

Ecology of Birds of Kuppi Plantation, Faisalabad, Pakistan II. Diversity of Bird

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Abstract

The study deals with the bird diversity in the Kuppi Plantation located in district Faisalabad. The study indicates that in spring and summer population of the birds in the plantation increases substantially. Birds of the Order Passeriformes seem to be most dominating group. The next dominating order was observed to be Falconiformes followed by birds of other groups. The study revealed that bird population in the plantation is dependant on the availability of food and habitat.

Keywords: Kuppi Plantation, birds, Passeriformes, Falconiformes, seasonal abundance.

Introduction:

Present paper is second on the series of studies on the avifauna of Kuppi Plantation located in district Faisalabad, Punjab. Study of the phytosociology of this plantation indicates a well-diversified flora and available habitat for bird species (Javed *et al.*, 2006). This relatively undisturbed plantation with adequate tree cover provide ideal habitat for a number of wildlife species including birds. Present study was designed to survey Kuppi and Chakku Irrigated Forest Plantations of central Punjab with special reference to avian species diversity. The study also encompasses seasonal abundance and variation in the population of bird species in the areas as well as to determine the relationship of vegetation with distribution of bird species in the selected plantations.

Bird fauna of Kuppi plantation has never been described separately, however, Ali and Ripley (1974) and Roberts (1991, 1992) have covered birds that are found in the surrounding area. Donald (1918; 1919a; 1919b; 1920a; 1920b; 1920c; 1921) worked on birds of prey of the Punjab. Whistler (1914, 1922a, 1922b) observed the birds of Jhelum and Jhang districts. Waite (1948) worked on the birds of Salt Range, district. Chaudhry *et al.* (1997a, 1997b) described the bird fauna of Salt Range and Cholistan.

Awan (1992) studied bird of Changa Manga plantation which is an oldest irrigated forest plantation of Pakistan, in district Kasur, Punjab. He recorded 81 bird species belonging to 60 genera in different habitats i.e. dense plantation of sheesham and mulberry, avenue tree plantations, amenity plantation in recreational

park, farmlands and wetlands created as a result of irrigating vast areas. Beg and Qureshi (1972) have listed birds found in Faisalabad and its vicinity. Beg *et al.* (1987) worked on food preference of house sparrow in the cultivated area of Faisalabad.

Present study is aimed to study the seasonal abundance and variation in the population of bird species in Irrigated Forest Plantation of Kuppi with especial reference to vegetation pattern of the area.

Materials and Methods:

For the management purpose Kuppi plantation is divided into 41 compartments (Javed *et al.*, 2006). Five transects were selected in the plantation keeping in view the plant species and their age in different compartments. The selected transects were sampled by walking at a slow and uniform pace to record the species of the birds present with the number of birds within 50 meter wide belt on either side of the survey line during the fixed hours of the day i.e. two and a half hour in the morning since sunrise and two and half hour in the evening till sunset. Salient features of the studied transects in Kuppi Forest Plantation are given in Table-I.

Results and Discussions:

Kuppi Plantation was observed to be rich in bird diversity (Table-II to V). In summer, a total of 12 orders of the birds consisting of 55 species were recorded from this Plantation (Table-II). Passeriformes was the largest represented order having 30 species. Out of 6,231 birds recorded, 3200 birds belong to 30 species of order Passeriformes. The next dominating order was Falconiformes, which was represented by 280 birds belonging to 5 species. The order Coraciiformes was represented by 4 species with

the total 420 birds. The order Columbiformes was also found to be rich with respect to the number of birds (1,366) but with respect to the number of species it was represented by only 3 species. The orders Ciconiformes and Piciformes were represented by 2 species, whereas Psittaciformes, Cuculiformes, Strigiformes, Galliformes, Charadriiformes and Caprimulgiformes were represented by single species. The overall density of birds per hectare was calculated to be 95.86. Transect wise diversity of species and abundance of birds show that transect 2, 3 and 5 are the most diversified with 41 species each. On the basis of their abundance; 23 species categorized as very common, 7 species as common, 11 species as less common, 12 species as not common species and 4 species as rare species.

In autumn, total of 3,008 birds were recorded (Table-III). It is apparent that the order Passeriformes was most dominating group with a total of 1,499 birds belonging to 29 species. Order Falconiformes was represented by 138 birds belonging to 4 species whereas order Columbiformes and Ciconiformes were represented by 3 species each. Order Piciformes was represented by 2 species whereas orders Psittaciformes, Charadriiformes, Cuculiformes, and Strigiformes were represented by one species each. Density of birds per hectare during autumn was calculated to be 46.28. Maximum number of birds are recorded in transect 2; whereas least number of birds are recorded in transect 5. In autumn, 10 species can be categorized to be very common, 3 species common, 14 species as not common, 16 species as less common and 7 species as rare.

In winter a total of 2,297 birds belonging to only 9 orders and 43 species were recorded (Table-IV). Passeriformes was observed to be the most diversified group represented by 26 species. Five species of order Falconiformes were recorded in winter. Orders Columbiformes and Coraciiformes were represented by 3 species each whereas Piciformes was represented by two species and orders Pstrigiformes, Cuculiformes and Charadriiformes were represented by one species each. Overall density of birds per hectare in the plantation during winter was 35.34. Maximum number of birds were recorded in transect 3 whereas minimum number was recorded in transect number 5. In winter, 6 species can be categorized as very common, 2 species as common, 9 species as less common, 18 species as not common and 8 species as rare species.

In spring, a total of 5,207 birds were recorded dominated by order Passeriformes that was represented by 33 species (Table-V). Order Falconiformes was represented by 5 species and 266 birds. Orders Coraciiformes and Cuculiformes were represented by 4 species each, whereas order Culumbiformes was represented by 3 species and order Piciformes by two species. Order Psittaciformes, Galliformes, Charadriiformes and Strigiformes by one species each. Study on the density of bird in winter revealed that transect 5 have a well diversified bird fauna with 49 species recorded in spring. Based on their abundance in spring, 11 species can be categorized as very common, 16 species as common, 16 species as less common, 8 species as not common and 5 species as rare species.

Table I: Features of transects in Kuppi Forest Plantation.

Transect #	Area (ha.)	Description
Transect 1	12	Consisted of five compartments in a row that is compartment No. 3, to compartment No. 7. Main tree species of this transect was Sheesham planted in 1955. The second important tree species was Kikar planted in 1978-80.
Transect 2	10	Consisted of three compartments on the eastern edge of the plantation. It consisted of pure Kikar planted in 1965.
Transect 3	14	Consisted of compartment 15 to 23. Young plantation of Kikar and natural tropical thorn forest species like <i>Tamarix kari</i> were dominating. Mesquite was also invaded in this transect.
Transect 4	15	This transect consisted of a compartment of 4 acres with six years old <i>Eucalyptus nianiation</i> . Besides, Sheesham and Kikar planted in 1978 to 1980. <i>Tamarix kari</i> is naturally grown shrubs. The Sheesham and Kikar were not well established due to shortage of water and soil salinity. Trees usually were thin, less in diameter with respect to their age, short in size and had poor canopy cover.
Transect 5	14	The soil was hard and saline. Major species are Sheesham and Kikar, which were planted in 1979-1981. Due to unfavourable conditions the plantation is not well established.

Table-II Density/hectare of birds in Kuppi Plantation during summer.

Bird Species	Transect					Total	Density (No./ha)	Status
	1	2	3	4	5			
Ciconiiformes								
Ardeidae								
Pond heron (<i>Ardeola grayii</i>)	2	12	0	0	1	15	0.23	NC
Cattle egret (<i>Bubulcus ibis</i>)	28	52	14	36	10	140	2.15	VC
Little egret (<i>Egretta garzetta</i>)	18	30	46	17	0	111	1.71	VC
Accipitriformes								
Accipitridae								
Black-winged kite (<i>Elanus caeruleus</i>)	2	3	1	0	0	6	0.09	NC
Black kite (<i>Milvus migrans</i>)	50	7	11	13	2	83	1.28	C
Egyptian vulture (<i>Neophron percnopterus</i>)	2	1	0	0	0	3	0.05	R
White-backed vulture (<i>Gyps bengalensis</i>)	132	51	0	0	0	183	2.82	VC
Indian sparrow hawk (<i>Accipiter badius</i>)	2	3	0	0	0	5	0.08	R
Galliformes								
Phasianidae								
Grey partridge (<i>Francolinus pondicerianus</i>)	0	0	9	0	0	9	0.14	NC
Charadriiformes								
Charadriidae								
Red-wattled lapwing (<i>Vanellus indicus</i>)	16	51	27	45	51	190	2.92	VC
Columbiformes								
Columbidae								
Indian ring dove (<i>Streptopelia decaocto</i>)	98	222	179	313	136	948	14.58	VC
Red collard dove (<i>Streptopelia tranquebarica</i>)	32	137	67	33	49	318	4.89	VC
Little brown dove (<i>Streptopelia senegalensis</i>)	0	35	34	25	6	100	1.54	C
Psittaciformes								
Psittacidae								
Rose ringed parakeet (<i>Psittacula krameri</i>)	42	80	83	132	45	382	5.88	VC
Cuculiformes								
Cuculidae								
Pied crested cuckoo (<i>Clamator jacobinus</i>)	3	1	0	4	0	8	0.12	NC
Koel (Common) (<i>Eudynamys scolopacea</i>)	6	4	0	0	2	12	0.18	NC
Common hawk cuckoo (<i>Cuculus varius</i>)	5	0	0	2	0	7	0.11	NC
Strigiformes								
Strigidae								
Spotted owl (<i>Athene brama</i>)	0	9	0	0	0	9	0.14	NC

Caprimulgiformes									
Caprimulgidae									
Grey nightjar (<i>Caprimulgus indicus</i>)	0	0	0	1	0	1	0.02	R	
Coraciiformes									
Alcedinidae									
White breasted kingfisher (<i>Halcyon smyrnensis</i>)	0	0	2	0	4	6	0.09	NC	
Meropidae									
Green small bee-eater (<i>Merops orientalis</i>)	48	25	35	37	53	198	3.05	VC	
Coraciidae									
Indian roller (<i>Coracias bengalensis</i>)	44	26	19	34	15	138	2.12	VC	
Upupidae									
Hoopoe (<i>Upupa epops</i>)	17	41	9	8	3	78	1.20	C	
Piciformes									
Picidae									
Golden backed woodpecker (<i>Dinopium bengalense</i>)	10	12	18	27	8	75	1.15	C	
Maharatta woodpecker (<i>Dendrocopos mahrattensis</i>)	0	0	2	0	4	6	0.09	NC	
Passeriformes									
Alaudidae									
Crested lark (<i>Galerida cristata</i>)	0	0	11	5	8	24	0.37	LC	
Oriental skylark (<i>Alauda gulgula</i>)	0	0	19	15	6	40	0.62	LC	
Campephagidae									
Common wood shrike (<i>Tephrodornis pondecarianus</i>)	6	12	10	14	15	57	0.88	C	
Motacillidae									
Large pied wagtail (<i>Motacilla maderaspatensis</i>)	2	0	0	6	4	12	0.18	NC	
Pycnonotidae									
Red vented bulbul (<i>Pycnonotus cafer</i>)	6	12	34	43	24	119	1.83	VC	
Turdidae									
Magpie robin (<i>Copsychus saularis</i>)	0	0	0	0	2	2	0.03	R	
Pied bush chat (<i>Saxicola caprata</i>)	0	3	7	5	1	16	0.25	NC	
Indian robin (<i>Saxicoloides fulicata</i>)	3	0	13	23	14	53	0.82	C	
Sylviidae									
Eurasian chiffchaff (<i>Phylloscopus collibyta</i>)	0	7	0	5	14	26	0.40	LC	
Black redstart (<i>Phoenicurus ochruros</i>)	0	0	10	5	15	30	0.46	LC	
Ashy wren warbler (<i>Prinia socialis</i>)	12	4	0	8	0	24	0.37	LC	
Muscicapidae									
Red-throated flycatcher (<i>Ficedula parva</i>)	0	2	3	10	20	35	0.54	LC	

Green warbler (<i>Phylloscopus nitidus</i>)	7	9	0	11	0	27	0.42	LC
Jungle Prinia (<i>Prinia sylvatica</i>)	15	8	0	5	4	32	0.49	LC
Rhipiduridae								
White-browed fantail (<i>Rhipidura aureola</i>)	4	0	3	4	7	18	0.28	NC
White throated fantail (<i>Rhipidura albicollis</i>)	4	3	0	8	6	21	0.32	LC
Timalidae								
Common babbler (<i>Turdoides caudatus</i>)	25	40	20	34	45	164	2.52	VC
Jungle babbler (<i>Turdoides striatus</i>)	44	54	52	35	34	219	3.37	VC
Nectariniidae								
Purple sunbird (<i>Nectarinia asiatica</i>)	20	0	23	45	34	122	1.88	VC
Oriolidae								
Golden oriole (<i>Oriolus oriolus</i>)	8	11	0	10	3	32	0.49	LC
Dicruridae								
Black drongo (<i>Dicrurus macrocercus</i>)	23	47	61	35	32	198	3.05	VC
Laniidae								
Rufous backed shrike (<i>Lanius schach</i>)	10	33	19	18	17	97	1.49	C
Bay-backed shrike (<i>Lanius vittatus</i>)	15	32	23	24	29	123	1.89	VC
Corvidae								
Indian tree pie (<i>Dendrocitta vagabunda</i>)	7	4	6	2	0	19	0.29	NC
House crow (<i>Corvus splendens</i>)	112	176	152	156	105	701	10.78	VC
Sturnidae								
Common myna (<i>Acridotheris tristis</i>)	77	97	32	68	151	425	6.54	VC
Bank myna (<i>Acridotheris ginginianus</i>)	40	84	15	15	14	168	2.58	VC
Common starling (<i>Sturnus vulgaris</i>)	29	113	15	0	0	157	2.42	VC
Passeridae								
House sparrow (<i>Passer domesticus</i>)	45	74	60	0	22	201	3.09	VC
Tree sparrow (<i>Passer montanus</i>)	7	0	11	0	20	38	0.58	LC
Area surveyed (ha)	12	10	14	15	14	65		
Total No. of species	41	41	38	39	41			
No. of birds in each habitat	1078	1627	1155	1336	1035	6231		
Density of birds/ha	89.83	162.70	82.50	89.07	73.93	95.86	95.86	

Table-III Density/hectare of birds in Kuppi Plantation during Autumn.

BIRD SPECIES	TRANSECT					TOTAL	DENSITY (NO./HA)	STATUS
	1	2	3	4	5			
Accipitriformes								
Accipitridae								
Black-winged kite (<i>Elanus caeruleus</i>)	12	7	11	9	2	41	0.63	LC
Black kite (<i>Milvus migrans</i>)	38	27	24	12	29	130	2.00	VC
Egyptian vulture (<i>Neophron percnopterus</i>)	21	5	12	10	0	48	0.74	LC
White-backed vulture (<i>Gyps bengalensis</i>)	0	4	0	2	1	7	0.11	NC
Falconidae								
Kestrel (<i>Falco tinnunculus</i>)	12	9	0	0	3	24	0.37	LC
Charadriiformes								
Charadriidae								
Red-wattled lapwing (<i>Venallus indicus</i>)	31	55	0	0	20	106	1.63	VC
Columbiformes								
Columbidae								
Indian ring dove (<i>Streptopelia decaocto</i>)	0	0	1	0	0	1	0.02	R
Red collard dove (<i>Streptopelia tranquebarica</i>)	1	0	1	0	0	2	0.03	R
Little brown dove (<i>Streptopelia senegalensis</i>)	11	20	15	16	21	83	1.28	C
Psittaciformes								
Psittacidae								
Rose ringed parakeet (<i>Psittacula krameri</i>)	18	41	86	66	47	258	3.97	VC
Cuculiformes								
Cuculidae								
Crow pheasant (<i>Centropus sinensis</i>)	17	20	16	30	22	105	1.62	VC
Strigiformes								
Strigidae								
Spotted owlet (<i>Athene brama</i>)	4	6	8	8	13	39	0.60	LC
Coraciiformes								
Alcedinidae								
White breasted kingfisher (<i>Halcyon smyrnensis</i>)	80	86	51	173	67	457	7.03	VC

Coraciidae								
Indian roller (<i>Coracias benghalensis</i>)	2	0	0	1	2	5	0.08	R
Upupidae								
Hoopoe (<i>Upupa epops</i>)	0	7	0	0	0	7	0.11	NC
Piciformes								
Picidae								
Golden backed woodpecker (<i>Dinopium benghalense</i>)	3	6	3	3	3	18	0.28	NC
Maharatta woodpecker (<i>Dendrocopos mahrattensis</i>)	23	8	14	12	16	73	1.12	C
Passeriformes								
Alaudidae								
Crested lark (<i>Galerida cristata</i>)	4	10	18	2	16	50	0.77	LC
Oriental skylark (<i>Alauda gulgula</i>)	10	0	3	2	11	26	0.40	LC
Hirundinidae								
Collard sand martin (<i>Riparia riparia</i>)	3	2	3	14	2	24	0.37	LC
Common house martin (<i>Delichon urbica</i>)	0	3	0	1	1	5	0.08	R
Motacillidae								
Yellow wagtail (<i>Motacilla flava</i>)	3	0	5	4	0	12	0.18	NC
White wagtail (<i>Motacilla alba</i>)	0	0	0	0	8	8	0.12	NC
Large pied wagtail (<i>Motacilla maderaspatensis</i>)	20	39	60	15	15	149	2.29	VC
Pycnonotidae								
Red vented bulbul (<i>Pycnonotus cafer</i>)	12	5	13	7	11	48	0.74	LC
Turdidae								
Pied bush chat (<i>Saxicola caprata</i>)	6	0	12	2	0	20	0.31	NC
Indian robin (<i>Saxicoloides fulicata</i>)	8	4	0	8	0	20	0.31	NC
Sylviidae								
Eurasian chiffchaff (<i>Phylloscopus collibyta</i>)	8	10	12	16	13	59	0.91	C
Black redstart (<i>Phoenicurus ochruros</i>)	2	0	3	6	0	11	0.17	NC
Ashy wren warbler (<i>Prinia socialis</i>)	0	2	3	9	2	16	0.25	NC
Muscicapidae								
Red- throated flycatcher (<i>Ficedula parva</i>)	0	0	10	5	6	21	0.32	LC

Jungle wren warbler (<i>Prinia sylvatica</i>)	6	4	6	0	0	16	0.25	NC
Rhipiduridae								
White-browed fantail (<i>Rhipidura aureola</i>)	4	5	10	8	7	34	0.52	LC
Timalidae								
Common babbler (<i>Turdoides caudatus</i>)	2	0	5	4	4	15	0.23	NC
Jungle babbler (<i>Turdoides striatus</i>)	9	7	0	13	0	29	0.45	LC
Dicruridae								
Black drongo (<i>Dicrurus macrocercus</i>)	5	8	0	10	0	23	0.35	LC
Laniidae								
Bay-backed shrike (<i>Lanius vittatus</i>)	10	6	0	14	0	30	0.46	LC
Corvidae								
Indian tree pie (<i>Dendrocitta vagabunda</i>)	0	0	0	5	2	7	0.11	NC
House crow (<i>Corvus splendens</i>)	0	0	8	0	3	11	0.17	NC
Sturnidae								
Common myna (<i>Acridotheris tristis</i>)	16	39	40	18	21	134	2.06	VC
Common starling (<i>Sturnus vulgaris</i>)	6	24	42	31	30	133	2.05	VC
Ploceidae								
House sparrow (<i>Passer domesticus</i>)	0	0	0	3	0	3	0.05	R
Tree sparrow (<i>Passer montanus</i>)	0	0	0	0	1	1	0.02	R
Area surveyed (ha)	12	10	14	15	14	65		
Total No. of species	26	29	31	30	27			
No. of birds in each habitat	505	457	571	452	312	2297		
Density of birds/ha	42.08	45.70	40.79	30.13	22.29	35.34	35.34	

Table-IV Density/hectare of birds in Kuppi Plantation during winter.

BIRD SPECIES	TRANSECT					TOTAL	DENSITY (NO./HA)	STATUS
	1	2	3	4	5			
Accipitriformes								
Black-winged kite (<i>Elanus caeruleus</i>)	9	1	3	2	2	17	0.26	NC
Black kite (<i>Milvus migrans</i>)	5	0	7	6	7	25	0.38	LC
Egyptian vulture (<i>Neophron percnopterus</i>)	0	0	0	2	0	2	0.03	R
White-backed vulture (<i>Gyps bengalensis</i>)	141	43	38	27	17	266	4.09	VC
Falconidae								
Kestrel (Common) (<i>Falco tinnunculus</i>)	0	0	0	1	0	1	0.02	R
Charadriiformes								
Charadriidae								
Red-wattled lapwing (<i>Vanellus indicus</i>)	0	3	8	0	15	26	0.40	LC
Columbiformes								
Columbidae								
Indian ring dove (<i>Streptopelia decaocto</i>)	33	69	60	24	20	206	3.17	VC
Red collard dove (<i>Streptopelia tranquebarica</i>)	0	0	0	15	0	15	0.23	NC
Little brown dove (<i>Streptopelia senegalensis</i>)	6	0	2	0	6	14	0.22	NC
Psittaciformes								
Psittacidae								
Rose ringed parakeet (<i>Psittacula krameri</i>)	59	61	71	90	42	323	4.97	VC
Cuculiformes								
Cuculidae								
Crow pheasant (<i>Centropus sinensis</i>)	0	2	0	0	0	2	0.03	R
Strigiformes								
Strigidae								
Spotted owl (<i>Athene brama</i>)	1	2	0	0	0	3	0.05	R
Coraciiformes								
Alcedinidae								
White breasted kingfisher	0	1	1	0	1	3	0.05	R

(*Halcyon smyrnensis*)

Coraciidae									
Indian roller	2	7	7	1	0	17	0.26	NC	
<i>(Coracias bengalensis)</i>									
Upupidae									
Hoopoe	7	9	9	6	5	36	0.55	LC	
<i>(Upupa epops)</i>									
Piciformes									
Picidae									
Golden backed woodpecker	2	18	5	0	6	31	0.48	LC	
<i>(Dinopium bengalense)</i>									
Maharatta woodpecker	1	1	0	0	0	2	0.03	R	
<i>(Dendrocopos mahrattensis)</i>									
Passeriformes									
Alaudidae									
Crested lark	0	0	10	3	0	13	0.20	NC	
<i>(Galerida cristata)</i>									
Oriental skylark	0	0	14	10	6	30	0.46	LC	
<i>(Alauda gulgula)</i>									
Hirundinidae									
Collard sand martin	0	0	30	0	0	30	0.46	LC	
<i>(Riparia riparia)</i>									
Common house martin	20	0	0	0	0	20	0.31	NC	
<i>(Delichon urbica)</i>									
Motacillidae									
Yellow wagtail	2	3	7	2	4	18	0.28	NC	
<i>(Motacilla flava)</i>									
White wagtail	4	3	7	2	4	20	0.31	NC	
<i>(Motacilla alba)</i>									
Large pied wagtail	0	2	1	3	0	6	0.09	NC	
<i>(Motacilla maderaspatensis)</i>									
Pycnonotidae									
Red vented bulbul	0	2	7	3	4	16	0.25	NC	
<i>(Pycnonotus cafer)</i>									
Muscicapidae									
Pied bush chat	4	1	7	4	3	19	0.29	NC	
<i>(Saxicola caprata)</i>									
Indian robin	4	2	7	6	12	31	0.48	LC	
<i>(Saxicoloides fulicata)</i>									
Eurasian chiffchaff	5	0	0	0	0	5	0.08	R	
<i>(Phylloscopus collibyta)</i>									

Black redstart (<i>Phoenicurus ochruros</i>)	0	0	4	5	8	17	0.26	NC
Red-breasted flycatcher (<i>Ficedula parva</i>)	2	0	6	5	7	20	0.31	NC
Ashy wren warbler (<i>Prinia socialis</i>)	5	7	0	4	0	16	0.25	NC
Jungle wren warbler (<i>Prinia sylvatica</i>)	8	4	0	7	0	19	0.29	NC
Rhipiduridae								
White-browed fantail (<i>Rhipidura aureola</i>)	0	0	5	7	0	12	0.18	NC
Timalidae								
Common babbler (<i>Turdoides caudatus</i>)	5	24	23	24	11	87	1.34	C
Jungle babbler (<i>Turdoides striatus</i>)	45	49	51	46	49	240	3.69	VC
Dicruridae								
Black drongo (<i>Dicrurus macrocercus</i>)	12	10	107	15	7	151	2.32	VC
Laniidae								
Bay-backed shrike (<i>Lanius vittatus</i>)	0	2	0	2	1	5	0.08	R
Corvidae								
Indian tree pie (<i>Dendrocitta vagabunda</i>)	1	4	1	2	3	11	0.17	NC
House crow (<i>Corvus splendens</i>)	114	54	43	119	47	377	5.80	VC
Sturnidae								
Common myna (<i>Acridotheris tristis</i>)	30	148	31	22	20	251	3.86	VC
Common starling (<i>Sturnus vulgaris</i>)	8	18	0	0	5	31	0.48	LC
Ploceidae								
House sparrow (<i>Passer domesticus</i>)	0	19	12	9	15	55	0.85	C
Tree sparrow (<i>Passer montanus</i>)	0	0	10	0	0	10	0.15	NC
Area surveyed (ha)	12	10	14	15	14	65		
Total No. of species	26	29	31	30	27			
No. of birds in each habitat	505	457	571	452	312	2297		
Density of birds/ha	42.08	45.70	40.79	30.13	22.29	35.34	35.34	

Table-IV Density/hectare of birds in Kuppi Plantation during spring.

BIRD SPECIES	TRANSECT					TOTAL	DENSITY (NO./HA)	STATUS
	1	2	3	4	5			
Cicniiformes								
Ardiidae								
Pond heron (<i>Ardeola grayii</i>)	0	0	39	0	15	54	0.83	C
Falconiformes								
Accipitridae								
Honey buzzard (<i>Pernis ptilorhynchus</i>)	4	2	3	2	1	12	0.18	NC
Black-shoulder kite (<i>Elanus caeruleus</i>)	15	4	0	1	5	25	0.38	LC
Black kite (<i>Milvus migrans</i>)	19	20	3	14	8	64	0.98	C
White-backed vulture (<i>Gyps bengalensis</i>)	71	75	5	2	0	153	2.35	VC
Falconidae								
Shikra (<i>Accipiter badius</i>)	0	3	4	4	1	12	0.18	NC
Galliformes								
Phasianidae								
Grey partridge (<i>Francolinus pondicerianus</i>)	0	0	2	0	2	4	0.06	R
Charadriiformes								
Charadriidae								
Red-wattled lapwing (<i>Vanellus indicus</i>)	19	8	9	5	10	51	0.78	LC
Columbiformes								
Columbidae								
Indian ring dove (<i>Streptopelia decaocta</i>)	22	64	40	211	134	471	7.25	VC
Red collard dove (<i>Streptopelia tranquebarica</i>)	63	21	19	71	128	302	4.65	VC
Little brown dove (<i>Streptopelia senegalensis</i>)	22	19	13	23	14	91	1.40	C
Psittaciformes								
Psittacidae								
Rose ringed parakeet (<i>Psittacula krameri</i>)	46	56	37	52	72	263	4.05	VC

Cuculiformes									
Cuculidae									
Pied crested cuckoo (<i>Clamator jacobinus</i>)	0	2	0	5	2	9	0.14	NC	
Common Koel (<i>Eudynamys scolopacea</i>)	6	3	6	4	2	21	0.32	LC	
Crow pheasant (<i>Centropus sinensis</i>)	0	20	0	0	6	26	0.40	LC	
Brain fever bird (<i>Cuculus varius</i>)	5	3	0	0	4	12	0.18	NC	
Strigiformes									
Strigidae									
Spotted owlet (<i>Athene brama</i>)	0	12	0	0	0	12	0.18	NC	
Coraciiformes									
Alcedinidae									
White breasted kingfisher (<i>Halcyon smyrnensis</i>)	0	0	0	0	2	2	0.03	R	
Meropidae									
Small green bee-eater (<i>Merops orientalis</i>)	25	60	45	43	64	237	3.65	VC	
Coraciidae									
Indian roller (<i>Coracias benghalensis</i>)	18	16	5	9	14	62	0.95	C	
Upupidae									
Hoopoe (<i>Upupa epops</i>)	15	9	0	0	10	34	0.52	LC	
Piciformes									
Picidae									
Golden backed woodpecker (<i>Dinopium benghalense</i>)	21	11	25	16	8	81	1.25	C	
Maharatta woodpecker (<i>Dendrocopos mahrattensis</i>)	0	0	4	0	2	6	0.09	R	
Passeriformes									
Alaudidae									
Crested lark (<i>Galerida cristata</i>)	0	0	19	11	2	32	0.49	LC	
Oriental skylark (<i>Alauda gulgula</i>)	0	0	7	5	2	14	0.22	NC	
Hirundinidae									
Collard sand martin (<i>Riparia riparia</i>)	0	0	0	8	3	11	0.17	NC	

Common swallow (<i>Hirundo rustica</i>)	0	0	27	0	0	27	0.42	LC
Campephagidae								
Common wood shrike (<i>Tephrodornis pondicerianus</i>)	11	11	12	10	7	51	0.78	LC
Motacillidae								
Tree pipit (<i>Anthus trivialis</i>)	0	4	0	0	0	4	0.06	R
Yellow wagtail (<i>Motacilla flava</i>)	8	0	12	14	3	37	0.57	LC
White wagtail (<i>Motacilla alba</i>)	0	0	16	15	3	34	0.52	LC
Large pied wagtail (<i>Motacilla maderaspatensis</i>)	0	0	0	9	10	19	0.29	NC
Pycnonotidae								
Red -vented bulbul (<i>Pycnonotus cafer</i>)	0	5	20	25	21	71	1.09	C
Turdidae								
Pied bush chat (<i>Saxicola caprata</i>)	0	0	12	16	5	33	0.51	LC
Indian robin (<i>Saxicoloides fulicata</i>)	0	0	7	14	2	23	0.35	LC
Sylviidae								
Eurasian chiffchaff (<i>Phylloscopus collybita</i>)	5	0	12	13	8	38	0.58	LC
Turdidae								
Black redstart (<i>Phoenicurus ochrurus</i>)	7	12	12	16	6	53	0.82	C
Muscicapidae								
Red-throated flycatcher (<i>Ficedula parva</i>)	0	13	11	7	18	49	0.75	LC
Sylviidae								
Ashy wren warbler (<i>Prinia socialis</i>)	17	17	14	17	21	86	1.32	C
Green warbler (<i>Phylloscopus nitidus</i>)	11	15	7	15	14	62	0.95	C
Jungle wren prinia (<i>Prinia sylvatica</i>)	14	10	24	19	17	84	1.29	C
Monarchidae								
Paradise flycatcher (<i>Terpsiphone paradisi</i>)	0	0	0	2	0	2	0.03	R

Rhipiduridae								
White-browed fantail flycatcher (<i>Rhipidura aureola</i>)	0	3	10	10	5	28	0.43	LC
White spotted fantail flycatcher (<i>Rhipidura albicollis</i>)	2	3	4	8	7	24	0.37	LC
Timalidae								
Common babbler (<i>Turdoides caudatus</i>)	17	49	27	42	27	162	2.49	VC
Jungle babbler (<i>Turdoides striatus</i>)	8	26	18	30	25	107	1.65	VC
Nectariniidae								
Purple sunbird (<i>Nectarinia asiatica</i>)	7	21	18	19	15	80	1.23	C
Oriolidae								
Golden oriole (<i>Oriolus oriolus</i>)	4	2	14	13	6	39	0.60	LC
Dicruridae								
Black drongo (<i>Dicrurus macrocercus</i>)	9	35	45	34	33	156	2.40	VC
Laniidae								
Rufous backed shrike (<i>Lanius schach</i>)	0	12	32	16	20	80	1.23	C
Bay-backed shrike (<i>Lanius vittatus</i>)	10	8	50	12	19	99	1.52	C
Corvidae								
Indian tree pie (<i>Dendrocitta vagabunda</i>)	9	14	0	0	0	23	0.35	LC
House crow (<i>Corvus splendens</i>)	77	48	244	446	459	1274	19.60	VC
Sturnidae								
Common myna (<i>Acridotheris tristis</i>)	22	39	61	37	66	225	3.46	VC
Bank myna (<i>Acridotheris ginginianus</i>)	0	24	21	30	0	75	1.15	C
Passeridae								
House sparrow (<i>Passer domesticus</i>)	35	0	25	16	25	101	1.55	VC
Area surveyed (ha)	12	10	14	15	14	65		
Total No. of species	33	40	43	45	49			
No. of birds in each habitat	644	779	1040	1391	1353	5207		
Density of birds/ha	53.67	77.90	74.29	92.73	96.64	80.11	80.11	

Seasonal fluctuation in the number of species recorded within plantation may be attributed to the in and out movements of birds from the plantation and seasonal rotation of crops in the surrounding agricultural land. In late summer and early autumn mostly rice is cultivated in surrounding agricultural fields whereas in late autumn and early winter wheat and sugar cane is mostly cultivated on the surrounding agricultural fields.

The study revealed that with the onset of spring, arrival of summer migrant and summer breeders start, thus resulting the increase in number of species in the plantations. Since Kuppi plantation is open type of woodland with two major tree species Sheesham and kiker whereas some patches of natural tropical thorn forest dominated by Tamarix, Jund and wan still exist. The harvesting of wheat in the nearby fields also helps in attracting different species of Columbiformes, which are predominantly graminivores. Order Ciconiformes is not well represented in spring. The species of this order are considered to have affinity with water. In late summer and early autumn water availability improves in the Plantation, which results in increase in the numbers of birds of Order Ciconiformes. Order Passeriformes also became much diversified in spring and summer season with the arrival of golden oriole, purple sunbird and shrikes. This order is well represented both in terms of number of species and their abundance.

With the onset of winter season, the number and abundance of the birds were observed to start decreasing. Orders Ciconiformes and Galliformes were observed to be totally absent during winter in the Plantation. Because of overall shortage of water during winter season especially due to closure of canal for desilting and change of crop pattern from paddy to wheat and sugarcane made habitat unattractive for Ciconiformes and was not recorded in winter.

Chaudhry *et al.* (1997a) studied biodiversity of birds in a sub-mountainous protected area of Chumbi Surla Wildlife Sanctuary in Salt Range and reported 113 plant species belonging to 35 families. The largest family was Poaceae represented by 41 species. Among the birds 71 species belonging to 57 genera from 34 families representing 14 orders were recorded from the sanctuary area. Chaudhry *et al.* (1997b) studied biodiversity of Cholistan desert in Punjab. Vegetation was studied at 26 different sites and

23 distinct plant communities were recognized on the basis of importance value of the plant species. Among birds 58 species were recorded representing 42 genera, 26 families and 12 orders.

In comparison to Chumbi-Surla and Cholistan, Kuppi Forest plantation is less diversified from vegetation point of view (Chaudhry *et al.*, 1997a, b). Only the sheesham and the kiker are the major planted species in the plantation, while other plants that can provide food and shelter to bird species are also present in the plantation. In addition shrubs and other undergrowth vegetation are also very poor in the area. The Plantation is also known for scarcity of water resulting in death of some plants. The above mentioned factors lead to a limited diversity of birds in this plantation.

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