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Research Article

Community composition and status of avian diversity at Campus and Agricultural landscapes of Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana)

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Abstract
Avian species diversity and their assemblage are responsible for maintaining the integrity and health of any ecosystem. Documentation of avian diversity in different habitats is sensitive tool for monitoring the environmental condition. The present investigation aimed to record the diversity of avian fauna at the main campus and agricultural landscapes of Chaudhary Charan Singh Haryana agricultural University, Hisar (Haryana). Line transect and point count methods were used to taking observations on different species of birds. A total of 101 bird species under 17 orders 43 families and 86 genera were recorded; out of them, 78, 17, 5 and one species were resident, winter migrant, summer migrant and passage migrant, respectively. Species richness of order Passeriformes was highest, followed by Pelecaniformes and Muscicapidae, the most diverse family in the study area. Analysis of food and feeding guilds revealed that the insectivorous guild is predominant, followed by Omnivore, Carnivore, Granivore, Frugivore and Nectarivore. Out of the total observed species, 23 have declining population trends at global level, whereas three species (Alexandrine Parakeet, Asian Woollyneck, Black-headed ibis) are listed as Near Threatened and Common Pochard is vulnerable as per IUCN Red List. The species richness was significantly higher in farmland, followed by main campus and experimental orchards. Jaccard's similarity index between habitats revealed that the main campus and farmland area has a maximum (0.73) similarity in bird communities. This emphasises the significance of these study sites as key habitats for bird species of conservation priorities.

Keywords: Avian diversity, Environment, Habitats, Jaccard's similarity index, Line transect method, Species richness

INTRODUCTION

The term biodiversity refers to the totality of genes, species, and ecosystems in any geographical given area (Shekhawat and Bhatnagar, 2014) whereas the existence of a wide variety of organisms reflects the biological richness of a region. Ecosystems with high diversity are regarded as more complex, stable or resistant to

disruption because extent of biodiversity helps to stabilise environmental variables (Ihuma *et al.,* 2016). Birds are the most common and widespread species of terrestrial and aquatic habitats. They are sensitive to environmental changes, so they act as bioindicators and play a vital role in the linkage of the food chain in any ecosystem (Rabou, 2019). The Indian subcontinent is part of the Oriental biogeography zones and is known for its richness of bird species. More than 9,000 bird's species exist worldwide (Gill and Donsker, 2019). India is home to nearly 1306 species which belongs to 26 orders, 111 families and 492 genera. So far, 450 bird species have been identified in Haryana (Praveen *et al*., 2016; Goyal *et al*., 2014). Avian fauna is an important component of the biotic community in the agroecosystems, though they cause some economic loss to crops but execute important roles like pollinators, seed dispersers, scavengers, nutrient depositors, predators of insect pests and rodents (Kumar and Sahu, 2020; Michel *et al*., 2020). Unfortunately, the bird's diversity is declining globally due to use of agrochemicals for intensive agricultural practices, climate change and urbanisation. As per Red List assessment of IUCN (2015) 1,375 bird species worldwide are endangered with extinction, including 84 from India (Datta, 2016). That's why a comprehensive understanding of current avian diversity status is the need of the hour.

Scientific data on diversity of birds is required for conservational strategies and information on avian diversity in protected areas and other natural habitats is available, but agricultural lands, and campuses of educational institutes are comparatively less considered sites for the study on avian diversity. Therefore, the present study aimed at authentic documentation of bird's fauna at the main campus and experimental areas including horticultural orchards and farmland of Chaudhary Charan Singh Haryana Agricultural University (CCSHAU) Hisar.

MATERIALS AND METHODS

Study area

Charan Singh Chaudhary Haryana Agricultural University (29° 08'59.1''N, 75° 42'16.8''E) is situated at Hisar, Haryana. The District Hisar falls in the western arid zone of Haryana. The University has diverse range of ecosystems, including buildings of colleges, hostels, residential area, roadside trees, grasslands, agricultural fields, several small and medium-sized ponds and a huge botanical garden which is home to many species of birds. The focus of the study was mainly on the University campus, Farmlands and Experimental orchards of HAU (Orchard 1 & Orchard 2).

Data collection

Observations on birds were taken by following line transects and point count method (Altman, 1974; Gaston, 1975; Sales and Berkmuller, 1988) from July 2019 to

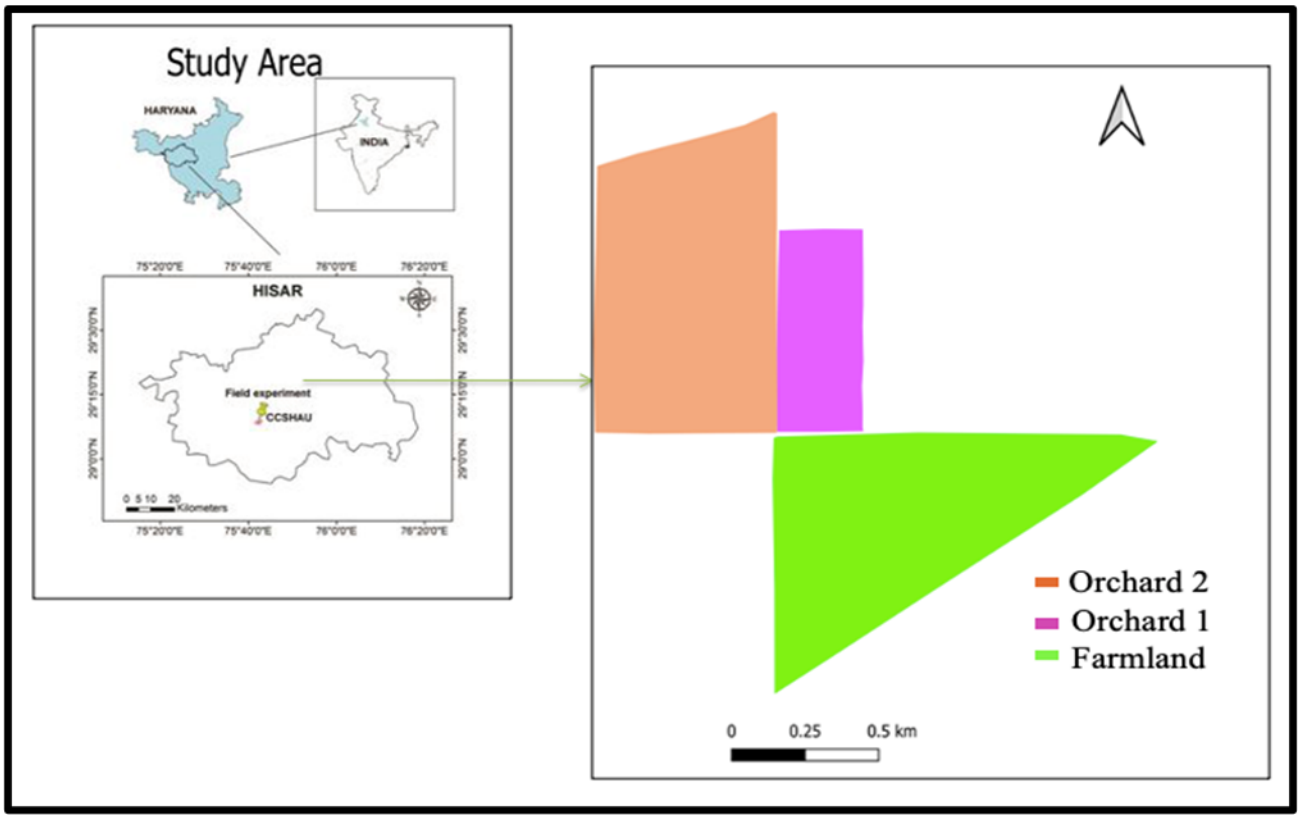

Fig.1. *Map of study area showing subareas*

July 2021, covering all the seasons i.e., summer (March-June), Monsoon (July-October) and winter (November- February). Birds were observed with binoculars to pin down their unique morphological features crucial for identification. After that, photographs were clicked with a COOLPIX NIKON P900 camera. All field surveys were conducted on a weekly basis from 6:00 to 9:00 A.M. and from 5.00 P.M. - 7.00 P.M. during the summer season, similarly from 8.00 - 10.00 A.M. and from 4.00 - 6.00 P.M. during the winter season. The survey was not conducted in harsh weather and on rainy days. The bird observed in all study areas were identified using reference books (Grimmet *et al.,* 2016). For identification and preparation of checklist authentic avian database (IUCN Red list of threatened species, Oriental Bird Club image database and Merlin bird ID) were also used. Bird's feeding status (e.g., Insectivore, Carnivore, Omnivore, Frugivore, Herbivore, Granivore, Nectarivore, and Piscivore) were categorised on the basis of field observations and available literature (Ali, 2002). Data related to each survey's was kept separate and examined for local abundance status based on the number of sightings: Very common (VC) were sighted > 10 times; Common (C) seven to nine times; Uncommon (UC) three to six times and Rare (Ra) were sighted once or twice (MacKinnon and Phillipps, 1993). The residential status of birds was also categorised on the basis of presence or absence in a particular season and different status categories were assigned: resident (presence throughout the year), winter migrant (present from October to March) and summer migrant (present from March to August) and Passage migrant (present from August to October). Deliberations of the CITES (2012) and IUCN (2021) conventions were used to assess the species conservation status and population trends. Relative diversity (RDi) was calculated using the following formula given by La Torre-Cuadros *et al*. (2007):

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

Species similarity between any two habitats was measured by Jaccard's similarity index (Kumar and Sahu, 2019)

$$(Cj) = a / (a + b + c) \quad \text{Eq.2}$$

Where **a** is number of species common to both the sites, **b** is number of species recorded at the first site and **c** is the number of species found only at the second site.

RESULTS AND DISCUSSION

The present study analysed the avian community structure of the Main Campus and Agricultural landscapes of CCSHAU, HISAR. The data on avifauna observed on Campus and Agricultural landscapes showed the presence of a total 101 bird's species belonging to 17 orders 43 families and 86 genera (Table 1). The avian diversity status is comparable with earlier studies conducted in different regions of India. For example, Devi *et al*. (2012) reported 109 species belonging to 44 families at Gauhati University Campus. Gupta and Singh (2014) observed 79 species in the agricultural area of Yamuna Nagar district (Haryana). Abdar (2014) recorded 97 bird species in agricultural regions of Maharashtra's Western Ghats and Rajashekara and Venkatesha (2017) recorded 106 species of birds belonging to 42 groups and 68 genera at Bangalore University Campus. From a taxonomic point of view, maximum number of bird species observed during present investigation belongs to Order Passeriformes with 51 species followed by Pelecaniformes, Anseriformes, Coraciformes, Cuculiformes with 5 species in each order, Columbiformes and Charadriiformes with 4 species each. Piciformes, Psittaciformes, Accipitriformes, Galliformes, Gruiformes with 3 species each, Strigiformes, Bucerotiformes with 2 species each, Podicipidiformes, Suliformes, Ciconiiformes with 1 species each (Table 1). Singh *et al*. (2018); Parveen *et al*. (2016) observed a similar trend as the order Passeriformes was the most prevalent taxon. The analysis of relative diversity revealed that the Muscicapidae was the most predominant avian family, consisting the highest number of species (11) with relative abundance (10.89%), followed by Motacillidae and Cisticolidae with 6 species (RDi-5.94%) Cuculidae and Anatidae with 5 species (RDi-4.95%) Columbidae, Estrildidae, Sturnidae with 4 species (RDi-3.96%) Accipitridae, Phasianidae, Rallidae, Corvidae, Leiotrichidae, Ardeidae, Psittacidae with 3 species (RDi-2.97%), Alcedinidae, Meropidae, Alaudidae, Hirundinidae, Threskiornithidae, Megalaimidae, Strigidae with 2 species each (RDi-1.98%), whereas 21 families namely Bucerotidae, Upupidae, Coraciidae, Burhinidae, Charadriidae, Recurvirostridae, Scolopacidae, Ciconiidae, Dicruridae, Fringillidae, Laniidae, Nectariniidae, Oriolidae, Passeridae, Phylloscopidae, Pycnonotidae, Ploceidae, Zosteropidae, Picidae, Podicipedidae and Phalacrocoracidae were poorly represented in the study area with only 0.99% relative abundance and one species in each family (Fig. 2 and Table 2).

Analysis of Relative diversity (RDi) results revealed that Muscicapidae was the highly diverse family with 11 species and the greatest RDi value, i.e., 10.89, compared to other families. The findings were similar to observations of Manakadan and Pittie (2001), who also recorded Muscicapidae as the largest family in India. Accipitridae and Muscicapidae was highly diverse family at Bangalore University Campus (Rajashekara and Venkatesha, 2017).

The presence of a greater number of insectivores birds

Table 1. Bird's species recorded from Campus and Agricultural landscapes of CCSHAU, HISAR, along with their respective habitat, guild, residential, abundance and conservation status

Order	Family	Scientific name	Common name	Habitats				Guild status	Residential status	Abundance status	Conservation status		
				HC	HF	O1	O2				GPT	IUCN	CITES
Accipitriformes	Accipitridae	Black Kite	*Milvus migrans* (Boddaert, 1783)	+	+	+	-	C	R	C	→	LC	II
		Black-winged Kite	*Elanus caeruleus* (Desfontaines, 1789)	+	+	+	+	O	R	C	→	LC	-
		Shikra	*Accipiter badius* (Gmelin, 1788)	+	+	+	-	C	R	C	→	LC	II
Anseriformes	Anatidae	African Comb Duck	*Sarkidiornis melanotos* (Pennant, 1769)	-	-	+	-	O	R	Ra	↓	LC	-
		Common Pochard	*Aythya ferina* (Linnaeus, 1758)	-	+	-	+	O	WM	UC	↓	VUL	-
		Lesser Whistling-duck	*Dendrocygna javanica* (Horsfield, 1821)	-	+	-	+	O	SM	UC	↓	LC	-
		Red-crested Pochard	*Netta rufina* (Pallas, 1773)	+	+	-	-	O	WM	C	?	LC	-
		Indian Spot- billed Duck	*Anas poecilorhyncha* (Forster, 1781)	+	+	-	+	O	R	VC	↓	LC	-
Bucerotiformes	Bucerotidae	Indian Grey Hornbill	*Ocyceros birostris* (Scopoli, 1786)	+	+	+	+	O	R	C	→	LC	-
	Upupidae	Common Hoopoe	*Upupa epops* (Linnaeus, 1758)	+	+	-	-	In	R	VC	↓	LC	-
Columbiformes	Columbidae	Eurasian Collared-dove	*Streptopelia decaocto* (Frivaldszky, 1838)	+	+	+	+	G	R	VC	↑	LC	-
		Laughing Dove	*Spilopelia senegalensis* (Linnaeus, 1766)	+	+	+	+	G	R	C	→	LC	-
		Rock Dove	*Columba livia* (Gmelin, 1789)	+	+	+	+	G	R	VC	↓	LC	-
		Yellow-footed Green-pigeon	*Treron phoenicopterus* (Latham, 1790)	+	+	+	+	F	R	C	↑	LC	-
Coraciiformes	Alcedinidae	Pied Kingfisher	*Ceryle rudis* (Linnaeus, 1758)	-	+	-	-	O	R	UC	?	LC	-
		White-breasted Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	+	+	+	+	C	R	VC	↑	LC	-
	Coraciidae	Indian Roller	*Coracias benghalensis* (Linnaeus, 1758)	+	+	+	+	C	R	C	↑	LC	-
	Meropidae	Asian Green Bee-eater	*Merops orientalis* (Latham, 1802)	+	+	+	+	In	R	VC	↑	LC	-
		Blue-cheeked Bee-eater	*Merops persicus* (Pallas, 1773)	+	-	-	-	In	SM	C	↑	LC	-
	Burhinidae	Indian Thick-knee	*Burhinus indicus* (Salvadori, 1865)	+	-	-	-	O	R	C	↓	LC	-
Charadriiformes	Charadriidae	Red-wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	+	+	+	+	In	R	VC	?	LC	-
	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus* (Linnaeus, 1758)	+	+	-	+	C	R	VC	↑	LC	-
	Scolopacidae	Green Sandpiper	*Tringa ochropus* (Linnaeus, 1758)	+	-	-	+	In	WM	UC	↑	LC	-
Ciconiiformes	Ciconiidae	Asian Woollyneck	*Ciconia episcopus* (Boddaert, 1783)	-	+	-	-	C	R	Ra	↓	NT	-

Contd.....

Table 1. Contd……..

Cuculiformes	Cuculidae	Greater Coucal	*Centropus sinensis* (Stephens, 1815)	+	+	+	+	O	R	C	→	LC	-
		Eastern Koel	*Eudynamys scolopaceus* (Linnaeus, 1758)	+	+	+	+	O	R	C	→	LC	-
		Common Hawk-cuckoo	*Hierococcyx varius* (Vahl, 1797)	-	+	+	-	In	R	UC	→	LC	-
		Grey-bellied Cuckoo	*Cacomantis passerinus* (Vahl, 1797)	-	+	+	-	In	SM	Ra	→	LC	-
		Jacobin Cuckoo	*Clamator jacobinus* (Boddaert, 1783)	+	+	+	+	O	SM	UC	→	LC	-
Galliformes	Phasianidae	Black Francolin	*Francolinus francolinus* (Linnaeus, 1766)	+	+	+	-	O	R	C	→	LC	-
		Grey Francolin	*Francolinus pondicerianus* (Gmelin, 1789)	+	+	+	+	O	R	C	→	LC	-
		Indian Peafowl	*Pavo cristatus* (Linnaeus, 1758)	+	+	-	-	O	R	VC	→	LC	-
Gruiformes	Rallidae	Common Coot	*Fulica atra* (Linnaeus, 1758)	+	+	-	+	O	R	C	↑	LC	-
		Common Moorhen	*Gallinula chloropus* (Linnaeus, 1758)	+	+	-	+	O	R	VC	↓	LC	-
		White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant, 1769)	+	+	+	+	O	R	C	?	LC	-
Passeriformes	Alaudidae	Ashy-crowned Sparrow-lark	*Eremopterix griseus* (Scopoli, 1786)	+	-	-	-	O	R	UC	→	LC	-
		Crested Lark	*Galerida cristata* (Linnaeus, 1758)	+	+	-	-	O	R	UC	↓	LC	-
	Cisticolidae	Ashy Prinia	*Prinia socialis* (Sykes, 1832)	+	+	+	+	In	R	C	→	LC	-
		Graceful Prinia	*Prinia gracilis* (Lichtenstein, 1823)	+	+	-	-	In	R	Ra	→	LC	-
		Plain Prinia	*Prinia inornata (Sykes, 1832)*	+	+	+	-	In	R	C	→	LC	-
		Yellow-bellied Prinia	*Prinia flaviventris* (Delessert, 1840)	+	-	-	-	In	R	UC	↓	LC	-
	Corvidae	Common Tailorbird	*Orthotomus sutorius* (Pennant, 1769)	+	+	+	-	In	R	UC	→	LC	-
		Zitting Cisticola	*Cisticola juncidis* (Rafinesque, 1810)	+	-	-	-	In	R	UC	↑	LC	-
		House Crow	*Corvus splendens* (Vieillot, 1817)	+	+	+	+	O	R	VC	→	LC	
		Large-billed Crow	*Corvus macrorhynchos Wagler,1827*	+	+	+	+	O	WM	C	→	LC	-
		Rufous Treepie	*Dendrocitta vagabunda* (Latham, 1790)	+	+	+	+	In	R	VC	↓	LC	-
	Dicruridae	Black Drongo	*Dicrurus macrocercus* (Vieillot, 1817)	+	+	+	+	In	R	VC	?	LC	-
	Estrildidae	Indian Silverbill	*Euodice malabarica* (Linnaeus, 1758)	+	+	+	+	G	R	C	→	LC	-
		Red Avadavat	*Amandava amandava* (Linnaeus, 1758)	+	-	-	-	G	R	UC	→	LC	-
		Scaly-breasted Munia	*Lonchura punctulata* (Linnaeus, 1758)	+	+	+	+	G	R	C	→	LC	-
		Tricoloured Munia	*Lonchura malacca* (Linnaeus, 1766)	+	-	-	-	G	R	UC	→	LC	-

Contd…..

Table 1. Contd……..

	Fringillidae	Common Rosefinch	*Carpodacus erythrinus* (Pallas, 1770)	-	+	+	-	F	WM	Ra	↓	LC	-
	Hirundinidae	Wire-tailed Swallow	*Hirundo smithii* (Leach, 1818)	+	+	-	+	In	R	VC	↑	LC	-
		Streak-throated Swallow	*Petrochelidon fluvicola* (Blyth, 1855)	+	+	-	+	In	R	C	↑	LC	-
	Laniidae	Bay-backed Shrike	*Lanius vittatus* (Valenciennes, 1826)	+	+	+	-	In	R	UC	→	LC	-
	Leiotrichidae	Large Grey Babbler	*Argya malcolmi* (Sykes, 1832)	+	+	+	+	O	R	VC	→	LC	-
		Jungle Babbler	*Argya striata* (Dumont, 1823)	+	+	+	+	O	R	VC	→	LC	-
		Striated Babbler	*Argya earlei* (Blyth, 1844)	+	+	-	-	O	R	UC	↓	LC	-
	Motacillidae	Paddyfield Pipit	*Anthus rufulus* (Vieillot, 1818)	-	+	+	-	In	R	C	→	LC	-
		Tree Pipit	*Anthus trivialis* (Linnaeus, 1758)	-	+	+	-	In	WM	UC	↓	LC	-
		White-browed Wagtail	*Motacilla maderaspatensis* (Gmelin, 1789)	+	+	-	-	In	R	C	→	LC	-
		White Wagtail	*Motacilla alba* (Linnaeus, 1758)	+	+	+	-	In	WM	C	→	LC	-
		Grey Wagtail	*Motacilla cinerea* (Tunstall, 1771)	+	+	-	+	In	WM	UC	→	LC	-
		Western Yellow Wagtail	*Motacilla flava* (Linnaeus, 1758)	+	+	+	+	In	WM	C	↓	LC	-
	Muscicapidae	Black Redstart	*Phoenicurus ochruros* (Gmelin, 1774)	+	+	+	-	In	WM	C	↑	LC	-
		Bluethroat	*Cyanecula svecica* (Linnaeus, 1758)	+	+	-	-	In	WM	C	→	LC	-
		Blue Whistling-thrush	*Myophonus caeruleus* (Scopoli, 1786)	-	+	+	-	In	WM	Ra	?	LC	-
		Brown Rockchat	*Oenanthe fusca* (Blyth, 1851)	+	+	-	-	In	R	C	→	LC	-
		Common Stonechat	*Saxicola torquatus* (Linnaeus, 1766)	+	+	-	-	In	WM	C	→	LC	-
		Indian Robin	*Saxicoloides fulicatus* (Linnaeus, 1766)	+	+	+	-	In	R	C	→	LC	-
		Oriental Magpie- robin	*Copsychus saularis* (Linnaeus, 1758)	+	+	+	-	In	R	C	→	LC	-
		Pied Bushchat	*Saxicola caprata* (Linnaeus, 1766)	+	+	-	-	In	R	VC	→	LC	-
		Red-breasted Flycatcher	*Ficedula parva* (Bechstein, 1792)	-	+	+	-	In	WM	Ra	↑	LC	III
		Variable Wheatear	*Oenanthe picata* (Blyth, 1847)	-	+	-	-	In	WM	UC	→	LC	-
		Verditer Flycatcher	*Eumyias thalassinus* (Swainson, 1838)	-	+	+	-	In	WM	Ra	→	LC	-
	Nectariniidae	Purple Sunbird	*Cinnyris asiaticus* (Latham, 1790)	+	+	+	+	N	R	C	→	LC	-
	Oriolidae	Eurasian Golden Oriole	*Oriolus oriolus* (Linnaeus, 1758)	-	+	+	-	O	SM	Ra	→	LC	-

Contd…..

Table 1. Contd……..

	Nectariniidae	Purple Sunbird	*Cinnyris asiaticus* (Latham, 1790)	+	+	+	+	N	R	C	→	LC	-
	Oriolidae	Eurasian Golden Oriole	*Oriolus oriolus* (Linnaeus, 1758)	-	+	+	-	O	SM	Ra	→	LC	-
	Passeridae	House Sparrow	*Passer domesticus* (Linnaeus, 1758)	+	-	+	-	G	R	C	↓	LC	-
	Phylloscopidae	Common Chiffchaff	*Phylloscopus collybita* (Vieillot, 1817)	-	+	+	-	In	WM	C	↑	LC	-
	Ploceidae	Baya Weaver	*Ploceus philippinus* (Linnaeus, 1766)	+	+	+	+	O	R	C	→	LC	-
	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	+	+	+	+	F	R	VC	↑	LC	-
	Sturnidae	Asian Pied Starling	*Gracupica contra* (Linnaeus, 1758)	+	+	+	+	O	R	C	↑	LC	-
		Brahminy Starling	*Sturnia pagodarum* (Gmelin, 1789)	+	+	-	-	O	R	VC	?	LC	-
		Common Myna	*Acridotheres tristis* (Linnaeus, 1766)	+	+	+	+	O	R	VC	↑	LC	-
		Rosy Starling	*Pastor roseus* (Linnaeus, 1758)	+	+	+	+	O	PM	C	?	LC	-
	Zosteropidae	Indian White-eye	*Zosterops palpebrosus* (Temminck, 1824)	+	+	+	-	In	R	UC	↓	LC	-
Pelecaniformes	Ardeidae	Indian Pond-Heron	*Ardeola grayii* (Sykes, 1832)	+	+	+	+	C	R	VC	?	LC	-
		Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)	+	+	+	+	C	R	VC	↑	LC	-
		Little Egret	*Egretta garzetta* (Linnaeus, 1766)	+	+	-	-	C	R	VC	↑	LC	-
	Threskiornithidae	Black-headed Ibis	*Threskiornis melanocephalus* (Latham, 1790)	-	+	+	-	C	R	UC	↓	NT	-
		Red-naped Ibis	*Pseudibis papillosa* (Temminck, 1824)	+	+	+	+	C	R	C	↓	LC	-
Piciformers	Megalaimidae	Brown-headed Barbet	*Psilopogon zeylanicus* (Gmelin, 1788)	+	+	+	+	F	R	C	→	LC	-
		Coppersmith Barbet	*Psilopogon haemacephalus* (Müller, 1776)	+	+	+	-	F	R	UC	↑	LC	-
	Picidae	Black-rumped Flameback	*Dinopium benghalense* (Linnaeus, 1758)	+	+	+	+	In	R	C	→	LC	-
Podicipediformes	Podicipedidae	Little Grebe	*Tachybaptus ruficollis* (Pallas, 1764)	+	+	-	+	C	R	C	↓	LC	-
Psittaciformes	Psittacidae	Alexandrine Parakeet	*Palaeornis eupatria* (Linnaeus, 1766)	+	+	+	+	F	R	C	↓	NT	-
		Plum-headed Parakeet	*Himalayapsitta cyanocephala* (Linnaeus, 1766)	+	-	-	-	F	R	UC	↓	LC	-
		Rose-ringed Parakeet	*Alexandrinus krameria* (Scopoli, 1769)	+	+	+	+	F	R	VC	↑	LC	-
Strigiformes	Strigidae	Spotted Owlet	*Athene brama* (Temminck, 1821)	+	+	+	+	In	R	C	→	LC	II
		Indian Scops-owl	*Otus bakkamoena* (Pennant, 1769)	+	-	-	-	C	R	C	→	LC	II
Suliformes	Phalacrocoracidae	Little Cormorant	*Microcarbo niger* (Vieillot, 1817)	+	+	-	+	C	R	C	?	LC	-

HC-HAU Campus, HF-HAU Farmland , O1- Orchard 1, O2- Orchard 2, , + Presence of species in the habitat, - Absence of species in the habitat, C-Carnivore, F-Frugivore, G-Granivore, In-Insectivore, N-Nectarivore, O- Omnivore, R-Resident, S-Summer migrant, W-Winter migrant, PM- Passage migrant, C-Common, VC-Very common, UC-Uncommon, Ra-Rare, GPT- Global population trend, ↑- Increasing, ↓- Decreasing, Stable - →, Unknown - ?, IUCN-International union for conservation of nature and natural resources, LC-Least concern, NT- Near Threatened, VUL-Vulnerable, CITES- Convention on International Trade in Endangered Species of Wild Fauna and Flora

may be due to availability of variety of insects in observed area. The observations on feeding guild of recorded species in the study area unveiled that Insectivore (39 species) is a highly dominated guild, followed by Omnivore (31 species), Carnivore (14 species), Granivore and Frugivore (8 species each) and Nectarivore with only one species. Similarly, Insectivores were a dominating group of birds in different areas reported by Narayana *et al*. (2019) in agricultural landscapes of Peddagattu and Sherpally area of Telangana, India, Kumar and Sahu (2020) in agricultural landscapes of Panipat, Haryana, Platt *et al*. (2021) at traditional rice ecosystem, Myanmar. These insectivorous birds are important in the biological control of a variety of insect pests that thrive in agriculture (Halder and Seni, 2021). So, scientific management methods should be applied to protect these insectivorous bird species in agricultural areas (Narayana *et al*., 2015).

Kumar and Sahu (2019); Sailo *et al*. (2019) recorded the maximum number of species visits during the winter season. Out of the total 101, resident species were 78, followed by winter migrants (17) only five species were summer migrants, whereas one species was a passage migrant. According to IUCN red list (2021), three species (Alexandrine Parakeet, Asian Woollyneck, Black-headed ibis) are near threatened species, one species (Common Pochard) is vulnerable with decreasing population trend and the remaining 97 species are categorized as least concern. Fourty six species out of these 97 have stable, 19 with decreasing, 22 species with increasing population trend and 10 species with unknown status were observed in the study areas (Fig. 3.)

Local abundance status of species on the basis of sightings revealed that 46 species were Common, 22 were Uncommon, 24 were Very common and 9 were Rare species (*Sarkidiornis melanotos*, *Ciconia episcopus*, *Cacomantis passerinus*, *Prinia gracilis*, *Carpodacus erythrinus*, *Myophonus caeruleus, Ficedula parva*, *Oriolus oriolus*, *Eumyias thalassinus*). Five species from the reported avian species fall under various

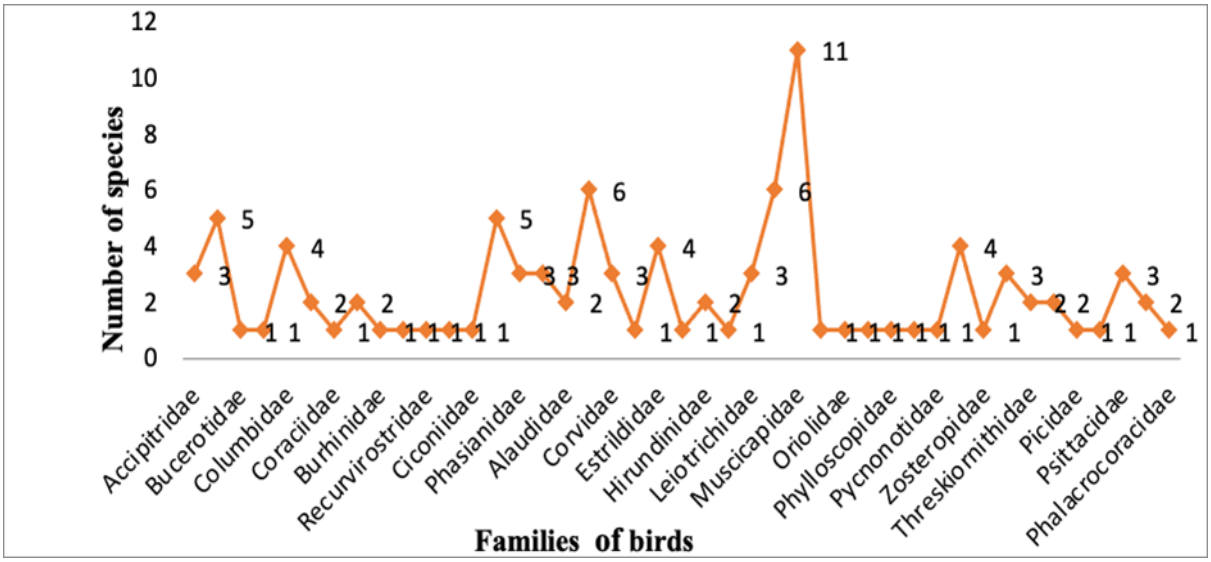

Fig. 2. *Family-wise abundance of observed bird species at Campus and Agricultural landscapes of CCSHAU, HISAR*

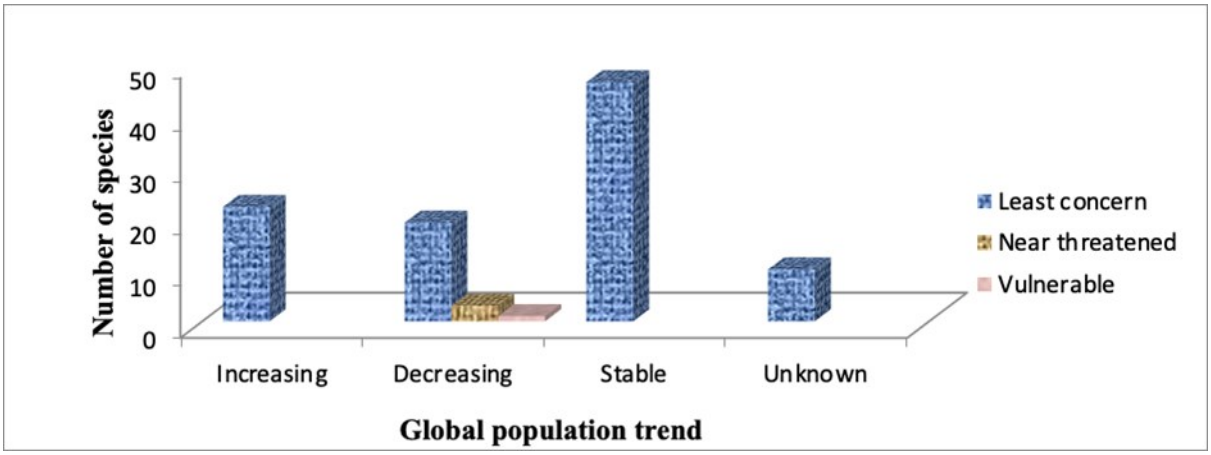

Fig. 3. *Comparison of IUCN status of avian species at Campus and Agricultural landscapes of CCSHAU, HISAR with its global population trend.*

Table 2. Relative diversity index (RDi) of various avian families recorded at Campus and Agricultural landscapes of CCSHAU, HISAR

Avian families	No. of recorded species	Relative diversity index (RDi)
Muscicapidae	11	10.89
Cisticolidae, Motacillidae	6	5.94
Anatidae, Cuculidae,	5	4.95
Columbidae, Estrildidae, Sturnidae,	4	3.96
Accipitridae, Phasianidae, Rallidae, Corvidae, Leiotrichidae, Ardeidae, Psittacidae,	3	2.97
Alcedinidae, Meropidae, Alaudidae, Hirundinidae, Threskiornithidae, Megalaimidae, Strigidae	2	1.98
Bucerotidae, Upupidae, Coraciidae, Burhinidae Charadriidae Recurvirostridae, Scolopacidae Ciconiidae, Dicruridae, Fringillidae, Laniidae, Nectariniidae, Oriolidae, Passeridae, Phylloscopidae, Ploceidae, Pycnonotidae, Zosteropidae, Picidae, Podicipedidae, Phalacrocoracidae	1	0.99

Table 3. Jaccard's similarity index for bird communities in different habitats of the study area

Sites	Campus	Farmland	Orchard 1	Orchard 2
Campus	-	0.73	0.54	0.57
Farmland	-	-	0.69	0.55
Orchard 1	-	-	-	0.51

categories of CITES (2012) presenting Appendix-II (*Milvus migrans*, *Accipiter badius*, *Athene brama*, *Otus bakkamoena)* and one (*Ficedula parva)* in Appendix-III. The species richness was significantly higher at farmland with 89 species belonging to 17 orders and 40 families, followed by Main Campus with 84 species belonging to 16 orders and 39 families while 64 (13 orders and 33 families) and 51 species (16 order 32 families) were reported at Orchard 1 and Orchard 2 respectively. The campus and farmland areas has ample amount of food and water availability, ensuring the survival of birds. The agro-ecosystem had the most species diversity (Ghosh, 2016). Factors like the availability of a variety of food and feeding resources, roosting sites, predation pressure, and noise pollution etc., are associated with the richness of birds in different ecosystems (Hossain and Aditya, 2016). The composition of the bird population is also influenced by type of vegetation, a number of fruiting trees and degree of human interference closer to the study sites (Chiawo *et al*., 2018). Among all the observed species, 39 were common and 62 species were different at all study sites. Comparatively more number of unique species (*Merops persicus*, *Burhinus indicus*, *Eremopterix griseus*, *Prinia flaviventris*, *Cisticola juncidis*, *Amandava amandava*, *Lonchura malacca*, *Himalayapsitta cyanocephala*, *Otus bakkamoena*) were spotted at Main Campus while at Farmland unique species were only *Ceryle rudis*, *Ciconia episcopus* and *Oenanthe picata*. *Sarkidiornis melanotos* was the only rare species at Orchard 1.

The similarity in species composition was measured by Jaccard's similarity index among the four selected habitats. These results revealed that the bird species similarity coefficient was found to be a maximum of 0.73 between campus and farmland. The minimum value of similarity coefficient was calculated as 0.51, which clearly reflected highly dissimilar avian fauna between the Orchard 1 and Orchard 2 (Table 3). This highest species similarity recorded between main campus and farmland might be due to habitat similarity. Despite being inhabited by humans, the main campus and agricultural area is reasonably free from dangers, hunting and timber extraction pressures. However, construction or other developmental activities at campus may affect the habitat diversity, resulting in diminished bird population. Numerous conservation efforts are recommended to protect the campus environment and agricultural area including habitat management strategies such as vegetation restoration and wetlands, as well as increasing plant and tree variety to maintain its avifaunal richness (Surasinghe and De Alwis, 2010). Constructions of fish ponds will also attract bird's species in large numbers. More native nectarine species and fruit-bearing plants should be introduced to augment floral variety (Solecki and Rosenzweig, 2004).

Conclusion

The present study concluded that the CCSHAU, Hisar is the home to 101 species belonging to 17 orders, 43 families and 86 genera due to the availability of different food resources and the presence of nesting/ roosting sites. The present findings on avian diversity can be used as a baseline for further research on the conservation and management of existing bird species in different habitats on campus and in agricultural landscapes. Long-term avian species monitoring in the study area should be continued, with a focus on habitat use, seasonal abundance, and nesting and breeding ecology to supplement a comprehensive approach of management and conservation strategy for the sustainability of bird ecosystem services.

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Conflict of interest

The authors declare that they have no conflict of interest.

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