International Journal of Ecology and Environmental Sciences 45 (4): 345-356, 2019
ISSN: 2320-5199 (Online)

Guild, Status and Diversity of Avifauna in Agricultural Landscapes of District Panipat, Haryana, India

PARMESH KUMAR [1]* AND SHARMILA SAHU [2]

Department of Zoology, Institute of Integrated & Honors Studies, Kurukshetra University, Kurukshetra 136119, Haryana, India
Email: [1] parmeshkuk@rediffmail.com; [2] sharmilaruhil@gmail.com

* Corresponding author

ABSTRACT

Diversity of avifauna is one of the most important ecological indicators to evaluate the integrity and stability of ecosystem structure and functions. Characteristic avifauna in landscapes enables predictions about the ecological health and possible deviations in the ecosystem functions. This is the first report on avian diversity in agricultural landscapes of Panipat district of Haryana. Surveys were conducted from April 2016 to March 2017, employing point-transect and direct observations to record bird species. A total of 103 bird species belonging 44 families and 15 orders were identified. Species richness was highest for the order Passeriformes (48), followed by Pelecaniformes (15) and rest 13 orders. Ardeidae was the richest mentioned family with 8 species and constituting 7.76% of the bird community in the study area. The agricultural landscapes support 80 residents, 17 winter migrants and 6 summer migrants. The highest species richness was recorded in the month of January compared to the remaining months. Six major feeding guilds were recorded. Most bird species were insectivorous (35) followed by carnivorous (27), omnivorous (26), granivorous (9), frugivorous (5) and nectarivorous (1). Among recorded avifauna, four species are listed as near threatened in IUCN Red list; six species are listed in Appendix II of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and five species are included in Schedule I of the Indian Wildlife (Protection) Act, 1972. Moreover, five species having a globally declining population trend are still common in the study area. This emphasizes that study sites are the habitat for bird species of conservation priorities. The current information is expected to provide a baseline for future research on monitoring the population and seasonal changes in the bird assemblages of agricultural landscapes.

Key Words: Avifauna; Diversity; Agricultural Landscape; Feeding Guild.

INTRODUCTION

Birds are potential indicators of integrity and stability of ecosystem structure and functions (Lawson et al. 1998, Gregory et al. 2008). Characteristic avifauna in landscapes enables predictions about the ecological health and possible deviations in the ecosystem functions. Changes in vegetation composition can affect the quality and quantity of habitats for birds in terms of food, water and cover, which can further influence their diversity, abundance and distribution (Western and Grimsdell 1979). Therefore, being very sensitive to environmental changes, birds act as an indicator of ecological health of a particular habitat (Sekercioglu 2012). Birds are key component of an agro-ecosystem and often execute varied functional roles as potential pollinators, seed dispensers, scavengers, nutrient depositors, predators of insect pests and rodents, indeed rightly called bio-indicators (Dhindsa and Saini 1994, Whelan et al. 2008, Sekercioglu 2006, 2012). Birds play crucial ecological functions also in other surrounding landscapes such as wetlands, urban or suburban and forest areas. Thus, avian diversity is an indicator of the overall biodiversity profile of the region (Malhi 2006, Birasal 2014).

The dual role of birds in agriculture is well known (Ali 1949, Dhindsa and Saini 1994, Bianchi et al. 2006). The agricultural landscapes provide a concentrated and highly predictable source of food to birds in the form of grains, seeds, fruits, vegetation of the crop plants, grasses, weeds, insects, other arthropods and rodents (Dhindsa and Saini 1994, Asokan et al. 2009). In agro-ecosystems, most bird species are insectivorous and have a potential check on harmful insects thereby are beneficial to farmers (Asokan et al. 2010, Narayana et al. 2015). In such situations, birds are considered as crucial biological control agents, suppressing the insect pests. Therefore, these insectivorous birds need to be encouraged in the agricultural landscape by use of appropriate management practices (Malhi 2006, Narayana et al. 2016). However, agricultural ornithology in India has received very little attention from conservation biologists as compared to natural and protected ecosystem (Dhindsa and Saini 1994, Hossain and Aditya 2016).

The state of Haryana in India, in the last few decades, has witnessed tremendous changes in its agro-ecosystem owing to massive deforestation, intensive agriculture and its mechanization, excessive use of pesticides and fertilizers along with rapid urbanization and industrial growth. All these anthropogenic activities have resulted in several ecological changes in the agro-ecosystems, which in turn have greatly affected the bird fauna of the state. There is a need to study the community structure and species diversity of birds of agro-ecosystems in order to investigate the impact of changing natural habitat and agricultural practices (Malik et al. 2015). Assessment of bird assemblages is thus being emphasized for monitoring ecosystem conditions and functions (Bradford et al. 1998, Browder et al. 2002). Information on species richness and community structure of birds will enable conservation planning for sustaining birds without interfering with the objective of intensive agricultural practices (Dhindsa and Saini 1994, Sundar and Kittur 2013). Panipat is one of the agriculturally important districts of the state of Haryana, India. However, till date no systematic attempt has been made to explore the status of avifauna in the agro-ecosystem of the district. In this context, the present study made an attempt to record avifaunal diversity in agricultural landscapes of district Panipat, Haryana.

STUDY AREA

The present study was carried out in all the five development blocks (Panipat, Samalkha, Israna, Bapoli and Madlauda) of district Panipat, Haryana, India, taking at least two study sites in each development block (Figure 1). Panipat, a district of Haryana, India is located at 29^0 09' to 29^o 27'N latitude and 76^o 38' to 77^o 09' E longitude at an elevation of 244.5 m and has an area of 1268 km^2. Net area sown in the district is 93000 ha which constitutes 71% of the total area. Agricultural activities of the district are dependent on tubewells and canals. The district is mainly drained by the river Yamuna and its tributaries. Rice-wheat cropping system dominates with the consequent marginalization of pulses and oilseed. Sunflower and sugarcane are also being grown in the study area as cash crops. The study area experiences sub-tropical climate with three major seasons i.e. rainy (July to September), a cool dry (October to February) and the hot dry season (March to June). Temperature is as high as 45^o C in summer and as low as 3^o C in winter. The average annual rainfall in the district is 467 mm.

METHODS

Bird surveys were conducted at two-week intervals in all the study sites from April 2016 to March 2017, following the point-transect method (Sutherland 2006). One km transect was laid at each study site and at every 200 m distance one point was selected and the birds species were recorded in 20 m radius. Birds were counted directly, aided by field binocular (Nikon 8 x 40), during hours of peak activity 06:00 to 10:00 h and 16:00 to 18:00 h. In addition to these regular surveys, opportunistic records of birds at other times were also included to document a comprehensive checklist. Birds were identified using field guides (Ali and Ripley 1987, Grimmett et al. 2011). Taxonomic position (Order and family), common name and scientific name of each recorded species were assigned following Praveen et al. (2016). Based on their seasonal dispersal pattern in the study area, birds were classified as resident, summer visitor and winter visitor following Grimmett et al. (2011). We also assigned a local status to each species on the basis of the percentage of frequency of sightings following Mackinnon and Phillipps (1993) as common (C) - sighted on 80-100% of field visits, fairly common (FC) - sighted on 60–79.9% of field visits, uncommon

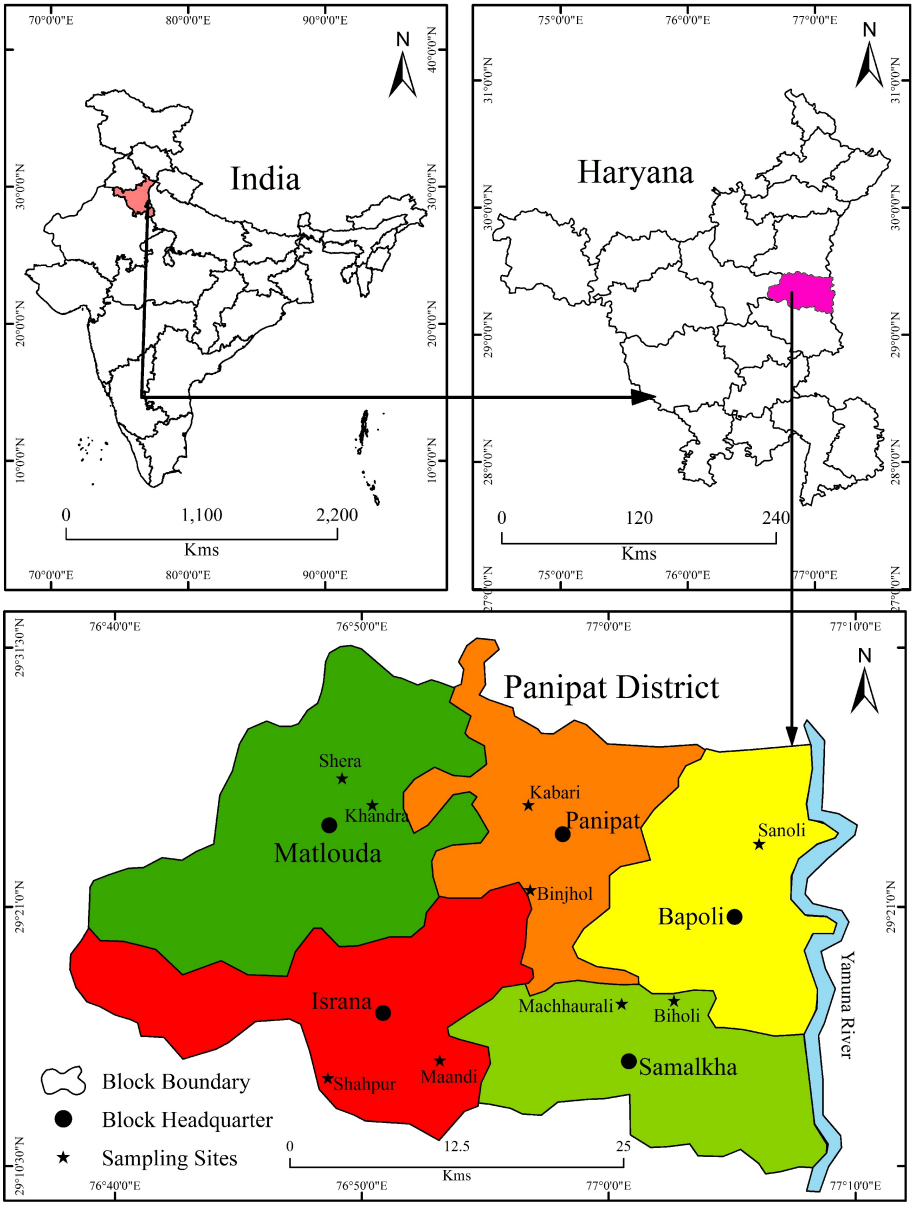

Figure1. Location of selected study sites (five blocks of District Panipat of Haryana, India)

(UC) - sighted on 20–59.9% of field visits, rare (RA) - sighted on less than 19.9% of field visits. For determination of the feeding guilds, foraging birds were observed with the help of binoculars in the study area. A foraging substrate and, if possible, the kind of food obtained was recorded. Feeding guilds were classified on the basis of direct observations and available literature (Ali and Ripley 1987).

For national and global conservation status of recorded bird species, we followed IWPA (1972), CITES (2012), and IUCN (2019). The global population trend of the species was taken from the Red List of IUCN (2019) and was compared with its local status in the study area.

Data Analysis

Species richness was estimated by recording the number of bird species observed in the study area. The relative diversity (RDi) of bird families was calculated using the following formula as per Torre-Cuadros et al. (2007):

$$RDi = \frac{\text{Number of bird species in a family}}{\text{Total number of species}}$$

Species similarity between any two habitats was measured by Jaccard's similarity index as

Jaccard's similarity index $C_j = a / (a + b + c)$

where, a is number of species common to both the habitats , b is number of species recorded in the first habitat only and c is the number of species recorded only in the second habitat.

RESULTS AND DISCUSSION

A total of 103 species of birds belonging to 82 genera, 44 families and 15 orders were recorded during the study period. The checklist of the bird species along with their taxonomic positions, residential status, feeding guild, local abundance, conservation status and global population trend is represented in Table 1. The study area supports about 19% of bird species recorded from Haryana (Kalsi et al. 2019), and 8% of species reported from India (Praveen et al. 2016). This richness of avifauna is comparable with earlier studies carried out in agricultural landscapes in different parts of India. For example, Malhi (2006) recorded of 128 bird species from agricultural habitat and other associated sub-habitats of Punjab. Gupta and Singh (2014) recorded 79 species from agricultural landscape in Yamuna Nagar district of Haryana. Abdar (2014) observed 97 species of birds from agricultural areas of Western Ghats, Maharashtra. Hossain and Aditya (2016) encountered 144 bird species from agricultural landscapes of Burdwan, West Bengal. However, Dhadse et al. (2009) observed 63 species of birds from industrial area (refinery) of Panipat. Maximum number of bird species was recorded for the order Passeriformes (48) followed by Pelecaniformes (15) and rest 13 orders. According to Praveen et al. (2016), passerines (order Passeriformes) form the most predominant avian taxon in India (about 54%). Analysis of data on relative diversity revealed that Ardeidae was the most diverse family in the study area (8 species, RDi = 7.76) followed by Muscicapidae and Motacillidae (6 species each, RDi = 5.82), while 22 families- Podicipedidae, Apodidae, Phalacrocoracidae, Recurvirostridae, Jacanidae, Strigidae, Bucerotidae, Upupidae, Picidae, Meropidae, Coraciidae, Alcedinidae, Campephagidae, Oriolidae, Dicruridae, Nectariniidae, Passeridae, Alaudidae, Acrocephalidae, Pycnonotidae, Sylviidae and Zosteropidae were poorly represented in the study area with a single species in each (RDi = 0.97; Table 2). Muscicapidae is the largest family of birds in India (Manakadan and Pittie 2001). In the study area, however, Ardeidae showed the highest diversity of species, followed by the Muscicapidae and Motacillidae. Nevertheless, several studies have also found Ardeidae to be the most diverse avian family, particularly in agricultural landscapes, sub-urban areas and wetlands in India (Basavarajappa 2006, Vijayan et al. 2006, Kumar 2006, Gupta and Singh 2014, Dal and Vaghela 2015, Mukhopadhyay and Mazumdar 2017). Of the total species identified, 41 species (39.81%) were recorded from all the five habitats, but 62 species (60.19%) were spotted at some specific agricultural habitats. Bird species similarity as measured by Jaccard's similarity index, between different habitat types is shown in Table 3. From observations it is apparent that Samalkha and Bapoli block (0.792) had the maximum species similarity, while similarity of Bapoli and Madlauda was minimum (0.505). This highest similarity recorded in species composition between Samalkha and Bapoli block might be attributed to habitat similarity. Habitat proximity and similarity have been reported to determine species diversity and similarity of birds among habitats (Tubelis and Cavalcanti 2001, Zeleke et al. 2015).

The analysis of data on residential status show that of the 103 avian species observed in the study area, 80 (77.67%) were residents, 17 (16.50%) winter migrants and 6 (5.83%) were summer migrants. Temporal variation in species richness of birds in the study area is presented in Figure 2. The variation in species richness over temporal scale could be related with arrival of migratory species. Species richness of resident birds showed no significant variation between seasons and remained same during the study period. Overall, maximum number of bird species was recorded in January (93 species), and minimum in August and September (78 species). It is evident from the figure that winter migratory birds start appearing at study area from October, reached a peak in the month of January, then start declining and leave the agricultural landscapes by March flying back to their breeding grounds.

The highest number of bird species was recorded at Bapoli block (94), followed by Samalkha block (87), Panipat block (73), Israna Block (62) and Madlauda block (55). From the observations it is evident that the species richness of the birds varied within the geographical area considered in the present study. Bird species richness and community structure differ from region to region (Pearson 1975, Richards 1996). The difference in avian diversity across different habitats

Table1. Checklist of bird species recorded from agricultural landscapes of District Panipat, Haryana, India

ORDER / Family Common and Scientific names	Residential Status	Feeding Gguild	Local Status	Habitat PA	SA	IS	BA	MA	Conservation Status IWPA	IUCN	Global Trend
Order: GALLIFORMES											
Phasianidae											
Indian Peafowl *Pavo cristatus*	R	O	CO	+	+	+	+	+	I	LC	STA
Black Francolin *Francolinus francolinus*	R	O	UC	-	+	-	+	+	IV	LC	STA
Grey Francolin *Francolinus pondicerianus*	R	O	FC	-	+	+	-	-	IV	LC	STA
Order: PHOENICOPTERIFOMES											
Podicipedidae											
Little Grebe *Tachybaptus ruficollis*	R	C	UC	-	+	-	+	-	IV	LC	DEC
Order: COLUMBIFORMES											
Columbidae											
Rock Pigeon *Columba livia*	R	G	CO	+	+	+	+	+		LC	DEC
Eurasion Collared Dove *Streptopelia decaocto*	R	G	FC	-	+	+	+	-	IV	LC	INC
Spotted Dove *Spilopelia chinensis*	R	G	FC	+	+	+	+	+	IV	LC	INC
Laughing Dove *Streptopelia senegalensis*	R	G	CO	+	+	+	+	+	IV	LC	STA
Yellow-legged Green Pigeon *Treron phoenicopterus*	R	F	UC	+	+	-	+	-	IV	LC	INC
Order: CAPRIMULGIFORMES											
Apodidae											
Indian House Swift *Apus affinis*	R	I	UC	-	+	-	+	-	__	LC	INC
Order: CUCULIFORMES											
Cuculidae											
Greater Coucal *Centropus sinensis*	R	O	CO	+	+	+	+	+	IV	LC	STA
Pied Cuckoo *Clamator jacobinus*	S	I	UC	+	+	-	+	-	IV	LC	STA
Asian Koel *Eudynamys scolopaceus*	R	O	FC	+	+	-	+	-	IV	LC	STA
Drongo Cuckoo *Surniculus lugubris*	S	I	RA	-	+	-	+	-	IV	LC	DEC
Common Hawk Cuckoo *Hierococcyx varius*	S	I	RA	-	+	-	+	-	IV	LC	STA
Order: GRUIFORMES											
Rallidae											
White-breasted Waterhen *Amaurornis phoenicurus*	R	O	CO	+	+	+	+	+	IV	LC	UNK
Purple Swamphen *Porphyrio porphyrio*	R	O	FC	-	+	-	-	+	IV	LC	UNK
Common Moorhen *Gallinula chloropus*	W	O	FC	+	+	+	+	+	IV	LC	STA
Order: PELECANIFORMES											
Ciconiidae											
Painted Stork *Mycteria leucocephala*	W	C	RA	-	+	-	+	-	IV	NT	DEC
Asian Openbill *Anastomus oscitans*	W	C	RA	-	+	-	+	-	IV	LC	UNK
Black-necked Stork *Ephippiorhynchus asiaticus*	W	C	RA	-	+	-	+	-	IV	NT	DEC
Ardeidae											
Black-crowned Night Heron *Nycticorax nycticorax*	R	C	UC	-	-	+	+	-	IV	LC	DEC
Indian Pond Heron *Ardeola grayii*	R	C	CO	+	+	+	+	+	IV	LC	UNK
Cattle Egret *Bubulcus ibis*	R	C	CO	+	+	+	+	+	IV	LC	INC
Grey Heron *Ardea cinerea*	R	C	RA	-	-	-	+	-	IV	LC	UNK
Purple Heron *Ardea purpurea*	R	C	RA	-	+	-	-	-	IV	LC	DEC
Great Egret *Ardea alba*	W	C	UC	-	+	-	+	-	IV	LC	UNK
Intermediate Egret *Ardea intermedia*	W	C	UC	+	+	+	+	+	IV	LC	DEC
Little Egret *Egretta garzetta*	R	C	UC	-	+	-	+	-	IV	LC	INC
Threskiornithidae											
Black-headed Ibis *Threskiornis melanocephalus*	R	C	UC	+	-	+	+	-	IV	NT	DEC
Indian Black Ibis *Pseudibis papillosa*	R	C	CO	+	+	+	+	+	IV	LC	DEC
Glossy Ibis *Plegadis falcinellus*	R	C	UC	+	+	+	+	+	IV	LC	DEC

ORDER / Family Common and Scientific names	Residential Status	Feeding Gguild	Local Status	Habitat PA	SA	IS	BA	MA	Conservation Status IWPA	IUCN	Global Trend
Phalacrocoracidae											
Little Cormorant *Microcarbo niger*	R	C	FC	+	+	-	+	-	IV	LC	UNK
Order: CHARADRIIFORMES											
Recurvirostridae											
Black-winged Stilt *Himantopus himantopus*	R	C	CO	+	+	+	+	+	IV	LC	INC
Charadriidae											
Little Ringed Plover *Charadrius dubius*	W	C	UC	-	+	-	+	-	IV	LC	STA
Red-wattled Lapwing *Vanellus indicus*	R	C	CO	+	+	+	+	+	IV	LC	UNK
White-tailed Lapwing *Vanellus leucurus*	W	C	UC	+	+	+	+	+	IV	LC	UNK
Jacanidae											
Pheasant-tailed Jacana *Hydrophasianus chirurgus*	S	O	RA	-	+	-	+	-	IV	LC	DEC
Scolopacidae											
Common Sandpiper *Actitis hypoleucos*	W	I	CO	+	-	+	-	-	IV	LC	DEC
Common Redshank *Tringa totanus*	W	C	FC	-	+	+	+	+	IV	LC	UNK
Order: ACCIPITRIFORMES											
Accipitridae											
Black-winged Kite *Elanus caeruleus*[*]	R	C	UC	+	-	-	-	+	I	LC	STA
Shikra *Accipiter badius*[*]	R	C	FC	+	+	+	+	+	I	LC	STA
Brahminy Kite *Haliastur indus**	R	C	RA	+	+	-	+	-	I	LC	DEC
Black Kite *Milvus migrans**	R	C	FC	+	-	+	-	+	I	LC	UNK
Order: STRIGIFORMES											
Strigidae											
Spotted Owlet *Athene brama**	R	C	FC	+	+	+	+	+	IV	LC	STA
Order: BUCEROTIFORMES											
Bucerotidae											
Indian Grey Hornbill *Ocyceros birostris*	R	O	FC	+	+	+	+	-	IV	LC	STA
Upupidae											
Common Hoopoe *Upupa epops*	R	O	CO	+	+	+	+	+	__	LC	DEC
Order: PICIFORMES											
Picidae											
Lesser Golden-Backed Woodpecker *Dinopium benghalense*	R	I	RA	+	-	-	+	-	IV	LC	STA
Ramphastidae											
Brown-headed Barbet *Psilopogon zeylanicus*	R	F	FC	+	+	+	+	-	IV	LC	STA
Coppersmith Barbet *Psilopogon haemacephalus*	R	F	FC	+	+	+	+	-	IV	LC	INC
Order: CORACIIFORMES											
Meropidae											
Green Bee-eater *Merops orientalis*	R	I	CO	+	+	+	+	+	__	LC	INC
Coraciidae											
Indian Roller *Coracias benghalensis*	R	I	FC	+	+	-	+	-	IV	LC	INC
Alcedinidae											
White-throated Kingfisher *Halcyon smyrnensis*	R	C	CO	+	+	+	+	+	IV	LC	INC
Order: PSITTACIFORMES											
Psittaculidae											
Alexandrine Parakeet *Psittacula eupatria**	R	F	RA	+	+	-	+	-	IV	NT	DEC
Rose-ringed Parakeet *Psittacula krameri*	R	F	CO	+	+	+	+	+	IV	LC	INC
Order: PASSERIFORMES											
Campephagidae											
Long-tailed Minivet *Pericrocotus ethologus*	W	I	UC	+	-	-	+	-	IV	LC	DEC
Oriolidae											
Eurasian Golden Oriole *Oriolus oriolus*	S	O	RA	+	-	-	+	-	IV	LC	STA

ORDER / Family Common and Scientific names	Residential Status	Feeding Gguild	Local Status	Habitat PA	SA	IS	BA	MA	Conservation Status IWPA	IUCN	Global Trend
Dicruridae											
Black Drongo *Dicrurus macrocercus*	R	I	CO	+	+	+	+	+	IV	LC	UNK
Laniidae											
Bay-backed shrike *Lanius vittatus*	R	I	FC	-	+	+	+	+	__	LC	STA
Long-tailed Shrike *Lanius schach*	R	I	FC	+	+	+	+	+	__	LC	UNK
Corvidae											
RufousTreepie *Dendrocitta vagabunda*	R	I	CO	+	+	+	+	-	IV	LC	DEC
House crow *Corvus splendens*	R	O	CO	+	+	+	+	+	V	LC	STA
Large-billed Crow *Corvus macrorhynchos*	W	O	UC	+	+	+	+	+	IV	LC	STA
Nectariniidae											
Purple Sunbird *Cinnyris asiaticus*	R	N	FC	+	+	+	+	+	IV	LC	STA
Ploceidae											
Black-breasted Weaver *Ploceus benghalensis*	R	G	UC	+	-	-	+	-	IV	LC	STA
Streaked Weaver *Ploceus manyar*	R	G	UC	-	+	+	+	-	IV	LC	STA
Baya Weaver *Ploceus philippinus*	R	G	FC	+	+	+	+	+	IV	LC	STA
Estrildidae											
Indian Silverbill *Euodice malabarica*	R	G	FC	-	+	-	+	+	IV	LC	STA
Scaly-breasted Munia *Lonchura punctulata*	R	G	FC	+	+	+	+	+	IV	LC	STA
Passeridae											
House Sparrow *Passer domesticus*	R	O	UC	+	+	+	+	+	IV	LC	DEC
Motacillidae											
Paddyfield Pipit *Anthus rufulus*	R	I	UC	-	+	-	+	+	IV	LC	STA
Western Yellow Wagtail *Motacilla flava*	W	I	UC	+	+	+	+	-	IV	LC	DEC
Grey Wagtail *Motacilla cinerea*	W	I	FC	+	+	+	+	+	IV	LC	STA
Citrine Wagtail *Motacilla citreola*	W	I	FC	+	-	+	+	-	IV	LC	INC
White-browed Wagtail *Motacilla maderaspatensis*	R	I	FC	+	+	+	+	+	IV	LC	STA
White Wagtail *Motacilla alba*	W	I	FC	+	+	-	+	-	IV	LC	STA
Alaudidae											
Crested Lark *Galerida cristata*	R	O	RA	-	+	-	-	+	IV	LC	DEC
Cisticolidae											
ZittingCisticola *Cisticola juncidis*	R	I	FC	-	+	-	+	-	IV	LC	INC
Ashy Prinia *Prinia socialis*	R	I	FC	+	+	+	+	+	IV	LC	STA
Plain Prinia *Prinia inornata*	R	I	FC	+	-	+	+	+	IV	LC	STA
Common Tailorbird *Orthotomus sutorius*	R	I	FC	+	+	+	+	+	IV	LC	STA
Acrocephalidae											
Paddyfield Warbler *Acrocephalus agricola*	S	O	RA	-	-	+	-	+	IV	LC	DEC
Hirundinidae											
Redrumped Swallow *Cecropis daurica*	R	I	UC	+	-	-	-	-	__	LC	STA
Wire-tailed Swallow *Hirundo smithii*	R	I	CO	+	+	+	+	+	__	LC	INC
Barn Swallow *Hirundo rustica*	R	I	RA	-	+	-	+	-	__	LC	DEC
Plain Martin *Riparia paludicola*	R	I	RA	+	+	-	-	-	__	LC	DEC
Pycnonotidae											
Red-vented Bulbul *Pycnonotus cafer*	R	O	CO	+	+	+	+	+	IV	LC	INC
Sylviidae											
Lesser Whitethroat *Sylvia curruca*	W	O	UC	-	-	-	+	-	IV	LC	STA
Zosteropidae											
Oriental White-eye *Zosterops palpebrosus*	R	I	UC	-	+	-	+	-	IV	LC	DEC
Leiothrichidae											
Large Grey Babbler *Argya malcolmi*	R	O	FC	+	+	+	+	+	IV	LC	STA
Common Babbler *Argya caudata*	R	O	FC	-	+	+	-	-	IV	LC	STA
Jungle Babbler *Turdoides striata*	R	O	FC	+	+	-	+	+	IV	LC	STA

ORDER / Family Common and Scientific names	Residential Status	Feeding Gguild	Local Status	Habitat PA	SA	IS	BA	MA	Conservation Status IWPA	IUCN	Global Trend
Sturnidae											
Common Starling *Sturnus vulgaris*	W	O	UC	+	+	-	+	-	IV	LC	DEC
Asian Pied Starling *Gracupica contra*	R	O	FC	+	+	+	+	+	IV	LC	INC
Brahminy Starling *Sturnia pagodarum*	R	O	UC	+	+	-	+	+	IV	LC	UNK
Common Myna *Acridotheres tristis*	R	O	CO	+	+	+	+	+	IV	LC	INC
Bank Myna *Acridotheres ginginianus*	R	I	FC	+	+	+	+	-	IV	LC	INC
Muscicapidae											
Indian Robin *Saxicoloides fulicatus*	R	I	FC	+	+	-	+	+	IV	LC	STA
Oriental Magpie Robin *Copsychus saularis*	R	I	FC	+	+	+	+	-	IV	LC	STA
Bluethroat *Cyanecula svecica*	W	I	RA	+	+	+	+	-	IV	LC	STA
Common Stonechat *Saxicola torquatus*	W	I	UC	+	+	+	+	+	IV	LC	STA
Pied Bushchat *Saxicola caprata*	R	I	CO	+	+	+	+	+	IV	LC	STA
Brown Rock Chat *Oenanthe fusca*	R	I	CO	+	+	+	+	+	IV	LC	STA

* Species with conservation status (Convention on International Trade in Endangered Species of Wild Fauna and Flora 2017):
Residential Status: R-Resident, S-Summer migrant, W-Winter migrant,
Feeding Guild: C- Carnivorous, F- Frugivorous, G- Grainivorous, I- Insectivorous, N- Nectarivorous, O- Omnivorous,
Local Status: CO-Common, FC-Fairly common, UC-Uncommon, RA-Rare,
Habitats: PA- Panipat, SA- Samalkha, IS- Israna, BA- Bapoli, MA- Madlauda, +- presence, - -Absence;
IWPA Status- I & IV refer to Schedule-I and Schedule-IV respectively, of Indian Wildlife Protection Act (IWPA)
IUCN Status - LC- Least Concern, NT- Near Threatened, STA-Stable, DEC- Decreasing, INC- Increasing, UNK- Unknown

Table 2. Relative diversity index (RDI) of bird families in agricultural landscapes of District Panipat, Haryana, India

Bird families	Number of Species	Relative Diversity Index (RDI)
Ardeidae	8	7.76
Muscicapidae, Motacillidae	6	5.82I
Columbidae, Cuculidae, Sturnidae	5	4.85
Accipitridae,Cisticolidae, Hirundinidae	4	3.88
Phasianidae,Rallidae,Ciconiidae, Threskiornithidae,Charadriidae,Corvidae, Ploceidae, Leiothrichidae	3	2.91
Scolopacidae, Ramphastidae,Psittaculidae, Laniidae, Estrildidae	2	1.94
Podicipedidae,Apodidae, Phalacrocoracidae, Recurvirostridae, Jacanidae, Strigidae, Bucerotidae, Upupidae, Picidae, Meropidae, Coraciidae, Alcedinidae, Campephagidae, Oriolidae, Dicruridae, Nectariniidae, Passeridae, Alaudidae, Acrocephalidae, Pycnonotidae, Sylviidae, Zosteropidae	1	0.97

Table 3. Bird species similarity between different habitat types in study area

Habitat	Panipat	Samalkha	Israna	Bapoli	Madlauda
Panipat	-	0.616	0.646	0.704	0.580
Samalkha	-	-	0.585	0.792	0.560
Israna	-	-	-	0.575	0.647
Bapoli	-	-	-	-	0.505

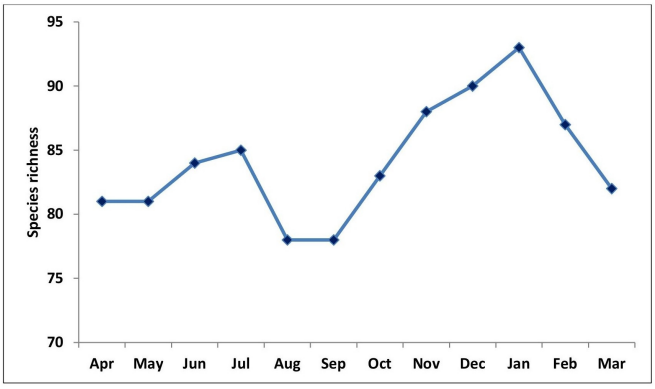

Figure 2. Temporal variation in overall species richness of avifauna in the study area during 2016-17

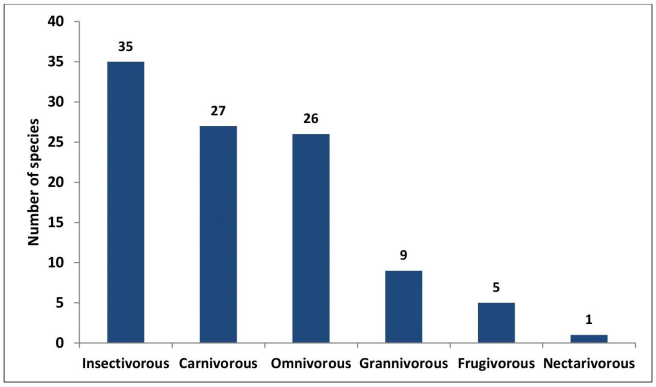

Figure 3. Feeding guilds of recorded avifauna in the agro-ecosystems of district Panipat, Haryana, India

might be associated with availability of food, roosting and nesting sites, predation pressure and disturbance (Hossain and Aditya 2016). Crop composition and farming intensity also influence the species richness and abundance of birds in the agricultural fields (Cunningham et al. 2013, Malik et al. 2015). The reason for the highest bird diversity recorded in Bapoli block could be due to habitat heterogeneity. The patches of tall wooded trees, scrub and bushy type stumpy vegetation, grasses and the wetlands (river Yamuna) around the agricultural fields contributed to the heterogeneity of landscape, and augmented resource variety to sustain different bird species. Such habitat diversity in the selected study site played a crucial role in supporting rich avian diversity. In contrast, agricultural landscapes of Madlauda block are being in the vicinity of industrial area (Thermal Power Plant of Panipat) showed lowest species richness. Reduced diversity of avifauna may be because of enhanced anthropogenic activities and pollution levels in the surrounding environment.

Birds are often heterogeneous in their feeding habits (Ali and Ripley 1987). The quality and quantity of food available is the crucial factor that determines the spatio-temporal distribution and relative abundance of birds in a given habitat (Rajashekhra and Venkatesha 2014, Mukhopadhyay and Mazumdar 2017). As far as foraging habits of birds in the study area are concerned, six major feeding guilds were identified (Figure 3). This occurrence of major trophic guilds in the study area indicated that the area holds a variety of food resources for birds. Most bird species were insectivorous (35) followed by carnivorous (27), omnivorous (26), grainivorous (9), frugivorous (5) and nectarivorous (1). Likewise, Dhadse et al. (2009) also observed the dominance of insectivorous birds in industrial area of Panipat. The results of present study are in consistent with previous records that insectivore is the dominant feeding guild in agricultural landscapes in India (Rajashekhra and Venkatesha 2014, Narayana et al. 2015). Majority of insectivorous birds belonged to Muscicapidae and Motacillidae (6 species each). The observations also reflect possible variation in ecological roles, feeding habits and resource utilization pattern of birds in the agricultural landscapes. Most bird species within the study area were insectivorous, indicating rich abundance of insects there. These insectivorous birds play an important role in the biological control of various insect pests thriving in agriculture, horticulture and forests (Mahabal 2005, Thakur et al. 2010). As birds are associated with farmer's activity as an important and effective control measure of insect pests in agro-ecosystem, the indiscriminate use of chemical insecticides and pesticides affects the bird population adversely through harmful effects of chemicals and reduction in its regular prey (Blus and Henny 1997). Hence, monitoring of the insectivorous species of this area may reflect the impact of excessive pesticide use on this avian guild.

Among the recorded avifauna, Painted Stork (*Mycteria leucocephala*), Black-necked Stork (*Ephippiorhynchus asiaticus*), Oriental White Ibis (*Threskiornis melanocephalus*) and Alexandrine Parakeet (*Psittacula eupatria*) are near threatened species, while the remaining 99 species are categorized as least concern species in the Red List of IUCN (2019). Additionally, six species are included in Appendix-II of CITES (2012). Five species, including four species of Acci-pitridae and one of Phasianidae, are considered nationally threatened as these are listed under Schedule-I of the Indian Wildlife (Protection) Act, 1972. An assessment of local

abundance revealed that 23 species were common, 36 species were fairly common, 27 species were uncommon and 17 species were rare in the study area. When this local abundance was compared with global population trend of the species, it was found that some species having a globally declining population trend are still common in the study area (Figure 4). Five species with globally declining trend, Rock Pigeon (*Columba livia*), Indian Black Ibis (*Pseudibis papillosa*), Common Sandpiper (*Actitis hypoleucos*), Common Hoopoe (*Upupa epops*) and Rufous Treepie (*Dendrocitta vagabunda*) were found to be common in our study area, which indicates that suitable resources for these avian species are still available in these agro-ecosystems. These species must be prioritized for regular and long-term monitoring from a global bird conservation perspective.

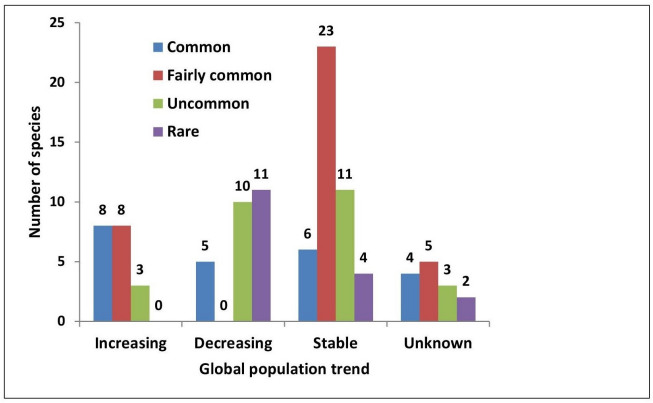

Figure 4. Comparison of local status and global population trend of avifaunal species recorded from agricultural landscape of District Panipat, Haryana, India

Documentation of the species richness and composition of birds in a particular landscape is crucial to assess their ecological importance. Species-specific roles and ecological services facilitate prioritization of the steps towards conservation of the bird species and sustenance of the ecosystem services, which in Indian context are far from being complete (Dhindsa and Saini 1994, Sundar and Kittur 2013, Hossain and Aditya 2016). In this context, the present study is the first scientific attempt towards documentation of avifaunal diversity in the agro-ecosystems of district Panipat, Haryana. Our findings on bird diversity can be used a baseline for further research and monitoring. Monitoring of bird species should be continued in the study area, focusing on seasonal abundance, habitat use, nesting and breeding ecology, to supplement holistic approach of conservation and management strategies for sustenance of ecosystem services derived from birds.

ACKNOWLEDGEMENTS

We are highly thankful to the Department of Zoology, Kurukshetra University, Kurukshetra for providing necessary research facilities.

Author contributions: P. Kumar conceived and designed the study as well as wrote the final draft of the manuscript. S. Sahu performed the field surveys, analysed the data and prepared rough draft of the manuscript. Both authors read and approved the final manuscript.

Conflict of interest: We declare that there is no conflict of interest regarding the publication of this paper.

REFERENCES

Abdar, M.R. 2014. Seasonal diversity of birds and ecosystem services in agricultural area of Western Ghats, Maharashtra state, India. Journal of Environmental Science, Toxicology and Food Technology 8(1): 100-105.

Ali, S. 1949. Bird friends and foes of the cultivator. Indian Farming 10: 385-387.

Ali, S. and Ripley, S.D. 1987.Handbook of the Birds of India and Pakistan. Oxford University Press, Delhi. 737 pages.

Asokan, S.; Ali, A.M.S. and Manikannan, R. 2009. Diet of three insectivorous birds in Nagapattinam District, Tamil Nadu, India- a preliminary study. Journal of Threatened Taxa 1(6): 327-330.

Asokan, S.; Ali, A.M.S. and Manikannan, R. 2010. Foraging behavior of selected birds in Cauvery Delta region of Nagapattinam District, Tamil Nadu, India - a preliminary study. Journal of Threatened Taxa 2(2): 690-694.

Basavarajappa, S. 2006. Avifauna of agro-ecosystems of Maidan area of Karnataka. Zoos' Print Journal 21(4): 2217-2219.

Bianchi, F.J.J.A.; Booij, C.J.H. and Tscharntke, T. 2006. Sustainable pest regulation in agricultural landscapes: a review on landscape composition, biodiversity and natural pest control. Proceedings of the Royal SocietyB 273: 1715-1727.

Birasal, N.R. 2014. Agricultural ecosystem: an encouraging field for ornithologists. Journal of Biodiversity and Endangered Species 2:1.

Blus, L.J. and Henny, C.J. 1997. Field studies on pesticides and birds: unexpected and unique relations. Ecological Applications 7(4): 1125-1132.

Bradford, D.F.; Franson, S.E.; Neale, A.C.; Heggem, D.T.; Miller, G.R. and Canterbury, G.E. 1998. Bird species assemblages as indicators of biological integrity in Great Basin Rangeland. Environmental Monitoring and Assessment 49: 1-22.

Browder, S.F.; Johnson, D.H. and Ball, I.J. 2002. Assemblages of breeding birds as indicators of grassland condition. Ecological Indicators 2: 257-270.

CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). 2012. Checklist of Convention on International Trade in Endangered Species of Wild Fauna and Flora. CITES, Geneva, Switzerland. http://www.cites.org (Last accessed 10/08/2019).

Cunningham, S.A.; Attwood, S.J.; Bawa, K.S.; Benton, T.G.; Broadhurst, L.M.; Didham, R.K.; McIntyre, S.; Perfecto, I.; Samways, M.J.; Tscharntke, T. and Vandermeer, J.2013. To close the yield-gap while saving biodiversity will require multiple locally relevant strategies. Agriculture, Ecosystems & Environment 173: 20-27.

Dal, P. and Vaghela, A.K. 2015. Preliminary survey of avifaunal diversity around Shetrunji River, Dhari, India. Journal of Biology and Earth Sciences 5(1): 19-24.

Dhadse, S.; Kotangale, J.P.; Choudhari, P.R. and Wate, S.R. 2009. Diversity of birds at Panipat refinery, Haryana (India). Environmental Monitoring and Assessment 158: 1-8.

Dhindsa, M.S. and Saini, H.K. 1994. Agricultural ornithology: an Indian perspective. Journal of Bioscience 19(4): 391-402.

Gregory, R.D.; Vorisek, P.; Noble, D.G.; Strien, A.V.; Klvanova,A.; Eaton, M.; Meyling, A.W.G.; Joys, A.; Foppen, R.P.B. and Burfield, I.J. 2008. The generation and use of bird population indicators in Europe. Bird Conservation International 18: S223–S244.

Grimmett, R.; Inskipp, C. and Inskipp, T. 2011. Birds of the Indian Subcontinent. Oxford University Press & Christopher Helm, London. 528 pages.

Gupta, N. and Singh, N. 2014. The abundance of avifauna in an agricultural landscape: a benefit of community conservation initiatives in Haryana, India. Indian Journal of Science and Technology 7(4): 537-541.

Hossain, A. and Aditya, G. 2016. Avian diversity in agricultural landscape: records from Burdwan, West Bengal, India. Proceedings of Zoological Society 69(1): 38-51.

Indian Wildlife Protection Act (IWPA). 1972. The Indian Wildlife (Protection) Act, 1972 (as amended upto 1993). Ministry of Environment, Forest and Climate Change, Government of India, Delhi. http://www.envfor.nic.in/legis/wildlife/wildlife1.html (Last assessed 28/07/2019).

IUCN (International Union for Conservation of Nature). 2019. The IUCN Red List of Threatened Species. www.iucnredlist.org (Last assessed 30/07/2019).

Kalsi, R.S.; Sharma, S.C. and Choudhary, J.R. 2019. Birds of Haryana. Unique Publications, Panipat, India. 602 pages.

Kumar, A.B. 2006. A checklist of avifauna of the Bharathpuzha river basin, Kerala. Zoos' Print Journal 21(8): 2300-2355.

Lawson, J.H.; Bignell, D.E.; Bolton, B.; Bloemers, G.F.; Eggleton, P.; Hammond, P.M.; Hodda, M.; Holt, R.D.; Larsen, T.B.; Mawdsley, N.A.; Stork, N.E.; Srivastava, D.S. and Watt, A.D. 1998. Biodiversity inventories, indicator taxa, and effects of habitat modification in tropical forest. Nature 391: 72-76.

MacKinnon, J. and Phillipps, K. 1993. A Field Guide to the Birds of Borneo, Sumatra, Java and Bali, the Greater Sunda Islands. Oxford University Press, Oxford. 692 pages.

Mahabal, A. 2005. Aves. Pages 275-339, In: The Director (Editor). Fauna of Western Himalaya. Zoological Survey of India, Kolkata.

Mallik, A.; Chand, D.S.; Singh, A. and Parida, S.P. 2015. Studies on avifauna diversity of agronomy field of O.U.A.T campus, Bhubaneswar, India. Current Life Sciences 1(2): 46-57.

Malhi, C.S. 2006. Status of avifauna in agricultural habitat and other associated sub-habitats of Punjab. Environment and Ecology 24 (1): 131-143.

Manakadan, R. and Pittie, A. 2001.Standardised common and scientific names of the birds of the Indian subcontinent. Buceros 6(1): 1-37.

Mukhopadhyay, S. and Mazumdar, S. 2017. Composition, diversity and foraging guilds of avifauna in a suburban area of southern West Bengal, India. Ring 39: 103-120.

Narayana, B.L.; Rao, V.V. and Pandiyan, J. 2015. Avifaunal diversity in different croplands of Nalgonda district, Telangana, Southern India. International Journal of Current Research 7(7): 17677-17682.

Narayana, B.L.; Rao, V.V. and Pandiyan, J. 2016. Four insectivorous birds in search of foraging niche in and around an agricultural ecosystem of Nalgonda district of Telangana, India. Ambient Science 3(1): 7–15.

Pearson, D.L. 1975. Range extensions and new records for bird species in Ecuador, Peru, and Bolivia. Condor 77: 96-99.

Praveen, J.; Jayapal, R. and Pittie, A. 2016. A checklist of the birds of India. Indian Birds 11(5&6): 113-172.

Rajashekara, S. and Venkatesha, M.G. 2014. Insectivorous bird communities of diverse agro-ecosystems in the Bengaluru region, India. Journal of Entomology and Zoology Studies 2(5): 142–155.

Richards, P.W. 1996. The Tropical Rain Forest: An Ecological Study. Cambridge University Press, Cambridge, UK. 575 pages.

Sekercioglu, C.H. 2006. Increasing awareness of avian ecological function. Trends in Ecology and Evolution 21: 464–471.

Sekercioglu, C.H. 2012. Bird functional diversity and ecosystem services in tropical forests, agroforests and agricultural areas. Journal of Ornithology 153(Suppl 1): S153–S161.

Sundar, K.G. and Kittur, S. 2013. Can wetlands maintained for human use also help conserve biodiversity? Landscape-scale patterns of bird use of wetlands in an agricultural landscape in north India. Biological Conservation 168: 49-56.

Sutherland, W.J. 2006. Ecological Census Techniques a handbook. Cambridge University Press, New York. 432 pages.

Thakur, M.L.; Mattu, V.K.; Lal, H.; Sharma, V.N.; Raj, H. and Thakur, V. 2010. Avifauna of Arki Hills, Solan (Himachal Pradesh), India. Indian Birds 5: 162-166.

Torre-Cuadros, M.D.L.A.L.; Herrando-Perez, S. and Young, K.R. 2007. Diversity and structure patterns for tropical montane and premontane forests of central Peru, with an assessment of the use of higher-taxon surrogacy. Biodiversity Conservation 16: 2965-2988.

Tubelis, D.P. and Cavalcanti, R.B. 2001. Community similarity and abundance of bird species in open habitats of a central Brazilian Cerrado. Ornitologia Neotropical 12: 57-73.

Vijayan, L.; Prasad, S.N.; Sridharan, N. and Guptha, M.B. 2006. Status of wetlands and wetland birds in selected districts of

Tamilnadu. Sálim Ali Centre for Ornithology & Natural History, Coimbatore; http://www.sacon.in/wp-content/uploads/2015/06/FT-2006-PR135s-STATUS-OF-WL-TN.pdf

Western, D. and Grimsdell, J.J.R. 1979. Measuring the Distribution of Animals in Relation to Environment. African Wildlife Foundation, Nairobi, Kenya. 64 pages.

Whelan, C.J.; Wenny, D.G. and Marquis, R.J. 2008. Ecosystem services provided by birds. Annals of the New York Academy of Sciences 1134: 25-60.

Zeleke, A.; Gadisa, T. and Gebremichael, G. 2015. Diversity and relative abundance of bird species of Sheko District, Bench Maji zone, Southwest Ethiopia. International Journal of Development & Research 5: 3975-3979.

Received 14 August 2019
Accepted 20 October 2019