

AVIAN DIVERSITY IN RICE CROPPING SYSTEM IN MILD TROPICAL PLAIN ZONE OF ARUNACHAL PRADESH, INDIA

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ABSTRACT

Community structure and diversity of avian fauna in paddy crop was studied in Pasighat, East Siang district of Arunachal Pradesh in the year 2013 and 2014. The line transect method was used for survey. A total of 24 species of birds belonging to 9 families were recorded in rice ecosystem. Common myna, *Acridotheres tristis* was most visiting bird in nursery and transplanting stages with 21.27 % and 20.93 % relative abundance, respectively. The cattle egret, *Bubulcus ibis* was most abundant bird with highest relative abundance of 22.01 % and 18.93 % in tillering and grain formation stages, respectively. The relative abundance of scaly-breasted munia, *Lonchura punctulata*, white-rumped munia, *Lonchura striata* and house sparrow, *Passer domesticus* was increased with crop stages. The relative abundance of common pariah kite, *Milvus migrans* and black shouldered kite, *Elanus caeruleus* was 0.69 and 0.52 %, respectively at harvesting stage. *B. ibis* was most abundant species throughout the cropping season with a relative abundance of 16.87 %. Overall, the relative abundance of predatory, omnivorous and granivorous birds was 44 %, 39 % and 17 % in entire crop season, respectively. The birds have significance as insect predators thus need special consideration for conservation.

INTRODUCTION

Arunachal Pradesh is one of the topmost birding areas in the world. Owing to great altitudinal variation, from less than 100 m to above 5,000 m in Arunachal Pradesh, five biomes are found in the state. The climate of Arunachal Pradesh varies with elevation. Areas that are at a very high elevation in the Upper Himalayas close to the Tibetan border enjoy an alpine or Tundra climate. Below the Upper Himalayas are the Middle Himalayas, where people experience a temperate climate. Areas at the sub-Himalayan and sea-level elevation generally experience humid, sub-tropical climate with hot summers and mild winters. A total of 700 species of birds belonging to 60 families inhabit in Arunachal Pradesh (Singh *et al.*, 2013). It is interesting to note that only 05 of about 1000 species of birds found in India (*i.e.*, only 2.1%) have been reported to inflict damage to crops and fruits (Dhindsa and Saini, 1994). Birds also play a vital ecological role as well. Some birds transport a variety of things through the environment. They serve to spread seeds of various plants, thereby helps in plant dispersal. They also served as a bio-control agent and bio-indicators. Although, these group of animal help us in many ways like maintaining ecosystem, giving recreation, etc.

Birds are acknowledged to be ecosystems health indicators worldwide (Croonquist and Brooks, 1991) and, there is a need for a better ecological understanding of the role of avian community in agriculture. Thus, they are widely used in conservation and population trends in farmland are one of the 'Quality of Life' indicators (Gregory and Strien, 2010). In addition, small landbirds in particular have often been

proposed as potential indicators for the presence of other unrelated taxa or as environmental change indicators to be integrated into broader monitoring schemes. Furthermore, they are frequently included in evaluation studies for overall biodiversity conservation (Gregory *et al.*, 2004; Kati and Sekercioglu, 2006). Although bird species have an important mission to continue for ecological balance, 1,012 species are being threatened by threats that habitat loss, human persecution and introduced predators (Owens and Bennett, 2000). Birds have a good system for spreading seeds. They eat berries and then when they dispose of their waste, the berry seeds are disposed along with it. Bird faeces provide good fertilization for the seeds with which they are dropped, giving seeds very good conditions with which to grow. In addition, a lot of bird species may have been significant browsers of forest vegetation. A large proportion of forest tree and shrub species had fleshy fruits which were attractive to birds (McEwen, 1978). In most habitats, plant communities determine the physical structure of the environment, and therefore, have a considerable influence on the distributions and interactions of animal species (Godley, 1979).

The bird activities results the damage of crops and grains which vary area to area. In India, most of such activities of birds are either advantageous or disadvantageous to the farmers. Birds create negative as well as positive impact on most of agricultural activities and some activities attract birds as special feeding opportunities (Kale *et al.*, 2012). Thus, birds play dual role in Indian agro-ecosystem. Different disturbance histories in semi-protected wetlands are becoming common in this region due

to deforestation, civil construction and poaching. So, there is a need for studies looking at how bird species composition, abundance, richness and diversity vary between farmlands and forests. The paper aims to study the abundance, richness and diversity of birds in wetland and upland rice ecosystem of Arunachal Pradesh. This study aims to promote better knowledge to help conservation.

MATERIALS AND METHODS

Observations were recorded in the months of July to December in the year 2013 and 2014 to determine the community structure, species diversity and species richness of birds in rice crop ecosystem in Pasighat, East Siang district, Arunachal Pradesh. The surveyed area is situated between 27° 43' and 29°20' North latitudes and 94°42' and 95° 15' East longitude with an altitude of 155-342 m above MSL. This location has warm and humid climate with distinct rainy season spread over 7 months from April to October and irregular mild shower of rain from November to March with an average annual rainfall of 4700 mm. The birds were surveyed with variable distance according to line transect method described by Verner, 1985. The transect of 500 metre length was selected and a 50 m wide strip on each side of the transect was observed (Bibby et al., 2000), while walking. Total six locations were observed each consisting of 500 m length so a total of 3 kms transect was used in rice growing region near Pasighat town. Transects were repeated at 15 days interval starting from 50 % fields were sown till last harvesting of the crop. The observation made on encounter of bird species, number of birds and details of microhabitat were noted. The time of sampling was undertaken between 5:00 to 8:00 AM during entire crop season. Sampling was avoided on rainy days. At each transect birds were counted using a binocular of Nikon with 8-24x25 zoom and identified. In case of doubtful identification,

photographs were taken and the species was identified later by consulting experts. The identification of birds was carried out using standard literature of Ali and Ripley (1983), Grimmett et al. (1998), Ali (2000), and Singh et al (2013).

RESULTS

The Community structure of birds has been identified in East Siang district of Arunachal Pradesh. A total of 24 species of birds were recorded visiting from nursery sowing stage to harvesting stage of the crop (Table 1). The species richness and relative abundance of 24 species belonging to 9 families are presented in table 1 and 2. The list revealed that out of the total species of birds recorded, 14 species were beneficial to rice ecosystem as they feed on harmful insect pests and most of the birds showed local movement and inhabitant of local area. Among 9 families, 2 species of birds belonged to Corvidae, 4 species belonged to Sturnidae, 2 belonged to Columbidae, 4 belonged to Ardeidae, 2 belonged to Hirundinidae, 1 to Meropidae, 6 to Passeridae, 1 to Alcedinidae and 2 belonged to Accipitridae (Fig. 1).

Common myna (*Acridotheres tristis*) was most abundant with 21.27 % and 20.93 % relative abundance (RA) followed by cattle egret (*Bubulcus ibis*) with 17.08 and 16.40 % RA, grey wagtails (*Motacilla cinerea*) with 8.97 and 10.67 % RA during nursery and transplanting stage, respectively. Most of the predatory birds were reported to feed on insects including birds belonging to Sturnidae, Ardeidae, Hirundinidae and Passeridae (Table 1). Out of 345 birds reported in nursery stage, 47 % birds were predatory, 45 % birds were omnivorous and 8 % birds were granivorous (Fig. 2). Common myna (*A. tristis*) white-vented myna (*Acridotheres cinereus*), house sparrow (*Passer domesticus*), pied myna (*Sturnus contra*) and jungle crow (*Corvus macrorhynchos*) were common among omnivorous birds. The omnivorous birds generally feed on

Table 1: Relative abundance of birds recorded in rice crop ecosystem during different growth stages (Pooled mean of year 2013 and 2014)

Bird species	Family	Avian population in different crop stages									
		Nursery		Transplantation		Tillering		Grain formation		Harvesting	
		Number	RA(%)	Number	RA(%)	Number	RA(%)	Number	RA(%)	Number	RA(%)
Jungle crow, <i>Corvus macrorhynchos</i>	Corvidae	15	4.34	17.5	4.67	26	8.41	10.5	3.61	7.5	2.59
Common myna, <i>Acridotheres tristis</i>	Sturnidae	73.5	21.27	78.5	20.93	24.5	7.93	29.5	10.15	18.5	6.3
Pied myna, <i>Sturnus contra</i>	Sturnidae	17.5	5.07	12.5	3.33	10.5	3.40	7	2.41	9	3.11
Jungle Myna, <i>Acridotheres fuscus</i>	Sturnidae	3.5	1.01	3	0.80	3.5	1.13	1.5	0.52	1.5	0.52
White-Vented Myna, <i>Acridotheres cinereus</i>	Sturnidae	22.5	6.51	23	6.13	12	3.88	6.5	2.24	16.5	5.7
Blue rock pigeon, <i>Columba livia</i>	Columbidae	4	1.16	5	1.33	1.5	0.49	4.5	1.55	9.5	3.28
Cattle egret, <i>Bubulcus ibis</i>	Ardeidae	59	17.08	61.5	16.40	68	22.01	55	18.93	28	9.67
Median egret, <i>Mesophoyx intermedia</i>	Ardeidae	19.5	5.64	30.5	8.13	15.5	5.02	21	7.23	18.5	6.39
Little egret, <i>Egretta garzetta</i>	Ardeidae	13	3.76	14.5	3.87	23	7.44	14.5	4.99	1.5	0.52
Common Swallow, <i>Hirundo rustica</i>	Hirundinidae	0	0.0	0.5	0.13	1.5	0.49	2.5	0.86	0.5	0.17
Red-rumped Swallow, <i>Hirundo daurica</i>	Hirundinidae	0	0.0	0	0.0	0.5	0.16	1	0.34	1	0.35
Indian pond heron, <i>Ardeola grayii</i>	Ardeidae	0.5	0.14	1.5	0.40	2	0.65	0	0.0	0	0.0
Black drongo, <i>Dicrurus macrocerus</i>	Corvidae	9	2.60	10.5	2.80	17.5	5.66	3.5	1.20	1	0.35
Green bee eater, <i>Merops orientalis</i>	Meropidae	0.5	0.14	2	0.53	4	1.29	2.5	0.86	0.5	0.17
Scaly-breasted Munia, <i>Lonchura punctulata</i>	Passeridae	11.5	3.33	8.5	2.27	24.5	7.93	39	13.43	65.5	22.63
White-rumped Munia, <i>Lonchura striata</i>	Passeridae	5	1.45	8	2.13	11.5	3.72	23	7.92	20.5	7.08
Spotted Dove, <i>Streptopelia chinensis</i>	Columbidae	6	1.74	3.5	0.93	2	0.65	3.5	1.20	9.5	3.28
House sparrow, <i>Passer domesticus</i>	Passeridae	22.5	6.51	25	6.67	28.5	9.22	40.5	13.94	68	23.49
Grey wagtail, <i>Motacilla cinerea</i>	Passeridae	31	8.97	40	10.67	13	4.21	8	2.75	5.5	1.90
Yellow wagtail, <i>Motacilla flava</i>	Passeridae	11.5	3.33	11.5	3.07	10.5	3.40	11	3.79	3	1.04
White wagtail, <i>Motacilla alba</i>	Passeridae	19.5	5.64	16.5	4.40	5	1.62	1	0.34	0	0.0
Common kingfisher, <i>Alcedo atthis</i>	Alcedinidae	1	0.29	1.5	0.40	3.5	1.13	2.5	0.86	0.5	0.17
Common pariah kite, <i>Milvus migrans</i>	Accipitridae	0	0.0	0	0.0	0.5	0.16	1.5	0.52	2	0.69
Black-shouldered Kite, <i>Elanus caeruleus</i>	Accipitridae	0	0.0	0	0.0	0	0.0	1	0.34	1.5	0.52

*Data are the total of 10 days observations each consist of 1 km long transect during a crop season, RA = relative abundance (%)

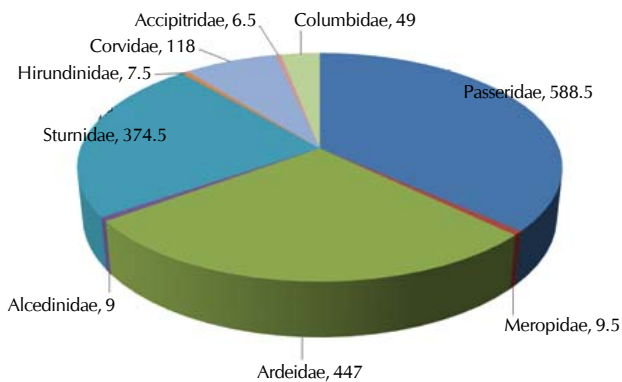


Figure 1: Number of birds and their families in rice crop

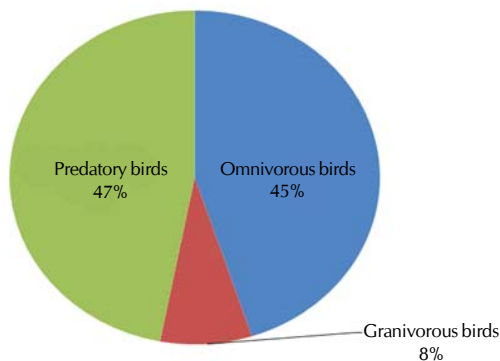


Figure 2: Bird's community in nursery stage

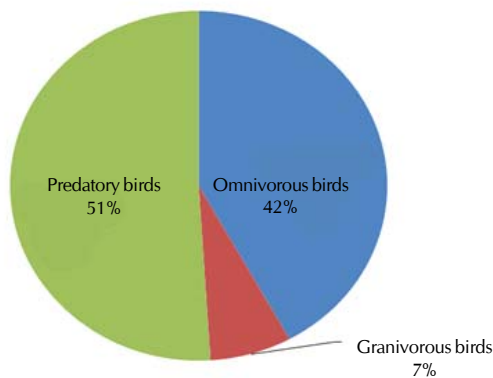


Figure 3: Bird's community in transplanting stage

insects and other arthropods but sometimes, they feed on grains and other plant materials. The granivorous bird's community comprised of blue rock pigeon (*Columba livia*), munia (*Lonchura punctulata*, *L. striata*) and spotted dove (*Streptopelia chinensis*) and all are found to feed on seeds of rice nursery. A total 11 predatory bird species reported in transplanting stage, of which cattle egret (*B. ibis*), median egret (*Mesophoyx intermedia*), grey wagtail (*M. cinerea*) were most abundant (Table 1). 21 species of birds with their total population was 375, of which 42 % birds were omnivorous, 7 % were granivorous and 51 % were predatory in feeding

nature (Fig. 3).

The relative abundance of predatory birds increased with subsequent increase in total foliage of the crop as the numbers of insect pests were increased. The cattle egret (*B. ibis*) was again most abundant bird with highest relative abundance (22.01 %) followed by house sparrow (*P. domesticus*) (9.22 %). The omnivorous community of birds in tillering stage of the crop was mainly composed of house sparrow (*P. domesticus*), common myna (*A. tristis*), white-vented myna (*A. cinereus*) and jungle crow (*C. macrorhynchos*), and all were feeding on insects at this stage of crop. The abundance of mollusks, insects, its larvae and other matters attract large number of migratory birds. The relative abundance of omnivorous, granivorous and predatory birds was 34 %, 13 % and 53 %, respectively (Fig. 4) in tillering stage of the crop. The relative abundance of scaly-breasted munia (*L. punctulata*), white-rumped munia (*L. striata*) and house sparrow (*P. domesticus*) increased up to 13.43, 7.92 and 13.94 %, respectively when the crop reached in grain formation and dough stage. They visited the rice crop in small flocks of 5-15 birds. Highest relative abundance again maintained by cattle egret, *B. ibis* (18.93 %) in grain formation stage. The relative abundance of granivorous, omnivorous and predatory birds was 24 %, 33 % and 43 %, respectively as per feeding nature (Fig. 5).

At the time of harvesting the activity of granivorous birds increased in the crop. Highest relative abundance (23.49 %) recorded by house sparrow (*P. domesticus*), although, it's omnivorous in nature and sometimes feed on grains followed by scaly-breasted munia, *L. punctulata* (22.63 %). Blue rock pigeon (*C. livia*) and spotted doves (*S. chinensis*) were also noticed to feed on shredded grains on ground. Common pariah kite (*Milvus migrans*) and black shouldered kite (*Elanus caeruleus*) were also noticed at this stage and observed to clutch the rodents. They attracted to rodents as the population of rodents noticed in the fields when crop attained grain and harvesting stages. The activity of granivorous and omnivorous birds increased when the crop attained the harvesting stage. It might be happened due to availability of abundant food resources as grains in the fields. The relative abundance of omnivorous, granivorous and predatory birds was 42 %, 36 % and 22 %, respectively (Fig. 6).

A total 1629 birds were observed from rice ecosystem during the year 2013 where as 1590 birds were observed during 2014. Table 2 revealed that cattle egret (*B. ibis*) was most abundant species throughout the cropping season with a relative abundance of 16.87 % followed by common myna, *A. tristis* (13.96 %), house sparrow, *P. domesticus* (11.46 %) and scaly-breasted munia, *L. punctulata* (9.25 %). Moreover, 44 % population of avian comprised by predatory birds, 39 % population by omnivorous and 17 % population by granivorous birds throughout the cropping season (Fig. 7).

DISCUSSION

Most of bird species play a useful role in agriculture by having a potent check on insect and rodent pests. Some granivorous birds have adapted to the agricultural habitats and are conflicting with our goals of agricultural production by

Table 2: Monthly data on species diversity of birds and their relative abundance in rice ecosystem

Bird species	Year 2013										Year 2014										Total	RA(%)	Pooled RA (%)
	July	Aug	Sep	Oct	Nov	Dec	Total	RA(%)	July	Aug	Sep	Oct	Nov	Dec	Total	RA(%)							
Jungle crow, <i>C. macrorhynchos</i>	15	5	19	11	18	22	90	5.52	14	13	11	18	5	2	63	3.96	4.74						
Common myna, <i>A. tristis</i>	43	36	24	51	30	18	202	12.4	65	48	55	34	24	21	247	15.53	13.96						
Pied myna, <i>S. contra</i>	11	24	9	2	17	5	68	4.17	7	14	11	4	6	3	45	2.83	3.51						
Jungle Myna, <i>A. fuscus</i>	3	5	1	0	2	1	12	0.74	5	2	4	1	0	2	14	0.88	0.82						
White-Vented Myna, <i>A. cinereus</i>	16	8	27	14	13	6	84	5.16	15	10	18	24	7	3	77	4.84	5						
Blue rock pigeon, <i>C. livia</i>	2	1	0	0	4	12	19	1.17	1	0	1	0	8	20	30	1.88	1.53						
Cattle egret, <i>B. ibis</i>	77	56	39	16	8	5	201	12.34	89	105	67	48	22	11	342	21.51	16.87						
Median egret, <i>M. intermedia</i>	51	24	13	18	3	2	111	6.81	36	22	18	12	5	6	99	6.23	6.53						
Little egret, <i>E. garzetta</i>	11	5	79	1	0	0	96	5.89	7	10	9	2	5	4	37	2.32	4.14						
Common Swallow, <i>H. rustica</i>	0	0	2	0	1	1	4	0.25	1	0	1	3	1	0	6	0.38	0.3						
Red-rumped Swallow, <i>H. daurica</i>	0	0	1	0	1	1	3	0.18	0	0	0	1	0	1	2	0.13	0.15						
Indian pond heron, <i>A. gravii</i>	0	2	1	0	2	0	5	0.31	0	1	0	1	1	0	3	0.19	0.26						
Black drongo, <i>D. macrocerus</i>	15	18	14	5	2	1	55	3.38	2	10	8	4	3	1	28	1.76	2.57						
Green bee eater, <i>M. orientalis</i>	4	3	1	2	0	0	10	0.61	2	1	3	0	0	3	9	0.57	0.6						
Scaly-breasted Munia, <i>L. punctulata</i>	16	4	11	18	38	47	134	8.23	12	8	21	27	34	62	164	10.31	9.25						
White-rumped Munia, <i>L. striata</i>	2	1	6	12	16	31	68	4.17	1	3	4	8	20	32	68	4.28	4.22						
Spotted Dove, <i>S. chinensis</i>	4	1	2	5	7	5	24	1.47	8	5	2	1	2	7	25	1.57	1.53						
House sparrow, <i>P. domesticus</i>	39	42	27	18	44	68	238	14.61	17	26	14	9	27	38	131	8.24	11.46						
Grey wagtail, <i>M. cinerea</i>	21	16	24	33	12	8	114	7	15	7	10	23	18	8	81	5.09	6.04						
Yellow wagtail, <i>M. flava</i>	12	7	3	0	7	4	33	2.03	16	14	15	10	2	5	62	3.9	2.95						
White wagtail, <i>M. alba</i>	9	13	5	8	6	1	42	2.58	13	4	8	7	3	7	42	2.64	2.61						
Common kingfisher, <i>A. attilis</i>	2	1	5	1	1	0	10	0.61	1	1	2	1	2	1	8	0.5	0.56						
Common pariah kite, <i>M. migrans</i>	0	0	1	0	1	2	4	0.25	0	0	0	1	1	2	4	0.25	0.26						
Black-shouldered Kite, <i>E. caeruleus</i>	0	0	0	0	1	1	2	0.12	0	0	0	0	1	2	3	0.19	0.15						

*Data are the total of 10 days observations each consist of 1 km long transect during a crop season, RA= Relative abundance (%)

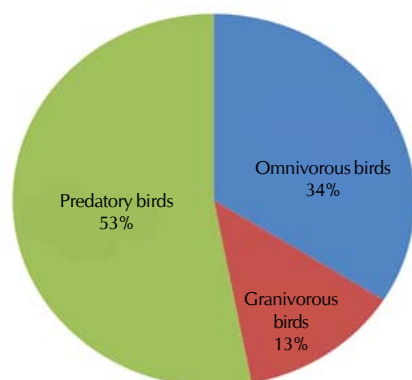


Figure 4: Bird's community in tillering stage

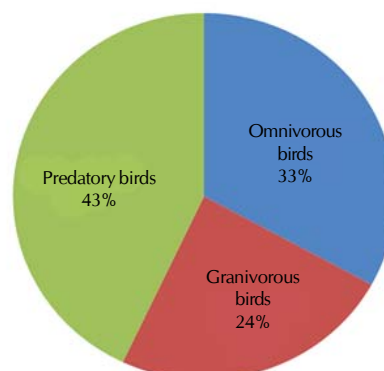


Figure 5: Bird's community in grain formation stage

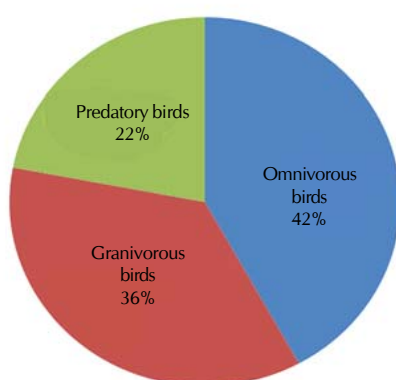


Figure 6: Bird's community in harvesting stage

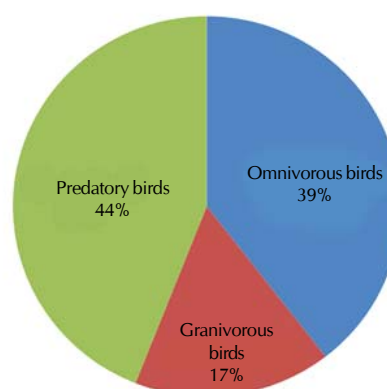


Figure 7: Bird's community during entire crop season

inflicting economic losses to crops, fruits and stored grains. In the present study, spotted doves, house sparrows, scaly-breasted munia and white-rumped munia caused damage in rice grains. It justifies the statement of Dhindsa and Saini (1994) that only 2.1% species of birds found in India have been reported to inflict damage to crops and fruits. Bird community in agricultural lands is characterized by over dominance of only a few granivorous and omnivorous species while the rest of species are represented in very small numbers (Dhindsa and Saini, 1994). Similarly, the present study revealed that only few species of omnivorous, predatory and granivorous birds dominated in the rice crop ecosystem. Dominance by a few very common species is typical of disturbed habitats (MacArthur, 1970) however the present study areas have one of the highly disturbed habitats.

Bird management involves both the conservation of useful species and control of pests, thus agricultural ornithology is of special importance in predominantly agricultural countries. The abundance of mollusks, insects, its larvae and other arthropods attract large number of migratory birds in rice crop (Paliwal and Bhandarkar, 2014; Joshi and Shrivastava, 2012). Birds like wagtails, mynas, green bee-eater, black drongo, egrets and swallows have an important role in predation on insects in rice crop (Laxmi Narayana *et al.*, 2014). Patel *et al.* (1987) found that house sparrow, common myna, red-vented bulbul, *Pycnonotus cafer* play important role in reducing *Catopsilla* sp. larvae in medicinal crop. Several species of insectivorous

birds have been found to feed on insect pests of crops including *Helicoverpa armigera* (Chakravarthy, 1988; Parasharya *et al.*, 1988; Singh *et al.*, 1990). The birds with small population have less significance as insect predators but are important in view of their low numbers thus need special consideration for conservation. It is presumed that the native flora including tall trees, dense large trees and bushy scrubs around the paddy fields might have decreased in Pasighat town day by day due to interferences of modern developmental activities in the area. It might decrease the comfortable shelter and foraging freedom for many birds. It appears that human-induced disturbances and possibly presence of variety of foraging sites contribute to the variation of abundance, composition, richness and diversity of bird species in this area. In addition, many birds associated with agro-ecosystem are forced to leave the habitat as local tribal people have habit of hunting. The key threats to avian fauna of the region are the illegal felling of trees is mainly because of the growing human population and also logging, continuing conversion of natural grassland and wetlands for agricultural and urban land use, clearing of forest areas for unsustainable shifting cultivation in the state and poaching (Singh *et al.*, 2013). A timely intervention is necessary to check this salient killing. Therefore the preservation of breeding patches is essential to restore and conserve birds. A more detailed study is required to obtain a clearer picture of bird population and species dominance of birds of this region and it will be useful for comparison in future study.

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