

T-PERCHES DETERMINING AVIAN FEEDING GUILDS IN MAIZE

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ABSTRACT

Avian diversity is considered an environmental indicator for measuring ecosystem quality. The availability of food and its diverse types influence bird distribution and their community structure in agricultural landscapes. The current study investigated the role of T-perches as bird attractants in maize at the Punjab Agricultural University, Ludhiana. A total of 39 species were observed belonging to 12 orders and 24 families. Insectivorous birds were observed as the most dominant feeding guild constituting 47.12%. Black drongo, jungle babbler, common myna, house crow, green bee-eater, and red-vented bulbul were noted utilizing t-perches for foraging purposes. The key factor driving the increase in insectivorous bird species seemed to be the additional perching sites available by installing T-perches.

Key words: Insectivorous birds, maize, passeriformes, agricultural landscapes, T-perches, environmental indicator, pest control, black drongo, ecofriendly, avian diversity, vegetative stage, foraging sites

India has 1210 bird species, with 993 of them being terrestrial (Kler and Kumar, 2015), and out of these, 328 are found in Punjab (Jerath and Chadha, 2006). Avian diversity and feeding guilds are important environmental indicators (Newton, 2003). Analyzing bird guilds in agroecosystems provide a stronger insight into the community structure of bird species, as well as their habitat usage and services, and results in better maintenance of those species in agricultural landscapes (Shew et al., 2019). The distribution of birds and community structure is influenced by food resources and patterns of food utilization in a particular habitat. (Sohil and Sharma, 2020). Classifying birds into feeding guilds is one of the best ways to understand the structure of their communities. Foraging and breeding sites for resident and migratory species are provided by agricultural landscapes (Blount et al., 2021). In Punjab, maize is an important cereal crop and its yield/ha is 35.82 quintals (Anonymous, 2021). Numerous bird species are pests' natural adversaries and act as biocontrol agents. Therefore, they must be kept within optimum ranges in the agroecosystem (Kaur and Sidhu, 2021). T-perches can be installed to attract birds to fields and aid in pest control. Artificial perches help to increase local bird diversity and improve structural complexity (Horgan et al., 2016). They mimic the barren trees that are commonly found in landscapes (Vogel et al., 2018, Kumar and Cheema, 2020). The main objective of this study was to evaluate the effect of T-shaped perches on bird diversity and various feeding guild patterns in maize.

MATERIALS AND METHODS

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The present study was conducted at the Punjab Agricultural University Ludhiana, Punjab, India from July 2021 to November 2021 in maize. The variety PMH1 was raised according to cultural practices provided in 'Package and practices of kharif crops', Directorate of Extension, Punjab Agricultural University, Ludhiana (Anonymous, 2021). Experiment comprised of two types of plots; one was installed with T-perches and the other without as a control plot. T-perches were installed at non-grain stages (initial vegetative stage, knee-height stage, and mature vegetative stage). The height of T- perches was chosen 60 cm higher than the crop height. A total of 15 T-perches were installed in 2500m² with 10 m distance between each, and these were made by nailing shorter (horizontal) stick over the larger (vertical) stick (Kler, 2005). The point count method was followed to record bird species thrice a week/identification of species and their feeding guilds have been given as per keys given by Ali (1960). The community structure of bird species was calculated as: i. Species richness: Total number of species observed in experimental plots; ii. Species diversity calculated as Shannon- Weiner Index; iii. Relative abundance calculated by formula: Ni/ N × 100. Where, Ni is number of birds of the ith species. N is the total bird population observed; and iv. Species evenness: Species evenness was calculated by the formula: J = H/H'max. Where H denotes observed species diversity and H'max

denotes log of bird species richness (Krebs et al., 1985). Data was subjected to ANOVA followed by paired t-test to compare the feeding guilds and bird species using SPSS-25 software.

RESULTS AND DISCUSSION

The present study was conducted to observe the difference in bird feeding guilds and overall bird diversity with and without integration of T-perches in maize. A total of 39 bird species (12 orders and 24 families) and 36 bird species (12 orders and 24 families) were in T-perches installed plot and control plot, respectively. The most dominant order was Passeriformes (38%) (Table 1). Overall insectivorous bird species number was higher (18) in T-perches installed plot than in the control plot (15). These findings are similar to those of Kler (2005) in Bt cotton. Bird species richness of other feeding guilds (carnivorous, omnivorous, granivorous and nectarivorous) was similar in both T-perches installed plot and control plot. A total of 18 bird species were observed utilizing T-perches in combined data of studied crop stages, out of which 14 were insectivorous followed by 2 omnivorous and 1 granivorous bird species. Insectivorous birds were more species rich in the T-perches installed plot (18, 13, and 13) than control plot (9, 10, and 10). Three insectivorous bird species (Indian Robin, White-browed Wagtail, and Yellow Wagtail) were exclusive at the initial vegetative stage of the T-perches installed plot only. Species richness was slightly higher (7) at the knee-height stage of the control plot than T-perches installed plot (6) (Table 2). Avian feeding guilds exhibited significant differences in both T-perches installed and control plots. While stagewise analysis revealed no significant differences.

Overall, the most dominant avian feeding guilds were insectivorous (47.12%) and omnivorous (40.84%). The abundance of insectivorous bird species was 52.62%, 44.57%, and 44.18% at the initial vegetative, kneeheight, and mature vegetative stage in fields installed with T-perches, respectively. Whereas the insectivorous bird species abundance in the control plot was 26.76%, 20.56 5, and 39.75% at initial vegetative, knee-height, and mature vegetative stages respectively (Table 3). It is evident from the above finding that T-perches contributed as additional sites for insectivorous birds thereby helping them in prey-hunting.

At the initial vegetative stage, the most dominant bird species were house crow (18.08 %) followed by black drongo (14.60%) and other abundant species utilizing T-perches. House Crow (17.58 %) followed by

both Common Tailorbird and Common Myna (13.19%) were found most abundant species at the mature vegetative stage utilizing T-perches (Table 1). ANOVA revealed that bird species were significantly different at all the stages of T-perches installed plot. Stage-wise analysis revealed non-significant difference among all the stages. Bird species utilizing T-perches at the mature vegetative stage of the crop were significantly different from both initial vegetative and knee-height stage. However, bird species utilizing T-perches at the initial vegetative stage exhibited non-significant differences from the knee-height stage of T-perches installed plot. The initial vegetative stage was found to be having maximum species diversity (3.52) followed by both the knee-height stage (3.43) and mature vegetative stage (3.43) in the T-perches installed plot which was greater than the species diversity at the initial vegetative (3.09), knee-height (3.29) and mature vegetative stage (3.25) of control plot. Species richness was found higher at the initial vegetative stage (34), knee-height stage (31), and mature vegetative stage (31) of the T-perches plot (34) as compared to the same stages (22, 27, and 26, respectively) of control plot (Table 4).

The abundance of black drongo at the initial vegetative stage, knee-height stage, and mature vegetative stage of the plot installed with T-perches was higher (13.06%, 9.31%, and 9.88%, respectively) compared to control plots. Asokan and Ali (2010) observed that white-throated kingfishers and black drongos watched their prey from the apexes or vintax points of trees. Black drongos were observed in groups as well as singly perching in the T-perches plots showing similar observations to Kaur and Kler (2018). According to Sidhu and Kler's (2018) findings, black drongo preferred agricultural farms more than orchards. At the initial vegetative stage of the T-perches plot, the most abundant species was house crow (14.1%). These observations contrdict with those of Chand (2005) in cabbage and by Kaur and Kumar (2021) in barseem crop which mentioned common myna as the most abundant species. The most abundant species at the knee-height stage of the T-perches plot were common myna (10.79%) followed by house crow (10.24%) and then black drongo (9.31%). These observations were correspondent to the results of Chand (2005). House crow (16.88%) was observed as the most abundant species followed by common myna (15.25%) and then black drongo (9.88%) at the mature vegetative stage of the T-perches plot (Table 4). On the other hand, the most abundant bird species at the initial vegetative stage of control plot were found to be house crow (13.95%)

Table 1. Overall avian diversity and composition observed in maize (PAU Ludhiana, Punjab)

itiformes Accipitridae Black kite Black-winged kite Black-winged kite Black-winged kite Common hoopoe Common hoopoe Black winged stilt Charadriidae Black winged stilt Charadriidae Eurasian collard dove Little brown dove Rock pigeon Rocaciidae Green bee-eater Coraciidae Asian koel Greater coucal Oricuridae Asian koel Greater coucal Asian koel Greater coucal Rock pigeon Rotacillidae Paddy field pipit White wagtail White wagtail White wagtail White wagtail White wagtail Rocaciidae Brown rock chat Indian robin Pied bushchat Nectariniidae Brown rock chat Indian robin Pied bushchat Rocaciidae Brown rock chat Indian robin Rocaciidae Grown rock chat Indian robin Rocaciidae Brown rock chat Indian robin Bank myna Rocaciidae Grown rock chat Indian pond heron Little egret Indian pond heron Little egret Strigidae Strigidae Stockopole	Order	Family	common name	Scientific name	Status in	Residential	IUCN	Feeding	Observed at
Accipitridae Black-winged kite Elamas caecuteus C R B Black-winged kite Elamas caecuteus C R R Common hooped Common hooped C Common hooped Elamas caecuteus C R R Charadriidae Rect-watted lapwing Translutin indicas C R R R Roch-watted lapwing Translutin indicator of Columbia trivior R R R Roch-watted lapwing Translutin indicas C R R R R Roch-chard R Roch pigeon C Columbia trivior R R R R R R R R R R R R R R R R R R R		•			Punjab	status	status	guild	stages
Black-winged kite Ednus caeruleus C RM Charadriidae Gommon hoopoe Upupa epops Charadriidae Red-watted lapwing Intellus indicase Columbidae Larisaian collard dove Sitematopus himantopus NC R Lutite brown dose Sitematopus intellus indicase Columbidae Larisaian collard dove Sitematopus intellus columba livite RR Rock pigeon Columba livite RA Alcedinidae White-throated kingfisher Halcyon snymensis VC R R Meropidae Green bee-eart Alcoyon snymensis VC R Meropidae Green bee-eart Coracias bengalaelussis C R Greatre coued Centropus sinersis C R Indian roller Coracias bengalaelussis C R Massianidae Grey francolin Perancolinus pondicerinus C R Motacillidae Common tailorbird Orthoromus sutorius VC R Motacillidae Black drongo Dicturus macrocercus VC R Muscicapidae Brown rock columba Anthus rufultus C R Muscicapidae Brown rock and Coracias bengalaensis C R Muscicapidae Brown rock and Coracialla alba C C R Muscicapidae Brown rock columba Coracialla alba C C R Muscicapidae Brown rock and Saxicololaes fulfactua VC R Peasserdae Purple sunbtre Gravitolite grava Noctariniidae Purple sunbtre Gravitolite accoracial Anthus columba Acridolheves risias Suuridae Revented bulbul Saxicololaes siriatus VC R Bank myna Acridolheves risias Corvidae House sparrow Acridolheves risias Ardeidae Common myna Acridolheves risias Corvidae Red naped ibis Pegadas falcinellus Intreskontithidae Glossy ibis Brown Ardeola graviti VC R Ardeolae Rose-ringed parakeet Psittaciale Rusiner Psittacidae Soptiaciale Arteria brander Brander Soptiaciale Arteria Brander	Accipitriformes	Accipitridae	Black kite	Milvus migrans	ΛC	R	CC	C	IV, KH, MV
Upupidae Common hoopoe Upupa epops C RM S Recurviosstridae Black winged still Himanopus himanopus N C R R Columbidae Red-wattled lapwing Famelius indicas VC R R Rock pigeon Columba himanopus in the canocoro VC R R Rock pigeon Columba himanopus in the canocoro VC R R Alcedinidae White-throated kinglisher Halcyon smyrmensis VC R R Alcedinidae Green bee-eater Alcoys orientalis VC R R Meropidae Green bee-eater Alcoys orientalis VC R R Coracicidae Indian roller Eudynamys scolopaceus C R R Phasianidae Grey francolim Francolim Pondicerinus C R R Contactidae Indian peafowl Francolimus pondicerinus C R R Dicrutidae Common taliobirid Orthonomus sutorius VC R R Muscicapidae Black drongo Dicrutus macrocercus VC R R White-browed wagtail Motacilla diba C R R White-wagtail Motacilla diba C R R White-browed wagtail Motacilla diba C R R White-browed wagtail Motacilla diba C R R White-browed wagtail Motacilla france C R R White-browed wagtail Motacilla france C R R White-browed wagtail Alotacilla france C R R Nectarinidae Ped bushchat Saxicola captratus VC R F Passerdae House sparrow Passerdiae House sparrow Passerdiae House sparrow Cornus splendens Suricials Glossy ibis Plegadis falcinellus C C R R Ardeidae Grey the Bubbler Francholheres frists VC R R Ardeidae Red vented bulbul Pyconomis cafer VC R R Pycrononidae Red vented bulbul Arteelof grayiti VC R R Ardeidae Roce-writed bulbul Arteelof grayiti VC R R Psittacidae Roce-writed bulbul Arteelof grayiti VC R R Shriacidae Roce-writed bulbul Arteelof grayiti R VC R R Shriacidae R Roce-writed Bulbuctura Alcoy R R Little egret Bulbuctura Alcoy R R Little egret R Roce-writed R R R R R R R R R R R R R R R R R R R			Black-winged kite	Elanus caeruleus	C	R	Γ C	C	IV, KH, MV
s Recurvivostridae Black winged stilt Himantopus himantopus VC R Columbidae Red-wated lapwing Vanishing indicus VC R Columbidae Eurasian collard dove Sigmatopelia senegalensis VC R Rock pigeon Columba livia VC R Meropidae Green bee-eater Merops orientalis VC R Coracidae Asian koel Eudyamays scolopaceus C R Cuculidae Asian colim Francolims pondicerims C R Phasianidae Grey francolim Francolims pondicerims C R Dicruridae Black drongo Dicruridae Black drongo Dicruridae R Dicruridae Black drongo Dicruridae Nain dical pondecina C R	Bucerotiformes	Upupidae	Common hoopoe	Upupa epops	C	RM	Γ C	Ι	IV, KH, MV
Charadriidae Red-wattled lapwing Gnellus indicus VC Rachinbidae Eurasian colard dove Sireptopelia decaocio VC Rachinadae Little brown dove Sireptopelia decaocio VC Rachindae Minie-throated kingfisher Haticyon swymensis VC Rachindae Asian koel Eudymanys scolopaceus C Rachindae Asian koel Eudymanys scolopaceus C Rachindae Grey francolin Gentropus sinensis C Coracidae Grey francolin Francolinus pondicerinus C Rachindae Grey francolin Anna radian sulfation Orthonoms sutorius VC R Rachindae Black drongo Dicrurus macroceccus VC R Rachindae Grey francolin Motacilla alba C Rachindae Minie Anna radian Motacilla alba C Rachindae Rown rock chat Octaviculae alba Motacilla maderaspatensis C R Rachindae Durple subbird C Common myna Acridorlees filicata VC R R Piece bushchat Sumina Corvidae House sparrow Corvidae House sparrow Corvidae Bank myna Araian pied starling Suturus contra Rama myna Acridorleese stristis VC R R Pesudibis papiticae Rochingae Red naped bibla Phylanomers gnegation Araian pied starling Suturus contra Corvidae Rad myna Asian pied starling Suturus contra Corvidae Rad myna Araian pied starling Suturus contra Corvidae Rad myna Araian pied starling Bank myna Corvidae Rad myna Araian pied starling Suturus contra C R R Phenonotidae Rad vende bulbul Pycnonotia C R R Phenonotidae Rad vende bulbul Pycnonotia C R R Phenonotidae Rad vende bulbul Pycnonotia R R Phenonotidae Rad vende bulbul Pycnonotia R R Phenonotidae R R R R R R R R R R R R R R R R R R R	Charadriiformes	Recurvirostridae	Black winged stilt	Himantopus himantopus	VC	R	Γ C	Ι	IV, KH, MV
Columbidae Eurasian collard dove Signandopelia senegalensis VC R R Rock pigeon Columba livia VC R R Rock pigeon Green bee-eater Action to Coracias benghalensis VC R R Coracidae Minite-throated kingfisher Halcyon smyrnensis VC R R Coracidae Indian roller Coracias benghalensis C R R Coracidae Asian koel Eudynamys sociopaceus C R R Coracidae Greey francolin Francolinus pondicerinus C R R Francolinus pondicerinus C R R Prancolinus pondicerinus C R R Prancolinus pondicerinus C R R Dictural Moracillidae Daddy field bipit Anthus ruffulus VC R R Minite-browed wagtail Moracilla alba C R R Moracillidae Brown rock chat Oenambe fisca C R R Moracillidae Brown rock chat Oenambe fisca C R R Moracillidae Brown rock chat Oenambe fisca C R R Filow wagtail Moracilla flow C R R Filow septiat Saxicolo capratus VC R R Timaliniae Iungle babbler Turdoides striatus VC R R Timaliniae Durple sunbird C Turdoides striatus VC R R Timaliniae Lungle babbler Turdoides striatus VC R R Turdoide Rovn mana Actiothers tristis VC R R Action House sparrow Corvidae Common myna Actiothers tristis VC R R Action House crow Corvidae Columns capra C C R R Action Brown Columns C		Charadriidae	Red-wattled lapwing	Vanellus indicus	VC	R	Γ C	Ι	IV, KH, MV
Little brown dove Sigmatopelia senegalensis VC R Rock pigeon Columba livia VC R R Meropidae Green bee-eater Merops orientalis VC R R Great bee-eater Coracias benghalensis C C R R Great bee-eater Coracias benghalensis C C R R Great coucal Great coucal Centropus sinensis C R R Indian roller Coracias benghalensis C R R Great coucal Centropus sinensis C R R Great coucal Coracias benghalensis C R R Great Common tailorbid Corristatus C R R Districtulae Black drongo Dicturus macrocercus VC R R Dicturulae Black drongo Dicturus macrocercus VC R R White wagtail Motacilla flow C R R White wagtail Motacilla flow C R R Yellow wagtail Motacilla flow C R R Millian robin Soxicoloides fulicata VC R R Pied bushchat Soxicoloides fulicata VC R R Pied bushchat Soxicoloides fulicata VC R R Pied bushchat Common myna Acridoiners singiniams VC R R Asian pied starling Sturmus contra Asian pied starling Sturmus contra Asian pied starling Predoute singinis papillosa C C R R Ardeidae Common myna Acridoineres singiniamus VC R R Asian pied starling Psitatacidae Red vented bulbul Pycomonius cafer VC R R Ardeidae Cathe Cathe Bushchat Acridoineres singiniamus VC R R Ardeidae Cathe Cathe Bushchat Bushchat Common Sturmus contra Red vented bulbul Pycomonius cafer VC R R Ardeidae Cathe Cathe Bushchat Bushchat Bushchat Common Sturmus Cortica Common myna Acridoineres singiniamus VC R R Ardeidae Cathe getet Bushchat Common Starian Sturmus Cortica Cathe getet Red vented bulbul Bushchat Bushchat Cortica Cortica Cathe getet Red vented bushchat Bushcha	Columbiformes	Columbidae	Eurasian collard dove	Streptopelia decaocto	VC	R	Γ C	Ů	>
Alcedinidae White-throaded kingfisher Halcyon swipmensis VC R Halcyon swipmensis VC R R Green bee-eater Aderopso orientaries VC R R Green bee-eater Aderopso orientaries VC R R Indian roller Coracias benghalensis C R R Greater coural Centropius sinensis C R R Indian peafowl Crew francolinn Francolinns sondicerinus C R R Dicrutidae Common tailorbird Pavo cristatus C R R Dicrutidae Paddy field pipit Anthus rightlus VC R R White-browed wagtail Motacillidae Paddy field pipit Anthus rightlus VC R R White-browed wagtail Motacilla maderaspatensis C R R White-browed wagtail Motacilla maderaspatensis C R R Yellow wagtail Motacilla maderaspatensis C R R Pied bushchat Saxicolo caprata C R R Passeridae House sparrow Common was a Common was a Saxicolo caprata C R R Passeridae House sparrow Passeridae House sparrow C C R R Passeridae House sparrow C C R R Passeridae House sparrow Passeridae VC R R Passeridae House sparrow C Convinders strigins VC R R Threskiomithidae Glossy ibis Peaulinis papillosa C R R Pistracidae Red vented bulbul Promontus capra C R R Pistracidae Red vented bulbul Promontus capra C R R Pistracidae Red vented bulbul Advanceria VC R R Pistracidae Red vented bulbul Advanceria VC R R Printendia Rose-ringed parakeet R Pistracidae Rose ringed graphic Advanceria VC R R Strictidae Rose-ringed parakeet Psitneral Advanceria VC R R Strictidae Rose-ringed parakeet Psitneral brana Antheria Psitneria brana Athena Brana			Little brown dove	Stigmatopelia senegalensis	VC	R	Γ C	C	IV, KH, MV
Alcedinidae White-throated kingfisher Merops orientalis VC R Merops orientalis VC R R Coracitade Green bee-eater Coracitade Brain roller Coracitade R Saian keel Eudyanamys scolopaceus C R R Greater coucal Centropus sinensis C R R Indian peafowl Francolinus pondicerinus C R R Dicruridae Black drongo Dicruridae Paddy field pipit Anthus rugfulus VC R R White-browed wagtail Motacilla flowar C R R White-browed wagtail Motacilla flowar C R R White-browed wagtail Motacilla flowar C R R Muscicapidae Bank white sugali Motacilla flowar C R R Pied bushchat Soxicoloides fullcata VC R R Passeridae Common myma Acridotheres tristis VC R R Asian pied starling Summs contra Corvidae House sparrow Corvidae Red vented bulbul Pycnonous cafer VC R R Ardeidae Red vented bulbul Pycnonous cafer VC R R Pietadidae Classy bis Peaulibis of Pietadia graptil Andeola graptil C R R Pietadidae Red maped bis Bushchat Summidae C C R R Pietadidae Red maped bis Phetadicus shis of C R R Pietadidae Red maped bis Phetadia graptil C C R R Pietadidae Red maped bis Phetadia graptil C C R R Pietadidae Roseringed parakeet Pietadia graptil C C R R Pietadidae Roseringed parakeet Pietadia pond heron Andeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pondeola graptil C C R R Pietadidae Roseringed parakeet Pietadia Pietadia R P			Rock pigeon	Columba livia	VC	R	Γ C	Ü	IV, KH, MV
Meropidae Green bee-eater Merops orientalis VC R Coraciidae Indian roller Coracias benghulensis C R Cuculidae Asian koel Eudynamys scolopaceus C R Greater coucal Centropus sinensis C R Phasianidae Grey francolin Francolinus pondicerinus C R Indian peatown Cortocomus suorius C R Dicturidae Black drongo Dorthotomus suorius VC R Motacillidae Paddy field pipit Motacilla alba C R White wagtail Motacilla alba C R White wagtail Motacilla alba C R White wagtail Motacilla maderaspatensis C R Muscicapidae Brown rock chat Oenanthe fusca C R Muscicapidae Purple sunbird Cimpris caprata C R Timalinae Jungle babbler Thradiotides straitus VC R Passeridae House sparrow Passer domesticus VC R Stumidae Corvidae Red vented bulbul Acridotheres tristis VC R Asian pied starling Stumus contra VC R Ardeidae Red vented bulbul Pycnonotus cafer VC R Intestiomithidae Red neaded bis Petegadis falcinellus VC R Ardeidae Canthe Growns splendens C R Bubulcus ibis Petegadis fulcinellus VC R Ardeidae Cattle egret Bubulcus ibis Nore Corvis Splendens C C C R Ardeidae C Cattle egret Red naped bis Splendens C C R Ardeidae Cattle egret Red naped bis Splendens C C R Bubulcus ibis Peteble frameric C R Articolae Promotic C C R Articolae Red vented bulbul Primacolae Red vented bulbul Primacolae Red vented bulbul Primacolae Red vented bulbul Primacolae R Bubulcus ibis Peteble R Ardeidae C C R Articolae R Bubulcus ibis Peteble R Ardeidae C C R Articolae R Ardeidae C C R Articolae R Ardeidae C C R Articolae R Articolae R Ardeidae C C R Articolae R Ardeidae C C R Articolae R Articolae R Ardeidae C C R Articolae R Ardeidae	Coraciiformes	Alcedinidae	White-throated kingfisher	Halcyon smyrnensis	VC	R	Γ C	П	IV, KH, MV
Coracidae Indian roller Coracias benghalensis C R Asian koel Eudynamys scolopaceus C R R Indian koel Centropus sinensis C R R Francolinus pondicerinus C R R Indian peafowl Peror cristatus C R R Dicturuidae Black drongo Orthotomus sutorius VC R R Dicturuidae Black drongo Orthotomus sutorius VC R R Motacillidae Paddy field pipti Anthus rifutus VC R M White-browed wagtail Motacilla alba C C R R White-browed wagtail Motacilla alba C R R Muscicapidae Brown rock chat Orthotomus c C R R Muscicapidae Brown rock chat Orthotomus C R R Pied bushchat Soxicoloides fulicata VC R P Passeridae House sparrow Passeridae Common myna Saxicoloides fulicata VC R R Stumidae Common myna Acridotheres tristis VC R R Asian pied starling Stumus contra Orthotomus cafer VC R P Pycnonotidae Red vented bulbul Pycnonous cafer VC R R Pycnonotidae Red vented bulbul Pycnonous cafer VC R R Pycnonotidae Red vented bulbul Pycnonous cafer VC R R Pycnonotidae Cattle egret Bushchars Bubulcus bis Bubulcus by C R R Pistateidae Cattle egret Bushchars Pasteria Bubulcus by C R R Pistateidae Cattle egret Bushchars Pycnonous cafer C R R Pistateidae Cattle egret Bushchars Pycnonous cafer C R R Pistateidae Rose-ringed parakeet Psitacula framania VC R R Pistateidae Rose-ringed parakeet Psitacula framania VC R R Psitateidae Rose-ringed parakeet Psitacula framania VC R R Psitateidae Rose-ringed parakeet Athen brana Athen Pycnon R Psitacula framania VC R R Psitateidae Rose-ringed parakeet Psitacula framania VC R R Psitacula Proper Pycnon R Psitacula framania VC R R Psitacula Psitacula framania VC R R R Psitacula R Psitacula framania VC R R R R Psitacula R Psitacula framania VC R R R R R R R R R R R R R R R R R R		Meropidae	Green bee-eater	Merops orientalis	VC	R	Γ C	Ι	IV, KH, MV
Cuculidae Asian koel Eudynamys scolopaceus C R Greater coucal Centropus sinensis C R R Indian peatow		Coraciidae	Indian roller	Coracias benghalensis	C	R	Γ C	Ι	IV, KH, MV
Phasianidae Greater coucal Centropus sinensis C Grey Grey Trancolinn Prancolinus pondicerinus C R R Cisticolidae Common tailorbird Pavo cristatus C R B Dicruridae Black drongo Dicrurius macrocercus VC R Motacillidae Paddy field pipit Anthus rufilus VC R M Motacillidae Paddy field pipit Anthus rufilus C R M Motacillidae Brown rock chat Motacilla alba C R R Pielow wagtail Motacilla diba C R R M Indian robin Saxicola caprata C R R Pied bushchat Saxicola caprata C R R Passeridae House sparrow Passer domesticus VC R R Surmidae Common myna Acridotheres ginginiams VC R Bank myna Acridotheres ginginiams VC R R Asian pied starling Surmins capter Corrus splendens R Red vented bulbul Pronontus caper VC R R Ardeidae Giossy bis Pregadis falcinellus C R R Red caped ibis Pegadis falcinellus C R R Red raped ibis Pregadis falcinellus VC R R Printe egret Bank myna Cartie capra C C R R Printe egret Bank myna C C R R Printe egret Bank myna C C R R Red raped ibis Pregadis falcinellus VC R R Printe egret Bank myna C C R R Printende R Rose-ringed parakeet Psitacula farameri VC R R Printende R Rose-ringed parakeet Athene branna VC R R Armen Psintacidae Rose-ringed paramet Athene branna	Cuculiformes	Cuculidae	Asian koel	Eudynamys scolopaceus	C	R	Γ C	0	IV, KH, MV
Phasianidae Grey francolin Francolinus pondicerinus C R Indian peafowl Pavo cristatus C Cormon tailorbird Orthotomus sutorius VC R Dicruridae Black drongo Dicrurus Motacillidae Paddy field pipit Anthus rafulus VC R M White-browed wagtail Motacilla alba C R R M White-browed wagtail Motacilla alba C R R M Muscicapidae Brown rock chat Ocmanthe fusca C R R Pied bushchat Saxicola caprata C R R Pied bushchat Saxicola caprata C R R Pied bushchat Saxicola caprata C R R Passeridae House sparrow Passeridaes striatus VC R Passeridae House sparrow Passer domesticus C R R Asian pied starling Sturnia contra Asian pied starling Sturnus contra R Asian pied starling Pycnonotidae Red vented bulbul Pycnonotus cafer VC R R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R R R Red vented bulbul Pycnonotus cafer C R R Red vented bulbul Bubulcus ibis VC R R Red vented bulbul Bubulcus ibis VC R R Psittacidae C Cattle egret Bubulcus ibis VC R R Psittacidae Rose-inged parakeet Buttacida Striatia Psittacidae Rose-inged parakeet Athene Brama VC R R Strigtidae Rose-inged parakeet Athene Brama VC R R Strigtidae Rose-inged parakeet Athene Brama VC R R Strigtidae Spotted owlet Athene Brama VC R R Strigtidae Spotted owlet Athene Brama VC R R Strigtidae Spotted owlet Athene Brama Mana VC R R Strigtidae Spotted owlet Athene Parameri			Greater coucal	Centropus sinensis	C	RM	Γ C	C	IV, KH, MV
Cisticolidae Common tailorbird Orthotomus suttorius C R Black drongo Dicrurus macrocercus VC R R Dicruridae Black drongo Dicrurus macrocercus VC R Motacillidae Paddy field pipit Anthus rufulus VC R M White wagtail Motacilla alba C R M White-browed wagtail Motacilla maderaspatensis C R M Yellow wagtail Motacilla flava C R R Muscicapidae Brown rock chat Oenanthe fusca C R R Indian robin Saxicoloides fulicata VC R Pied bushchat Saxicola caprata C R R Pied bushchat Saxicola caprata C R R Passeridae House sparrow Acridotheres tristis VC R Passeridae House sparrow Acridotheres tristis VC R Asian pied starling Summus contra VC R R Bank myna Acridotheres ginginianus VC R R Asian pied starling Survaye adjacinellus C C R R Ardeidae Glossy ibis Pewaldibis papillosa VC R R Indian pond heron Ardeola gravii VC R R Little egret Bublucus ibis Pastet tagarzetta C R Rostiacidae Rose-ringed parakeet Pattered armaeri Arthene bronna VC R Stiriaidae Shotted owlet Arthene bronna VC R Stiriaidae Shotted owlet Arthene bronna VC R Stiriaidae Shotted owlet	Galliformes	Phasianidae	Grey francolin	Francolinus pondicerinus	C	R	Γ C	0	IV, KH
Cisticolidae Common tailorbirid Orthotomus sutorius VC R Dicruridae Black drongo Dicrurus macrocercus VC R Motacillia Motacilla alba C C RM White-browed wagtail Motacilla flava C C RM Indian robin Saxicolides fulficata VC R Pied bushchat Saxicoloides fulficata VC R Timalinae Durple sunbird Cimyris asiaticus VC R Passeridae House sparrow Passer domesticus VC R Sturnidae Common myna Acridotheres tristis VC R Asian pied starling Sturnus contra VC R Bank myna Acridotheres tristis VC R Asian pied starling Sturnus contra Corvus splendens Pycnonotidae Red vented bulbul Pycnonotus cger VC R Threskiomithidae Glossy ibis Pseudibis papillosa C R Indian pond heron Ardeola grayii VC R Indian pond heron Ardeola grayii VC R Baittacidae Rose-ringed parakeet Psitugarzetta C R Sturiadae Shotted owlet Ahtene brana			Indian peafowl	Pavo cristatus	C	R	Γ C	0	IV, KH, MV
Dicruridae Black drongo Dicrurus macrocercus VC R Motacillidae Paddy field piptt Anthus rufulus VC R White wagtail Motacilla alba C RM White-browed wagtail Motacilla maderaspatensis C RM Wuscicapidae Brown rock chat Oenanthe fusca C RM Indian robin Saxicoloides fulicata VC R Pied bushchat Saxicoloides fulicata VC R Passeridae Purple sunbird Cinnyris asiaticus VC R Timalinae House sparrow Passeridae VC R Sturnidae Common myna Acridotheres tristis VC R Sturnidae Glossy ibis Pycnonous cafer VC R Bank myna Acridotheres ginginiamus VC R Bank myna Acridotheres ginginiamus VC R Bank myna Acridotheres ginginiamus VC R R Asian pied starling Sturnus contra VC R Bank myna Acridotheres ginginiamus VC R Bank myna Acridotheres ginginiamus VC R Bank myna Acridotheres ginginiamus VC R Bycnonotidae Red vented bulbull Pycnonous cafer VC R Threskiomithidae Glossy ibis Pseudibis papillosa C R Ititle egret Cattle egret Barbucus ibis VC R Indian pond heron Ardeola gravii C R Stiteidae Rose-ringed parakeet Psittacidae Sootted owlet Athene branne	Passeriformes	Cisticolidae	Common tailorbird	Orthotomus sutorius	VC	R	Γ C	Ι	IV, KH, MV
Motacillidae Paddy field pipit Anthus rufulus VC R White wagtail Motacilla alba C RM White-browed wagtail Motacilla maderaspatensis C R Yellow wagtail Motacilla flava C RM Muscicapidae Brown rock chat Oenanthe fusca C RM Indian robin Saxicololae fullcata VC R Pied bushchat Saxicolae fullcata VC R Nectariniidae Purple sunbird Cimpris asiaticus VC R Nectariniidae Purple sunbird Cimpris asiaticus VC R Passeridae House sparrow Passer domesticus VC R Sturnidae Common myna Acridotheres tristis VC R Sturnidae Red vented bulbul Pycnonotus cafer VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Pregadis falcinellus VC R		Dicruridae	Black drongo	Dicrurus macrocercus	VC	R	Γ C	Ι	KH, MV
White wagtail Motacilla alba C RM White-browed wagtail Motacilla maderaspatensis C RM Yellow wagtail Motacilla flava C RM Indian rok chat Oenanthe fusca C RM Indian robin Saxicoloides fulicata VC R Pied bushehat Saxicoloides fulicata VC R Timallinae Jungle babbler Cinnyris asiaticus VC R Passeridae House sparrow Passer domesticus VC R Sturmidae Common myna Acridotheres tristis VC R Bank myna Acridotheres ginginianus VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Gilossy ibis Pregadis falcinellus LC RM Indian pond heron Ardeola grayii VC R Ititle egret Bulanch Bulbulcus ibis Pseudibis papillosa C R Ititle egret Bulanch Bulanch C R Red naped ibis Red ragarzetta C R R Psittacidae Rose-ringed parakeet Psittacula rameri VC R Strieidae Spotted owlet Athene brama		Motacillidae	Paddy field pipit	Anthus rufulus	VC	R	Γ C	Ι	IV, KH, MV
White-browed wagtail Motacilla maderaspatensis C RM Yellow wagtail Motacilla flava C RM Indian robin Saxicola caprata C RM Pied bushchat Saxicola caprata C RR Pied bushchat Saxicola caprata C R Timalinae Jungle babbler Turdoides striatus VC R Passeridae House sparrow Passer domesticus VC R Sturmidae Common myna Acridotheres tristis VC R Bank myna Acridotheres ginginianus VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiornithidae Glossy ibis Plegadis falcinellus C R Red naped ibis Pseudibis papillosa C R Red naped ibis Bubulcus ibis VC R R Pstracidae Rose-ringed parakeet Psittacidae Rose-ringed parakeet Psittacidae Shotted owlet Athene brama			White wagtail	Motacilla alba	C	RM	Γ C	Ι	IV, KH, MV
Yellow wagtail Motacilla flava C RM Muscicapidae Brown rock chat Oenanthe fusca C RM Indian robin Saxicoloides fulicata VC R Pied bushchat Saxicola caprata C R Nectariniidae Purple sunbird Cinnyris asiaticus VC R Timaliinae Jungle babbler Turdoides striatus VC R Passeridae House sparrow Passeridae VC R Sturnidae Common myna Acridotheres tristis VC R Sturnidae Common myna Acridotheres ginginiamus VC R Sturnidae Red vented bulbul Pycnonotus cafer VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiornithidae Glossy ibis Plegadis falcinellus VC R Arteidae Cattle egret Bubulcus ibis VC R Initile egret Egret tagarzetta C R			White-browed wagtail	Motacilla maderaspatensis	C	R	Γ C	Ι	IV, KH, MV
Muscicapidae Brown rock chat Oenanthe fusca C RM Indian robin Saxicoloides fulicata VC R Pied bushchat Saxicola caprata C R Imaliinae Purple sunbird Cimyris asiaticus VC R Passeridae House sparrow Passer domesticus C R Sturnidae Common myna Acridotheres tristis VC R Sturnidae Asian pied starling Sturnus contra VC R Bank myna Acridotheres ginginianus VC R Corvidae House crow Corvus splendens VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Preudibis papillosa VC R Ardeidae Cattle egret Bubulcus ibis VC R Ardeidae Little egret Psittacula krameri VC R Britacidae Rose-ringed parakeet Psittacula krameri VC R			Yellow wagtail	Motacilla flava	C	RM	Γ C	Ι	IV, KH
Indian robin Saxicoloides fulicata VC R Pied bushchat Saxicola caprata C R Nectariniidae Purple sunbird Cinnyris asiaticus VC R Timaliinae Jungle babbler Turdoides striatus VC R Passeridae House sparrow Passer domesticus C R Sturnidae Common myna Acridotheres tristis VC R Sturnidae Asian pied starling Sturnus contra VC R Bank myna Acridotheres ginginianus VC R Corvidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Preudibis papillosa VC R Ardeidae Cattle egret Bubulcus ibis VC R Ardeidae Cattle egret Bubulcus ibis VC R Psittacidae Rose-ringed parakeet Psittacula krameri VC R Striigidae Spotted owlet Athene brame VC R		Muscicapidae	Brown rock chat	Oenanthe fusca	C	RM	Γ C	Ι	N
Pied bushchat Saxicola caprata C R Nectariniidae Purple sunbird Cinnyvis asiaticus VC R Timaliinae Jungle babbler Turdoides striatus VC R Passeridae House sparrow Passer domesticus C R Sturnidae Common myna Acridotheres tristis VC R Sturnidae Asian pied starling Sturnus contra VC R Bank myna Acridotheres ginginianus VC R Corvidae House crow Corvus splendens VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Plegadis falcinellus VC R Ardeidae Cattle egret Bubulcus ibis VC R Ardeidae Cattle egret Bubulcus ibis VC R Indian pond heron Ardeola grayii VC R Psittacidae Rose-ringed parakeet Psittacula krameri VC R Sturisidae Spotted owlet Athene brama VC			Indian robin	Saxicoloides fulicata	VC	R	Γ C	Ι	IV, KH, MV
Nectariniidae Purple sunbird Cinnyris asiaticus VC R Timaliinae Jungle babbler Turdoides striatus VC R Passeridae House sparrow Passer domesticus C Sturmidae Common myna Acridotheres tristis VC R Bank myna Acridotheres ginginianus VC R Bycnonotidae Red vented bulbul Pycnonotus cafer VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Plegadis falcinellus C R Radeidae Cattle egret Bubulcus ibis VC RM Indian pond heron Ardeola grayii VC R Egret tagarzetta C R Stristidae Sbotted owlet Athene brama			Pied bushchat	Saxicola caprata	C	R	Γ C	Ι	IV, KH, MV
Timalinae Jungle babbler Turdoides striatus VC R Passeridae House sparrow Passer domesticus C R Sturnidae Common myna Acridotheres tristis VC R Asian pied starling Sturnus contra VC R Bank myna Acridotheres ginginianus VC R Corvidae House crow Corvus splendens VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Plegadis falcinellus LC RM Ardeidae Cattle egret Bubulcus ibis VC R Ardeidae Cattle egret Bubulcus ibis VC R Indian pond heron Ardeola grayii VC R Little egret Egret tagarzetta C R Spitiacidae Spotted owlet Athene brama VC R		Nectariniidae	Purple sunbird	Cinnyris asiaticus	VC	R	Γ C	Z	IV, KH, MV
Passeridae House sparrow Passer domesticus C R Sturnidae Common myna Acridotheres tristis VC R Asian pied starling Sturnus contra VC R Bank myna Acridotheres ginginianus VC R Corvidae House crow Corvus splendens VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Plegadis falcinellus LC RM Ardeidae Cattle egret Bubulcus ibis VC R Ardeidae Cattle egret Bubulcus ibis VC R Indian pond heron Ardeola grayii VC R Little egret Egret tagarzetta C R Psittacidae Rose-ringed parakeet Psittacula krameri VC R Strisidae Sbotted owlet Athene brama VC R		Timaliinae	Jungle babbler	Turdoides striatus	VC	R	Γ C	П	IV, KH, MV
Sturmidae Common myna Acridotheres tristis VC R Asian pied starling Sturnus contra Bank myna Acridotheres ginginiamus VC R Bank myna Acridotheres ginginiamus VC R House crow Corvus splendens VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Plegadis falcinellus C R Red naped ibis Preudibis papillosa C R Indian pond heron Ardeola grayii VC RM Little egret Egret tagarzetta C R Psittacidae Rose-ringed parakeet Psittacula krameri VC R Strisidae Sbotted owlet Athene brama		Passeridae	House sparrow	Passer domesticus	C	×	Γ C	0	IV, KH, MV
Asian pied starling Sturnus contra VC R Bank myna Acridotheres ginginianus VC R Corvidae House crow Corvus splendens VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Plegadis falcinellus LC RM Red naped ibis Preudibis papillosa C R Ardeidae Cattle egret Bubulcus ibis VC RM Indian pond heron Ardeola grayii VC R Little egret Egret tagarzetta C R Psittacidae Rose-ringed parakeet Psittacula krameri VC R Strisidae Spotted owlet Athene brama		Sturnidae	Common myna	Acridotheres tristis	ΛC	×	Γ C	0	IV, KH, MV
Bank myna Acridotheres ginginianus VC R Corvidae House crow Corvus splendens VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Plegadis falcinellus LC RM Red naped ibis Pseudibis papillosa C R Ardeidae Cattle egret Bubulcus ibis VC R Indian pond heron Ardeola grayii VC R Little egret Egret tagarzetta C R Psittacidae Rose-ringed parakeet Psittacula krameri VC R Strigidae Sbotted owlet Athene brama VC R			Asian pied starling	Sturnus contra	ΛC	~	Γ C	0	IV, KH, MV
Corvidae House crow Corvus splendens VC R Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiornithidae Glossy ibis Plegadis falcinellus LC RM I Red naped ibis Pseudibis papillosa C R I Ardeidae Cattle egret Bubulcus ibis VC RM I Indian pond heron Ardeola grayii VC R I Little egret Egret tagarzetta C R I Psittacidae Rose-ringed parakeet Psittacula krameri VC R I Strigidae Sbotted owlet Athene brama VC R I			Bank myna	Acridotheres ginginianus	VC	R	Γ C	0	IV, KH, MV
Pycnonotidae Red vented bulbul Pycnonotus cafer VC R Threskiomithidae Glossy ibis Plegadis falcinellus LC RM I Red naped ibis Pseudibis papillosa C R R I Indian pond heron Ardeola grayii VC RM I Little egret Egret tagarzetta C R R I Spittacidae Rose-ringed parakeet Psittacula krameri VC R I Strisidae Sbotted owlet Athene brama VC R I I	Passerine	Corvidae	House crow	Corvus splendens	VC	R	Γ C	0	IV, KH, MV
Threskiomithidae Glossy ibis Plegadis falcinellus LC RM I Red naped ibis Pseudibis papillosa C R I Indian pond heron Ardeola grayii VC RM I Little egret Egret tagarzetta C R I Spittacidae Rose-ringed parakeet Psittacula krameri VC R I Strisidae Spotted owlet Athene brama		Pycnonotidae	Red vented bulbul	Pycnonotus cafer	ΛC	R	Γ C	Ι	IV, KH, MV
Ardeidae Cattle egret Bubulcus ibis VC RM Indian pond heron Ardeola grayii VC RM Little egret Egret tagarzetta C R R I Egret tagarzetta C R R I Stritacidae Sootted owlet Athene brama VC R I I	Pelecaniformes	Threskiornithidae	Glossy ibis	Plegadis falcinellus	Γ C	RM	Γ C	C	IV, KH, MV
Ardeidae Cattle egret Bubulcus ibis VC RM I Indian pond heron Ardeola grayii VC R I Little egret Egret tagarzetta C R I Systiacidae Rose-ringed parakeet Psittacula krameri VC R Strigidae Spotted owlet Athene brama VC R			Red naped ibis	Pseudibis papillosa	C	×	Γ C	C	IV, KH, MV
Indian pond heron Ardeola grayii VC R I Little egret Egret tagarzetta C R I ss Psittacidae Rose-ringed parakeet Psittacula krameri VC R Strigidae Spotted owlet Athene brama VC R		Ardeidae	Cattle egret	Bubulcus ibis	ΛC	RM	Γ C	C	IV, KH, MV
Little egret Egret tagarzetta C R I ss Psittacidae Rose-ringed parakeet Psittacula krameri VC R Strigidae Spotted owlet Athene brama VC R			Indian pond heron	Ardeola grayii	ΛC	R	Γ C	C	IV, KH
ss Psittacidae Rose-ringed parakeet <i>Psittacula krameri</i> VC R Strigidae Spotted owlet Athene brama VC R			Little egret	Egret tagarzetta	C	×	Γ C	C	N
Strigidae Spotted owlet	Psittaciformes	Psittacidae	Rose-ringed parakeet	Psittacula krameri	ΛC	R	Γ C	Ü	IV, KH, MV
in a manufacture and a manufac	Strigiformes	Strigidae	Spotted owlet	Athene brama	VC	R	Γ C	Ι	IV

M - Resident migrant; IUCN Status: LC - Least Concerned; Feeding guild: O - Omnivorous, I - Insectivorous, G - Granivorous, I/G - Insectivorous, I/C - Insectivorous, I/C - Insectivorous, I/C - Insectivorous, I/C - Frugivorous, I/C - Frugivorous, I/C - Frugivorous, I/C - Frugivorous, I/C - Insectivorous, I/C - Insectivorous

Table 2. Stage-wise relative abundance of bird species utilizing T-perches in maize crop

	Bird species (common name)	Initial vegetative	Knee-height	Mature vegetative	Feeding guild
1	Bank myna	4.17	1.14	3.30	0
2	Black drongo	14.60	20.45	9.89	I
3	Brown rock chat	-	1.70	2.20	I
4	Common hoopoe	1.39	-	6.59	I
5	Common myna	8.35	23.30	13.19	O
6	Common tailorbird	6.26	-	13.19	I
7	Eurasian collared dove	-	1.70	-	G
8	Green bee-eater	9.74	9.66	3.30	I
9	House crow	18.08	20.45	17.58	O
10	Indian robin	0.316	-	-	I
11	Indian roller	1.39	0.57	1.10	I
12	Jungle babbler	13.21	11.93	7.69	I
13	Paddy field pipit	4.87	0.00	5.49	I
14	Pied bushchat	-	0.57	2.20	I
15	Red-vented bulbul	11.82	3.98	9.89	I
16	White-browed wagtail	0.41475	-	-	I
17	White-throated kingfisher	4.87	4.55	4.40	I
18	Yellow wagtail	0.523375	-		I
	Species richness	15	12	14	
	Species diversity	2.7	2.48	2.64	
	Species evenness	0.86	0.79	0.91	

Species Richness along with feeding guilds observed

Treatment plot	T-	perches p	lot	Control plot			
Crop stages	Initial vegetative			Initial egetative	Knee- height	Mature vegetative	
Feeding guilds Species richness							
Carnivorous	7	6	6	5	7	5	
Granivorous	3	4	4	4	3	3	
Insectivorous	18	13	13	9	10	10	
Nectarivorous	1	1	1	1	1	1	
Omnivorous	6	7	7	6	6	7	
Total No. of species	35	31	31	25	27	26	

followed by common myna (13.08%) and bank myna (7.25%). At the knee-height stage, the most abundant bird species was house crow (15.11%) followed by common myna (13.61%) and purple sunbird (7.46%). The most abundant bird species at the mature vegetative

stage of the control plot was common hoopoe (13.34%) followed by purple sunbird (9.2%) and grey francolin (9.08%) (Table 4). Bird species were significantly different in both T-perches installed and control plots. Initial vegetative stages of the before-mentioned plots

Table 3. Feeding guilds with avian diversity at different crop stages of maize

Treatment plot	T-	lot	Control plot					
Crop stages	Initial vegetative	Knee- height	Mature vegetative	Initial vegetative	Knee- height	Mature vegetative		
Feeding guilds	ndance (%)							
Carnivorous	16.08	10.42	8.21	10.33	17.7	12.05		
Granivorous	1.37	13.75	5.38	16.04	14.16	4.35		
Insectivorous	52.62	44.57	44.18	26.76	20.56	39.75		
Nectarivorous	0.12	1.41	0.38	0.73	7.46	9.2		
Omnivorous	29.95	29.84	41.85	46.19	41.71	34.64		

Table 4. Stage wise avian diversity and composition in maize

		T-perches plot			Control plot			
	Cro	Initial vegetative	Knee- height	Mature vegetative	Initial vegetative	Knee- height	Mature vegetative	
	Bird species (common name)	Bird species (scientific name)		<u> </u>	Relative abu			
1	Asian koel	Eudynamys scolopaceus	0.1	1.7	0.48	0.73	1.47	1.44
2	Asian pied starling	Sturnus contra	3.71	2.09	6.31	6.86	5.54	4.23
3	Bank myna	Acridotheres ginginianus	3.57	-	0.58	7.25	4.98	8.82
4	Black drongo	Dicrurusmacrocercus	13.06	9.31	9.88	4.99	3.27	1.84
5	Black kite	Milvus migrans	5.23	3.45	0.38	1.53	1.83	_
6	Black winged stilt	Himantopus himantopus	-	1.72	-	-	1.08	_
7	Black winged-kite	Elanus caeruleus	1.07	1.62	2.91	1.83	-	2.12
8	Brown rock chat	Oenanthe fusca	3.12	2.9	1.05	_	_	2.05
9	Cattle egret	Bubulcus ibis	4.21	2.01	0.58	3.7	7.1	4.2
10	Common hoopoe	Upupa epops	0.98	1.81	4.87	3.14	_	13.34
11	Common myna	Acridotheres tristis	8.36	10.79	15.25	13.08	13.61	2.36
12	Common tailorbird	Orthotomus sutorius	2.76	2.92	1.46	1.47	-	4.53
13	Eurasian collared dove	Streptopelia decaocto	0.63	3.91	1.63	6.06	6.82	2.94
14	Glossy ibis	Plegadis falcinellus	2.33	-	-	-	1.34	,
15	Greater coucal	Centropus sinensis	-	0.92	2.63	1.54	1.49	2.52
16	Green bee-eater	Merops orientalis	7.23	4.28	2.8	3.06	1.63	-
17	Grey francolin	Francolinus pondicerianus	-	1.73	0.3	-	1	9.08
18	House crow	Corvus splendens	14.1	10.24	16.88	14.95	15.11	7.94
19	House sparrow	Passer domesticus	-	2.42	2.05	3.32	-	-
20	Indian peafowl	Pavo cristatus	0.11	0.87	-	-	_	0.77
21	Indian pond heron	Ardeola grayii	0.42	-	_	_	1.52	-
22	Indian robin	Saxicoloides fulicata	0.32	_	_	_	-	_
23	Indian roller	Coracias benghalensis	3.63	1.22	0.96	_	0.5	7.5
24	Jungle babbler	Argya striata	5.66	5.19	3.87	2.64	5.32	2.54
25	Little brown dove	Spilopelia senegalensis	0.27	3.34	1.44	0.53	-	0.49
26	Little egret	Egretta garzetta	0.27	0.86	0.86	-	2.47	1.59
27	Paddy field pipit	Anthus rufulus	1.56	1.93	2.52	5.21	2.43	1.59
28	Pied bushchat	Saxicola caprata	2.64	1.58	2.23	0.78	2. 4 3	1.62
29	Purple sunbird	Cinnyris asiaticus	0.12	1.41	0.38	0.73	7.46	9.2
30	Red naped ibis	Pseudibis papillosa	1.85	1.56	0.85	1.73	1.95	1.62
31	Red-vented bulbul	Pycnonotus cafer	2.32	4.75	0.48	-	1.57	0.61
32	Red-wattled lapwing	Vanellus indicus	6.17	5.05	8.87	5.1	1.56	4.13
33	Rock pigeon	Columba livia	0.17	5.46	1.73	7.25	2.47	4.13
34	Rose-ringed parakeet	Psittacula krameri	-	1.04	0.58	2.2	4.87	0.92
35	Spotted owlet	Athene brama	1.11	0.6	0.38	0.37	4.07	0.92
36	White wagtail	Motacilla alha	0.8			-	2.81	
30 37	White-browed wagtail	Motacilla maderaspatensis	0.8	-	-	-	2.01	-
38	White-throated	Halcyon smyrnensis	0.42	1.31	5	-	0.39	-
39	kingfisher Yellow wagtail	Motacilla flava	0.53	-	-	_	-	_
<i></i>	Species richness	1.10 months juria	34	31	31	22	27	26
	Species diversity		3.52	3.43	3.43	3.09	3.29	3.25
	Species evenness		0.85	0.9	0.82	0.88	0.89	0.9

showed significantly different results through paired t-test. But knee-height stage and mature vegetative stage exhibited non-significant difference in both type of plots. Most of the bird species (23) were observed as very common (VC) followed by common (C) (15) and less common (LC) (1) according to their status in Punjab. Residential status of bird species has shown that most species were resident and least were resident migratory. IUCN status was found least concern of

all the observed bird species (Kler and Kumar, 2015) (Table 1).

Overall observations revealed that a greater number of bird species were found foraging in plots with T-perches and most of them were insectivorous indicating that the perches attracted foraging birds and these proved efficient in increasing avian diversity. Plots with T-perches were preferred by most of the insectivorous birds. Similar findings were found in soybean fields of Australia, where T-perches were installed to increase the useful area for birds and it resulted in the decline of pests (Lindell et al., 2018). For thousands of years, birds have been used in agriculture. They, along with other native predatory animals, are rarely able to eradicate a pest issue, but they could be a component of an IPM strategy. According to Nyffeler et al. (2018), 400-500 mt of insects are consumed annually by insectivorous birds, with 28 mt (or 7% of the total) being from agricultural regions. Ecological pest-control strategies, such as using insectivorous birds, are now being used by farmers who are professionals with IPM ideas (Seni and Halder, 2022). The present study suggests that the utilization of T-shaped perches is one of the ecofriendly or inexpensive technology for farmers.

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AUTHOR CONTRIBUTION STATEMENT

First Author Khushdeep Kaur has carried out field work as MSc student, second Dr Tejdeep Kaur Kler has conceptualized and supervised the study as major advisor and third author Dr Surinder Kaur Sandhu has facilitated in the execution of research problem.

CONFLICT OF INTEREST

No conflict of interest.

REFERENCES

- Ali S. 1996. The book of Indian birds. Oxford University Press, Delhi.
- Asokan S, Ali A M S. 2010. Foraging behaviour of selected birds in Cauvery Delta region of Nagapattinam District, Tamil Nadu, India. Journal of Threatened Taxa 2(2): 690-94.
- Anonymous 2021. Package of practices for kharif crops. Punjab Agricultural University, Ludhiana. pp. 24-35, 138.
- Blount, J D, Horns J J, Kittelberger K D, Neate-Clegg M H C, Sekercioglu C H. 2021. Avian use of agricultural areas as migration stopover sites: a review of crop management practices and ecological

- correlates. Frontiers in Ecology and Evolution 9, 650641 https://doi.org/10.3389/fevo.2021.650641
- Chand J. 2005. Evaluation of birds as predators of insect pests infesting cabbage and cauliflower. MSc Thesis, Punjab Agricultural University, Ludhiana.
- Horgan F G, Ramal A F, Villegas J M, Almazan M L P, Bernal C C, Jamoralin A, Pasang M, Orboc G, Agreda V, Arroyo C. 2016. Ecological engineering with high diversity vegetation patches enhances bird activity and ecosystem services in Philippines rice fields. Regional Environment Change, Berlin 17(5): 1355-1367.
- Jerath N, Chadha J. 2006. Biodiversity in Shivalik ecosystem of Punjab. Punjab State Council for Science and Technology, Chandigarh. 193 pp.
- Kaur G, Kler T. 2018. Feeding behaviour and perching preference of Black Drongo (*Dicrurus macrocercus*) in Ludhiana district (Punjab). Journal of Entomology and Zoology Studies 6(4): 232-39.
- Kaur H, Kumar M, Choudhary A. 2021. Artificial T- perches as attractant for insectivorous birds against *Helicoverpa armigera* (Hubner). Indian Journal of Entomology. https://doi.org/10.5958/0974-8172.2021.00183.8
- Kaur N, Sidhu H K. 2021. Avifaunal diversity in wheat crop: A case study of Bathinda district of Punjab. Indian Journal of Entomology. https://doi.org/10.55446/IJE.2021.98
- Kler T. 2005. 'T' Shape perches encourage insectivorous birds in cotton crop. Pestology 29(2): 28-31.
- Kler T K, Kumar M. 2015. Avian fauna in agricultural habitats of Punjab state. Agricultural Research Journal 52(3): 83-90.
- Krebs C J (ed). 1985. Ecology: The experimental analysis of distribution and abundance. pp. 513-42. Harper and Row, New York.
- Kumar R, Cheema H K. 2020. Restricting lepidopteran herbivory through trap cropping and bird perches in Egyptian clover (*Trifolium alexandrium* L.). Egyptian Journal of Biological Pest Control 30: 1-8
- Lindell C, Eaton R A, Howard P H, Roels S M and Shave M E (2018) Enhancing agricultural landscapes to increase crop pest reduction by vertebrates. Agriculture, Ecosystem and Environment. 257: 1-11.
- Newton I. 2003. The speciation and biogeography of birds. Academic Press, London, UK. 668 pp.
- Nyffeler M, Sekercioglu C H, Whelan C J. 2018. Insectivorous birds consume an estimated 400–500 million tons of prey annually. The Science of Nature 105: 47.
- Seni A, Halder J. 2022. Role of predatory birds in insect pest management in agriculture. Agriculture Letters 3(2). ISSN: 2582-6522.
- Shew J J, Nielsen C K, Sparling D W. 2019. Finer-scale habitat predicts nest survival in grassland birds more than management and landscape: a multi-scale perspective. Journal of Applied Ecology 56: 929-945.
- Sidhu S K, Kler T K. 2018. Avian composition and damage assessment in guava fruit crop at Punjab. Journal of Entomology and Zoology Studies 6(2): 2422-26.
- Sohil A, Sharma N. 2020. Assessing the bird guild patterns in heterogeneous land use types around Jammu, Jammu and Kashmir, India. Ecological Processes. 9: 49.
- Vogel H F, McCarron, Zocche J J. 2018. Use of artificial perches by birds in ecological restoration areas of the Cerrado and Atlantic Forest biomes in Brazil. Neotropical Biology and Conservation 13(1): 24-36.

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