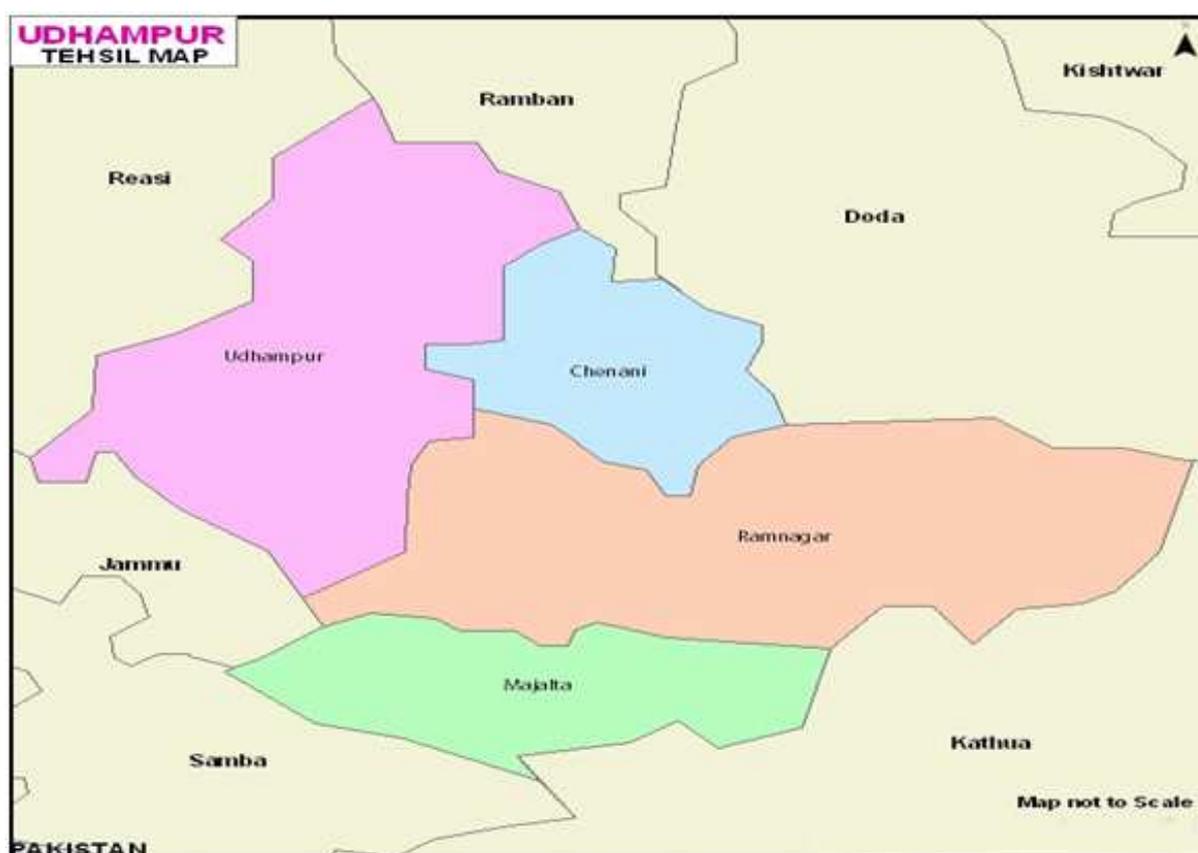


Figure 1. Map showing Study Area (Tehsil Udhampur).

The geographical location of the town Udhampur lies between $32^{\circ} 55' 08''$ N and $75^{\circ} 07' 52''$ E with an elevation is 745 m from mean sea level. The climate of study area is sub tropical and the temperature ranges between 40 degrees during summer while in winter dips to 2 degrees or even sometimes to zero with annual rainfall is 130 cm mainly in monsoons and winters due to Western disturbances. However due to changing climate patterns snowfall has been experienced in some years. Heavy

hailstorms with piles of hail can be experienced in February and March of 2012. The forest is of temperate type. The pre-dominant tree species comprises of *Pinus rouxbergii*, *Cedrus deodara* and *Quercus* sps. Mixed deciduous forests and scrubby areas are also found. The common species of Mixed Deciduous forests are *Dalbergia sisso*, *Zizyphus marutiana*, *Punica granatum*, *Acacia nilotica*, *Melia azadirachtica*, *Robinia pseudocasia*, *Pyrus pashia*, *Aegle marmelos*, *Populus ciliate*, *Grewia optica*, *Olea*

cuspidate, *Ficus* sps., *Carissa opaca*, etc. The common species of scrubby area are *Punica granatum*, *Berberis artista*, etc.

Methodology

Variable width line transects method adopted by Burnham *et al.* (1980) was used in which observer walks through a fixed path counting the birds seen or heard on both sides of the path. Line Transect Method and Visual Count Method were applied for the record of avian diversity. Census was carried out twice in a month starting from April 2011 to April 2012. During the census a distance of 4 km was covered with a fixed duration of 120 minutes, thus covering 2 km/hour and this census was maintained throughout census. The transect were selected of the representative habitats of the area namely Scrubby Area, Mixed Deciduous Forest, Coniferous Forest, Cultivated Areas and Urban areas. 24 samples of line transects were collected from the study area during 12 months period.

In order to maintain uniformity, all surveys were conducted from 6:30 am to 10:30 am in the morning and 4:30 pm to 6:30 pm in the evening during summer and 7:30 am to 11:30 am in the morning and 3:30 pm to 5:30 pm in the evening during winter. Binoculars (Bushnell 750, USA made) were used to record the observation from a distance to avoid any disturbance to the birds and photography was done by making use of Cannon T-70 camera with 210 mm and 300 mm lens. Whenever a bird was spotted, it was identified and details like number of birds and habitat were noted. For identification and field diagnosis of birds, colourful plates of Ali and Ripley (1968-74) and Grimmett *et al.* (1998) were used. For recording the abundance of the avifauna during the survey, the terminology used by Ahmed and Sahi (2005) was used.

C = common: means it can be invariably be seen in that habitat where it occurs with the proviso of course that the reason is also appropriate.

F= Frequent: means that visiting appropriate habitat it will not be seen or heard invariably, perhaps only in one visit out of three.

O= Occasional: means seen or heard only in one visit out of six.

R= rare: means even less likelihood of occurrence

The five habitats surveyed were:

1. Scrub forest Habitat (SF)
2. Deciduous forest habitat (DF)
3. Coniferous Forest Habitat (CF)
4. Cultivated Areas habitat (CA)
5. *Urban areas(UA)*

Statistical analysis

To compare bird community, various indices calculated at each station. Species diversity was determined by applying Shannon-Weaver Diversity Index (Shannon and Weaver, 1949), $H' = - \sum_{i=1}^S p_i \ln(p_i)$, in which H' is the information content of sample (bits/individuals), S is the number of species and pi is the proportion of total species belonging to its species. Simpson's Index of dominance (C) was calculated by formula $C = \sum_{i=1}^S p_i^2$ (Stone and Pence, 1978) where pi is the proportion of total number of individuals of each species. Species richness was determined applying Marglef's Index (Marglef, 1968), $d' = S - 1/\text{Log } n$ (N), in which S is the total number of species, N is the total number of individuals in sample and Log n is the Natural log. Evenness was calculated using the Pielou Index, $E = H'/\ln S$ (Pielou, 1969), where H' is the Index of diversity of Shannon-Weaver, ln is the Natural log and S is the total number of species. Percentage similarity of the bird communities at different stations was calculated by Sorenson's Quotient of Similarity (Sorenson, 1948), $Q/S = (2j/a+b) 100$, where j is the number of species common to both samples, a is the total number of species in sample 1 and b is the total number of species in sample 2. The relative dominance of each bird species in different habitats was calculated by determining the Dominance Index. The formula $D=n_i * 100/N$ was used for calculating the Dominance index (D) where n_i is number of individuals of the species, N is total number of individuals of all the species seen during the study period.

RESULTS

A total of 3884 birds were counted belonging to 66 species, 11 orders and 27 families with annual abundance 946, 287, 928, 819 and 904 at CA, CF, MDF, SA and UA respectively. The systematic list of 66 species belonging to 11 orders and 27 families along with their migratory status, abundance and feeding guild is presented in Table 1.

Table 1. Checklist of Birds of Tehsil Udhampur with migratory status, abundance and feeding guild.

S. No.	Name	Status	Abundance	Feeding Guild
Order 1: Passeriformes				
Family 1: Passeridae				
1.	White Wagtail <i>Motacilla alba</i>	SM	F	Inst.
2.	Large Pied Wagtail <i>Montacilla maderaspatens</i>	Rst	O	Inst.
3.	Yellow Waigtail <i>Montacilla flava</i>	SM	R	Inst.
Family 2 : Nectrainidae				
4.	Purple Sunbird <i>Nectarinia asiatica asiatica</i>	Rst	O	Inst.
5.	Yellow backed Sunbird <i>Aethopyga siparaja</i>	Rst	O	Inst.
Family 3: Musciapiidae				
6.	Jungle Babbler <i>Turdoides striatus somervillei</i>	Rst	C	Inst.
7.	Common Babbler <i>Turdoides caudatus caudatus</i>	Rst	C	Inst.
8.	Paradise Flycatcher <i>Terpsiphone paradise paradise</i>	SM	O	Inst.
9.	Indian Tailor Bird <i>Orthotomus sutorius guzuratus</i>	Rst	C	Inst.
10.	Indian Magpie Robin <i>Copsychus saularis saularis</i>	WM	O	Inst.
11.	Pied Bush Chat <i>Saxicola caprata bicolour</i>	Rst	O	Inst.
12.	Indian Robin <i>Saxicoloides fulicata cambaiensis</i>	Rst	F	Inst.
13.	Brown Rock Chat <i>Cercomela fusca</i>	Rst	R	Inst.
14.	Pied Bush Chat <i>Saxicola caprata bicolour</i>	Rst	C	Inst.
Family 4: Lanidae				
15.	Rufous- backed Shrike <i>Lanius scahach erythronotus</i>	Rst	F	Car.
Family 5: Oriolidae				
16.	Indian Golden Oriole <i>Oriolus oriolus kundoo</i>	SM	O	Inst.
Family 6: Dicruridae				
17.	Black Drongo <i>Dicrurus adsimilus</i>	Rst	C	Inst.
Family 7: Sturnidae				
18.	Indian Myna <i>Acridotheres tristis tristis</i>	Rst	C	Inst.
19.	Brahminy Myna <i>Sturnus pagodarum</i>	Rst	O	Inst.
20.	Bank Myna <i>A. ginginnianus</i>	Rst	C	Inst.
Family 8: Corvidae				
21.	House Crow <i>Corvus splendens splendens</i>	Rst	C	Omn.

22. Jungle Crow <i>C.macrorhynchos culminates</i>	Rst	F	Omn.
23. North Eastern Treepie <i>Dendrocitta vagabunda</i>	Rst	O	Omn.
24. Yellow Billed Blue Magpie <i>Cissa flavirostris</i>	Rst	F	Omn.
25. Himalayan Whistling Thrush <i>Myiophonus caeruleus</i>	Rst	F	Inst.
26. Long Tailed Minivet <i>Pericrocotus ethologus</i>	Rst	R	Inst.
Family 9: Pycnonotidae			
27. Red- vented Bulbul <i>Pycnonotus cafer cafer</i>	Rst	C	Inst.
28. White-cheeked Bulbul <i>P. leucogenys leucogenys</i>	Rst	C	Inst.
Family 10: Hirundinidae			
29. Red-rumped Swallow <i>Hirundo daurica</i>	Rst	C	Inst.
30. Wire Tailed Swallow <i>Hirundo smithii</i>	Rst	O	Inst.
Family 11: Monarchinae			
31. Verdicator Flycatcher <i>Muscicapa thalassaina thalassaina</i>	SM	O	Inst.
Family 12: Turnidae			
32. White Capped Redstart <i>Chaimarrornis leucocephalus</i>	Rst	O	Inst.
Family 13: Ploceidae			
33. Indian House Sparrow <i>Passer domesticus indicus</i>	Rst	C	Grn.
34. Spotted Munia <i>Lunchura punctulata</i>	SM	C	Grn.
Family 14: Paridae			
35. Grey Tit <i>Parus major</i>	Rst	F	Frg.
36. Green Backed Tit <i>Parsus monticolus</i>	Rst	R	BF
Family 15 : Emberizinae			
Family 16: Phylloscopidae			
37. Grey-Hooded Warbler <i>Phylloscopus xanthoschistos</i>	Rst	C	Inst.
Order 2: Falconiformes			
Family 17: Accipitridae			
38. Long-Billed Vulture <i>Gypus indicus</i>	Rst	C	Car.
39. White-Rumped Vulture <i>Gypus bengalensis</i>	Rst	F	Car.
40. Pariah Kite <i>Milvus migrans govinda</i>	Rst	C	Car.

41. Steppe Eagle <i>Aquila nepalensis</i>	WM	R	Car.
42. Indian Shikra <i>Accipiter badius dussumieri</i>	Rst	C	Car.
Order 3: Galliformes			
Family 18: Phasianidae			
43. Indian Red Jungle Fowl <i>Gallus gallus murghi</i>	Rst	R	Inst.
44. Grey Partridge <i>Francolinus pondiecirianus</i>	Rst	R	Grn.
45. Black Partridge <i>Francolinus francolinus</i>	Rst	O	Grn.
Order 4: Columbiformes			
Family 19: Columbidae			
46. Indian Blue Rock Pigeon <i>Columbia livia</i>	Rst	F	Grn.
47. Indian Spotted Dove <i>Streptopelia decaocta decaocta</i>	Rst	F	Grn.
48. Rufous Turtle Dove <i>S. orientalis orientalis</i>	SM	O	Grn.
49. Indian Ring Dove <i>Streptopelia chinensis suratensis</i>	Rst	C	Grn.
Order 5 : Psittaciformes			
Family 20: Psittacidae			
50. Rose Ringed Parakeet <i>Psittacula krameri manillensis</i>	SM	C	Frg.
51. Blossom Headed Parakeet <i>P. cynocephali</i>	SM	C	Frg.
Order 6: Strigiformes			
Family 21: Strigidae			
52. Northern Spotted Owllet <i>Athene brama indica</i>	Rst	O	Car.
53. Barred Jungle Owllet <i>Glaucidium radiatum radiatum</i>	Rst	R	Car.
54. Great Horned Owl <i>Bubo bubo bengalensis</i>	Rst	C	Car.
Order 7: Coraciiformes			
Family 22: Alcedinidae			
55. White Breasted Kingfisher <i>Halcyon smyrnensis smyrnensis</i>	Rst	C	Car.
Order 8: Upupiformes			
Family 23: Upupidae			
56. European Hoopoe <i>Upupa epops epops</i>	Rst	C	Inst.
Family 24: Picidae			
57. Maharatta Woodpecker <i>Picooides maharathensis maharathensis</i>	Rst	O	Inst.

58. Lesser Golden Backed Woodpecker <i>Dinopium benghalense benghalense</i>	Rst	R	Inst.
59. Brown-fronted woodpecker <i>Dendrocopos auriceps</i>	Rst	O	Inst.
60. Blue-throated Barbet <i>Megalaima asiatica</i>	Rst.	F	Omn.
Order 9: Cuculiformes			
Family 25: Cuculidae			
61. Indian Koel <i>Eudynamys scolopacea scolopacea</i>	Rst	C	Inst.
Order 10: Cicconiformes			
Family 26: Ardeidae			
62. Cattle Egret <i>Bubulcus ibis</i>	Rst	C	Car.
63. Indian Pond Heron <i>Ardeola grayii grayii</i>	Rst.	C	Car.
64. Little Egret <i>Egretta garzetta</i>	Rst	R	Car.
65. Cattle Egret <i>Bubulcus ibis coromandus</i>	Rst	C	Car.
Order 11: Gruiformes			
Family 27: Rallidae			
66. White Breasted Waterhen <i>Amaurornis phoenicurus phoenocurus</i>	Rst	C	Car.

SM= Summer Migrant, WM= Winter Migrant, Rst. =Resident, Inst.= Insectivores, Omn.=Omnivorous, Car.= Carnivorous, Frg.= Frugivorous, Grn.= Granivores, BF=Bark feeder.

Relative abundance

Annual abundance of birds was observed to be 946, 287, 928, 819 and 904 respectively at Cultivated Areas (CA), Coniferous forest (CF), Mixed deciduous forest (MDF), Scrubby Areas (SA) and Urban Areas respectively (Table 2). Approximately proportions of species fell into each of the four abundance categories common (30.43%), occasional (27.53%), frequent

(24.63%) and rare (17.39%). Out of 11 orders, order Passeriformes dominated the bird community (56.06%) followed by Piciformes (10.14%), Falconiformes (7.57%), Upupiformes (7.54%), Columbiformes (6.06%), Cicconiformes (6.06%), Galliformes (4.54%), Stringiiformes (4.54%), Psittaciformes (3.03%), Cuculiformes (1.5%) and Coraciiformes (1.5%) (Figure 2).

Table 2. Site wise population of birds at five different habitats.

Name	Cultivated areas	Coniferous forests	Mixed Deciduous forests	Scrub by Areas	Urban areas	Total
Bank Myna	9	0	0	0	74	83
White Capped Redstart	0	6	6	0	0	12
Great Horned Owl	4	1	1	0	0	6

Maharatta						
Woodpecker	3	3	7	0	0	13
Lesser Golden						
Backed Woodpecker	8	9	11	0	0	28
Brown Fronted						
woodpecker	5	7	12	0	0	24
Indian Koel	15	0	16	0	0	31
Indian Pond Heron	6	0	0	0	0	6
White Breasted						
Waterhen	5	0	0	0	0	5
Northern Spotted						
Owlet	3	3	4	1	0	11
Yellow Waigtail	1	4	3	2	0	10
Yellow Billed Blue						
Magpie	2	9	6	2	0	19
Long Tailed Minivet	3	5	8	2	0	18
Verdicator						
Flycatcher	0	4	7	2	0	13
Steppe Eagle	0	8	7	2	0	17
Barred Jungle Owlet	3	6	3	2	0	14
White Breasted						
Kingfisher	8	0	5	2	7	22
Yellow Backed						
Sunbird	3	0	9	4	0	16
Paradise Flycatcher	3	6	7	4	0	20
House Crow	34	0	0	4	65	103
North Eastern						
Treepie	6	7	16	4	0	33
Indian Red Jungle						
Fowl	0	21	7	4	0	32
Blue-throated Barbet	9	0	17	4	0	30
Indian Shikra	6	6	9	5	0	26
Indian Golden Oriole	15	3	29	6	0	53
Lon Billed Vulture	0	7	9	6	0	22
Rose Ringed						
Parakeet	33	0	46	6	19	104
Purple Sunbird	16	2	0	7	0	25
Pariah Kite	0	14	4	7	26	51
Rufous Turtle Dove	11	0	9	7	0	27
Cattle Egret	13		0	7	2	22
Brahminy Myna	7	0	9	8	4	28
Wire Tailed Swallow	18	0	6	8	48	80
Little Egret	9	0	0	8	0	17
Indian Robin	12	3	8	9	4	36
Jungle Crow	25	21	17	9	132	204
Red-rumped						
Swallow	15	0	6	9	102	132

Spotted Munia	23	0	13	9	0	45
Cattle Egret	16	0	7	9	0	32
Grey Partridge	2	4	6	11	0	23
Black Partridge	9	7	17	11	0	44
Large Pied Wagtail	2	7	11	12	0	32
White-rumped Vulture	0	26	7	13	0	46
White Wagtail	4	6	13	14	0	37
European Hoopoe	5	7	17	14	0	43
Indian Tailor Bird	8	0	2	17	0	27
Indian Myna	41	0	26	17	235	319
Green-backed Tit	9	0	31	17	0	57
Indian Magpie Robin	4	2	14	18	0	38
Rufous-backed Shrike	17	0	19	18	7	61
Grey Tit	36	0	37	18	0	91
Himalayan Whistling Thrush	6	15	18	19	0	58
Indian Spotted Dove	17	0	8	19	0	44
Brown Rock Chat	0	5	19	21	0	45
Indian Ring Dove	29	0	31	22	0	82
Red-vented Bulbul	24	0	56	23	9	112
Blossom Headed Parakeet	27	0	16	24	4	71
Black Drongo	17	0	25	27	5	74
Indian House Sparrow	173	0	0	31	86	290
Indian Magpie Robin	5	13	21	32	4	75
Jungle Babbler	15	19	47	35	0	116
White-cheeked Bulbul	46	0	76	37	21	180
Grey Hooded Warbler	36	0	24	37	0	97
Pied Bush Chat	18	2	23	45	0	88
Common Babbler	16	4	31	46	3	100
Indian Blue Rock Pigeon	31	15	9	62	47	164
Total	946	287	928	819	904	3884

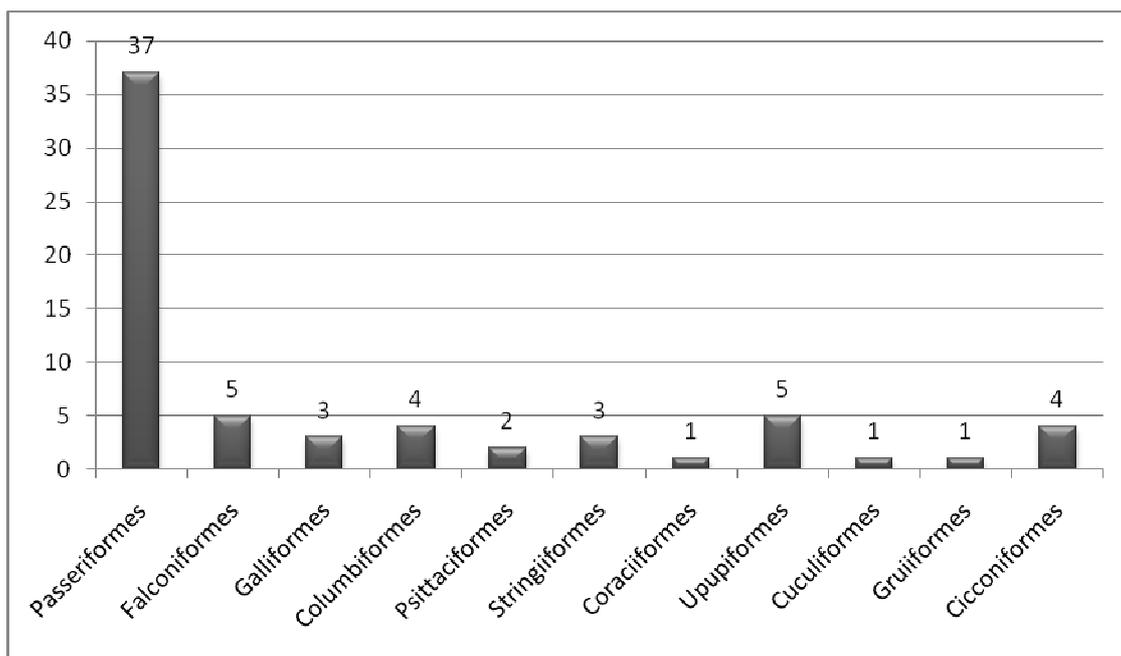


Figure 2. Bar diagram showing the distribution of Bird species of different orders.

Habitat utilization

The order of utilization of different habitats was recorded as CA>MDF> UA> SA > CF in order of their relative abundance in different habitats. But the maximum numbers of species (58 out of 66) were found in MDF.

Migration status

Out of total 66 species, 55 species were Resident and 11 species were migrant. Out of 15 migrant species, 9 species were summer migrant and 2 species were winter migrant (Figure 3).

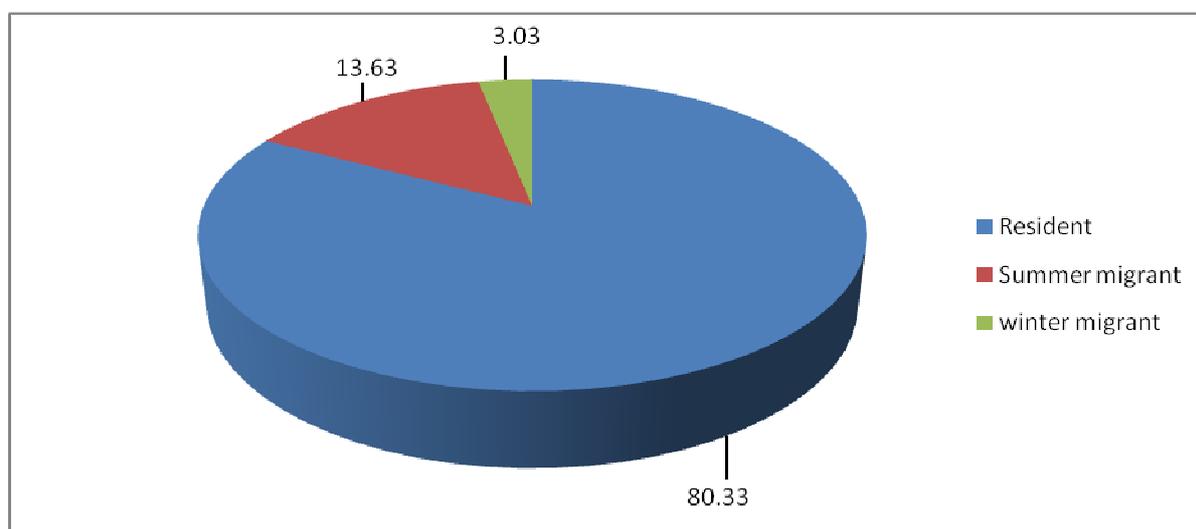


Figure 3. Pie diagram showing relative percentage of migratory status of avifauna of the study area.

Diversity indices variations

The variations in diversity indices of bird community at five different habitats of study area are given in Table 3. The Shannon Index of diversity found maximum (3.75) at MDF and

minimum (3.33) at CA. Simpson Diversity Index was greatest at Cultivated Area (0.067) and lowest at Mixed Deciduous Forests (0.027). The highest Marglef’s richness index value (9.8) was calculated at Mixed Deciduous Forests and lowest (3.4) at Urban Areas. Highest Marglef’s

species richness index (which considers both abundance and species number) at Mixed Deciduous Forests revealed that this site harboured a good number of bird taxa. Pielos Evenness Index showed maximum evenness at Coniferous Forest (0.930) and minimum at Urban Area (0.773). Highest Marglef's species

richness index (which considers both abundance and species number) at Deciduous Forests revealed that this site harboured a good number of bird taxa. Simpson diversity index was found maximum (0.130) at Urban Areas and minimum (0.030) at Mixed Deciduous Forests.

Table 3. Diversity indices of bird community in five different habitats of study area.

Diversity indices	Cultivated Area	Coniferous Forests	Mixed Deciduous Forests	Scrubby area	Urban areas
Shanon-Weaver Index	3.52	3.33	3.75	3.69	2.35
Marglef Richness Index	6.5	6.4	9.8	8.4	3.4
Abundance	946	287	928	819	904
Simpson Diversity Index	0.051	0.042	0.030	0.034	0.130
Reciprocal Simpson Index	18.86	22.89	32.68	31.56	7.69
Pielos Evenness index	0.868	0.930	0.920	0.913	0.773

Relative Dominance

The relative dominance of species in different habitats is given in Table 4. House sparrow was found dominant in rural habitation and Cultivated Areas because of lot of nesting sites available in mud houses present in the study area and food availability. White Rumped Vulture

was found dominant in Coniferous forests. The dominant species of Mixed Deciduous Forests found was White Cheeked Bulbul. Scrubby Areas has Indian Rock Pigeon as dominant species. Common Myna was found as dominant species in Urban Areas.

Table 4. Dominance index of selected species at five different habitats.

Cultivated areas	Mixed Deciduous Forests	Coniferous Forests	Scrubby Areas	Urban areas
Indian House Sparrow (0.18)	White-rumped Vulture (0.081)	White-cheeked Bulbul (0.099)	Indian Blue Rock Pigeon (0.075)	Indian Myna (0.3528)
White-Cheeked Bulbul (0.045)	Jungle Crow (0.060)	Red Vented Bulbul (0.073)	Common Babbler (0.056)	Jungle Crow (0.146)
Indian Myna(0.043)	Indian Red Jungle Fowl (0.050)	Jungle Babbler (0.073)	Pied Bush Chat (0.054)	Red-rumped Swallow (0.112)
Grey Hooded Warbler (0.038)	Jungle Babbler (0.049)	Rose Ringed Parakeet (0.066)	Grey Hooded Warbler (0.054)	Indian House Sparrow (0.095)
Grey Tit (0.038)	Indian Blue Rock Pigeon (0.048)	Grey Tit (0.052)	White-cheeked Bulbul (0.045)	Bank Myna (0.081)

Similarity index

Comparison between habitats was made by using qualitative presence-absence type and it was found that Cultivated Areas and Scrubby Area

were found more similar with highest value of Sorenson's Quotient of similarity (Q/S) (86.95%) whereas lowest similarity (19.71%) was calculated between urban areas and coniferous forest habitats (Table 5).

Table 5. Sorenson's similarity indices to compare the community structure of five types of habitats.

Compared habitats A vs B	No. of species			Sorenson's Quotient
	A	B	Common	
CA vs CF	58	36	28	59.57%
CA vs MDF	58	58	50	86.20%
CA vs SA	58	57	50	86.95%
CF vs MDF	36	58	34	72.34%
CF vs SA	36	57	31	66.66%
MDF vs SA	58	57	52	82.05%
CA vs UA	58	21	20	50.63%
CF vs UA	36	21	6	21.05%
MDF vs UA	58	21	17	43.03%
SA vs UA	57	21	20	51.28%

Feeding Guild

In order to study feeding biology of the birds in the study area 6 major feeding guilds were reported and divided into six categories viz. insectivorous, carnivorous, grainivorous, omnivorous, frugivorous and bark feeders. Of the total 66 species reported, 34 species were insectivores, 15 species were carnivorous, 8 species were grainivorous, 5 species were omnivorous, frugivorous were 3 species and 1

species were Bark Feeder (Figure 4). The data depicts that the overall highest proportion is of insectivores birds followed by carnivorous. The species composition of bird association and guilds changed periodically. Availability of food resource appeared to be a very influential factor controlling seasonal fluctuation of bird communities, the other being changes of climatic conditions and consequent emigration and immigration.

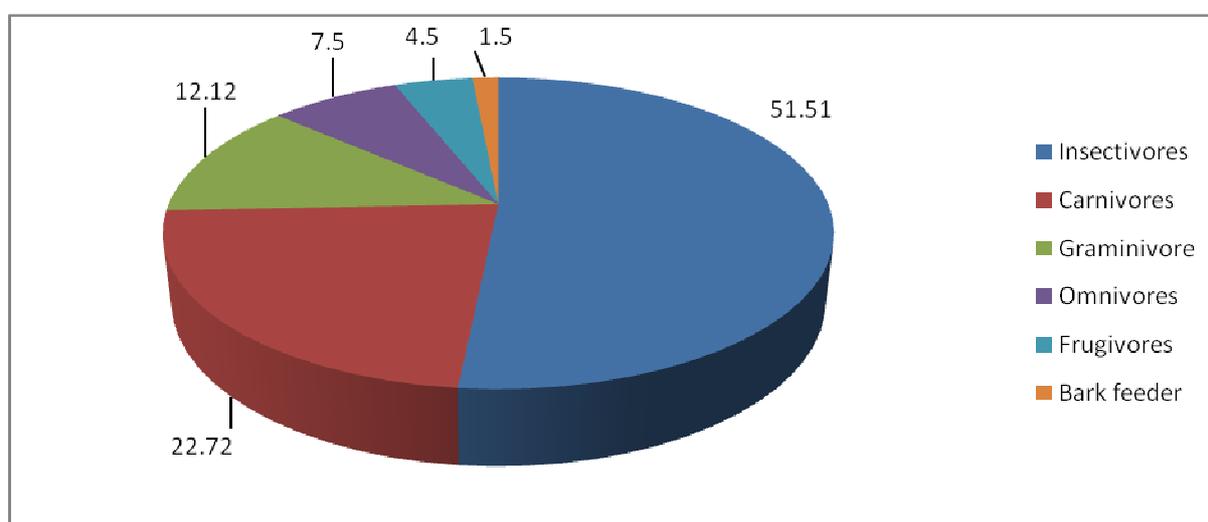


Figure 4. Pie diagram showing relative percent of feeding guild used by bird communities in the study area.

DISCUSSION

Ahmed and Sahi (2005) have reported 41 species belonging to 6 orders and 22 families from Tehsil Doda which is about 106 km and is located in lower Himalayas. Singh *et al.* (2013b)

has also reported 69 species, 11 orders and 29 families in Tehsil Chenani which is 24 km away from the Udhampur Town. During the course of study order Passeriniiformes was found dominant. Singh *et al.* (2013a) and Ahmed and Sahi (2005) also reported order Passeriniiformes as dominant

order in Tehsil Chenani and Tehsil Doda respectively.

During study it was found that Jungle crow, Common Myna, Bank Myna and Pariah Kite number increases in urban areas because of their wide adjustably in different areas. The House Sparrow number was found to decreasing in urban areas because of lack of nesting sites, lack of roosting sites, competition for nesting sites with other birds etc. The number of House Sparrow was found to be less in Urban Areas than Rural Areas. Singh *et al.* (2013b) has also reported the lack of nesting sites, the lack of spiny shrubs and trees less than 7 ft. height, lack of animal diet in early stage of nestling diet and intense competition for nesting sites for birds like Common Myna, Red -Rumped Swallow etc. as cause of decline of House sparrow in urban areas of Jammu.

The bird community composition is correlated to the species richness of trees and not to its abundance and also that the population size of bird species is unaffected by tree diversity (Das, 2008). The Mixed Deciduous Forest was found to support maximum species of birds in present study. The deciduous forests have variety of broadleaved, grasses and herbs and thus support a large population of birds. The deciduous forests also provide lot of nesting sites for birds. Singh *et al.* (2013b) found maximum abundance in MDF (instead of CA in present study) out of four different habitats studied (CA, MDF, SA and CF) but maximum number of species (64 out of 69) were reported from MDF. Dass (2008) has studied bird community structure in six habitats namely Evergreen with grassland (EGGL), Disturbed Evergreen (EGD), Evergreen (EG), Shola Forests (SHOLA) and Shola with Grassland (SHOLAG) and Broad-leaved hill forests (BLHF). The maximum species (59.2%) and individuals (27.2%) were in evergreen forest habitat which also has maximum species richness for plant species and minimum in BLHF (22.8 % and 5.73% respectively). Jayson and Mathews (2002) compared bird community structure of two different habitats tropical evergreen and moist deciduous forests and found that the latter supported maximum number of species and it also had more species richness of vegetation. The variation in species diversity and species

evenness at various habitats may be due to the availability of food to the birds, nesting sites, change of climatic conditions and consequent emigration and immigration (Singh *et al.*, 2013a).

In rural habitation and Cultivated Areas, the House Sparrow was found to be dominant because of lot of nesting sites available in mud houses present in the study area and food availability. The House Sparrow is primarily associated with human habitations e.g., agricultural land, villages and urban areas (Lowther and Cink, 1992).

Order Insectivore was found to be dominant in present study. Insectivore feeding guild has also been reported as major feeding guild in Tehsil Doda (Ahmed and Sahi, 2005) and in Tehsil Chenani (Singh *et al.*, 2013a). Karr *et al.* (1990) observed that the presence of food resources available to and exploited by birds in defining the trophic structure of the community. According to Wiens (1989) similarities or difference among species in diet composition are especially relevant to the tests of niche or guild concept. The species composition of bird association and guilds changed periodically. Availability of food resource appeared to be a very influential factor controlling seasonal fluctuation of bird communities, the other being changes of climatic conditions and consequent emigration and immigration.

CONCLUSIONS

The results showed that there was a significant difference in the avian diversity among different habitats. The study depicted that the maximum bird diversity is directly linked with maximum plant diversity. Tehsil Udhampur represents 5% of the bird species out of the total birds species i.e. 1300 species recorded from Indian sub-continent. Thus the study area supports an extremely rich and diverse bird community. The observed bird diversity in relatively small area underlines the importance of this area for biodiversity conservation.

To conclude it can be said that the study area has a potential as a habitat for avian species. The need is to enlist the data and manage the habitat in consideration with various requirements of avian fauna. Our understanding of avifauna diversity is still insufficient to guarantee proper

conservational strategies and only scientific research can through light on the improved methods of management and conservation.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest associated with this article.

ACKNOWLEDGEMENTS

The authors are highly acknowledged to the Department of Zoology, University of Jammu for providing the necessary facilities to carry out the study.

REFERENCES

- Acharya, B.K., 2008. Bird Communities and their Distribution Pattern along the elevation gradient of Teesta Valley, Sikkim. Ph.D. Thesis, Bharathiar University, Coimbatore, India.
- Ahmed, A. and Sahi, D.N., 2005. Diversity and status of birds of Tehsil Doda. *J. Nacton.*, 17(1): 135-143.
- Ali, S. and Ripley, S.D., 1968-74. The Handbook of Birds of India and Pakistan. Ten Volumes. Oxford University Press, Bombay.
- Ali, S. and Ripley, S.D., 1983. Compact Handbook of Birds of India and Pakistan. Oxford Univ. Press, Bombay.
- Bates, R.S.P. and Lowther, E.H.N., 1952. Breeding Birds of Kashmir. Oxford University Press, Bombay.
- Blake, J.G., 2007. Neo-tropical forest bird communities: a comparison of species richness and composition at local and regional scales. *Condor*, 109: 237-255.
- Burnham, K.P., Anderson, D.R. and Laake, J.L., 1980. Estimation of density from line transect sampling of biological population. *Wildlife Monogr.*, 72: 1-202.
- Chettri, N., Sharma, E. and Deb, D.C., 2001. Bird community structure along a trekking corridor of Sikkim Himalaya: a conservation perspective. *Biol. Conservation*, 102: 1-16.
- Daniels, R.J.R., 1989. A conservation strategy for the birds of the Uttara Kannada District. Ph.D. thesis, Indian Institute of Science, Bangalore.
- Das, K.S.A., 2008. Bird community structure along the altitudinal gradient in Silent Valley National Park, Western Ghats, India. Ph.D. Thesis, Bharathiar University, Coimbatore, India.
- Green, R.J. and Catterall, C.P., 1998. The effect of forest clearing and regeneration on the fauna of Wivenhoe Park, south-east Queensland. *Wildlife Res.*, 25: 677-690.
- Grimmett, R., Inskipp, C. and Inskipp, T., 1998. Birds of the Indian subcontinent. Oxford Univ. Press, Delhi.
- Javed, S., 1996. Study on bird community structures of Terai forest in Dudwa National Park. Ph.D. Thesis, Aligarh Muslim University, India.
- Jayson, E.A. and Mathew, D.N., 2002. Structure and composition of two bird communities in the south Western Ghats. *J. Bombay Nat. Hist. Soc.*, 99(1): 8-25.
- Jerdon, T.C., 1862-1864. The Birds of India. Calcutta (2 Vols).
- Johnsingh, A.J.T. and Joshua, J., 1994. Avifauna in three vegetation types on Mundathurai plateau, South India. *J. Trop. Ecol.*, 10: 323-335.
- Karr, J.R., Robinson, S. K., Blake, J.G. and Berregard, R.O., 1990. The bird communities of four neotropical forest. (A. Gentry, Ed.). Yale University Press, New Haven, C.T. pp: 237-269.
- Kattan, G.H. and Franco, P., 2004. Bird diversity along elevational gradients in the Andes of Colombia: area and mass effects. *Global Ecol. Biogeogr.*, 13: 451-458.
- Khan, J.A., Khan, D.N., Ahmed, A., 1993. Preliminary investigations of bird community structure at Aligarh, India. *Trop. Ecol.*, 34:217-225.
- Khan, S.K., Rao, R.J. and Wani, K.A., 2012. Studies on bird diversity of Overa-Aru Wildlife Sanctuary of Jammu and Kashmir, India. *J. Threatened Taxa*, 4(13): 3228-3232.
- Kremen, C., 1992. Assessing the indicator properties of the species assemblages for natural areas monitoring. *Ecol. Appl.*, 2: 203-217.

- Latta, S.C., Rimmer, C.C. and McFarland, K.P., 2003. Winter bird communities in four habitats along an elevational gradient on Hispaniola. *Condor*, 105: 179-197.
- Lowther, P.E. and Cink, C.L., 1992. House sparrow. No. 12. In: *The Birds of North America* (A. Poole, P. Stettenheim, and F. Gill, eds.). Philadelphia Academy of Sciences, Philadelphia.
- Mac Arthur, R.H. and Mac Arthur, J.W., 1961. On bird species diversity. *J. Ecol.*, 42: 594-598.
- Marglef, R., 1968. *Perspectives in ecological theory*, University of Chicago Press, Chicago, II.
- Pielou, E.C., 1969. *An introduction to mathematical ecology*, John Wiley, New York.
- Price, T., Zee, J., Jamdar, K. and Jamdar, N., 2003. Bird species diversity along the Himalaya: a comparison of Himachal Pradesh with Kashmir. *J. Bombay Nat. Hist. Soc.*, 100: 394-410.
- Raman, T.R.S., Rawat, G.S. and Johnsingh, A.J.T., 1998. Recovery of tropical rainforest avifauna in relation to vegetation succession following shifting cultivation in Mizoram, Northeast India. *J. Appl. Ecol.*, 35: 214-231.
- Shafiq, T., Javed, S., Khan, J.A., 1997. Bird community structure of middle altitude oak forest in Kumaon Himalayas, India: a preliminary investigation. *Int. J. Ecol. Environ. Sci.*, 23: 389-400.
- Shannon, C.E. and Weaver, W., 1949. *The mathematical theory of communication*, University of Illinois Press, Urbana, II.
- Singh, R., Kour, D.N., Ahmed, F., and Sahi, D.N., 2013a. Species diversity, relative abundance and habitat use of the bird communities of Tehsil Chenani, District Udhampur, Jammu and Kashmir, India. *Indian J. Life Sci.*, 2(2): 81-90.
- Singh, R., Kour, D.N., Ahmed, F., and Sahi, D.N., 2013b. The causes of decline of house sparrow (*Passer domesticus*, Linnaeus 1758) in urban and suburban areas of Jammu region, J & K. Munis. *J. Entomol. Zool.*, 8 (2): 803-811.
- Sorensen, T., 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content and its application to analyses of the vegetation on Danish commons, *Kongelige Danske Videnskabernes Selskab Biologiske Skrifter*, 5: 1-34.
- Stone, J. E., and Pence, D.B., 1978. Ecology of helminth parasitism in the bobcat from West Texas, *J. Parasitol.*, 64: 295-302.
- Sultana, A. and Khan, J.A., 1999. Avian community in the Kumaon Himalaya, India - a preliminary study. *Int. J. Ecol. Environ. Sci.*, 25: 167-176.
- Sultana, A. and Khan, J.A., 2000. Birds of oak forests in the Kumaon Himalaya, Uttar Pradesh, India. *Forktail*, 16: 131-146.
- Sultana, A., Hussain, M.S. and Khan, J.A., 2007. Bird communities of the proposed Naina and Pindari wildlife sanctuaries in the Kumaon Himalaya, Uttarakhand, India. *J. Bombay Nat. Hist. Soc.*, 104: 19-29.
- Terborgh, J., Robinson, S.K., Parker, T.A., Munn, C.A. and Pierpont, N., 1990. Structure and organisation of an Amazonian forest bird community. *Ecol. Monogr.*, 60: 213-238.
- Thiollay, J.M., 1994. Structure, density and rarity in an Amazonian rain forest bird community. *J. Trop. Ecol.*, 10: 449-481.
- Wiens, J.A., 1989. *Ecology of Bird Communities*. Vols. I & II. Cambridge University Press, Cambridge.
- Willson, M.F. and Comet, T.A., 1996. Bird communities of northern forests: patterns of diversity and abundance. *Condor*, 98: 337-349.