

Documentation of Avian Species Composition and Assemblage in Agricultural Landscapes of Sirsa, Haryana

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ABSTRACT

Avian communities maintain ecological balance by eliminating pests, providing ecosystem services, and acting as biological indicators, thereby playing a pivotal role in conserving agricultural landscapes' integrity and stability; thus from an environmental monitoring standpoint, assessment of bird aggregations in various landscapes is necessary. A two-year bird survey was conducted from May 2020 and 2021 to October 2020 to 2021 to document the checklist, density, and diversity of bird species assemblage of

agricultural landscapes in the Sirsa district of Haryana, India, to obtain the richness of birds in two different agricultural habitats. A total of 87 bird species from 39 families and 16 orders were recorded; four bird species (Alexandrine Parakeet, Asian Woolly-neck, Black-Headed Ibis, and Painted Stork) are listed as Near Threatened in the 'IUCN' (2010) category. Surprisingly, 13 species with global declining population trends are rare in the study area. The Passeriformes order, with 44 species, is the most diverse in the study area. In all habitats, analysis of food and feeding guilds, as well as perching activity, revealed that the insectivorous guild (32) is dominant, followed by Omnivore (29), Carnivore (13), Granivore (7), Frugivore (5), and Nectarivore (2). The findings from this study suggest that biodiversity-friendly agricultural practices should be implemented to improve bird habitat quality in agricultural landscapes.

Keywords Aves, Agriculture landscape, *Kharif* crops, Biodiversity-friendly agriculture.

INTRODUCTION

Agroecosystems including agricultural areas play a vital role in sustaining biodiversity by providing food resources to several species. Aside from providing a variety of ecosystem services, agricultural landscapes provide a unique habitat for a wide range of wildlife, including invertebrates, amphibians, reptiles, birds, and mammals. Agriculture accounts for

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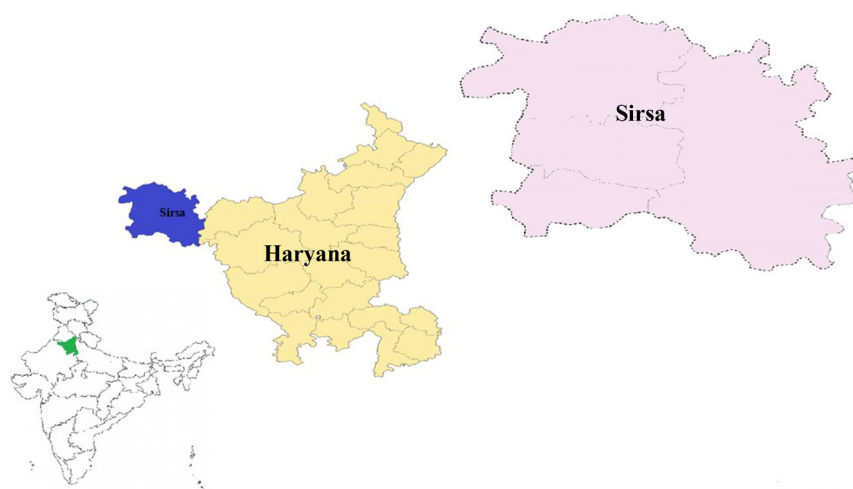


Fig. 1. Study area map.

approximately 60.45% of the total land area in India (Yashmita-Ulman and Singh 2021a). Agroecosystems are among the most productive ecosystems on the planet, occupying 38% of the earth's terrestrial area. Birds, one of the most important components of agroecosystems play a dual role either by functioning as pests by feeding on grains and seeds or as biocontrol agents by feeding on crop insect pests (Yashmita-Ulman *et al.* 2021a). Many bird species rely on agricultural landscapes for a concentrated and highly predictable source of food, such as grains, seeds, fruits, and green vegetation from crop plants, grasses, weeds, insects, other invertebrates, and rodents. Insectivorous bird species are the most dominant in agroecosystems and play an important and beneficial role for farmers by maintaining insect pest populations. Some bird species can promote pollination and help spread plants, and also benefit as food sources or as pets. Compared to the benefits that are availed from birds by humans and the environment, the various disadvantages are not so great. Due to agricultural intensiveness and consequent mechanization, excessive use of pesticides and fertilizers, rapid urbanization, and increasing industrialization, Haryana State has experienced substantial modifications in its agroecosystem throughout the past few decades affecting avifaunal diversity. Documentation of bird assemblages in agroecosystems is needed in order to determine and assess the impact of changing natural habitats and agricultural practices on avian

diversity (Mallik *et al.* 2015, Hossain and Aditya 2016, Narayana *et al.* 2019). The development of appropriate conservation strategies for preserving birds without compromising the goal of intensive agricultural practices in heterogeneous agricultural landscapes will be aided by knowledge of the species richness and community structure of birds (Hossain and Aditya 2016). Sirsa district is among one of the agriculturally developed regions of Haryana. There are currently few, or no data is available regarding the diversity of birds found in Sirsa district's agricultural landscapes. The goal of the attempted current study is to document the species diversity and composition of the avian fauna in the agricultural landscapes of Sirsa District, Haryana.

MATERIALS AND METHODS

Description of study area : The district Sirsa lies between 29.14° and 30.0° north latitude and 74.29° and 75.18° east longitudes (Fig. 1). The plain elevations in Sirsa vary from 192 to 207 exhibiting a small slope in the direction of northeast to southwest and 250 m above Mean Sea Level. The ephemeral river Ghaggar flows from East to West in Sirsa district. The climate of Sirsa is semi-arid type can be defined as sub-tropical, semi-arid and continental with monsoon four distinct seasons can be distinguished in both the areas : Dry (March–June), the hot rainy (monsoon) season (July–September), the post monsoon season

Table 1. Birds species recorded in the selected agricultural landscapes of Sirsa district, Haryana. LC = Least Concern, NT= Near Threatened, + = presence of birds species, - = Absence of birds species, O = Omnivore, Ca = Carnivore, In = Insectivore, G = Grainivore, F = Frugivore, N = Nectarivore, R = Resident, WM = Winter Migrant, SM = Summer Migrant, C = Common, UC = Uncommon, VC = Very Common, Ra = Rare, ↓ = Decreasing, ↑ = Increasing, → = Stable, ? = Unknown, LC = Least Concern, NT = Near Threatened.

Sl. No.	Scientific name	Common name	Site		Order	Resi- den- tial status	Abun- dance status	GPT	Conservation status			
			Ba	Ph	Family				IUCN (2022)	IWPA (1972)	CITES (2012)	Habi- tat
1. Accipitriformes Family-1, Species-3												
1.1.	Accipitridae											
1	Black kite	<i>Milvus migrans</i> (Boddaert 1783)	-	+	Ca	R	UC	→	LC	I	II	T
2	Black-winged kite	<i>Elanus caeruleus</i> (Desfontaines 1789)	+	+	O	R	UC	→	LC	I	II	T
3	Shikra	<i>Accipiter badius</i> (Gmelin 1788)	+	+	Ca	R	VC	→	LC	I	II	T
2. Anseriformes Family-1, Species-2												
2.1.	Anatidae											
4	African comb duck	<i>Sarkidiornis melanotos</i> (Pennant 1769)	+	-	O	R	Ra	↓	LC	IV	II	A
5	Indian spot – billed duck	<i>Anas poecilorhyncha</i> (Forster 1781)	+	-	O	R	Ra	↓	LC	IV	-	A
3. Bucerotiformes Family-1, Species-1												
3.1.	Bucerotidae											
6	Indian grey hornbill	<i>Ocyrceros birostris</i> (Scopoli 1786)	+	-	O	R	Ra 3	→	LC	IV	-	A
4. Columbiformes Family-1, Species-5												
4.1.	Columbidae											
7	Eurasian collared dove	<i>Streptopelia decaocto</i> (Frisvaldszky 1838)	+	+	G	R	VC	↑	LC	IV	-	A
8	Laughing dove	<i>Spilopelia senegalensis</i> (Linnaeus 1766)	+	+	G	R	C	→	LC	IV	-	B
9	Rock dove	<i>Columba livia</i> (Gmelin 1789)	+	+	G	R	VC	↓	LC	IV	-	Y
10	Yellow-footed green-pigeon	<i>Treron phoenicopterus</i> (Latham 1790)	+	+	F	R	C	↑	LC	IV	-	B
11	Spotted Dove	<i>Streptopelia chinensis</i> (Scopoli 1786)	+	+	G	R	Ra	↑	LC	IV	-	T
5. Coraciiformes Family-3, Species-4												
5.1.	Alcedinidae											
12	White – breasted kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus 1758)	+	+	Ca	R	VC	↑	LC	IV	-	B
5.2.	Coraciidae											
13	Indian roller	<i>Coracias benghalensis</i> (Linnaeus 1758)	+	+	Ca	R	VC	↑	LC	IV	-	A
5.3.	Meropidae											
14	Asian green bee-eater	<i>Merops orientalis</i> (Latham 1802)	+	+	In	R	VC	↑	LC	IV	-	Ts
15	Blue- cheeked bee- eater	<i>Merops persicus</i> (Pallas 1773)	+	+	In	SM	VC	↑	LC	IV	-	T

Table 1. Continued.

Sl. No.	Scientific name	Common name	Site		Order	Resi- den- tial sta- tus	Abun- dant- status	GPT	Conservation status			
			Ba	Ph	Family				IUCN (2022)	IWPA (1972)	CITES (2012)	Habi- tat
6. Charadriiformes Family-4, Species-4												
6.1.	Burhinidae											
16	Indian thick-knee	<i>Burhinus indicus</i> (Salvadori 1865)	+	+	O	R	VC	↓	LC	IV	-	T
6.2.	Charadriidae											
17	Red-wattled lapwing	<i>Vanellus indicus</i> (Boddaert 1783)	+	+	In	R	C	?	LC	IV	-	T
6.3.	Recurvirostridae											
18	Black winged stilt	<i>Himantopus himantopus</i> (Linnaeus 1758)	+	+	Ca	R	C	↑	LC	IV	-	T
6.4.	Scolopacidae											
19	Green sandpiper	<i>Tringa ochropus</i> (Linnaeus 1758)	+	-	In	WM	UC	↑	LC	IV	-	T
20	Common sandpiper	<i>Actitis hypoleucos</i> (Linnaeus 1758)	+	-	In	WM	UC	↓	LC	IV	-	A/T
7. Ciconiiformes Family-1, Species-2												
7.1.	Ciconiidae											
21	Asian wolly-neck	<i>Ciconia episcopus</i> (Boddaert 1783)	+	-	Ca	R	Ra	↓	NT	IV	-	T
22	Painted stork	<i>Mycteria leucocephala</i> (Pennant 1769)	+	-	Ca	R	Ra	↓	NT	IV	I	T
8. Cuculiformes Family-1, Species-5												
8.1.	Cuculidae											
23	Greater coucal	<i>Centropus sinensis</i> (Stephens 1815)	+	+	O	R	C	→	LC	IV	-	T
24	Eastern koel	<i>Eudynamis scolopaceus</i> (Linnaeus 1758)	+	+	O	R	C	→	LC	IV	-	T
25	Common hawk-cuckoo	<i>Hierococyx varius</i> (Vahl 1797)	+	+	In	R	UC	→	LC	IV	-	T
26	Grey bellied cuckoo	<i>Cacomantis passerinus</i> (Vahl 1797)	+	+	In	SM	Ra	→	LC	IV	-	T
27	Jacobin cuckoo	<i>Clamator jacobinus</i> (Boddaert 1783)	+	+	O	SM	UC	→	LC	IV	-	T
9. Galliformes Family-1, Species-2												
9.1.	Phasianidae											
28	Black francolin	<i>Francolinus francolinus</i> (Linnaeus 1766)	+	+	O	R	C	→	LC	IV	-	T
29	Grey francolin	<i>Francolinus pondicerianus</i> (Gmelin 1789)	+	+	O	R	C	→	LC	IV	-	T
10. Gruiformes Family-1, Species- 3												
10.1.	Rallidae											
30	Common coot	<i>Fulica atra</i> (Linnaeus 1758)	+	-	O	R	Ra	↑	LC	IV	-	T
31	Common moorhen	<i>Gallinula chloropus</i> (Linnaeus 1758)	+	-	O	R	Ra	↓	LC	IV	-	T
32	White-breasted waterhen	<i>Amaurornis phoenicurus</i> (Pennant 1769)	+	+	O	R	VC	?	LC	IV	-	T

Table 1. Continued.

Sl. No.	Scientific name	Common name	Site		Order	Resi- den- tial sta- tus	Abun- dant status	GPT	Conservation status			
			Ba	Ph	Family				IUCN (2022)	IWPA (1972)	CITES (2012)	Habi- tat
11. Passeriformes Family-18, Species-43												
11.1.	Acrocephalidae											
33	Paddyfield warbler	<i>Anthus rufulus</i>	+	-	In	R	Ra	↓	LC	IV	-	T
11.2.	Alaudidae											
34	Ashy crowned sparrow - lark	<i>Eremopterix griseus</i> (Scopoli 1786)	+	+	O	R	UC	→	LC	IV	-	T
35	Crested lark	<i>Galerida cristata</i> (Linnaeus 1758)	+	+	O	R	UC	↓	LC	IV	-	T
11.3.	Cisticolidae											
36	Ashy prinia	<i>Prinia socialis</i> (Sykes 1832)	+	+	In	R	VC	→	LC	IV	-	T
37	Plain prinia	<i>Prinia inornata</i> (Sykes 1832)	+	+	In	R	VC	→	LC	IV	-	T
38	Common tailorbird	<i>Orthotomus sutorius</i> (Pennant 1769)	+	+	N	R	Ra	→	LC	IV	-	T
39	Yellow – bellied prinia	<i>Prinia flaviventris</i> (Delessert 1840)	+	-	In	R	Ra	↓	LC	IV	-	T
11.4.	Corvidae											
40	House crow	<i>Corvus splendens</i> (Vieillot 1817)	+	+	O	R	C	→	LC	IV		T
41	Rufous treepie	<i>Dendrocitta vagabunda</i> (Latham 1790)	+	+	In	R	VC	↓	LC	IV	-	T
11.5.	Dicruridae											
42	Black drongo	<i>Dicrurus macrocercus</i> (Vieillot 1817)	+	+	In	R	C	?	LC	IV	-	T
11.6.	Estrildidae											
43	Indian silverbill	<i>Euodice malabarica</i> (Linnaeus 1758)	+	+	G	R	VC	→	LC	IV	-	T
44	Scaly – breasted munia	<i>Lonchura punctulata</i> (Linnaeus 1758)	+	+	G	R	VC	→	LC	IV	-	T
11.7.	Hirundinidae											
45	Wire – tailed swallow	<i>Hirundo smithii</i> (Leach 1818)	+	+	In	R	UC	↑	LC	IV	-	T
46	Streak throated swallow	<i>Petrochelidon flavicola</i> (Blyth 1855)	+	+	In	R	UC	↑	LC	IV	-	T
11.8.	Leiotrichidae											
47	Large grey babbler	<i>Argya malcolmi</i> (Sykes 1832)	+	+	O	R	VC	→	LC	IV	-	T
48	Jungle babbler	<i>Argya striata</i> (Dumont 1823)	+	+	O	R	VC	→	LC	IV	-	T
49	Striated babbler	<i>Argya earlei</i> (Blyth 1844)	+	+	O	R	Ra	↓	LC	IV	-	T
50	Common Babbler	<i>Argya caudata</i>	+	+	O	R	C	→	LC	IV		
51	Paddyfield pipit	<i>Anthus rufulus</i> (Vieillot 1818)	+	-	In	R	UC	→	LC	IV	-	T
52	Tree pipit	<i>Anthus trivialis</i> (Linnaeus 1758)	+	+	In	WM	UC	↓	LC	IV	-	T

Table 1. Continued.

Sl. No.	Scientific name	Common name	Site		Order	Resi- den- tial sta- tus	Abun- dance status	GPT	Conservation status			
			Ba	Ph	Family				IUCN (2022)	IWPA (1972)	CITES (2012)	Habi- tat
11.9. Motacillidae												
53	White bro- wed wagtail	<i>Motacilla maderas- patensis</i> (Gmelin 1789)	+	+	In	R	C	→	LC	IV	-	T
54	White wagtail	<i>Motacilla alba</i> (Linnaeus 1758)	+	+	In	WM	C	→	LC	IV	-	T
55	Grey wagtail	<i>Motacilla cinerea</i> (Tunstall 1771)	+	+	In	WM	UC	→	LC	IV	-	T
56	Western yel- low wagtail	<i>Motacilla flava</i> (Linnaeus 1758)	+	+	In	WM	Ra	↓	LC	IV	-	T
11.10. Muscicapidae												
57	Black redstart	<i>Phoenicurus ochruros</i>	+	+	In	WM	UC	↑	LC	IV	-	T
58	Blurthroat	<i>Cyanecula svecica</i> (Linnaeus 1758)	+	+	In	WM	UC	→	LC	IV	-	T
59	Brown rock- chat	<i>Oenanthe fusca</i> (Blyth 1851)	+	+	In	R	C	→	LC	IV	-	T
60	Common ston- echat	<i>Saxicola torquatus</i> (Linnaeus 1766)	+	+	In	WM	C	→	LC	IV	-	T
61	Indian robin	<i>Saxicoloides fulicatus</i> (Linnaeus 1766)	+	+	In	R	C	→	LC	IV	-	T
62	Oriental mag- pie -robin	<i>Copsychus saularis</i> (Linnaeus 1758)	+	+	In	R	VC	→	LC	IV	-	T
63	Pied bushchat	<i>Saxicola caprata</i> (Linnaeus 1766)	+	+	In	R	VC	→	LC	IV	-	T
11.11. Nectariniidae												
64	Purple sunbird	<i>Cinnyris asiaticus</i> (Latham 1790)	+	+	N	R	C	→	LC	IV	-	T
11.12. Passeridae												
65	House sparrow	<i>Passer domesticus</i> (Linnaeus 1758)	+	+	G	R	C	↓	LC	IV	-	T
11.13. Phylloscopidae												
66	Common chif- fchaff	<i>Phylloscopus collybita</i> (Vieillot 1817)	+	+	O	WM	VC	↑	LC	IV	-	T
11.14. Ploceidae												
67	Baya weaver	<i>Ploceus philippinus</i> (Linnaeus 1766)	+	+	O	R	C	→	LC	IV	-	T
11.15. Pycnonotidae												
68	Red – vented bulbul	<i>Pycnonotus cafer</i> (Linnaeus 1766)	+	+	F	R	C	↑	LC	IV	-	T

Table 1. Continued.

Sl. No.	Scientific name	Common name	Site		Order	Residential status	Abundance status	GPT	Conservation status			
			Ba	Ph	Family				IUCN (2022)	IWPA (1972)	CITES (2012)	Habitat
69	White – eared bulbul	<i>Pycnonotus leucotis</i> (Gould 1836)	+	+	O	R	Ra	↓	LC	IV	-	T
11.16. Sturnidae												
70	Asian – pied starling	<i>Gracupica contra</i> (Linnaeus 1758)	+	+	O	R	Ra	↑	LC	IV	-	T
71	Brahminy starling	<i>Sturnia pagodarum</i> (Gmelin 1789)	+	+	O	R	Ra	?	LC	IV	-	T
72	Common myna	<i>Acridotheres tristis</i> (Linnaeus 1766)	+	+	O	R	C	↑	LC	IV	-	T
73	Common starling	<i>Sturnus vulgaris</i> (Linnaeus 1758)	+	+	O	WM	Ra	↓	LC	IV	-	T
74	Rosy starling	<i>Pastor roseus</i> (Linnaeus 1758)	+	+	O	WM	UC	?	LC	IV	-	T
11.17. Sylviidae												
75	Lesser white-throat	<i>Sylvia curruca</i> (Linnaeus 1758)	+	+	O	WM	Ra	→	LC	IV	-	T
11.18. Zosteropidae												
76	Oriental white - eye	<i>Zosterops palpebrosus</i>	+	+	In	R	Ra	↓	LC	IV	-	T
12. Pelecaniformes Family-2, Species-5												
12.1. Ardeidae												
77	Indian pond heron	<i>Ardeola grayii</i> (Sykes 1832)	+	+	Ca	R	C	?	LC	IV	-	A
78	Cattle egret	<i>Bubulcus ibis</i> (Linnaeus 1758)	+	+	Ca	R	C	↑	LC	IV	-	A
79	Little egret	<i>Egretta garzetta</i> (Linnaeus 1766)	+	+	Ca	R	C	↑	LC	IV	-	B
12.2. Threskiornithidae												
80	Black headed Ibis	<i>Threskiornis melanocephalus</i> (Latham 1790)	+	+	Ca	R	Ra	↓	NT	IV	-	T
81	Red naped ibis	<i>Pseudibis papillosa</i> (Temminck 1824)	+	+	Ca	R	C	↓	LC	IV	-	T
13. Piciformes Family-1, Species-1												
13.1. Megalaimidae												
82	Brown headed barbet	<i>Psilopogon zeylanicus</i> (Gmelin 1788)	+	+	F	R	C	→	LC	IV	-	T

Table 1. Continued.

Sl. No.	Scientific name	Common name	Site		Order	Resi- den- tial sta- tus	Abun- dance status	GPT	Conservation status			
			Ba	Ph	Family				IUCN (2022)	IWPA (1972)	CITES (2012)	Habi- tat
14. Psittaciformes Family-1, Species- 2												
14.1. Psittacidae												
83	Alexandrine parakeet	<i>Palaeornis eupatria</i> (Linnaeus 1766)	+	+	F	R	UC	↓	NT	IV	II	T
84	Rose- ringed parakeet	<i>Alexandrinus krameri</i> (Scopoli 1769)	+	+	F	R	C	↑	LC	IV	-	T
15. Strigiformes Family-1, Species-2												
15.1. Strigidae												
85	Spotted owl	<i>Athene brama</i> (Temminck 1821)	+	+	In	R	VC	→	LC	IV	II	T
86	Indian scops - owl	<i>Otus bakkamoena</i> (Pennant 1769)	+	+	Ca	R	UC	→	LC	IV	II	T
16. Upupiformes Family-1, Species-1												
16.1. Upupidae												
87	Common hoopoe	<i>Upupa epops</i> (Linnaeus 1758)	+	+	In	R	VC	↓	LC	IV	-	T

(October–November) and temperature varies from a high of 48°C in summer to a low of 4°C in winter. The two sites selected for the study are agricultural fields of Bajekan and Phoolkan village of Sirsa district which are dominantly Paddy-Wheat and mix crop area, respectively.

Data collection

Fortnightly ornithological field surveys were conducted from March 2020 – November 2020 and March 2021 – November 2021 following combination of Scan sampling and point count-line transects. Bird data was collected using (8×42, 8°) binoculars and photographs were taken with the help of COOLPIX NIKON P900 from 06.00–10.00 h and 16.00–18.00 h in a range of up to 25 m radius on one-km transect point avoiding rainy, windy, foggy and cloudy weather conditions to minimize error in observations.

Authentic avian database (IUCN, Oriental Bird Club image database, Merlin bird ID and e-bird) and standard field guides (Ali *et al.* 2002, Grimmett *et al.* 2011) were used for identification and documentation of avian checklist. On the basis of field feeding activities and available literature, bird species were categorized into six feeding guilds i.e., Insectivorous, Carnivorous, Omnivorous, Frugivorous, Grainivorous and Nectarivorous (Ali *et al.* 2002). The assessment of residential/Migratory (resident, winter visitor

Table 2. Jaccard's similarity index.

No. of species common in both sites	Species unique one site-I (bajekan)	Species unique to site-II (phoolkan)
74	12	1
$(C_j) = 74 / (74 + 12 + 1) = 0.850$		

Table 3. Family-wise relative diversity index (RDi).

Family	No. of species	RDi
Bucerotidae, Alceididae, Coraciidae, Bruhinidae, Charadriidae, Recurvirostridae, Acrocephalidae, Dicruridae, Nectariniidae, Passeridae, Phylloscopidae, Ploceidae, Sylviidae, Zosteropidae, Megalimidae, Upupidae	1	1.14
Anatidae, Meropidae, Scolopacidae, Ciconiidae, Phasianidae, Alaudidae, Corvidae, Estrilidae, Hirundinidae, Pycnonotidae, Threskiornithidae, Psittacidae, Strigidae	2	2.29
Accipitridae, Rallidae, Ardeidae	3	3.44
Cisticolidae, Motacillidae	4	4.59
Columbidae, Cuculidae, Sturnidae, Pelecaniformes	5	5.74
Leiotrichidae	6	6.89
Muscicapidae	7	8.04

and summer visitor) status was done on the basis of existence and non-existence of bird and categorized as (Grimmett *et al.* 2011, Kumar and Sahu 2019). Observed bird species were examined and assigned local abundance status on percentage of sightings and number of sighting in field visits basis (Mackinnon and Phillips 1993) - Common (C) - seven to nine times (80–100%), Very Common (VC) - less than ten times (60 - 79.9%), Uncommon (UC) - three to six times (20–59.9%) and Rare (RA) - once or twice (19.9%). The conservation status and global population trend of bird species (decreasing, increasing, stable or unknown) were collated from IWPA (1972), CITES (2012) and IUCN Red List (2021).

Data analysis

The relative diversity index (RDi) analysis of bird families was calculated by formula given by La Torre-Cuadros *et al.* (2007):

$$\text{RDi} = \frac{\text{Total number of species in a family}}{\text{Total number of species}} \times 100 \quad \text{Eq.1}$$

A quantification of the similarity distance between birds in selected site was measured by using Jaccard's similarity index as:

$$\text{Jaccard's similarity index (Cj)} = \frac{a}{a + b + c} \quad \text{Eq.2}$$

Where a= Number of species common to both sites, b = Number of the species unique to the first site and c is the number of the species unique to the second site.

RESULTS

A total of 87 bird species of 38 families, and 16 orders were recorded (Table 1). The order Passeriformes was with maximum number of bird species (44%) while order Columbiformes, Cuculiformes, Charadriiformes and Pelecaniformes had 5 bird species each followed by Coraciiformes (4), Accipitriformes (3), Gruiformes (3), Galliformes (2), Psittaciformes (2), Strigiformes (2), Ciconiiformes (2), Anseriformes (2) and the remaining had Bucerotiformes (1), Upupiformes (1) and Piciformes (1). The presence of a greater number of insectivore birds may be due to availability of variety of insects in observed area. The feeding guild revealed that Insectivore (32 species) is highly dominated guild, followed by Omnivore (29 species), Carnivore (13 species), Granivore (7) and Frugivore (5 species) and Nectarivore with only two species. Out of the total 87 species, resident species were 71, followed by winter migrants (13) whereas three species were summer migrant. According to IUCN red list (2021), four species (Alexandrine Parakeet, Asian Woollyneck, Black-headed ibis and Painted Stork) were categorized under near threatened with decreasing population trend and the remaining are least concern with stable (39), decreasing (23) and 19 species with increasing and 6 species with unknown population trend were recorded from the study area. Local abundance status revealed that 27 species were Common, 18 were Uncommon, 21 were very common and 21 were rare species. Species diversity comparison of both sites showed that Bajekan has highest number of bird species then Phoolkan village (Table 1). Overall, bird species found in Bajekan and Phoolkan were similar, while the Bajekan village had slightly different species of birds.

The species composition similarity as measured by Jaccard's index, between the selected agricultural landscapes is shown in Table 2, revealed that both the

Table 4. Order-wise percent composition.

Avian order	No. of species	Percentage
Accipitriformes	3	3.44
Anseriformes	2	2.29
Bucerotiformes	1	1.14
Columbiformes	5	5.74
Coraciiformes	4	4.59
Charadriiformes	5	5.74
Ciconiiformes	2	2.29
Cuculiformes	5	5.74
Galliformes	2	2.29
Gruiformes	3	3.44
Passeriformes	44	50.57
Pelecaniformes	5	5.74
Piciformes	1	1.14
Psittaciformes	2	2.29
Strigiformes	2	2.29
Upupiformes	1	1.14

habitat shows 0.850 similarities in bird communities that might be due to landscape characteristics.

Relative diversity data analysis (Table 3) revealed Muscicapidae as the most diverse and pre-dominant family in the study area (7 species, $RDi = 8.04$) followed by Leiotrichidae, (6 species, $RDi = 6.89$), Columbidae, Cuculidae and Sturnidae (5 species, $RDi = 5.74$) Cisticolidae and Motacillidae (4 species, $RDi = 4.59$) Accipitridae, Rallidae and Ardeidae (3 species, $RDi = 3.44$), Anatidae, Meropidae, Phasianidae, Alaudidae, Corvidae, Strilidae, pycnonotidae, Hirundinidae, Psittacidae, Strigidae, Scolopacidae and Threskiornithidae (2 species, $RDi = 2.29$) while 16 families viz., Bucerotidae, Alceididae, Coraciidae, Bruhinidae, Charadriidae, Recurvirostridae, Acrocephalidae, Dicuridae, Nectarinidae, Passeridae, Phylloscopidae, Ploceidae, Sylviidae, Zosteropidae, Megalimidae and Upupidae (1 species, $RDi = 1.14$) were least present in the study area.

The percent composition (Table 4) of different orders shows that Passeriformes (44 species) is the most abundant order with a total percentage of 50.57 followed by Pelecaniformes (5) and Columbiformes (5) with 5.74% each. The order Accipitriformes (3) and Gruiformes (3) have percent composition of with 3.44% and the orders having least percent composition are Bucerotiformes (1) and Piciformes

(1) with only 1.14%.

DISCUSSION

The status of avian species diversity is comparable with several studies conducted in different agricultural landscapes of India. The ornithological surveys in different agricultural landscapes of India by Abdar (2014) in the Western Ghats, Maharashtra; Hos-sain and Aditya (2016) in Burdwan, West Bengal; Narayana *et al.* (2019) and Gupta and Singh (2014) in Yamuna Nagar, Haryana recorded 97, 144, 128 and 79 avian species, respectively in these regions with passeriformes as the most predominant avian taxa. The avian diversity in agri fields of Nalgonda and Peddagattu and Sherpally area of Telangana, India showed insectivore as dominant group of birds species which may aid in biological pest control activities of area so, scientific management methods should be applied to protect these insectivorous bird species in agricultural areas (Narayana *et al.* 2015, Narayana *et al.* 2019). Greater structural similarity between habitats was associated with similar bird communities (Andrade *et al.* 2018). However, urbanization or other developmental activities at selected site may affect the habitat diversity, resulting in diminished bird population. The evidence from this study suggests that biodiversity-friendly agricultural practices should be implemented to improve habitat quality for birds in agriculture landscapes. Numerous conservation efforts are recommended to protect agricultural landscape of the area including habitat management strategies such as vegetation restoration and wetlands, as well as increasing plant and tree variety to maintain its avifaunal richness.

REFERENCES

- Abdar MR (2014) Seasonal diversity of birds and ecosystem services in agricultural area of Western Ghats, Maharashtra State, India. *J Environ Sci Toxicology Food Technol* 8 (1) : 100—105.
- Ali S, Ripley SD, Dick JH (2002) Compact handbook of the birds of India and Pakistan.
- Andrade R, Bateman HL, Franklin J, Allen D (2018) Water bird community composition, abundance and diversity along an urban gradient. *Landscape and Urban Planning* 170 : 103—111.
- Convention on International Trade in Endangered Species of Wild

- Fauna and Flora (CITES) (2012) Geneva, Switzerland. <https://www.cites.org>.
- Grimmett R, Inskipp C, Inskipp T (2011) Birds of the Indian Subcontinent. Oxford University Press and Christopher Helm, London.
- Gupta N, Singh N (2014) The abundance of avifauna in an agricultural landscape : A benefit of community conservation initiatives in Haryana, India. *Ind J Sci Technol* 7 (4) : 537.
- Hossain A, Aditya G (2016) Avian diversity in agricultural landscape : Records from Burdwan, West Bengal, India. *In Proceedings of the Zoological Society Springer India* 69 (1) : 38—51.
- Indian Wildlife Protection Act (IWPA) (1972) https://www.wiienvis.nic.in/Database/Schedule Species Database_7969.aspx.
- International Union for Conservation of Nature Red List of Threatened Species (IUCN Red List) (2021) Gland, Switzerland. <https://www.iucnredlist.org>.
- Kumar P, Sahu S (2019) Avian diversity in agricultural landscapes of district Panipat, Haryana, India. *Asian J Conserv Biology* 8 (2) : 188—198.
- La Torre MDLÁ, Errando-Perez S, Young, KR (2007) Diversity and structural patterns for tropical montane and premontane forests of central Peru, with an assessment of the use of higher-taxon surrogacy. *Biodiversity Conservation* 16 (10) : 2965.
- Mackinnon J, Philips K (1993) A field guide to the birds of Borneo, Sumatra, Java and Bali. Oxford University Press, Oxford.
- Mallik A, Chand DS, Singh A, Parida SP (2015) Studies on avifauna diversity of agronomy field of OUAT campus, Bhubaneswar, India. *Current Life Sci* 1 (2) : 46—57.
- Narayana BL, Rao VV, Pandiyan J (2015) Avifaunal diversity in different croplands of Nalgonda district, Telangana, Southern India. *Internat J Curr Res* 7 (7) : 17677—17682.
- Narayana BL, Rao VV, Venkateswara Reddy V (2019) Composition of Birds in Agricultural Landscapes of Peddagattu and Sherpally Area: A proposed uranium mining sites in Nalgonda, Telangana, India. *In Proceedings of the Zoological Society* (Vol. 72, No. 4, pp. 380-400), Springer India.
- Yashmita-Ulman, Singh M (2021a) Bird composition, diversity and foraging guilds in agricultural landscapes : A case study from eastern Uttar Pradesh, India. *J Threatened Taxa* 13 (8) : 19011—1902.