

Diversity, Abundance and Seasonal Assessment of Wild Birds in Urban Habitat of District Chiniot, Pakistan

Ahmad Zaman, Azhar Rafique*, Farhat Jabeen and Tayyaba Sultana

Department of Zoology, GC University, Faisalabad, Punjab, Pakistan

ABSTRACT

The current study was conducted to find out the avian diversity of district Chiniot, Pakistan. The surveys were performed from March, 2020 to February 2021 on weekly basis, using point count method for the collection of data. Naked eyes and binocular telescope (10x50) were used to count the birds and camera was used to photograph the birds. The study area was divided into two major landscapes types such as open field area (agricultural land, river Chenab sides, canals and cemeteries) and built up area (settlements, residential neighborhoods, and institutional grounds). We recorded 87 species of bird of 70 genera belonging to 39 families representing 16 orders. According to Bull and McCackle method, 3 species were very abundant i.e. house crow, common myna, house sparrow, 6 species i.e. green bee-eater, pied bushchat, cattle egret, black drongo, red wattled lapwing, red vented bulbul were abundant, 7 species i.e. purple sunbird, bank myna, The white wagtail, baya weaver, laughing dove, Rofous tail lark and Greater coucal were very common, 23 species were common, 27 species were fairly common, 15 species were uncommon, 5 species were rare while black francolin was single infrequent species. A total of 268013 individual birds were observed from seven selected sampling sites. There was a highly significant difference ($P < 0.01$) in the diversity and abundance of open field area and built-up area. All 87 species and 203304 individuals were observed from open field area while built up area harbor only 55 species and 64709 individual birds. Among sampling sites, agriculture land was the most dominant site in terms of number of individuals while highest avian diversity was observed at river Chenab sides. Summer season was the most fertile season with respect to number of individuals, followed by winter, spring and autumn while highest number of species was observed in winter season followed by summer, spring and autumn.

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AZ conducted the field survey. AZ and AR identified the species. FJ performs written work of manuscript while TS contributed for statistical calculation.

Key words

Avian diversity, Abundance status, Diversity index, Point count method, Winter visitors

INTRODUCTION

It is estimated that by 2050, majority of the global population will live in urban areas (Gatesire *et al.*, 2014). Threats to biodiversity are particularly inherent to such rapid urbanization, which raises concerns over the future of the already reduced diversity in settings surrounding urban neighborhoods (Evans *et al.*, 2011). In many developing countries, a large number of wildlife survives outside protected areas on farmlands, pasture lands, and in urban areas (Bolwig *et al.*, 2006). Among all wildlife, birds are one of the most common wildlife in urban areas

such as neighborhoods and cities (Loss *et al.*, 2009). Bird populations have been declining as a result of landscape changes due to urban expansion (Strohbach *et al.*, 2009).

At the local level, these major changes include high rates of land conversion into urban uses and increasing human pressure on biodiversity due to rapid population growth. Due to the important role that birds play in maintaining ecosystems and supporting biodiversity, many seek their protection to manage biological threats and efficiently protect the environment (Stevenson and Fanshawe, 2002). Birds fulfill many ecological functions in their habitats. For instance, they are bioindicators of healthy ecosystems (Mistry *et al.*, 2008). In addition, insectivorous species and raptors regulate disease vectors, including mosquitoes and rodents. Scavenger birds, such as the pied crow (*Corvus albus*), contribute to biomass recycling and to some degree reduce levels of disposable wastes. Frugivorous birds play an important role in seed dispersal of fleshy fruit-producing plants (Stevenson and Fanshawe, 2002). Birds are also important in plant pollination as demonstrated by sunbirds, which participate in cross breeding of flowering plants, especially those

* Corresponding author: azharrafique96@gmail.com
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with bird-pollination syndrome (Umar *et al.*, 2018) and seed dispersal to pest and disease control i.e., vultures play a vital task of removing disease from the ecosystem through consumption of carrion (Whelan *et al.*, 2008). The landscape of the Faisalabad Division in the Province of Punjab has been undergoing major changes due to rapid urbanization driven by a fast growing human population. Avian populations are changing rapidly as a result of extensive environmental change and these rates of change are expected to accelerate over the coming decades (Gregory *et al.*, 2009). Human activities have some serious effects on avian diversity and bring changes which may lead to local and even worldwide extinction of avian fauna (Sumaila *et al.*, 2020).

Anthropogenic activities are the main driver of these bird population declines, such activities are still ongoing despite international consensus that biodiversity loss must be arrested (Butchart *et al.*, 2010). Understanding ecological factors such as vegetation that control the stability and persistence of bird populations is therefore crucial in establishing conservation as it is the key part of avian habitat (Mola *et al.*, 2021). By increasing urban development, the avian population has been changed. In urban areas, not only the ecological factors but industrial agents and the behavior of human beings also affect the ecological processes (Altaf *et al.*, 2012). Urbanization shows immediate effects and bring dramatic loss in biodiversity (Kondratyeva *et al.*, 2020).

The importance of maintaining heterogeneous human-modified habitats is not only limited to favor species movements across landscapes, but also to provide suitable areas available for native species (Ewers and Didham, 2006; Fischer and Lindenmayer, 2007). Bird's diversity is very essential due to its clarity and attraction to natural environment. Pakistan is showing a huge variety of bird's fauna due to its ideal location in biological realms and its diversity (Grimmett *et al.*, 1998).

MATERIALS AND METHODS

Study area

The study area Chiniot ($31^{\circ}43'12''N$, $72^{\circ}58'44''E$) is the administrative District of Faisalabad division located in the province of Punjab, Pakistan. Chiniot district is surrounded by Faisalabad in the East, Jhang at the South, Sargodha in the West and Hafizabad in the North (Fig. 1).

Point count method

Survey was conducted on weekly bases. Four visits were done during each month and a total of 48 in a year. Data about bird's diversity and abundance was collected using 15 to 20 min birds point count to a radius of 30

meters. The distance between two points was at least 250 m to eliminate the risk of double counting of the same bird at the same point. For each selected sampling site 12-point counts were made, for seven sampling sites (Agriculture land, River Chenab sides, streams or canals, cemeteries, settlement, residential neighborhood and institutional grounds) with a net total of 84-point count. Sugar cane, corn, wheat and rice are widely cultivated crops of the study area. Naked eyes and binocular telescope (10x50) was used to count the birds and camera was used to photograph the birds. During each visit, out of two major study area only one was observed. So, each major site area was visited twice in a month. For survey a low noise motorcycle was used with slow speed and with suitable stay as needed at each sub habitat by only one observer. Each major study area was observed for at least 3 h in dawn and 2 h in dusk. Morning timings were at 6:30 AM to 9:30 AM in summer months and 7:30 AM to 10:30 AM in winter months and evening timings were 5:00 PM to 7:00 PM in summer and 4:00 PM to 6:00 PM in winter months with little fluctuation of time sometimes. Naked eyes, binocular and camera (Canon EOS 5D) were used to photograph the birds. For identification of bird species, various practical guides (Roberts, 1992; Mirza and Wasiq, 2012) were consulted.

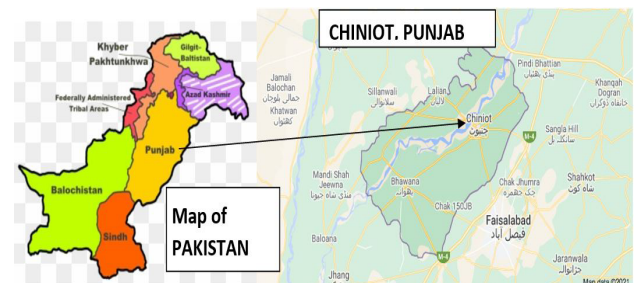


Fig. 1. Map of study area Chiniot in the province of Punjab (Pakistan). Landscape of Chiniot study area is classified into two major categories: (a) open fields included agricultural land, River Chenab sides, streams or canals and cemeteries; (b) built-up areas included settlements, residential neighborhoods and institutional grounds. The sampling was done from seven sites. site 1 comprised agricultural land, site 2 (River Chenab sides), Site 3 (streams or canals), site 4 (cemeteries), site 5 (settlements), site 6 (residential neighborhoods) while site 7 represents institutional grounds.

Shannon weiner index

For statistical analysis, PAST version 3 was used (Hammer *et al.*, 2001) to find out the Shannon and Simpson diversity (H). The Shannon-Wiener diversity index (H) is a measure of diversity that combines species richness

(the number of species in a given area) and their relative abundances. Following formula was used for Shannon wiener index.

$H = -\sum[(p_i) * \log(p_i)]$, where H is Shannon diversity index, p_i Proportion of individuals of i^{th} species in a whole community. $p_i = n/N$, where n indicate number of individuals of a species while N show number of all individuals in the community. \sum is the sum; log is usually the natural logarithm. Status of bird was declared in terms of very abundant if observed (more than 1000 individuals per day), abundant (201 to 1000 individuals per day), very common (51 to 200 individuals per day), common (21 to 50 individuals per day), fairly common (7 to 20 individuals per day), uncommon (1 to 6 individuals per day), rare (1 to 6 individuals per season) and very rare are infrequent (Bull, 1964; McCaskle, 1970 method).

Simpson index (D)

Simpson index determined the chance that two individuals randomly selected from a sample will belong to the same species. Simpson index is used to estimate dominance of the species and has no role in species richness.

$D = 1 - \{\sum n(n-1)/N(N-1)\}$, where n indicate number of individuals of a species while N shows show number of all individuals of all the species.

RESULTS

Abundance status of avian fauna at district Chiniot

In current study, we recorded 87 species of bird of 70 genera from 39 families representing 16 orders. Passeriformes was the most dominant order representing, 31 species, 23 genera and 17 families followed by Charadriiformes with 13 species, 12 genera and 5 families. Accipitriformes containing 8 species, 6 genera and 1 family. Coraciiformes have 7 species, 5 genera and 3 family. Pelecaniformes contains 5 species, 5 genera and single family. Columbiformes possess 4 species, 3 genera and single family. Cuculiformes contains 4 species, 4 genera and single family. Gruiformes have 3 species, 3 genera and single family. Galliformes, Bucerotiformes, Psittaciformes, Falconiformes have 2 species each while Strigiformes, Anseriformes, Piciformes and Suliformes represented by single species each.

According to Bull and McCaskle method, three most abundant species were *Passer domesticus* (house sparrow), *Corvus splendens* (Indian house crow), *Acridotheres tristis* (common myna). Six abundant species were *Dicrurus macrocercus* (black drongo), *Sexicola caprata* (pied bushchat), *Pycnonotus cafer* (red vented bulbul), *Venellus indicus* (red wattled lapwing), *Bubulcus ibis* (cattle egret)

and *Merops orientalis* (green bee eater).

Seven very common species were *Cinnyris asiaticus* (purple sunbird), *Acridotheres ginginianus* (bank myna), *Motacilla alba* (the white wagtail), *Ploceus philippinus* (baya weaver), *Spilopelia senegalensis* (laughing dove), *Ammomanes phoenicurus* (rofulous tail lark) and *Centropus sinensis* (greater coucal).

Twenty three common species were *Hirundo smithi* (the wire tailed swallow), *Gracupica contra* (Asian pied starling), *Dendrocitta vagabunda* (rofulous treepie), *Lanius schach* (long tail shrike), *Argya striatus* (jungle babbler), *Argya earlei* (striated babbler), *Iduna caligata* (booted warbler), *Actitis hypoleucos* (common sandpiper), *Elanus caeruleus* (black winged kite), *Aquila nipalensis* (steppe eagle), *Athene noctua* (little owl), *Upupa epops* (hudhud), *Ergetta garzetta* (little egret), *Ardeola grayii* (Indian pond heron), *Ixobrychus sinensis* (yellow bittern), *Columba livia* (rock pigeon), *Streptopelia decaocto* (Eurasian collared dove), *Coracias benghalensis* (Indian roller), *Halcyon smyrnensis* (white throated king fisher), *Gallinula galeata* (common gallinule), *Amaurornis phoenicurus* (white breasted water hen), *Dinopium benghalense* (black rumped woodpecker), *Eudynamis scolopacea* (Asian koel).

Twenty eight fairly common species were *Motacilla citreola* (citrine wagtail), *Tringa ochropus* (green sand piper), *Calidris temminckii* (temminck stint), *Cuculus poliocephalus* (little cuckoo), *Alcedo atthis* (common kingfisher), *Merops superciliosis* (blue cheeked bee eater), *Merops philippinus* (blue tailed bee eater), *Petrochelidon fluvicola* (streak throated swallow), *Lanius vittatus* (bay backed shrike), *Circus cyaneus* (hen harrier), *Milvus migrans* (Indian kite), *Lanius excubitor* (great grey shrike), *Motacilla flava* (yellow wagtail), *Copsychus saularis* (oriental magpie robin), *Oenanthe pleschanka* (pied wheat eater), *Saxicoloides fulicatus* (Indian robin), *Argya caudate* (common babbler), *Rhipidura aureola* (white browed fantail), *Himantopus himantopus* (black winged stilt), *Xenus cinereus* (terek sandpiper), *Pernis ptilorhynchus* (crested honey buzzard), *Accipiter nisus* (Eurasian sparrow hawk), *Falco tinnuculis* (common kestrel), *Ardea intermedia* (intermediate egret), *Ceryle rudis* (pied kingfisher), *Clamator jacobinus* (jacobin cuckoo), *Psittacula krameri* (rose ringed parakeets), *Columba eversmanni* (yellow eyed pigeon).

Fifteen uncommon species were *Phylloscopus neglectus* (plain leaf warbler), *Tockus nasutus* (grey hornbill), *Gallinago gallinago* (common snipe), *Limosa limosa* (black tail godvit), *Galerida cristata* (crested lark), *Porphyrio porphyria* (purple moorhen), *Recurvirostra avosetta* (pied avosetta), *Aquila chrysaetos* (golden eagle), *Chettusia leucura* (white tail lapwing), *Psittacula roseate* (blossom headed parakeet), *Oriolus kundoo* (Indian

golden oriole), *Butastur teesa* (white eye buzzard), *Falco peregrines* (peregrine falcon), *Dendrocygna javanica* (lesser whistling duck).

Four rare species were *Anhinga melanogaster* (darter or snake bird), *Glareola pratincola* (collared pratincole), *Sterna acuticauda* (black bellied tern), and *Francolinus pondicerianus* (grey francolin) while single infrequent species was *Francolinus francolinus* (black francolin) as its only single pair was observed during the whole survey. Figure 2 shows percentage abundance status of avian fauna.

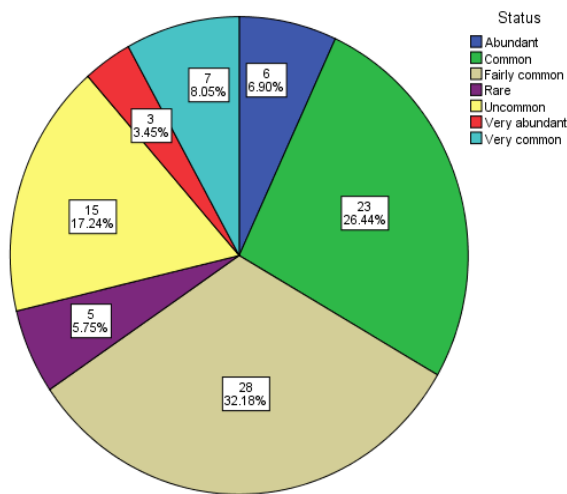


Fig. 2. Pie chart showing abundance status of birds at district Chiniot.

Number of bird species and individuals in open field area and built-up area

Landscape in the study area was classified into two major types such as open field area and built-up area. A highly significant difference was observed in open field area and built-up area. ($t = 193.28$; $P = 0.0000$, Table I). More diversity was observed in open field area.

Table I. Comparison between open area and built up area regarding Shannon Diversity Index and t test.

	Area	
	Open area	Closed area
S	87	55
N	203304	64709
Shannon's index	3.0476	1.8228
Variance	0.0000101	0.0000301
t-value	193.28**	
Prob.	0.0000	

**, Highly significant ($P < 0.01$); N, Total abundance; S, Richness (number of species).

Similarly, the total number of bird species identified in both open field area and built-up area was very different (Open fields= 87 built-up= 55). A total of 203304 individual birds of 87 species were identified from open field area while 64709 individuals of 55 species were isolated from built up area. Table I also shows that open field area has much higher (3.08) Shannon Diversity Index compared to built up area (1.823).

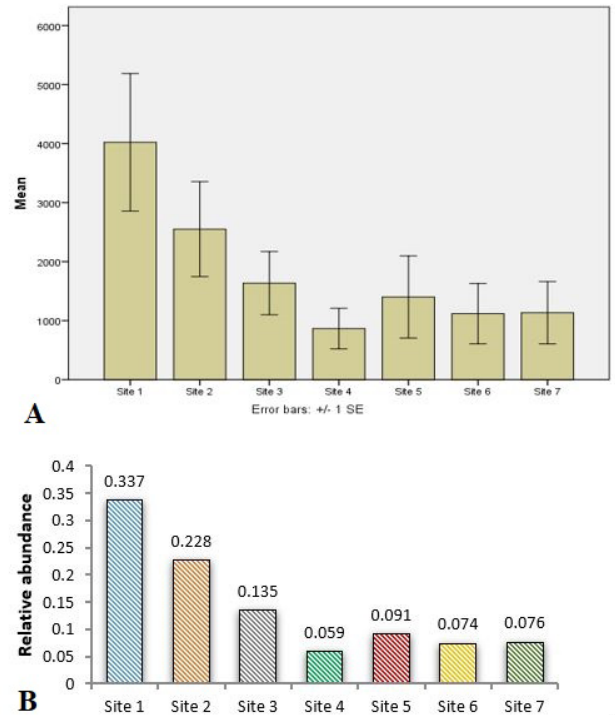


Fig. 3. Mean number of bird individuals per plot visit (A) and relative abundance of birds (B).

Avian diversity at seven selected sampling sites of district Chiniot

During one year survey, a total of 268013 estimated individual birds were observed from seven selected sampling sites (Site 1-Agriculture land, Site 2-River Chenab sides, Site 3-Canals, Site 4-Cemeteries, Site 5-Settlement, Site 6-Residential neighborhood and Site 7-institutional grounds). Agriculture land was the most dominant site in terms of number of individuals as 90495 (33.76%) birds were observed, followed by river Chenab sides with 61090 (22.79%) individuals, canals 36030 (13.44%) individuals, settlement 24381 (9.09%) individuals, institutional grounds 20437 (7.62%) individuals, residential neighborhood 19891 (7.42%) individuals and cemeteries 15689 (5.85%) individuals. As for as species diversity at different sites is concern, River Chenab site was the richest sampling area with 79 species

out of total 87 species, followed by Agriculture land with 72 species, canals 71 species, institutional grounds 50 species, cemeteries 38 species, residential neighborhoods 36 species and settlement with least number of 23 species. House sparrow, Indian house crow and common myna were the most dominant species at all the sampling sites (Table II).

Figure 3A indicates mean number of birds' individuals for all selected study sites. Agriculture land has the highest mean number while cemeteries have the lowest mean number.

Relative abundance

Site 1 has the highest relative abundance value

(0.337) while site 4 has the lowest relative abundance value (0.059) which shows that maximum birds abundance was observed at agriculture land and least number of individuals were observed at cemeteries (Fig. 3B).

Shannon Wiener Index for site 2 is (3.043) with (0.713) evenness and lowest value is for site 5 which is 1.61. These values indicate that river Chenab site was the most diverse site while settlement was the least diverse site in terms of number of species. Reverse Simpson index is highest (0.917) for site 1 followed by sites 2, 3 and four which show that agriculture land was the most dominant site in terms of bird individuals (Table III). Diversity and evenness values regarding different sites indicate that habitats have pivotal impact on the diversity of wild birds.

Table II. Brief description of top 30 most common species at study area of Chiniot. Open field (site 1-agriculture land, site 2-River Chenab sides, site 3-canals, site 4-cemetries). Built up area (site 5- settlement, site 6-residential neighborhoods, site 7- institutional ground).

S. No	Birds species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Total
1	House sparrow	13840	6941	7971	3056	9995	6667	7712	56182
2	Indian house crow	12061	10995	4131	4705	6800	5542	4811	49045
3	Common myna	14124	9035	5221	3400	4122	3900	3500	43302
4	Red vented bulbul	4561	3695	2380	843	1222	1329	1581	15611
5	Cattle egret	4290	6119	1014	0	145	256	51	11875
6	Green bee eater	4316	2522	1791	330	22	64	167	9212
7	Pied bushchat	3479	2481	1678	811	140	180	231	9000
8	Red wattled lapwing	6210	881	1213	18	22	41	82	8467
9	Black drongo	3475	2400	1234	108	129	155	110	7611
10	The white wagtail	1412	1178	653	78	0	0	40	3361
11	Purple sunbird	848	971	422	381	325	191	121	3259
12	Bank myna	1625	1078	168	124	70	84	60	3209
13	Rofous tail lark	623	431	425	305	512	375	267	2938
14	Baya weaver	1804	678	149	65	0	20	0	2716
15	Laughing dove	717	613	218	27	256	190	111	2132
16	Striated babbler	812	334	256	55	0	41	71	1569
17	White throated king fisher	657	325	411	8	15	44	79	1539
18	Jungle babbler	768	319	193	83	0	40	93	1496
19	Hudhud	468	329	214	32	40	119	281	1483
20	Little egret	544	638	145	0	29	68	0	1424
21	Asian pied starling	578	405	115	84	75	68	91	1416
22	White breasted water hen	515	390	412	0	0	25	19	1361
23	Long tail shrike	612	348	211	22	0	31	95	1319
23	Black winged kite	710	331	258	0	0	0	0	1299
24	Indian roller	705	423	139	10	0	0	18	1295
25	Asian koel	728	316	33	27	0	22	126	1252
26	Rofous treepie	785	180	120	105	0	0	60	1250
27	Black rumped woodpecker	412	301	25	258	0	42	171	1209
28	Common gallinule	0	265	912	0	0	0	0	1177
29	Indian pond heron	321	168	536	2	0	71	22	1120
30	Little owl	352	102	144	481	3	17	1	1100

Note: The dominant species with more than 1000 individuals have been described here.

Table III. Diversity and evenness regarding different sites and different seasons.

Sites	S (rich- ness)	N	Shannon wiener index	Simpson index	Reverse simpson index	Even- ness
Site 1	72	90495	3.040	0.083	0.917	0.713
Site 2	79	61090	3.043	0.088	0.912	0.694
Site 3	71	36030	2.968	0.097	0.903	0.696
Site 4	38	15689	2.136	0.183	0.817	0.587
Site 5	23	24381	1.615	0.278	0.722	0.515
Site 6	36	19891	1.850	0.234	0.766	0.516
Site 7	50	20437	1.942	0.234	0.766	0.496
Total	87	268013	2.831	0.114	0.886	0.634
Seasons						
Spring	44	44264	2.408	0.148	0.852	0.636
Summer	60	125665	2.796	0.109	0.891	0.683
Autumn	43	21330	2.540	0.135	0.865	0.675
Winter	70	76754	2.915	0.108	0.892	0.686
Total	87	268013	2.831	0.114	0.886	0.634

S, species richness; N, number of individuals.

Impact of seasonal variations on avian fauna

The study was conducted for a year to point out the impact of seasonal variation (spring, summer, autumn and winter) on the abundance and diversity of avian fauna in the study area. Eighty seven species were identified during one year field survey. As for as species distribution is concern, winter season was the most fertile season because 70 species were observed during winter. Twenty six species were winter visitor. Sixty species were observed during summer in which sixteen species were summer visitor. Forty four species were identified in spring while 43 species were noted in autumn.

Summer was the most productive season with regards to no of individuals as 125665 (46.88%) individuals were observed during summer followed by winter with 76754 (28.63%) individuals; spring 44264 (16.51%) individuals and autumn with least number of 21330 (7.95%) individuals. Figure 4 shows highest abundance in summer and lowest in autumn.

Resident birds

The species which exist all along the year are called resident birds. Forty-three species (49%) were resident in the study area. The resident species were *Passer domesticus*, *Corvus splendens*, *Acridotheres tristis*, *Dicrurus macrocercus*, *Sexicola caprata*, *Pycnonotus cafer*, *Venellus indicus*, *Bubulcus ibis*, *Motacilla alba*, *Ploceus philippinus*, *Ammomanes phoenicurus*, *Centropus*

sinensis, *Hirundo smithi*, *Gracupica contra*, *Dendrocitta vagabunda*, *Lanius schach*, *Argya striatus*, *Argya earlei*, *Elanus caeruleus*, *Aquila nipalensis*, *Athene noctua*, *Upupa epops*, *Ergetta garzetta*, *Ardeola grayii*, *Ixobrychus sinensis*, *Columba livia*, *Streptopelia decaocto*, *Coracias benghalensis*, *Halcyon smyrnensis*, *Gallinula galeata*, *Amaurornis phoenicurus*, *Dinopium benghalense*, *Argya caudate*, *Lanius vittatus*, *Himantopus himantopus*, *Ceryle rudis*, *Acridotheres ginginianus*, *Psittacula krameri*, *Francolinus pondicerianus*, *Porphyrio porphyrio*, *Galerida cristata*, *Lanius excubitor*, and *Milvus migrans*.

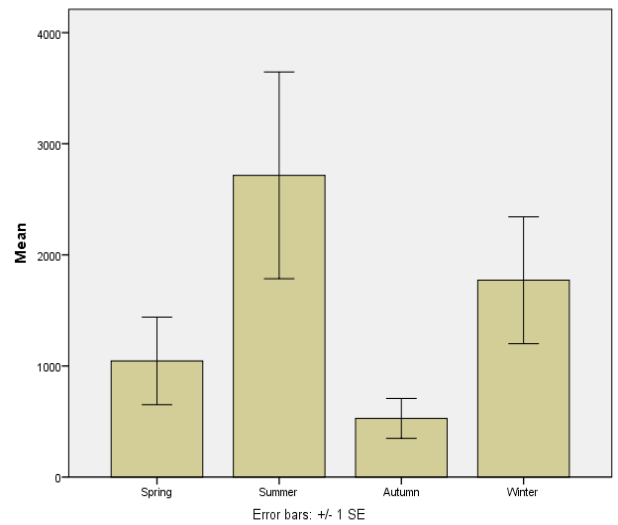


Fig. 4. Mean number of bird individuals per plot visit in spring, summer, autumn and winter.

Summer visitor

Sixty species of birds were observed during summer season in which sixteen species (18%) were summer visitors. Forty four species were the part of resident birds. The summer birds include *Cinnyris asiaticus*, *Ploceus philippinus*, *Merops orientalis*, *Eudynamis scolopacea*, *Merops superciliosis*, *Merops philippinus*, *Ardea intermedia*, *Oriolus kundoo*, *Tockus nasutus*, *Clamator jacobinus*, *Anhinga melanogaster*, *Glareola pratincola*, *Dendrocygna javanica*, *Saxicoloides fulicatus* and *Copsychus saularis*.

Winter visitors

Seventy species were identified in winter season. Twenty-seven species were winter visitors. Winter visitors include *Iduna caligata*, *Actitis hypoleucos*, *Motacilla citreola*, *Tringa ochropus*, *Calidris temminckii*, *Cuculus poliocephalus*, *Alcedo athis*, *Petrochelidon fluvicola*, *Circus cyaneus*, *Motacilla flava*, *Oenanthe pleschanka*, *Xenus cinereus*, *Pernis ptilorhynchus*, *Accipiter nisus*,

Falco tinnuculis, *Columba eversmanni*, *Phylloscopus neglectus*, *Gallinago gallinago*, *Limosa limosa*, *Recurvirostra avosetta*, *Aquila chrysaetos*, *Chettusia leucura*, *Psittacula roseate*, *Butastur teesa*, *Falco peregrines*, *Sterna acuticauda* and *Rhipidura aureola*.

Passage vagrant

A species which migrates for away from its natural habitat is called Passage vagrant. *Francolinus francolinus* was a single vagrant species of our study as only two individuals were observed once on river Chenab bank during the month of May. Shannon Wiener index value for winter is 2.9 which show that winter was the most diverse season. Winter contains the highest Shannon Wiener index (2.915) with evenness 0.686 which indicate that avian diversity was maximum during winter followed by summer (2.796). Table III shows brief description about avian diversity and abundance in different seasons.

DISCUSSION

Punjab is the most populous province of Pakistan. Due to rapid urbanization, avifauna has some serious threat due to loss of habitat. During current study, 87 species of birds were observed during one year survey conducted in district Chiniot located at the central region of Punjab while Altaf *et al.* (2012) pointed out 41 species of avian fauna from urban habitats of Gujranwala. Out of 41 species, 2 species were abundant, 11 common, 1 very common, 4 fairly common, 4 uncommon, 2 very rare and 7 rare. As for as status of birds species in current study is concern, 3 species were very abundant, 6 species were abundant, 7 species were very common, 23 species were common, 15 species were uncommon, 27 species were fairly common, 5 species were rare and single species was infrequent. Both studies share 29 species. This difference shows that land of Chiniot is more fertile with regards to avian diversity. More variation in the nature of habitats supports this argument. Sidra *et al.* (2013) determined the bird's diversity of Punjab University Lahore (new campus) and reported 76 bird species. Indian roller, pied kingfisher, pied cuckoo, grey francolin, black francolin and greater coucal which were observed in current study were not pointed out at Punjab university Lahore by Sidra *et al.* (2013). High number of bird's species may be due to undisturbed environment and rich availability of food. Mahboob *et al.* (2013) find out birds diversity of district Jhang and reported 55 species of 42 genera, 28 families and belonging from 13 orders. Current study identified 87 species from 70 genera, 39 families and 16 orders. Both studies share 35 species. Furthermore Mahboob *et al.* (2013) estimated 2550219 individuals of birds while

our aggregate findings of individual birds is 268013 which is too less. More open area and food availability may be the cause of avian abundance. Houbara bustard, common quail, and raven species existed in district Jhang were not found in our study which may be due to the lack of desert region in Chiniot. These species preferably favor desert area which is found in district Jhang. Black francolin was observed in Chiniot in agriculture field on the bank of river chenab even though it was infrequent, was not pointed out at District Jhang by Mahboob *et al.* (2013). Another study at Lahore Safari Zoo conducted by Mahmood *et al.* (2018) identified 5456 individuals from 71 species of birds belonging to 41 families and 12 orders. Both studies have similar reports regarding the abundance of house crow, house sparrow and common myna. Mahmood *et al.* (2018) investigated that Passeriformes was the most dominant order by representing 37 species. In current study, Passeriformes was also dominant order with 31 species. In contrast to safari zoo study, our study area is more fertile with respect to abundance and diversity of avian fauna. Mahmood *et al.* (2012) find out the diversity of three falcon species including red headed merlin, sakor falcon and common Kestrel in district Chakwal, Pakistan. Our study also noted common kestrel with status of being fairly common. red headed merlin, sakor falcon were not found in our study. Peregrine falcon was observed in Chiniot with status of uncommon but it is not pointed out in Chakwal. Khan *et al.* (2020) reported the diversity of birds at Trimmu barrage district Jhang and investigated 26 species of birds during one year survey. Our findings are different from Khan *et al.* (2020) because at the same type of habitat (River Chenab and its near area), 79 species of birds were identified which is twice more than the avian diversity of Trimmu barrage. In both studies only 12 species are common despite the fact that both sampling sites show similar features. Local disturbance in the form of more hunting pressure may be one major reason for diversity difference in both study areas as the author observed very little hunting practices at Chiniot. Our study finding in regards of agriculture land site sampling resembles with Gillings *et al.* (2008) in which high bird diversity and abundance was observed at farm land. More food availability and secure area from predator would be the cause of rich avian diversity at agriculture sites. Gatesire *et al.* (2014) conducted a survey to determine bird distribution and diversity in urban landscape types of Musanze city, Rwanda. This study concluded that both open field area and built up area have equal type of birds diversity as they identified 63 species from built up areas and 61 species from open field areas. In contrast our study pointed out a significant difference in both open field area and built up area by identifying

all 87 species from open field area while only 55 species were observed out of 87 species from built up areas which were also the part of species found in open field area. Our findings also vary with respect of micro landscape types by identifying highest number of species from agriculture land and Chenab riverside as each site harbor 72 species and 79 species of birds respectively. While study of Musanze city reported highest number of species (N=42) from institutional grounds followed by residential neighborhoods (N=41). More feeding opportunities for food and shelter may be the cause for highest diversity and distribution. Pathan *et al.* (2014) investigated the diversity of birds in Swat district, KPK, Pakistan and reported 138 species with Passeriformes being the most dominant order by representing 31 species. With sense of Passeriformes being the most dominant order our findings are alike as we also identified 31 species of Passeriformes. Since Swat lies on the route of migratory birds, and also have more favorable climatic condition. That is why it's avian diversity is much rich as compared to Chiniot. Ali *et al.* (2016) conducted a study during winter season at district Thatta, Sind, Pakistan and reported 4280 individuals of 39 species belonging to 33 genera and 21 families. Little egret, cattle egret, Greater egret, greater flamingo and common coot were the most abundant species of Keti Bunder, Thatta district. According to our study, during winter 76754 individuals belonging to 70 species were observed. Cattle egret was abundant, little egret was common while Intermediate egret was fairly common. Fazal *et al.* (2014) find out the Passerine diversity of Lahore and reported 71 species of birds. House crow, house sparrow and common myna were the most abundant species while red vented bulbul was abundant. Bank myna was very common, common babbler and jungle babbler were common while Asian pied starling, Indian robin, purple sunbird, black drongo, white browed fantail were fairly common, long tail shrike and rofous treepie were rare. We also noted highest number (N=31) of Passeriformes species in Chiniot. As for as status comparison of both studies is concern, similar to Fazal *et al.* (2014) study, in our survey house crow, house sparrow and common myna were the most abundant species, red vented bulbul was abundant, bank myna was very common, jungle babbler was common, Indian robin, white browed fantail were fairly common. Our finding were different with regards of status of Asian pied starling, purple sunbird, black drongo, as these species were common, very common and abundant respectively. Long tail shrike and rofous treepie abundance also vary as their status in our study is common but both these species were declared rare by the survey conducted at Lahore. Kler *et al.* (2015) investigated avian diversity in the urban land scape of Ludhiana, Indian Punjab and reported 25 species.

House crow and rock pigeon were the most abundant species. Our study reported eighty seven species in district Chiniot. Similar to Kler study, house crow was among the most abundant species but different to Kler investigation, rock pigeon status was common and was not among the most abundant species.

CONCLUSION

Even though Chiniot have rich avian diversity due to variety of habitats and seasonal changes but according to local villagers' reports (as no previous study in this area conducted) the birds abundance and diversity fall down rapidly in last few years. The population explosion may be one major cause for decline of avian diversity. After receiving the status of district in 2009, network of Govt. offices, educational institutions and residential houses were established and the city spread dramatically and disturbs the natural environment for birds. Pollution and some local hunters are also threats for avian diversity. So it is concluded from our study that urbanization and seasonal variations are major causes for the decline of abundance and diversity of avian fauna. More and more plantation and awareness can reduce the risk of species decline as plants are the major habitat for avian fauna. Population growth rate must be controlled.

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Statement of conflict of interest

The authors have declared no conflict of interest.

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