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Abundance and feeding ecology of Black Ibis (*Pseudibis papillosa*) in agricultural fields of Punjab, India

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Abstract

The present investigation was undertaken to study the abundance and feeding ecology of Black Ibis *Pseudibis papillosa* in agricultural field areas of Ludhiana, Punjab from March 2015 to February 2016. Over all annual relative abundance of *Pseudibis papillosa* was 11.79% and total feeding niche recorded was 32 in the area under investigation. The field area under study was divided into four different sites i.e. Site I, II, III and IV. The relative annual abundance of Black Ibis was highest (15.74%) at site III making it the most preferred habitat having irrigated agricultural fields, large tree plantation providing roosting places, presence of water bodies having abundance of feeding materials. Maximum flock size of 28 individuals was recorded feeding together. Probing, standing fly catching, bill dragging, head swaying and hopping were the feeding activities recorded. It was concluded from the study that the habitat preference was directly proportional to the presence of feeding materials and roosting places.

Keywords: Black Ibis *Pseudibis papillosa*, feeding ecology, feeding niche, agricultural ecosystem

1. Introduction

The India is known to harbor about 12.5% of world's avifauna i.e. a total of 1263 species of birds [1]. The Indian checklist acknowledges inclusion of Black Ibis *Pseudibis papillosa* as an important bird species in agricultural ecosystem. According to Ali the Black Ibis is wide spread in Indian subcontinent, occurring almost all over India, Pakistan, Nepal, Bangladesh and China [2]. This bird is popularly known as "farmer's friend" as it feed on large number of insects. The Black Ibis inhabits agricultural fields, waste water bodies, municipal garbage dumping station and waste land [2]. Black Ibis does not accumulate enough reserve food in their body as compared to high daily energy expenditure so a constant food intake is essential on day to day basis to fulfill energy demand [3]. Bird living in mosaic of natural habitat patch may face space and time constraints while securing their food requirements. Therefore, foraging strategies adapted by birds are one of the major interesting fields. According to Titus and Pereira [4] the Ibis exhibits several kinds of feeding behavior that can be broadly classified as probing behavior, bill dragging, flipping, and foot ranking. They are found to feed on beetles, snails, fish, plant matter, animal matter, insects and organic matter. Kushlan [5] summarized various aspects of feeding ecology of wading birds. Vast literature on foraging ecology of wading birds exists, but Ibises are much less explored. Very little is known about the foraging ecology and gut contents of Black Ibis except the general description about feeding ecology given by some workers [6, 7]. Several studies have been conducted at Rajkot [8-10] Junagarh [11], Churu [12] and at Jamnagar [13]. These studies revealed that habitat utilization by the Black Ibis is non-stereotypic and varied in different localities. It evinced to the problem of habitat selection in the Black Ibis that might be influenced by constraints of foraging behavior and availability of food. Seasonal rainfall pattern changes availability of food for birds. For most of the wading birds, critical seasonality is created by wet and dry cycles of weather [14, 15]. Many ibises undertook regional movements with seasonal changes in prey availability which allows utilizing productive habitats available in other areas [16, 17]. Some ibises altered habitat use to exploit sequential availability of food in different habitats [18, 19]. Seasonal variation in habitat use was also recorded in the Black Ibis [9, 11]. However, seasonal pattern of habitat selection and its relation to food availability could not be established by researchers.

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2. Materials and Methods

2.1 Study area

The present study on the abundance and foraging ecology of Black Ibis was under taken in agricultural field areas of Punjab Agricultural University, Ludhiana (30 ° 53' 59.81" N and 75 ° 47' 32.10" E) from March 2015 to February 2016. This location was further divided into four different site i.e. site I which include fruit crops, agricultural crops and less tree plantation; Site II includes mainly agricultural area having medium number of tree plantation; Site III includes agricultural fields, water bodies and high number of large tree plantation and Site IV includes agricultural fields and high number of small trees. These four sites were different in some respects having different crops, trees and water bodies. Point counted method was used for taking the observation about Black Ibis. Identification of birds was done on the basis of visual observations of their morphological characteristics by using binocular and comparing them with those described by Ali ^[2]. Observations were taken from 6:00-10.00 am and from 5.00 -7.00 pm in summer and from 7.00 -11.00 am in morning and from 4.00 -6.00 pm in evening during winter. Instruments used during the study were digital camera (Nikon P 500), Bushnell (8X42) Binocular for observing birds. Relative abundance, species richness, species evenness and feeding association of Black Ibis with other bird species were recorded during the study.

2.2 Statistical Analysis

Data collected on occurrence and abundance of birds will be subjected to bird species, richness, their relative abundance, species diversity and species evenness will be calculated as per Shannon's-Wiener's Index ^[20].

3. Results and discussion

A total of 21 bird species were recorded during the study with Cattle Egret *Bubulcus ibis* (30.25%) and House Crow *Corvus splendens* (20.89%) were dominant bird species followed by *Pseudibis papillosa* as the third most abundant bird species with annual relative abundance of 11.79% (Table 1). Relative abundance of *Pseudibis papillosa* was highest (18.8%) in the month of October 2015; this may be due to the presence of maximum feeding niches available in the form of irrigated fields and completion of breeding season (Table 1). Species evenness was also maximum (0.98) in the month of October 2015. Minimum relative abundance (3.52%) was recorded in the month of April 2015; it may be because of maturing Wheat crop present in agricultural fields providing less opportunity for feeding (Table 1). It was observed during the study that abundant food supply leads to high relative abundance of *Pseudibis papillosa* i.e. the abundance of *Pseudibis papillosa* was directly proportional to the presence of feeding niches. Similar type of observation was also recorded by Kushlan ^[21] which noted that there was a positive relationship with the abundance of food supply and flock size of birds. More relative abundance was recorded in the month of August to December this may be due to breeding season of *Pseudibis papillosa*. Similar kind of observations were also recorded by Soni ^[22]. Relative abundance of *Pseudibis papillosa* was more in the habitat having water bodies, presence of poultry farm and fish ponds, fields having cattle dung as manure, as they harbor insects, aquatic larvae and small invertebrates which were feed upon by the *Pseudibis papillosa*.

During the study it was recorded that the *Pseudibis papillosa* feeds individually or in the flock of 5-28. Maximum flock size of 28 individuals was recorded feeding together during

the study at site I. Different feeding activity like Probing (Shallow probing, Deep probing, Step probing, Multiple probing, Stationary probing), Standing fly catching, Bill dragging, Head swaying and Hopping were observed (Table 3). A total of 32 feeding niches were recorded during the study. At site I, maximum 10 feeding niches were observed this may be due to the reason that the crops like rice, wheat, corn, vegetables, legumes and sugarcane were sown and harvested in this area (Table 2). This area was mostly irrigated throughout the year. Feeding behavior seen in this area was deep probing, shallow probing, step probing, multiple probing, stationary probing and head swaying. *Pseudibis papillosa* prefer to feed near the water bodies because the presence of different type of insects, reptile and small invertebrates. *Pseudibis papillosa* show feeding association prominently with Cattle Egret, House Crow, Blue Rock Pigeon (*Columba livia*) and Red-wattled Lapwing (*Vanellus indicus*). At site II seven feeding niches were recorded. This area was observed to have more cropping activity, presence of fodder crops, sugarcane crops and dry conditions. In this area feeding association is basically seen with Cattle Egret, House Crow, Blue Rock Pigeon, Common Myna (*Acridotheres tristis*) and Red-wattled Lapwing. Deep probing, step probing, stationary probing, bill dragging and hopping behavior were observed. At site III, eight feeding niche were recorded which may be due to the presence of garbage dump harboring different types of insects, small invertebrates and small reptiles. At this site crop production activities and tree diversity was high. Association of Black Ibis was observed with other bird species like Cattle Egret, House Crow, Common Myna and Pariah Kite (*Milvus migrans*). At site III, shallow probing, step probing and stationary probing were observed. Site IV, seven feeding niche were recorded. This site has low tree diversity and includes agricultural fields having fodder, rice and legumes crops. Irrigation at this site was less as compare to other sites. Feeding association of *Pseudibis papillosa* was recorded with Cattle Egret, House Crow, Pariah Kite and Red-wattled Lapwing in this area. Presence of other birds like Cattle Egret, House Crow, Red-wattled Lapwing, Pariah Kite and Common Myna did not affect the feeding activities. Feeding activities observed in this area were deep probing, shallow probing, standing fly catch and bill dragging. They are found to feed on beetles, snails, fish, plant matter, animal matter, insects and also on organic matter. Some other workers also recorded similar kinds of feeding behavior in Ibis i.e. probing behavior, bill dragging, flipping and foot ranking ^[3, 4, 15]. Overall feeding activity observed during the study were probing (deep probing, shallow probing, step probing, multiple probing, stationary probing), standing fly catching, bill dragging head swaying and hopping (Table 3). *Pseudibis papillosa* needs a region where bird roosts or built their nests and a region from where it gets its food. Most preferred habitat site was Site III having highest relative abundance (15.74%) of *Pseudibis papillosa* (Table 2). It has irrigated agricultural fields with plantation, water bodies and abundant feeding sites and materials like aquatic larvae, insects, small crustaceans and small invertebrates. Least relative abundance (7.19%) of *Pseudibis papillosa* was recorded at site II which may be due to the reason that this area was having maximum cropping resulting in anthropogenic disturbance and use bird pest management practices. Our result in reference to abundance and feeding of *Pseudibis papillosa* in different habitat and association with other birds, matches with results published by other workers ^[23, 3, 4, 15].

Table 1: Relative annual abundance (%) of *Pseudibis papillosa*

S. No.	Birds species	March 2015	April 2015	May 2015	June 2015	July 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Annual abundance
1	Cattle Egret (<i>Bubulcus ibis</i>)	24.86	24.61	16.87	30.88	19.27	37.4	62.81	29.08	37.12	27.96	32.75	19.35	30.25
2	House Crow (<i>Corvus splendens</i>)	14.97	18.75	18.11	22.66	32.45	26.91	9.63	27.07	23.02	24.31	14.91	17.85	20.89
3	Black Ibis (<i>Pseudibis papillosa</i>)	12.43	3.52	10.29	10.76	17.04	9.54	11.37	18.8	12.62	13.37	10.53	11.18	11.79
4	Blue Rock Pigeon (<i>Columba livia</i>)	15.82	14.45	12.76	11.05	6.09	4.96	0	0.85	0.74	12.46	9.06	17.2	8.79
5	Red-wattled Lapwing (<i>Vanellus indicus</i>)	7.34	6.64	7.82	7.65	9.33	3.44	3.47	12.25	8.17	5.78	5.56	9.25	7.22
6	Pariah Kite (<i>Milvus migrans</i>)	3.95	7.03	9.05	2.55	6.5	4.58	1.54	6.55	4.95	4.26	5.56	6.67	5.27
7	Common Myna (<i>Acrideros tristis</i>)	8.2	9.38	6.58	5.38	4.46	4.2	3.28	1.99	2.22	1.82	6.43	7.31	5.10
8	Black Winged stilt (<i>Himantopus himantopus</i>)	0	2.34	3.7	0	0.61	1.72	0.58	0	1.98	1.52	4.09	2.15	1.56
9	Black Drongo (<i>Dicrurus adsimilis</i>)	1.98	0.39	3.7	1.98	0.61	1.34	0.96	0.57	0.99	1.22	1.46	2.15	1.45
10	Indian peafowl (<i>Pavo cristatus</i>)	2.54	2.34	1.23	1.7	0.61	0.38	1.35	0.29	0.25	1.22	1.46	1.29	1.22
11	Asian Pied Starling (<i>Sturnus contra</i>)	2.26	4.3	0	1.13	0.41	1.72	1.16	0	0.48	0	0.58	1.08	1.10
12	Green Bee Eater (<i>Merops orientalis</i>)	0.85	1.56	2.46	0.28	0.2	0.38	0.58	0.85	1.5	1.52	1.67	1.29	1.10
13	Rose-Ringed Parakeet (<i>Psittacula krameri</i>)	2.26	1.17	1.23	0.57	0.2	1.53	0.77	0.28	1.73	0	1.67	1.08	1.04
14	White Breasted Kingfisher (<i>Halcyon smyrnensis</i>)	1.13	0.78	0.82	0.28	0.61	0.38	0.96	0.57	0	1.82	2.05	0.47	0.82
15	Common Babbler (<i>Turdoides caudatus</i>)	0	0	3.7	0	0.81	0	0	0	0.99	0	1.75	1.08	0.69
16	Indian Roller (<i>Coracias benghalensis</i>)	0.85	0.78	0	1.13	0.2	0.19	0.39	0.85	0.25	1.22	1.46	0.43	0.65
17	Common Hoopoe (<i>Upupa epops</i>)	0	0.78	1.23	1.13	0.61	0.38	0.96	0	0.5	1.22	0	0.22	0.59
18	White throated Munia (<i>Lonchura punctulata</i>)	0.28	0.78	0.41	0.85	0	0	0	0	0	0.3	0	0	0.22
19	Eurasian Collared Dove (<i>Streptopelia decaocto</i>)	0	0	0	0	0	0.76	0	0	0.5	0	0	0	0.11
20	Red Vented Bulbul (<i>Pycnonotus cafer</i>)	0.28	0.39	0	0	0	0	0	0	0	0	0	0	0.06
21	White Ibis (<i>Threskiornis aethiopica</i>)	0	0	0	0	0	0.19	0.19	0	0	0	0	0	0.03
	Species richness	16	18	16	16	17	18	16	13	17	15	16	17	
	Species diversity	2.21	2.27	2.38	2.03	1.95	1.89	1.43	1.76	1.92	2.03	2.20	2.25	
	Species evenness	0.80	0.78	0.86	0.73	0.69	0.65	0.52	0.98	0.68	0.75	0.79	0.79	

Table 2: Abundance and habitat ecology of *Pseudibis papillosa*

	Site I	Site II	Site III	Site IV
Habitat structure	Agricultural crops and vegetables, mostly irrigated area, less tree plantation	Agricultural crops, fodder crops, legumes and vegetables, medium tree plantation	Agricultural crops and fodder crops and large tree plantation	Fodder crops and some agricultural crops, high number of tree plantation
Water bodies	Not present	Not present	Fish ponds were present	Water treatment plant was present in this area
Relative Abundance of <i>Pseudibis papillosa</i>	11.01%	7.19%	15.74%	12.80%

Table 3: Feeding behavior of *Pseudibis papillosa*

Site	Feeding niche	Feeding behavior								
		Probing					Standing fly catching	Bill dragging	Head swaying	Hopping
		Deep probing	Shallow probing	Step probing	Multiple probing	Stationary probing				
Site I	10	√	√	√	√	√	X	X	√	X
Site II	7	√	X	√	X	√	X	√	X	√
Site III	8	X	√	√	X	√	X	X	X	X
Site IV	7	√	√	X	X	X	√	√	X	X

4. Conclusion

It was concluded from the study that the habitat preference was directly proportional to the presence of feeding materials and roosting places. The habitat having irrigated agricultural fields, large tree plantation providing roosting places, presence of water bodies harboring abundance of feeding materials was the most preferred habitat by the *Pseudibis papillosa*. Habitat having more feeding niches was most preferred locations for day to day feeding activities. As *Pseudibis papillosa* feeds on insect, it can be useful as bio control agent. Their breeding ecology was not precisely recorded in India so further continuing future study on bio-ecology of this bird in different agricultural habitats will be the need of the hour.

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