Research Article

Eco-biology and conservation of potential insectivorous birds in the arable biomes of central Punjab

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Abstract

The present study was conducted to investigate the eco-biology of insect predator avian species and the effects of environmental factors on the eco-biology and bird populations in Punjab, Pakistan. Data on ecology and other aspects of bank myna was collected from three districts of Central Punjab including Faisalabad (an industrial area with large effects of heavy metals by usage of sewage water of industries in irrigation & pesticides), Sargodha (with medium level of industries & pesticides use) and Mandi Bahauddin (no industry and low use of pesticide). Specimens were collected to observe gut contents. Gut contents were analyzed to account for the prey and feeding niche. Major insect pests of crops were identified and listed from gut contents. Relative population density of useful birds was assessed and continuously monitored for population trends around the year. Breeding ecology of both predacious birds was studied to evaluate breeding success, mortality rate and to weigh up the effects of pesticides used and pollution. Breeding ecology, population dynamics and gut contents analysis were significantly ($P \leq 0.001$; $R^2 \geq 0.75$) influenced by the use of pesticides. It was concluded that use of pesticides without studying their toxic effects is detrimental to these predacious birds. Blind sprays should be prohibited and alternatives should be adopted to conserve the predacious birds in order to achieve effective biological control.

Keywords: Predacious birds; Eco-biology; Population dynamics

Introduction

The bank myna (*Acridotheres ginginianus*) is a member of family Sturnidae, native to South Asia, smaller in size but similar in colour to the common mynah (*A. tristis*) the major differences are: the presence of a brick red bare skin patch behind the eye in place of yellow; greyer undersides with

presence of slight tuft of feathers, bearing a resemblance with the jungle myna (*A. fuscus*). Head is black on the crown and sides and the upper plumage is slaty grey while the underside is lighter grey with pale pink plumage towards the center of the abdomen the birds have black wings with a wing patch at the base of the primaries, and

the tips of the outer tail feathers are pale pinkish buff. The sexes are indistinguishable in the field. Young birds have a browner head and neck [1]. Bank mynas feed on grains, insects and fruits. They feed on a variety of insects, including some crop pests such as *Achaea janata* whose caterpillars feed on castor [2]. Clutch size normally ranges from 4-6 eggs and average size of egg measured 30.8×21.99 mm. Incubation period ranges from 17-18 days and fledging period from 22-24 days [3]. Bank mynas build nests in cavities of trees, walls and canal bank and breed from sea-level to 3000 m in the Himalayas. Nesting material usually consists of twigs, roots, tow and rubbish. Sometime they also use nests of woodpeckers, parakeets, etc. and aggressive behaviour is used to contribute towards its success as an invasive species [4].

Food choice of birds can be assessed by analyzing gut contents. Population structure and gut contents of 32 bird species were analyzed by [5]. Among them 31 species were Passeriformes and one Coraciiform. Whereas 23 were endemic and 9 were migratory in nature. Indian wren warbler, bank myna and jungle babbler, were recorded frequently Rosy Pastor, Jungle Sparrow, Yellow-throated Sparrows were rare; small Green Bee Eater was recorded during maturity stage of cotton with density of 0.8 birds/hectare and potential in insect predation. Indian wren warbler, jungle babbler, common babbler and bank myna, were recorded throughout the year and their combined population was estimated up to 7.1 birds/ha. The total estimated bird density was 14.6 birds per hectare. More than 1/3 (37%) of the bird species mostly concentrate on insects for food. Insects belonging to the orders Hymenoptera and Hemiptera formed the major proportion of arthropod based food. Common aphids and thrips dominated the food of the Indian Wren Warbler. Cattle movements disturb insect population in

fields. However, [6] investigated ecological linkages of the bird species with livestock. The insects in the pastureland dislodged by the livestock are eaten by cattle egrets, bank mynas and black drongos. Bank mynas and black drongos were estimated to consume insect mass of consuming upto 1/6 of their body weight per day; however, Cattle Egrets and Crested Larks were recorded consuming upto 1/3 of their own body weight per day. The percentage of grasshoppers and beetles in diets of these species was found higher than found in guts of other insectivorous bird species.

Ticks are also found in gut contents. [7] observed crops (n=7,334) contents from 239 species of birds for ticks. They recorded ticks in bank myna, helmeted guinea fowl, crowned plover and lila breasted roller. All these ticks belonged to genera *Boophilus*, *Hyalomma* and *Rhipicephalus*. Gut content of birds' species reported showed diversity of insect species preyed by birds. Some birds prefer certain insects while others reject them. It implies that birds are prey specific to some extent.

Clutch size normally ranged from 4-6 eggs and average size of egg measured 30.8×21.99mm. Incubation period ranged from 17-18days and fledging period from 22-24 days [8]. Some time they also use nests of woodpeckers, parakeets etc. and aggressive behavior is recorded for success towards invasive species [4]. Cattle Egrets spend their life in colonies. Breeding season varies within Asia. Nesting usually begins with onset of monsoons [8]. Breeding success is related to number of newly hatched birds. [9] evaluated the breeding success of *Bubulcus ibis* (Ardeidae), *Egretta thula*, *Nycticorax nycticorax*, *Phimosus infuscatus* and *Plegadis chihi* for two consecutive nesting seasons. Mean clutch size for *B. ibis* was 2.59 and 2.49, respectively. The mean number of nestlings/nest was 1.85 for *B. ibis*. In both

nesting seasons all the species had major success, laying three eggs and raising two nestlings, except for *B. ibis*. However, breeding success for *B. ibis* ranged from 1.16 in the first period to 0.99 in the second.

Materials and methods

The present experiment was conducted at three locations of Punjab (Faisalabad, Sargodha and Mandi Bahauddin). Two sites were selected in each district with GPS readings to identify the actual location of selected study site. Faisalabad 30° 40' to 31° 47' N, 72° 42' to 73° 40' E, Sargodha 31° 49' 60N, 72° 37' 60E and Mandi Bahauddin 32° 34' 60N, 73° 30' 0E. Population surveys of the selected birds from three habitats (six sites) were made to record the distribution of bird species among these sites. Survey was conducted using three method: i) By direct visual analysis, ii) by telescope studies iii) by taking pictures and counting birds. Among these sites, there was an extremely large range of population sizes among bird species, (<1000 mature individuals) and these fluctuated with regard to the nature of habitat extent/ quality. In some places population size was recorded in small number at 2-3 locations/ fragmentation [10]. Population was estimated by transect methods through searching and counting active nests of the cattle egret and bank myna in the aforesaid areas, either on foot, by boat or vehicle. Active nests were identified by seeing the pairs engaged in nest building and/or renovation. Gut content analysis was made to determine the detrimental effects of pesticides and pollution. 10 birds were hunted/shot each time and 24 observations were completed during the study by two weeks sampling (n=240), The birds were killed using an air gun/shot gun (Diana 35 Model BB shots) according to a specific schedule at 10-11 am and 4-5 pm. The crop of each killed bird was extracted in the field, tagged properly,

brought to the lab and was preserved in 10% alcohol for final analyses (Pedigo, 1996), the morphological measurements made from the hunted birds. At the end of each trip the crops were cut opened; contents were weighed and taken out in a shallow pans or petri-dishes. Needles were used to spread the items for identification. Fragments of the insects were isolated to identify the species and the total number of useful and harmful arthropods consumed. Field lens (10X) and microscope was also used occasionally to confirm the identification of insects. Observations were recorded continuously throughout the research period according to the previously described schedule [1, 11]. After collection, data were analyzed statistically using Analysis of Variance or Chi square tests. The statistical packages Statistix version 8.1 and SPSS version 16.0 were used for all analysis.

Results and discussion

Morpho-taxonomical features

During present study 10 birds of bank myna were killed and 15 live birds were visualized by telescope in each survey to study the morphological features (Table 1) from each study site at the end of sampling season (October and March), and following observations were recorded: it was difficult to differentiate between sexes in the field and juveniles were with a browner head and neck; head of each birds was black on the crown and sides, whereas upper plumage was slaty grey and underside was lighter grey with pale pink plumage towards the center of the abdomen. Wings were black, having a wing patch at the base of the primaries and the tips of the outer tail feathers were pale pinkish buff. However, naked skin behind the eye was brick red, legs were yellow, and iris was deep red. The study was confirmed by other scientist as the results were in the same pattern [12].

Table 1. Physical characteristics of bank myna

Character	Measurement(cm)	Character	Measurement(cm)
Body length	10-15	Wing span	40-50
Wing length	20-25	Tail length	8-10
Bill length	2-2.5	Body weight	75-300 gm

Clutch size

Clutch size of bank mynah on average in non-treated areas, was the largest at Mandi Bahauddin (4.00 ± 0.87) with average egg size of (1.08×0.86), followed by Sargodha (3.83 ± 0.76 ; 1.08×0.86) and then

Faisalabad (3.17 ± 0.58 ; 1.07×0.86). Similar trend was found in treated areas. However, the largest clutch size was recorded from Mandi Bahauddin (Table 2). There clutch study was in the pattern of [13].

Table 2. Clutch size and egg measurements of bank myna observed at three sites

Location	No. of nests observed	Clutch size (Mean $\pm$ SD)	Avg. Egg Measurement (inch)	Clutch size (Mean $\pm$ SD)	Avg. Egg Measurement (inch)
		Non-treated		Treated	
Faisalabad	15	3.17 ± 0.58^A	1.07×0.86^A	2.33 ± 0.29^B	1.03×0.83^B
Sargodha	15	3.83 ± 0.76^A	1.08×0.86^A	2.83 ± 0.76^B	1.04×0.84^B
Mandi Bahauddin	15	4.00 ± 0.87^A	1.08×0.86^A	2.67 ± 0.58^B	1.07×0.85^B

Gut content analysis

Gut content analyses are given in Table 3. The largest material was found in the gut of birds in non-treated areas of Mandi Bahauddin (5.89 ± 0.40 grams) which ranged from 4.2-6.25g. The smallest contents were observed in the crops of birds from treated areas of Faisalabad (5.14 ± 0.95 grams) that ranged from 3.2-6.2 g. Insect material was recorded the largest from non-treated areas of Mandi Bahauddin (3.76 ± 0.51 grams) and the smallest from treated areas of Faisalabad (2.71 ± 0.55 grams). Weight of fed material other than insects was recorded the largest from treated areas of Faisalabad (2.44 ± 0.73 grams) and the smallest from non-treated areas of Mandi Bahauddin (2.13 ± 0.47 grams). However, average number of insects fed was the highest among non-treated areas of Mandi

Bahauddin (63.78 ± 7.46 grams) and lowest among non-treated areas of Faisalabad (51.76 ± 7.63 grams). Percentage (%) of harmful insects fed was different in different areas. It was observed the largest in non-treated areas of Mandi Bahauddin (85.42%) and the smallest in treated areas of Faisalabad (41.67%). Percentage of harmful insects fed by bank myna was high in treated areas of Faisalabad (46.25%) as compared to non-treated areas (41.67%). It was due to frequent availability of insect pests feeding on garbage and decayed fruits, and daily house wastage near the city areas. Observed variations in gut contents might be due to seasonal variation in frequency of pest. The major portion of food of the common mana is insects [5]. The study was also confirmed on other bird species [14].

Table 3. Mean weight of gut contents of bank myna from three sites

Location	Treatment	AGCW (Mean $\pm$ SD)	AIW g (Mean $\pm$ SD)	ANIW g (Mean $\pm$ SD)	ANI (Mean $\pm$ SD)	% HIF
Faisalabad	Non-treated	5.14 $\pm$ 0.95 ^A	2.71 $\pm$ 0.55 ^B	2.43 $\pm$ 0.62 ^A	51.76 $\pm$ 7.63 ^B	41.67 ^B
	Treated	5.40 $\pm$ 0.88 ^A	2.96 $\pm$ 0.56 ^A	2.44 $\pm$ 0.73 ^A	55.42 $\pm$ 9.99 ^A	46.25 ^A
Sargodha	Non-treated	5.67 $\pm$ 0.64 ^A	3.34 $\pm$ 0.64 ^A	2.33 $\pm$ 0.61 ^B	58.96 $\pm$ 9.97 ^A	59.67 ^A
	Treated	5.18 $\pm$ 0.85 ^B	2.83 $\pm$ 0.53 ^B	2.35 $\pm$ 0.54 ^A	54.83 $\pm$ 6.33 ^B	41.75 ^B
Mandi	Non-treated	5.89 $\pm$ 0.40 ^A	3.76 $\pm$ 0.51 ^A	2.13 $\pm$ 0.47 ^B	63.78 $\pm$ 7.46 ^A	85.42 ^A
Bahauddin	Treated	5.37 $\pm$ 0.56 ^B	3.03 $\pm$ 0.44 ^B	2.34 $\pm$ 0.52 ^A	56.61 $\pm$ 7.52 ^B	76.96 ^B

AGCW= Avg. Gut content weight (fresh); AIW= Avg. Weight if insect material; ANIW= Avg. Weight of other material other than insects; ANI= Avg. No. of insect fed; HIF= harmful insects fed

Comparison of feeding flocks of bank myna

The differences between locations were significant ($P < 0.05$) for feeding flock sizes (Table 4). Data on sampling feeding flocks of bank myna from three districts is presented in Table 5.2.6. Average number within feeding flocks of bank myna ($\pm$ SD) was 695 ± 60.6 birds. The largest flocks were recorded from Mandi Bahauddin and

Sargodha districts (45 ± 4.2 birds) while the smallest population was recorded from Mandi Bahauddin district (25 ± 4.2 birds). However, equal population from Mandi Bahauddin and Sargodha districts was owing to that in Mandi Bahauddin district, control areas were adjoining to village residences (limiting the population size) and pesticides were equally affecting both the populations [15].

Table 4. Average number of Feeding Flocks of bank myna in three habitats

Habitat	Faisalabad	Sargodha	Mandi Bahauddin
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
Crop Land	20.0 $\pm$ 0.00	27.5 $\pm$ 3.54	37.5 $\pm$ 3.54
Irrigated Fields	86.5 $\pm$ 12.02	114.0 $\pm$ 7.07	119.0 $\pm$ 19.80
Marsh Areas	93.0 $\pm$ 14.14	101.5 $\pm$ 16.26	117.5 $\pm$ 6.36
Canal side	89.0 $\pm$ 26.87	107.5 $\pm$ 10.61	160.0 $\pm$ 0.00
Ploughed Fields	161.0 $\pm$ 9.90	166.5 $\pm$ 16.26	145.0 $\pm$ 15.56
Ponds	143.5 $\pm$ 21.92	214.0 $\pm$ 18.38	256.0 $\pm$ 16.97
Newly Harvested Fields	89.5 $\pm$ 30.41	109.5 $\pm$ 20.51	119.5 $\pm$ 34.65

Conclusion

The results demonstrated that these birds are gregarious feeders, live together and breed in flocks, feed on crop insect pests and play a very important role in the management of insect population.

Authors' contributions

Conceived and designed the experiments: M Akhtar, Performed the experiments: M Akhtar, Analyzed the data: RA Khan Contributed reagents/ materials/ analysis

tools: MT Saddiqui, Wrote the paper: HA Khan.

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