Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(5): 2142-2147

Received: 26-07-2018
Accepted: 28-08-2018

Gursimran Kaur
MSc. Student, Department of Zoology, Punjab Agricultural University, Ludhiana, Punjab, India

Tejdeep Kaur Kler
Senior Ornithologist & Principal Investigator in All India Network Project on Vertebrate Pest Management (Agricultural Ornithology) Department of Zoology, Punjab Agricultural University, Ludhiana, Punjab, India

Correspondence
Tejdeep Kaur Kler
Senior Ornithologist & Principal Investigator in All India Network Project on Vertebrate Pest Management (Agricultural Ornithology) Department of Zoology, Punjab Agricultural University, Ludhiana, Punjab, India

Breeding biology of Black Drongo (*Dicrurus macrocercus*) in relation to nest-site selection and habitat characterization in agricultural landscape

Gursimran Kaur and Tejdeep Kaur Kler

Abstract
The study on the nest-site selection and breeding activities of Black Drongo in relation to habitat features was carried out for one year from January 2017 to December 2017 in the campus of Punjab Agricultural University (PAU), Ludhiana i.e. location I, village Baranhara (district Ludhiana) i.e. location II and village Ladiankhurd (district Ludhiana) i.e. location III. The breeding season of Black Drongo extended from May to August at all the studied locations. Detailed observations on 18 nests of Black Drongo were made on its breeding parameters and egg characteristics. The clutch size varied from 3-4 eggs. The average incubation period was of 13±0.34 days. The hatching and fledging success of Black Drongo were noted. Tree species specificity (four indigenous and one exotic) of Black Drongo for nesting preferences was recorded. The data generated on breeding biology of Black Drongo along with habitat characteristics could provide impetus to conservation efforts of this species in agricultural ecosystem.

Keywords: Black Drongo, clutch size, eggs, incubation period, nesting material

1. Introduction
Birds act as important ecological indicators to understand the quality of habitats in agro-ecosystem [11]. Habitat of birds is decreasing due to habitat destruction and anthropogenic factors [9]. Insectivorous bird species constitute important group in avian biodiversity of agricultural areas [6]. Majority of the birds hunt their food from the agro-ecosystem and check the build up of insect pest species [17]. Avian insectivorous bird species are most sensitive to agricultural field disturbances, making them beneficial as essential sentinels of agriculture ecosystem change [23]. They act as important bio-indicators in the agricultural field areas [25]. Changes in agricultural patterns pose maximum threat to birds, leading to habitat loss which is a major threat to the biodiversity. Black Drongo *Dicrurus macrocercus* is a small, terrestrial insectivorous bird and constitute a major component of agro-ecosystem [8]. It belongs to the family Dicruridae and has a distinct forked tail [2]. It builds a flimsy bottomed cup shaped nest of fine twigs and fibres in the forked branch of the tree [3]. Okosodo *et al.* mentioned that Black Drongo being fairly terrestrial and perch close to the ground in cultivation and grasslands [21]. It predates on the insects which are found on ground level vegetation. Birds select the resources that are best able to satisfy theirnutritional requirements. It prefers one habitat over the other habitat on the availability of the basic requirements in the microhabitats [19]. Narayana *et al.* stated that the habitat selection of Black Drongo depend upon the availability of perching sites and their heights [18]. Kaur *et al.* had found relative abundance of Black Drongo ranging from 1.73% to 4.38% in and around village ponds of district Barnala, Punjab [13]. Sidhu and Kler reported that Black Drongo was found lesser observed bird species at the orchards and was found mainly near the crop fields [28]. The present study was designed to observe the breeding biology of Black Drongo in relation to nest-site selection and habitat characterization in agricultural landscapeof Ludhiana district.

2. Materials and Methods
2.1 Study area
The present study on the nesting and breeding activities of Black Drongo was carried out from January 2017 to December 2017 in the campus of Punjab Agricultural University (PAU), Ludhiana i.e. location I, village Baranhara (district Ludhiana) i.e. location II and village Ladiankhurd (district Ludhiana) i.e. location III, which were further divided into transects.

Each transect had a distinct diversity of tree species, crop plantation and food availability. The PAU campus (30^0 54' 3.4740" N, 75^0 51' 26.1972" E) is located in the west of the Ludhiana city comprising of large stretch of agriculture fields. A total of five transects i.e. transect I, transect II, transect III, transect IV and transect V) were selected at PAU campus site. Transects I, III and IV were in the field area near official building, transect II was selected in botanical garden, transect V was along road in the crop field area. The village Baranhara (30^0 54' 3.4740" N, 75^0 51' 26.1972" E) is situated to the west of Ludhiana district and lies to the left side of the Hambran road. Two transects were selected in the village Baranhara namely transect VI and transect VII. Transect VI was selected in residential area starting from main road to village interior. Transect VII was selected from village interior up to seasonal water stream (Buddha Nala) that drains into Sutlej river. The village Ladiankhurd (30^0 54' 3.4740" N, 75^0 51' 26.1972" E) is located in the west tehsil of Ludhiana district. Two transects were selected in the village Ladiankhurd namely transect VIII and transect IX. Transect VIII was selected in residential area of the village interior. Transect IX was selected in the agricultural area of the village outskirts around the village pond. In the selected transects, breeding behaviour of Black Drongo was studied in detail.

2.2 Methodology

Direct observations on the breeding activities of Black Drongo were noted twice a week during morning and evening hours at all the studied locations. Breeding behaviours of the individuals were observed using Bushnell binocular of magnification 8X and objective lens of 42 mm, without disturbing them. Point count method was followed to note the nesting sites utilized by Black Drongo [32]. Observations were made to note different breeding activities such as nest site selection, clutch size, incubation period and behaviour of nestlings.Clutch size was considered as the total number of eggs laid in a single breeding attempt by the female. Incubation duration was considered to be the time period between laying of the last egg of the clutch and hatching of the last young one. Nestling period was defined as the time duration between hatching of the first young one and fledging of all the hatched young ones in the nest [29]. Observations were also made to determine the cause of egg/nestling loss. Photography was done with the Nikon coolpix B500 camera (16.0 Mega pixels and 40x Optical zoom). All the values are presented in Mean ± SE.

2.3 Measurements

The total height (in metres) of the nest and the nesting tree from the ground was measured using an altimeter. Digital vernier calliper was used to determine length and breadth of the eggs of Black Drongo. Common weighing balance was used to measure the weight of the eggs. Egg volume was determined from length and breadth using an empirical formula [7].

Egg volume = $(0.457).(L).(B^2.).10\text{-}^3$ml.

An egg shape index (ESI) of the eggs was determined using the following formula [31]

$$\text{Egg shape index} = \frac{\text{Egg breadth (mm)}}{\text{Egg length (mm)}} \text{ x } 100$$

Specific gravity of the eggs was calculated according to Stadelman and Cotterill using the formula given as under [31]:

$$\text{Egg specific gravity (gm/cm}^3\text{)} = \frac{\text{Egg weight (gm)}}{\text{Egg volume (cm}^3\text{)}}$$

The hatching and fledging success of Black Drongo was determined using the formula given as under:

$$\text{Hatching success (\%)} = \frac{\text{Number of eggs hatched}}{\text{Total number of eggs laid}} \text{ X } 100$$

$$\text{Fledging success (\%)} = \frac{\text{Number of nestlings fledged}}{\text{Total number of eggs hatched}} \text{ X } 100$$

2.4 Statistical analysis

One Way Analysis of Variance (ANOVA) (for 3-4 egg clutches) was used to find difference in morphometric characters (length, width and weight) of eggs within clutch as well as eggs in different clutches, using SPSS software 20. Tukey B Test was used to determine the statistical difference in the mean values. Values are presented in Mean ± SE.

3. Results

In the present study, it was noted that Black Drongo utilized a total of five different tree species for nesting purposes at all the studied locations. Three tree species namely Indian mahogany (*Chukrasia tabularis*), Sukh Chain (*Pongamia pinnata*) and Neem (*Azadirachta indica*) were utilised by Black Drongo for nesting purposes at transects I, II and III respectively. Dhek (*Melia azedarach*) was utilized for nesting at both the transects IV and V. Two tree species namely Neem (*Azadirachta indica*) and Dhek (*Melia azedarach*) were utilized by Black Drongofor nesting purposes at transects VI and VII respectively. Two tree species namely Poplar (*Populus deltoids*) and Dhek (*Melia azedarach*) were utilized by Black Drongo for nesting purposes at transects VIII and IX respectively.

Nine nesting sites were observed in PAU campus (transects I,II,III,IV and V) out of which two were located on Indian Mahogany, two on Sukh Chain, one on Neem and four on Dhek (Table 1). Five nesting sites were observed in the village Baranhara (transect VI and VII) out of which two were located on Neem and three on Dhek tree (Table 2). A total of four nesting sites were observed at village Ladiankhurd (transect VIII and IX) out of which two were located on Poplar and two on Dhek (Table 3). It was noted that the nesting trees were always in close proximity to agricultural fields and electric power lines. Two nests of Black Drongo were not found on a single tree at studied locations which showed intra species competition and antagonistic behaviour between breeding pairs.

Table 1: Mean tree height and mean nest height of Black Drongo at location I

Transects	Nests located	Tree species utilized for nesting	Mean tree height (m)	Mean nest height (m)
I	2	Indian mahogany* (*Chukraia tabularis*)	13.50	7.50
II	2	Sukh Chain* (*Pongamia pinnata*)	16.00	8.50
III	1	Neem* (*Azadirachta indica*)	13.50	9.10
IV	1	Dhek* (*Melia azedarach*)	14.50	6.90
V	3	Dhek* (*Melia azedarach*)	10.70	7.50

*Two or more than two nests on the same tree were not observed

Table 2: Mean tree height and mean nest height of Black Drongo at location II

Transects	Nests located	Tree species utilized for nesting	Mean tree height (m)	Mean nest height (m)
VI	2	Neem* (*Azadirachta indica*)	13.50	10.50
V1I	3	Dhek* (*Melia azedarach*)	15.00	11.25

*Two or more than two nests on the same tree were not observed

Table 3: Mean tree height and mean nest height of Black Drongo at location III

Transects	Nests located	Tree species utilized for nesting	Mean tree height (m)	Mean nest height (m)
VIII	2	Poplar* (*Populus deltoids*)	15.00 `	11.50
IX	2	Dhek* (*Melia azedarach*)	16.00	12.25

*Two or more than two nests on the same tree were not observed

In the present study, a total of 18 nests of Black Drongo were studied during the breeding season from May to August at all the locations. All the observed nests were bottom cup shaped, constructed in the forked branch of the tree. The nests were built of the nesting material such as grass, dry fibres and twigs. The morphometerical characteristics of the eggs of Black Drongo in different clutches were observed at all the studied locations. Eggs from various transects of three selected locations namely location I, location II and location III were measured. It was noted that the eggs were creamish in colour with brown spotting of varying sizes. Clutch size of 3–4 eggs was commonly observed; but clutches of 4 eggs were more frequent. Out of 18 clutches, 6 and 12 clutches were of 3 and 4 eggs respectively. The mean egg length (in mm) ranged between 23.75±0.75to 27.00±0.58, 23.75±0.75 to 25.67±0.88 and 23.67±0.29 to 25.00±0.50 at location I (Table 4), location II (Table 5) and location III (Table 6) respectively. The mean egg breadth (in mm) ranged between 15.67±0.0.29 to 19.67±0.33, 15.75±0.95 to 19.67±0.33 and 19.00±0.50 to 19.67±0.76 at location I, location II and location III respectively. The mean egg weight (in g) ranged between 4.53±0.03 to 5.13±0.09, 4.60±0.09 to 5.13±0.09 and 4.23±0.13 to 4.40±0.09 at location I, location II and location III respectively. The egg volume (in cm^3) ranged between 2.77 to 4.77, 2.77 to 4.54 and 3.90 to 4.42 at location I, location II and location III respectively. The egg shape index ranged between 63.52 to 74.75, 64.28 to 76.63 and 78.68 to 80.27 at location I, location II and location III respectively. The specific gravity of eggs (gm/cm^3) ranged between 1.04 to 1.85, 1.06 to 1.85 and 0.99 to 1.09 at location I, location II and location III respectively. In the present study, it was found that there was a significant difference in mean egg length, width and weight of clutches. Out of all the studied locations, maximum and minimum values of mean egg length were noted at transect III and IX respectively. Maximum of mean egg breadth were noted at transect III and VII while minimum values were noted at transect IV. Maximum values of mean weight were noted at transect II and VII while minimum was noted at transect VIII. The highest egg volume was recorded at transect III while lowest was noted at transect II, IV and VII. The highest and lowest egg shape index was noted at transect IX and IV respectively. The highest egg specific gravity was noted at transect VII, II and lowest was noted at transect IX. Abundant and wide range of food types was available at canteens in the transect III. In addition, people were also observed offering food to birds at lunch hours which might be the possible reason for increase in the egg length and egg weight at transects III and II respectively as compared to other transects.

Table 4: Morphometrical characteristics of eggs in different clutches during breeding season in 2017 at location I

Egg characteristics → / Transects ↓	Number of trees used for nesting	Nest number	Clutch size	Mean egg length ± S.E. (mm)	Mean egg breadth ± S.E. (mm)	Mean egg weight ± S.E. (g)	Egg volume (cm^3)	Egg shape index	Specific Gravity of Eggs (gm/cm^3)
I	2	1	4	24.75±0.85	18.50±0.65	4.60±0.09	3.88	74.75	1.18
		2	4	23.75±0.75	17.25±0.48	4.65±0.10	3.22	72.63	1.44
II	2	3	4	24.50±0.65	15.75±0.95	5.13±0.09	2.77	64.28	1.85
		4	4	25.25±0.85	16.25±0.63	5.05±0.06	3.05	64.36	1.65
III	1	5	4	27.00±0.58	19.67±0.33	4.97±0.03	4.77	72.85	1.04
IV	1	6	3	24.67±0.76	15.67±0.29	4.67±0.03	2.77	63.52	1.68
V	3	7	4	25.33±0.88	17.33±0.33	4.53±0.03	3.48	68.42	1.30
		8	3	26.003±0.58	17.003±0.58	4.703±0.06	3.43	65.38	1.37
		9	3	26.33±0.88	18.33±0.33	5.07±0.07	4.04	69.62	1.25

Table 5: Morphometrical characteristics of eggs in different clutches during breeding season in 2017 at location II

Egg characteristics → / Transects ↓	Number of trees used for nesting	Nest number	Clutch size	Mean egg length ± S.E. (mm)	Mean egg breadth ± S.E. (mm)	Mean egg weight ± S.E. (g)	Egg volume (cm^3)	Egg shape index	Specific Gravity of Eggs (gm/cm^3)
VI	2	10	4	24.75±0.85	18.50±0.65	4.60±0.09	3.88	74.75	1.18
		11	4	23.75±0.75	17.25±0.48	4.65±0.10	3.22	72.63	1.44
VII	3	12	4	24.50±0.65	15.75±0.95	5.13±0.09	2.77	64.28	1.85
		13	4	25.25±0.85	16.25±0.63	5.05±0.06	3.05	64.36	1.65
		14	4	25.67±0.88	19.67± 0.33	4.83± 0.03	4.54	76.63	1.06

Table 6: Morphometrical characteristics of eggs in different clutches during breeding season in 2017 at location III

Egg characteristics → / Transects ↓	Number of trees used for nesting	Nest number	Clutch size	Mean egg length ± S.E. (mm)	Mean egg breadth ± S.E. (mm)	Mean egg weight ± S.E. (g)	Egg volume (cm^3)	Egg shape index	Specific Gravity of Eggs (gm/cm^3)
VIII	2	15	3	25.00 ±0.50	19.67±0.76	4.40±0.09	4.42	78.68	0.995
		16	3	24.00 ±0.50	19.00±0.87	4.23±0.13	3.96	79.17	1.07
IX	2	17	4	24.75±0.63	19.50±0.87	4.33±0.10	4.30	78.79	1.01
		18	3	23.67±0.29	19.00±0.50	4.27±0.10	3.90	80.27	1.09

Table 7: Hatching and fledging success of Black Drongo at studied locations

Transects	Nest Number	Clutch Size	Incubation Period (Days)	Number of eggs hatched	Hatching success (%)	Nestling Period (Days)	Number of young fledged	Fledging success (%)
I	1	4	12	3	75.00	18	2	66.67
	2	4	11	3	75.00	20	2	66.67
II	3	4	13	4	100	21	4	100
	4	4	13	4	100	21	4	100
III	5	4	16	3	75.00	22	2	66.67
IV	6	3	14	3	100	19	3	100
V	7	4	13	4	100	17	4	100
	8	3	15	3	100	20	2	66.67
	9	3	12	3	100	20	3	100
VI	10	4	14	3	75.00	19	3	100
	11	4	14	2	50.00	18	2	100
VII	12	4	12	4	100	20	4	100
	13	4	11	4	100	19	3	75.00
	14	4	13	4	100	20	4	100
VIII	15	3	15	3	100	21	3	100
	16	3	12	2	66.67	20	2	100
IX	17	4	11	4	100	19	3	75.00
	18	3	13	3	100	19	3	100

In the present study, the average incubation period was 13±0.34 days.It was observed that both the parents shared all the parental duties during the nest formation and incubation period. While one of the parents was incubating the eggs, the other parent perched outside the nest. It was observed that after hatching of the eggs, one parent was always found around the nest, guarding the hatchlings from the invading predators while the other parent collected the food material to feed the hatchlings. The chicks were fed by both the parents.

Both the hatching pattern and hatching success of eggs of Black Drongo was studied in 18 clutches at the studied locations (Table 7). A total of 66 eggs were laid during the breeding season (from May to August), out of which only 59 eggs hatched. Hatching success was observed 100% in nest number 3, 4, 6, 7, 8, 9, 12, 13, 14, 15, 17 and 18. Fledging success was noted 100% in all the nest number 3, 4, 6, 7, 9, 10, 11, 12, 14, 15, 16 and 18.

4. Discussion

In the present study, it was noted that Black Drongo preferred tall trees for the nest construction. Similar results were given by Santisteban *et al.* that Black Drongo constructed nests at tall trees as increased nest height might safe guard it from invading predators [26]. Authors had mentioned that Black Drongo preferred perching on trees and electric power lines during breeding and non-breeding season respectively [12]. Lammers and Collopy stated that the avian predators are attracted to electric power lines as they provide better perches for prey detection and hunting [16]. Narayana *et al.* mentioned that perch types and perch height is interlinked with the habitat and availability of food resources [18]. Breeding season of Black Drongo was noted to extend from May to August at all locations. In contrast, Shukkur and Joseph reported that the breeding season of Black Drongo extended from April to June in Calicut University Campus, Kerala [27]. Black Drongo built a thin bottomed cup shaped nest in the fork of a tree made up of nesting materials i.e. grass, twigs, fibres and no vegetative material. The results correlated with Ali *et al.* [2]. Similar observations were noted by Shukkur and Joseph that no vegetative material was used by Black Drongo in nest construction [27]. Workers had mentioned that the breeding activities of Black Drongo were directly related to the food availability. Factors namely suitable mate, nesting materials, temperature and rainfall also determine the nesting season of

Black Drongo [30]. Radhakrishnan reported that out of the 21 Black Drongonests located, 48% were on Rain tree (*Enterolobium saman*), 28% on Babool tree (*Acacia nilotica*), 19% on Neem tree (*Azadirachta indica*) and 5% on Tamarind tree (*Tamarindus indicus*) [24]. Shukkur and Joseph stated that most of the nests of Black Drongo were found on the Jackfruit trees *Artocarpus integrifolia* at the Calicut University campus [27].During present investigations, it was found that Black Drongo preferred those trees for nesting that were in close proximity to agricultural areas and electric power lines. Similar observations were noted by Ali *et al.* that the nesting tree of Black Drongo had the potential habitats namely agricultural lands and perching sites i.e. trees proximal to electric power lines [2]. Asokan *et al.* also stated the preference of electric power lines in nesting tree selection in Common Mynas (*Acridotheres tristis*) [5]. Similar observations were also made by Ali in Baya Weavers (*Ploceus philippinus*). Author had mentioned that Black Drongo preferred trees for nesting near the electric power lines as they provide sites for perching and prey hunting [1].

In present investigations, it was noted that both the parents of Black Drongo shared parental duties during nest formation and defended the nests against the invading predators. The results correlated with Ali that both the sexes share all the domestic duties and were bold in defence of their nest during the breeding activity [3]. Kaur and Kler had mentioned that both the sexes of Black Drongo were not observed on ground together during the breeding season as they took turns for food and foraging, while one of them was always near the nesting site. During the incubation period, House Crows were noticed attacking the nests of Black Drongo [12]. It was found that the average clutch size of Black Drongo varied from 3 to 4. The results correlated with Ali *et al.* [2]. Similar clutch size range was more or less constant when compared to previous studies by Ali and Ripley [4]. Hussell and Quinney had mentioned that in many bird species, the variation in clutches is often related with abundance of food material [10]. Authors had stated that the eventual clutch size in birds is determined by the availability of nutrient reserves of the female or protein rich food [15]. Workers had mentioned that the clutch size of birds is often dependent on the age of the parents, with younger parents laying smaller number of eggs [20]. The egg of Black Drongo was incubated by both the parents. While one of the parents was incubating the eggs, the other parent was observed in close proximity to the nest. It was observed that the average incubation period of Black Drongo was 13±0.34 days. It was noted that the incubation period of Black Drongo lasted approximately from 13 to 16 days. Present observations found that both the parents took equal part in the nestling period and in feeding of chicks. Similar results were reported by Ali *et al.* [2].

Kler and Kumar stated that Black Drongo was found most abundant in the agricultural habitats [14]. Pidgeon *et al.* stated that the micro-habitat and vegetative composition around nesting tree are important factors in relation to nest placement and success of avian species. The micro-habitat and vegetation not only provide food and nesting site to the avian species but also provide nesting material for the nest construction [22]. Kaur *et al.* had mentioned that Black Drongo belonged to trophic level comprising of invertebrates [12]. The habitat features of transect V and transect VII constituted agricultural fields having abundant invertebrate food which might be the reason that the number of nests were higher at these sites.

5. Conclusion

In studied agricultural habitats, the breeding season of Black Drongo extended from May to August. Breeding pairs were never observed occupying same tree which indicated that the resource requirements might be the limiting factor. Black Drongo had selected five tree species (four indigenous and one exotic) as nesting sites. The average incubation period of Black Drongo was 13±0.34 days. Black Drongo fed its young ones on insect food which indicated its bio-control potential in field crops. It could be concluded that plantations of four indigenous trees species (Indian mahogany, Sukh Chain, Neem and Dhek) and one exotic tree species (Poplar) are required in agricultural habitats to provide nesting sites for Black Drongo, thereby resulting in its conservation.

6. Acknowledgement

Authors are grateful to Prof. & Head, Department of Zoology, Punjab Agricultural University, Ludhiana for providing necessary facilities.

7. References

1. Ali AMS. Nest characteristics, nest-site selection, nestling growth and prey delivery pattern to nestlings in the Baya Weaver (*Ploceus philippinus*). M.sc. Thesis AVC College, Mannampandal, Tamil Nadu, 2003.
2. Ali AMS, Asokan S, Manikannan R, Nithiyanandam GT. Nest-site Characteristics and Breeding Biology of the Black Drongo *Dicrurus macrocercus* in Cauvery Delta, Southern India. World Applied Sciences Journal. 2010; 9(11):1280-1285.
3. Ali S. (ed). The Book of Indian Birds. Oxford University Press, Bombay, 2002, 1-402.
4. Ali S, Ripley SD. Handbook of the Birds of India and Pakistan. Oxford University Press, New Delhi, India, 1998.
5. Asokan S, Ali AMS, Manikannan R. Diet of three insectivorous birds in Nagapattinam District, Tamil Nadu, India – a preliminary study. The Journal of Threatened Taxa. 2009; 1(6):327-330.
6. Dhindsa MS, Saini HK. Agricultural ornithology: an Indian perspective. Journal of Biosciences. 1994; 19:391-402.
7. Galbraith H. Effects of egg size and composition on the size, quality and survival of Lapwing (*Vanellus vanellus*) chicks. Journal of Zoology. 1988; 214:383-398.
8. Gomes VSM, Correia MCR, Lima HA, Alves MA. Potential role of frugivorous birds (Passeriformes) on seed dispersal of six plant species of a resting habitat, Southeastern Brazil. Revista de biologia tropical. 2008; 56(1):205-216.
9. Grewal B. Birds of the Indian subcontinent. Local colour limited, Hongkong, 2000, 213.
10. Hussell DJT, Quinney TE. Food abundance and clutch size of Tree Swallows. Imprint of the Haworth Press Inc, New York, London, 1987.
11. Joshi PP. Assessment of Avian Population in different habitats around Amolakchand Mahavidyalaya campus, Yavatmal, Maharashtra, India. Journal of Global Biosciences. 2015; 4(5):2244-2250.
12. Kaur G, Kler TK. Feeding behaviour and perching preferences of Black Drongo (*Dicrurus macrocercus*) in Ludhiana district (Punjab). Journal of Entomology and Zoology Studies. 2018; 6(4):232-239.
13. Kaur S, Kler TK, Javed M. Abundance and diversity of

water bird assemblages in relation to village ponds in Punjab. Journal of Entomology and Zoology Studies. 2018; 6(1):1375-1380.
14. Kler TK, Kumar M. Prevalence of bird species in relation to food habits and habitat. Agricultural Research Journal. 2015; 52(1):50-53.
15. Krapu GL. The role of nutrient reserves in Mallard reproduction. Auk. 1981; 98:29-38.
16. Lammers W, Collopy MW. Effectiveness of avian predator perch deterrents on electric transmission lines. Journal of Wildlife Management. 2007; 71(8):2752-2758.
17. Mariappan N, Kalfan BKA, Krishnakumar S. Assessment of Bird Population in Different Habitats of Agricultural Ecosystem. International Journal of Scientific Research in Environonmental Science. 2013; 1(11):306-316.
18. Narayana BL, Rao VV, Pandiyan J. Foraging Behaviour of Black Drongo (*Dicrurus macrocercus*) in Nalgonda District of Andhra Pradesh, India. The Bioscan. 2014; 9(2):467-471.
19. Nath NK, Das JP, Singha H, Sahu HK. Habitat preference by drongos (Dicruridae): A study conducted during non-breeding season in Kakoijana (proposed) Wildlife Sanctuary, Assam, India. Indian BIRDS. 2016; 10(6):64-68.
20. Ndithia H, Perrin MR, Waltert M. Breeding biology and nest site characteristics of the Rosy-faced Lovebird (*Agapornis roseicollis*) in Namibia. Ostrich. 2007; 78(1):13-20.
21. Okosodo EF, Orimaye JO, Odewumi OS. Diet and Foraging Ecology of Fork Tailed Drongo (*Dicrurus adsimilis*) in Leventis Foundation Nigeria, Agricultural School South West Nigeria. International Journal of Agricultural Environmental and Biotechnology. 2016; 1(2):252-256.
22. Pidgeon AM, Radeloff VC, Mathews NE. Landscape scale patterns of Black-throated Sparrow abundance and nest success. Journal of Applied Ecology. 2003; 13:530-542.
23. Powell LL, Cordeiro NJ, Stratford JA. Ecology and conservation of avian insectivores of the rainforest understory: A pantropical perspective. Biological Conservation. 2015; 188:1-10.
24. Radhakrishnan P. Studies on nest characteristics, nest-site selection and egg morphometry of selected birds in and around Mayiladuthurai, Tami Nadu. M.Phil Thesis, Bharathidasan University, Trichy, 2006.
25. Rajashekara S, Venkatesha MG. Insectivorous bird communities of diverse agro-ecosystems in the Bengaluru region, India. Journal of Entomology and Zoology Studies. 2014; 2(5):142-155.
26. Santisteban L, Sieving KE, Avery AL. Use of sensory cues by Fish Crows (*Corvus assifragus*), preying on artificial birds nests. Journal of Avian Biology. 2002; 33:245-252.
27. Shukkur EAA, Joseph KJ. Breeding biology of the Black Drongo. The Journal of the Bombay Natural History Society. 1978; 75:1205-1211.
28. Sidhu SK, Kler TK. Avian composition and damage assessment in guava fruit crop at Punjab. Journal of Entomology and Zoology Studies. 2018; 6(2):2422-2426.
29. Skutch AF. The nest as a dormitory. Ibis. 1960; 103:50-70.
30. Sokal RR, Rohlf FJ. Biometry. WH Freeman and Company, New York, 1981.
31. Stadelman WJ, Cotterill OJ. (ed). Egg Science and Technology. An Imprint of the Haworth Press Inc, New York, London. 1995, 1-590,
32. Verner J. Assessment of counting techniques. Current Ornithology. 1985; 2:247-302.