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RESEARCH ARTICLE

AVIFAUNAL DIVERSITY IN DIFFERENT CROPLANDS OF NALGONDA DISTRICT, TELANGANA, SOUTHERN INDIA

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ABSTRACT

A field survey was conducted during the period December 2010 to March 2011 to obtain the checklist, density, diversity and richness of birds in six different agricultural habitats viz., Paddy, Cotton, Castor, Red gram, Fruit garden and Open grassland. The study was carried out from December 2010 to March 2011. A total of 104 species of birds belonging to 43 families and 16 orders were recorded in the study area, two bird species are Near Threatened in 'IUCN' (2010) category, Oriental Darter *Anhinga melanogaster* and White Ibis or Black-headed Ibis *Threskiornis melanocephalus*. Of six major foraging categories, insectivorous birds and perching activity accounted for high percentage in all the habitats. ANOVA shows that there were a significant differences between the bird density and among the areas and months (P<0.05). However, among the habitats the bird diversity did not differ significantly but, bird species richness showed significant variations among the areas, habitats and months (P<0.05). Chi-square analysis revealed that there was a significant differences between species richness and among the habitats ($\chi 2$=43.07, df=6, P<0.05).

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INTRODUCTION

Bird populations are at risk due to the loss of natural habitats. Birds constitute an important component in the agro-ecosystems, is gaining more and more attention (Dhindsa and Saini, 1994. The role of birds in agriculture is well known (Ali, 1949; 1971). Agricultural ecosystem provides a concentrated and highly predictable source of food to many birds (O'Connor and Shrubb, 1986). This food includes grains, seeds, Fruits, green vegetation of the crop plants and grasses, insects, other arthropods, rodents etc., found in the soil, crops and other plants (Dhindsa and Saini, 1994; Asokan *et al.,* 2009). Birds that feed on harmful insects and other pests from the agro-ecosystem are beneficial to agriculturists (Mathew, 1976; Dhindsa, 1986; Toor *et al.,* 1986; Dhindsa *et al.,* 1988; Dhindsa and Saini, 1994; Sivakumaran and Thiyagesan, 2003; Asokan *et al.,* 2009; Asokan *et al.,* 2010; Mehta *et al.,* 2010). These bird groups depend on different types of food in the agro-ecosystem and have evolved various social structure and behavioural responses (Field and Anderson, 2004; Nocera *et al.,* 2007). Several species of birds are reported to prey on insect pests of agricultural crops in India. In many developing countries like India, agro-ecosystems are not completely modernised. The use of pesticides to control insect pests is avoided in certain areas, especially for low of revenue crops like millet, maize, etc. (Parasharya *et al.,* 1994). In such situations, birds become important bio-control agents, suppressing the insect pests. Therefore important predators like insectivorous birds need to be encouraged in the agro-ecosystem by use of appropriate management practices. Since these birds have attracted for many reasons, studies in agricultural ornithology in India have been given low priority (Dhindsa and Sani, 1994) most of the attention is given to threatened species (Mukherjee *et al.,* 2002).

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MATERIALS AND METHODS

Study area

The present study was carried out in and around the agricultural ecosystem of Sherpally, Nalgonda District, Andhra Pradesh from December 2010 to March 2011 (Figure 1).

Various crops have been cultivated in these districts such as cotton, rice, maize, ragi (*Eleusine coracana*), commonly finger millet grams and variety of vegetables. Nalgonda is located at 15°03′N 78°16′E/15.05°N 78.27°E with an average elevation of 421 meters (1381 ft). The climate is generally hot and dry with temperatures rising up to 43-45°C during May and dropping to 8-12°C in December. Increased irrigation facilities gave a boost to agricultural activity in the district. Out of a total of 1,423,423 ha land utilization in the district, more than 50% is cultivable land. The terrain of the district is suitable for irrigation development. The main crops grown in the district are Paddy, Jowar, Bajra, Ground Nut, Red gram, Green gram, Castor and Sugar cane in an area about 150,000 acres.

Estimation of bird population

Preliminary survey was made on foot in order to understand the nature of study areas and topography. To estimate the bird population, we have applied point count method (Javed and Kaul, 2002). Four different types of crop varieties were selected viz. Paddy, Castor, Cotton and Red gram, in addition to Fruit garden (*Citrus limetta*) and Open grassland. One kilometer transect was laid and at every 200 m distance one point was taken and the bird species were recorded in the 20 m radius (Hostetler and Main, 2001) in a duration of 20 minutes. A total of 48 transects (240 points) were surveyed; bird species, number of individuals, starting and ending time, weather condition, crop type, phenology of the crop, *etc*. were also recorded. In order to calculate the density, the sighting distance, sighting degree and perpendicular distance was recorded.

Bird species were identified using binoculars (7×50) and standard field guides (Ali, 2002; Ali and Ripley, 1987; Grimmett *et al.,* 1999b). The bird surveys were carried after two hours of sunrise and before two hours of sunset.

Data analysis

The density was calculated using the following formula: D=N/2Lr where D= Density, N= Number of individuals, L= Length of the transect and r= Mean angular distance. Species diversity was calculated using Shannon-Weiner (1949) index: H'=−ΣPi(lnPi) where H'= Shannon-Weiner Index, Pi = the proportion of the each species in the sample (Pielou, 1966), The Evenness' Pielou's index was calculated using the following formula: J'= H'−1/S where H= Species diversity index and S= Number of species. Species richness was calculated using the number of species recorded in various habitat types. We have applied ANOVA and Chi square tests to understand the impact of bird density, diversity and richness with reference to the different crop types and habitats.

RESULTS

A total of 104 species of birds belonging to 43 families and 16 orders were recorded in six different types of habitats namely, Paddy, Castor, Cotton, Red gram, Fruit garden, Open grassland (Table 1). Two bird species are Near Threatened in 'IUCN' category namely Oriental Darter *Anhinga melanogaster* and White or Black-headed Ibis *Threskiornis melanocephalus*. The highest species number was found in the family Phasianidae with 9 species. There were 36 species common in all the five habitats (Table 1). In the present study 87 species were resident and 17 migratory.

Table 1. Inventory list of birds species recorded in the different crop types/ habitats for the entire study periods from December 2010 to March 2011. [a]LC = Least Concern, NT= Near Threatened, * = presence of birds species- = Absence of birds species [b] U = Beneficial birds species, H = Depredatory birds species. [b] Habitats = Paddy, Cotton, Castor, Red gram, Fruit garden, Open grassland

Common Name	Scientific Name	Family	IUCN[a]	Habitats[b]						Status
				PA	CO	CA	RG	FG	OG	
Little grebe	*Tachybaptus ruficollis*	Podicipodidae	LC	-	-	-	-	-	-	H
Little cormorant	*Phalacrocorax niger*	Phalacrocoracidae	LC	*	-	-	-	-	-	H
Darter	*Anhinga melanogaster*	Anhingidae	NT	*	-	-	-	-	-	U
River tern	*Sternaa aurantia*	Laridae	LC	*	-	-	-	-	-	U
Red-wattled lapwing	*Vanellus indicus*	Charadriidae	LC	*	-	-	-	-	-	U
Yellow- wattled lapwing	Vanellus malabaricus	Charadriidae	LC	*	-	-	-	-	-	U
Little-ringed plover	*Charadrius dubius*	Charadriidae	LC	-	-	-	-	-	-	U
Common shelduck	*Tadorna tadorna*	Anatidae	LC	-	-	-	-	-	-	U
Purple heron	*Ardea purpurea*	Ardeidae	LC	*	-	-	-	-	-	U
Indian pond heron	*Ardeola grayii*	Ardeidae	LC	*	-	-	-	*	-	U
Black- crowned night heron	*Nycticorax nycticorax*	Ardeidae	LC	-	-	-	-	-	-	U
Little egret	*Egretta garzetta*	Ardeidae	LC	*	-	-	-	*	-	U
Cattle egret	*Bulbucus ibis*	Ardeidae	LC	*	*	-	-	-	*	U
Median egret	*Mesophoyx intermedia*	Ardeidae	LC	*	-	-	-	-	-	U
Black ibis	*Pseudibis papillosa*	Threskiornithidae	LC	*	-	-	-	-	-	U/H
Oriental white ibis	*Threskiornis melanocephalus*	Threskiornithidae	NT	*	-	-	-	-	-	U/H
Common coot	*Fulica atra*	Rallidae	LC	-	-	-	-	-	-	H
White-breasted water hen	*Amauronis phoenicurus*	Rallidae	LC	*	-	-	-	-	*	U
Purple moorhen	*Porphyrio porphyrio*	Rallidae	LC	*	-	-	-	-	-	U
Common sandpiper	*Actitis hypoleucos*	Scolopacidae	LC	*	-	-	-	-	-	U
Wood sandpiper	*Tringa galreola*	Scolopacidae	LC	*	-	-	-	-	-	U
Shikra	*Accipiter badius*	Falconidae	LC	*	*	*	*	*	*	U
Black kite	*Milvus migrans*	Falconidae	LC	-	-	-	-	-	-	
Brahminy kite	*Haliastur Indus*	Falconidae	LC	*	*	*	*	*	*	U
Black shouldered kite	*Elanus caeruleus*	Falconidae	LC	*	*	*	*	*	*	U
Grey francolin	*Francolinus pondicerianus*	Phasianidea	LC	*	*	*	*	-	*	U
Common quail	*Coturnix coturnix*	Phasianidea	LC	*	*	*	*	-	*	U
Bush quail	*Perdicula asiatica*	Phasianidea	LC	*	*	*	*		*	U
Indian peafowl	*Pavo cristatus*	Phasianidea	LC	*	-	-	-	*	*	H

……..Continue

Eurasian collard dove	*Streptopelia decaocto*	Pteroclididae	LC	*	*	*	*	*	*	H
Spotted dove	*Streptopelia chinensis*	Pteroclididae	LC	*	*	*	*	*	*	H
Blue rock pigeon	*Columba livia*	Pteroclididae	LC	*	*	*	*	*	*	H
Oriental turtle dove	*Streptopelia orientalis*	Pteroclididae	LC	-	-	-	*	-	-	H
Red collared dove	*Streptopelia tranquuebarica*	Pteroclididae	LC	*	*	*	*	*	*	H
Black-bellied sandgrouse	*Pterocles orientalis*	Pteroclididae	LC	-	-	-	-	-	-	H
Rose-ringed parakeet	*Psittacula krameri*	Psittacidae	LC	*	*	*	*	*	*	H
Plum-headed parakeet	*Psittacula cyanocephala*	Psittacidae	LC	-	-	-	*	*	-	H
Greater coucal	*Centropus sinensis*	Cuculidae	LC	*	*	*	*	*	*	U
Brain fever bird	*Hierococcyx varius*	Cuculidae	LC	*	*	*	*	*	*	U
Blue-faced malkoha	*Phaenicophaeus viridirostris*	Cuculidae	LC	*	*	*	*	*	*	U
Asian koel	*Eudynamys scolopacea*	Cuculidae	LC	*	*	*	*	*	*	U
Pied crested cuckoo	*Clamator jacobinus*	Cuculidae	LC	*	-	-	-	*	*	U
Indian cuckoo	*Cuculus micropterus*	Cuculidae	LC	*	-	-	-		*	U
Spotted owlet	*Athene brama*	Strigidae	LC	*	*	*	*	-	-	U
House swift	*Apus affinis*	Apodidae	LC	*	-	-	-	-	-	U
Asian palm swift	*Cypsiurus unicolar*	Apodidae	LC	*	*	*	*	*	*	U
Indian roller	*Coracias benghalensis*	Coraciidae	LC	*	*	*	*	*	*	U
Indian grey horn bill	*Ocyceros birostris*	Bucerotidae	LC	*	-	-		*	-	H
Small green bee- eater	*Merops orientalis*	Meropidae	LC	*	*	*	*	*	*	U
Blue-tailed bee –eater	*Meropphilippinus*	Meropidae	LC	*	*	*	*	*	*	U
Small blue kingfisher	*Alcedo atthis*	Acedinidae	LC	*	-	-	-	-	-	U
White-breasted kingfisher	*Halcyon smyrnensis*	Acedinidae	LC	*	*	*	*	*	*	U
Pied kingfisher	*Ceryle rudis*	Acedinidae	LC	-	-	-	-	-	-	U
Common hoopoe	*Upupa epops*	Upupidae	LC	-	*	*	*	*	*	U
Common golden-backed woodpecker	*Dinopium javanense*	Picidae	LC	*	-	-	-	-	*	H
Red-vented bulbul	*Pycnonotus cafer*	Pycnonotidae	LC	*	*	*	*	*	*	H
White browed bulbul	*Pycnonotus luteolus*	Pycnonotidae	LC	*	*	*	*	*	*	H
Loten's sunbird	*Nectarinia lotenia*	Nectarinidae	LC	*	*	*	*	*	*	H
Purple sunbird	*Nectarinia asiatica*	Nectarinidae	LC	*	*	*	*	*	*	H
Purple-rumped sunbird	*Nectarinia zeylonica*	Nectarinidae	LC	*	*	*	*	*	*	H
House crow	*Corvus splendens*	Corvidae	LC	*	*	*	*	*	*	H
Jungle crow	*Corvus macrorhynchos*	Corvidae	LC	*	-	-	-	*	*	H
Rufous treepie	*Dendrocitta vagabunda*	Corvidae	LC	*	-	-		*	*	H
Jungle babbler	*Turdoides striata*	Muscicapidae	LC	*	*	*	*	*	*	H
Common babbler	*Turdoides caudatus*	Muscicapidae	LC	*	*	*	*	*	*	H
Large grey babbler	*Turdoides malcolmi*	Muscicapidae	LC	*	*	*	*	*	*	H
Indian robin	*Saxicoloides fulicatus*	Muscicapidae	LC	*	*	*	*	*	*	U
Booted warbler	*Hippolais caligata*	Muscicapidae	LC	*	*	*	*	*	*	U
Pied bush-chat	*Saxicola caprata*	Muscicapidae	LC	*	*	*	*	*	*	U
Oriental magpie robin	*Copsychus saularis*	Muscicapidae	LC	*	-	-	-	*	-	H
Streaked fantail-warbler	*Cisticola juncidis*	Muscicapidae	LC	*	*	*	*	*	*	U
Plain prinia	*Prinia inornata*	Muscicapidae	LC	*	*	*	*		*	U
Ashy prinia	*Prinia socialis*	Muscicapidae	LC	*	*	*	*		*	U
Blythe's reed warbler	*Acrocephales dumetorum*	Muscicapidae	VL	*	*	*	*	*	*	U
Common wood shrike	*Tephrodornis pondicerianus*	Muscicapidae	LC	*	-	-	-	*	*	U
Brahminy starling	*Sturnus pagodarum*	Muscicapidae	LC	*	*	*	*	*	*	H
Common iora	*Aegithina tiphia*	Irenidae	LC	*	-	-	-	*	*	U
Tickell's flower-pecker	*Dicaeum erythrorhynchos*	Dicaeidae	LC	-	*	*	*	*	*	H
Common tailor bird	*Orthotomus sutorius*	Turdinae	LC	*	*	*	*	*	*	U
Bay backed shrike	*Lanius vittatus*	Daniidae	LC	*	-	-	-	-	*	U
Black drongo	*Dicrurus macrocercus*	Dicruridae	LC	*	*	*	*	*	*	U
Ashy drongo	*Dicrurus leucophaeus*	Dicruridae	LC	*	-	-	-	*	-	U
Common swallow	*Hirundo rustica*	Hirundinidae	LC	*	-	-	-	-		U
Ashy crowned sparrow lark	*Eremopterix grisea*	Alaudidae	LC	-	-	-	-	-	*	H
Indian bush lark	*Mirafra assamica*	Alaudiidae	LC	*	-	-	-	-	*	U
Singing lark	*Mirafra cantillans*	Alaudidae	LC	*	-	-	-	-	*	U
Rufous backed shrike	*Lanius schach*	Laniidae	LC	*	-	-	-	*	*	U
Spotted munia	*Lonchura punctulata*	Ploceidae	LC	*	-	-	-	*	*	H
Red munia	*Amandava amamdava*	Ploceidae	LC	-	-	-	-	*	-	H
Black headed munia	*Lonchura malavea*	Ploceidae	LC	-	-	-	-	*	*	H
White-throated munia	*Lonchura malabarica*	Ploceidae	LC	*	*	*	*	*	*	H
Yellow-throated sparrow	*Petronia xanthocollis*	Ploceidae	LC	*	-	-	-	-	*	H
House sparrow	*Passer domesticus*	Ploceidae	LC	*	-	*	-	-	*	H
Baya weaver	*Ploceus philippinus*	Ploceidae	LC	*	-	-	-	-	-	H
Small minivet	*Pericrocotus cinnamomeus*	Campephagidae	LC	*	-	-	-	-	-	U
Eurasian golden oriole	*Oriolus oriolus*	Oriolidae	LC	-	-	-	-	*	-	U
Pied wagtail	*Motacilla alba*	Motacillidae	LC	*	-	-	-	-	*	U
Yellow wagtail	*Motacilla flava*	Motacillidae	LC	*	-	-	-	-	-	U
White wagtail	*Motacilla alba*	Motacillidae	LC	*	-	-	-	-	-	U
Paddy field pipit	*Anthus rufulus*	Motacillidae	LC	*	-	-	-	-	*	U
Common myna	*Acridotheres tristis*	Sturnidae	LC	*	*	*	*	*	*	H
Rosy starling	*Sturnus roseus*	Sturnidae	LC	*	-	-	*	*	*	H
Asian paid starling	*Sturnuscontra*	Sturnidae	LC	*	-	-	-	-	-	H
Yellow-eyed babbler	Chrysomma sinense	Sylviidae	LC	*	-	-	-	-	-	H

Bird density: The density of birds in the Paddy fields was 139/ha and followed by Red gram (121/ha), Castor (114/ha), Open grassland (111/ha) Fruit garden (110/ha) and Cotton (105/ha) (Table 2). However, monthly data showed that - bird density was higher in December 2010 (148/ha) and lower in February 2011 (28/ha) (Table 3).

Species diversity and richness: In the Paddy field, the bird species diversity was (2.30) highest as compared to the other habitats. Red gram habitat was second (1.86) in species diversity followed by, Castor (1.71), Fruit garden (1.52) and Cotton (1.29) (Table 2). In month-wise variation of bird species diversity, highest diversity was recorded in February 2011(0.35) and lowest in December (0.25) 2010 (Table 3).

Table 2. Bird Species density, diversity, richness and evenness recorded in the different crop types/ habitats for the entire study periods from December 2010 to February 2011

Crop type/habitat	Number of individuals	H'-(Shannon Weiner) index	Pielou's evenness index	Species richness	Density/ha
Paddy	976	2.30	0.02	88	**139**
Cotton	220	1.29	0.28	45	**105**
Castor	457	1.71	0.44	45	**114**
Red gram	484	1.86	0.03	47	**121**
Fruit garden	422	1.52	0.02	56	**110**
Open grassland	447	1.18	0.01	65	**111**

Table 3. Bird Species density, diversity, richness and evenness recorded in the different months for the study period

Month	Number of individuals	H'-(Shannon Weiner) index	Pielou's evenness index	Species richness	Density/ha
December	1926	0.25	0.25	69	148
January	585	0.29	0.28	55	50
February	742	0.35	0.35	52	28

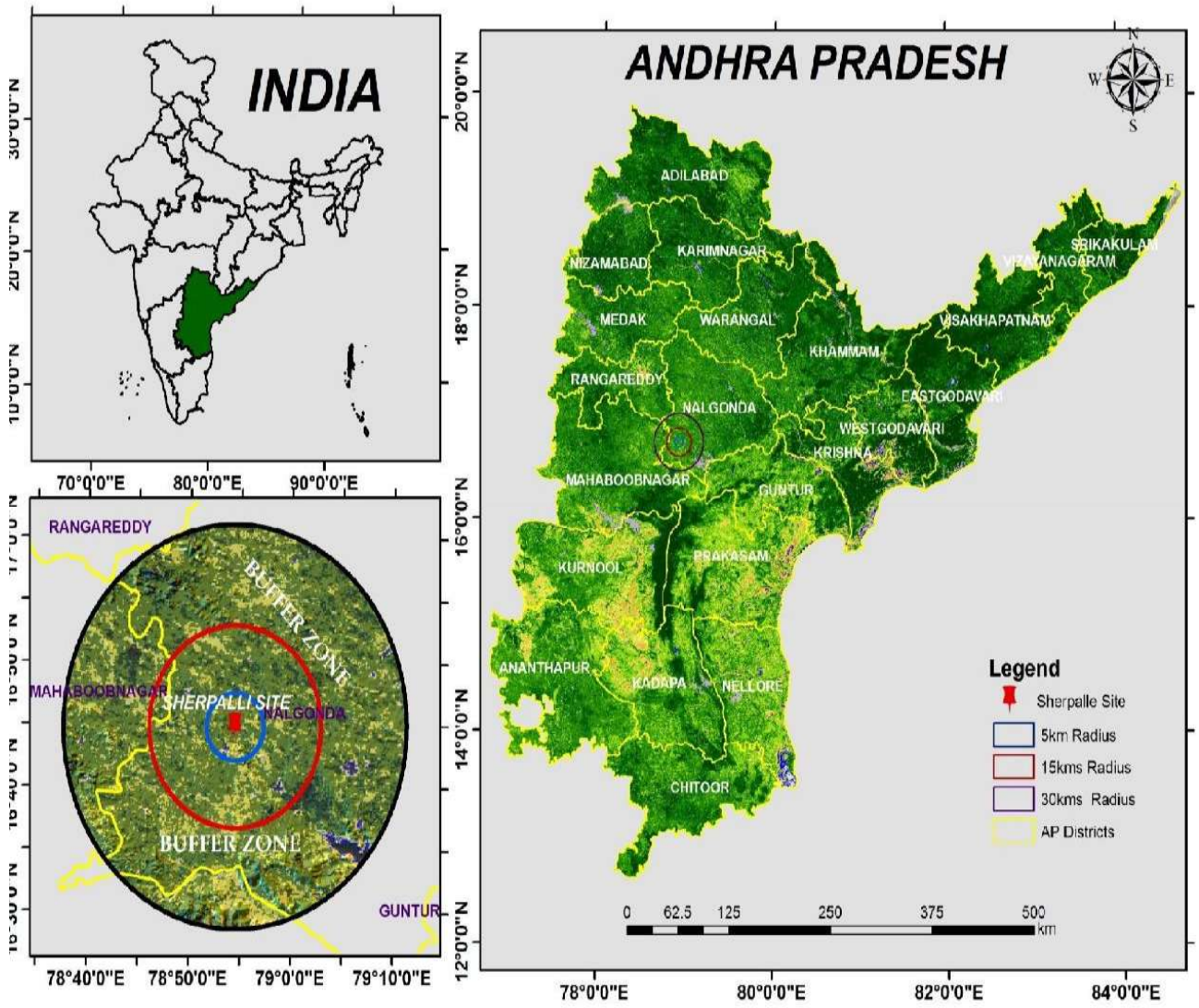

Figure 1. Study area map (Sherpally site)

Habitat of paddy field was again leading in term of species richness when compared to the other habitats. In addition, Open grassland and Fruit Gardens also have more species richness (Table 2). December 2010 was appeared to be richest in species richness while comparatively February 2011 was poor in species richness (Table 3).

Species evenness: The bird species evenness was observed in the Paddy (0.02), Cotton (0.28), Castor (0.44), Red gram (0.03), Fruit garden (1.52) and in the Open grassland (0.01) (Table 3). The bird species evenness was increased from 0.25 in December to 0.35 in February (Table 3). The ANOVA showed a significant differences between the bird density and among the areas and months (P<0.05) but the habitats did not show significant variations. The same trend was observed in the bird diversity among the areas and months which differed significantly (P<0.05). However, among the habitats the bird diversity did not show any differences. The - species richness showed significant variations among the areas, habitats and months (P<0.05). Chi square analysis, also revealed a significant difference between species richness and among the habitats ($\chi 2$=43.07, df=6, P<0.05).

Activity pattern: Activity patterns in various habitats namely, Paddy, Cotton, Castor, Red gram, Fruit garden and open grassland. In all the activities, perching was highest in all the habitats. Six major foraging categories of birds were recorded in the six aforesaid habitats. These were insectivorous (43.0%), omnivorous (29.9%), frugivorous (5.6%), gramnivorous (11.2%), carnivorous (6.5%) and nectarivorous (3.7%). Insectivorous birds were recorded maximum foraging categories in all the habitats.

An examination of foraging categories of birds revealed that insectivorous was highest with 46 species as compared to other foraging categories in the various habitat types. Among the six habitat types, Paddy supported highest number of birds (88). In Cotton and Castor similarly 45 bird species were found. In various habitats, presence of beneficial bird species was highest in Paddy with 55 (34.6%), while depredatory bird species in Fruit garden were dominated with 31 species (26.9%).

DISCUSSION

Results of the present study show that the study area is an ideal habitat for terrestrial bird species. Further, the study shows less number of migratory bird species since the study period was the migratory season. Red-vented Bulbul, Common Babbler, Common Myna, Black Drongo, Small Green Bee-eater were widespread and common species occurring abundantly in all habitats. Black Drongo was observed as the most dominant bird during the study period. These generalist birds are capable of thriving in a variety of habitats. Generalist is any phenotype whose fitness in one patch preciously equals its fitness in the other (Rosenzweig, 1981). Though Common Crow was common species but was not recorded in all the habitats during the study period. However, different phenologies of mentioned crop varieties were observed i.e., Paddy (Sapling, seeding, and harvesting); Castor (Flowering, seeding and harvesting); Cotton (Ripening and harvesting); Red gram (Flowering, seeding, and harvesting); Fruit garden (Flowering and fruiting). The trends indicate that shrubs attract more number of insectivorous birds by providing the required food resources to them. Besides the food supply, the shrubs also serve as ideal perching sites for the insectivore birds. Insectivores and omnivores are abundant in various habitat types. Foraging categories of birds revealed that insectivorous were recorded in high percentage in all habitats. A few graminivorous and nectarivorous bird species were recorded during the study period as there were no such flowering and fruiting crops (Red gram, Fruit garden). Bird species richness and community structure differ from region to region (Richards, 1969; Pearson, 1975; Karr, 1976). Within a single community, the structure may vary. There were noticeable variations among species richness, diversity and density in the 48 transects were surveyed in the present study. The present study results show the highest density and richness in the Paddy (139/ha) and lowest in the Cotton (105/ha).

Because these habitats are comprised of more resources in terms of shrubs and food source, which will provide the feeding and foraging sites for birds (especially insectivorous birds). Species diversity was observed to be the highest in Paddy (2.30), and lowest in Cotton (1.29). It is because the Paddy comprises of more number of sources (food, feeding sites, roosting, nesting sites, *etc*), whereas the Cotton provide lowest resources. The highest density was observed in the December (148/ha), the lowest density was observed in February (28/ha). The avian diversity of an area indicates the health of that ecosystem. They are highly mobile vertebrates and easily observed indicators of change. In recent year's loss of primary forest has been intensified more rapidly due to various reasons (Raman and Sukumar, 2002). Bird community studies have been frequently used for conservation assessment and monitoring (Daniels, 1989; Furness and Greenwood, 1993). Research at community level of birds in the Indian subcontinent is essential as large-scale changes have been taking place in natural habitat of birds (Khan *et al.,* 1993). A thorough understanding of the effect of habitat on birds may also help in predicting the effects of management on bird population (Javed and Kaul, 2002).

Density and diversity are very useful attributes and are valuable indicators of habitat quality and have great significance from the management perspective (Javed, 1996). The Telangana government has taken all measures to increase the percentage of land under cultivation by expanding irrigation facilities. The emphasis was not only on major irrigation projects but area specific and need specific; minor and lift irrigation projects were also given predominant importance. In the Nalgonda, grassland and other agricultural ecosystems have declined and represent a small percentage of land within an agriculturally dominated landscape, but these habitats are disproportionately important to birds. Because of the limited habitat availability to species depending on grassland or agricultural ecosystems, agriculturally-mediated changes can have profound implications for the management and sustainability of bird populations. There is also supporting evidence that production of agriculturally managed wetlands for water and pollution management purposes can exhibit biodiversity benefits (Pearson, 1975).

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