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Some notes on breeding behaviour of Brown-backed Indian Robin *Copsychus fulicatus cambaiensis* (Latham, 1790) in agricultural landscape of Punjab

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ABSTRACT

During the breeding seasons 2017-2020, breeding activities of the Brown-backed Indian Robin, *Copsychus fulcatus cambaiensis* were studied for eight clutches laid in three nests built in the northern semi-urban outskirts of Khanna city in Punjab. Observations on nest building, incubation time-budgeting, hatching, growth, parental provisioning frequency, removal of fecal sacs, and fledging of young ones were inferred from video-records totaling 316.47 hours, direct field observations, photographs and nest visits. These nesting cycles extended from March to July. The breeding pairs built oval cup shaped nests and the shortest diameter, longest diameter and depth measured on average 5 cm, 6 cm and 4.5 cm respectively. The clutch size was 2 eggs (n=3), 3 eggs (n=3) and 4 eggs (n=2) and the mean egg length, breadth and weight measured 19.77±0.86 mm, 14.57±0.30 mm and 2.23±0.16 gm respectively (n=16). The eggs were laid in morning hours before 8:00 am and the incubation period was recorded 11 or 12 days (mean: 11.5 days, n=6). Review of the video records of 127.83 hours diurnal total observation time (TOT) recorded over 10 consecutive days (between 5:00 am – 8:00 pm each day) of full incubation at the focal nest revealed that the female invested 55.47 hours (43.39% TOT) and 72.36 hours (56.61% TOT) as attentive periods and inattentive periods respectively. Hatching was completed synchronously in one or two successive days except for a single three-egged clutch with its youngest chick hatching asynchronously on the third successive day. During the nestling phase of 12 – 15 days, eyes of the altricial chicks opened on 8th day after hatching and approaching the day-12, the chick appeared fully feathered. Food provisioning was biparental and in TOT of 184.14 hours referable to 14 days of nestling life, male and female IR contributed a total of 1652 feeding visits at the nest, 878 (53.15%) and 774 (46.85%) feeding visits respectively at a rate of 8.97 visits per hour. The chicks were fed predominantly the grasshoppers and insect eggs, moths and occasionally the caterpillars and young lizards. Over the nestling phase the daily proportion of fecal sacs swallowed by parents decreased with a reciprocal increase in proportion of fecal sacs disposed of by parents. Of the total 490 fecal sacs handled by the parents, 150 (30.61%) were swallowed and 340 (69.39%) were disposed of away from the nest. A hatching success of 85.71% and fledging success of 94.44% were recorded in the study.

Key-words: *Indian Robin, Egg-laying, Incubation, Parental provisioning, Fecal sacs, Breeding.*

Introduction

The Indian Robin *Copsychus fulicatus* is a small Passerine bird referable to the Family Muscicapidae. It is a wide spread resident bird in India and there exists four different subspecies on basis of minor

differences in size and colouration of back (Ali, 1941; Whistler, 1941; Ali and Ripley, 1987). The subspecies named as the Brown-backed Indian Robin (hereafter referred to as BIR) *Copsychus fulicatus cambaiensis* extends from Pakistan to North and North-west India and lowlands of Nepal (Ali and Ripley, 1987; Clements *et al*., 2019). It occurs in dry stony areas with scrub, cultivation edges and in vicinity of human habitations (Grimmett and Inskipp, 2010; Manakadan *et al*., 2011; Arlott, 2014). The male BIR is dark brown above with a white wing patch, tail black and undersurface is blue-black with chestnut vent whereas the Female BIR lacks wing patch and is grey-brown below (Ali and Ripley, 1987). It feeds chiefly on insects and their larvae (Ali, 1941; Whistler, 1941; Ali and Ripley, 1987) and as an insectivorous bird, it is a component of the bird assemblage associated with agricultural landscapes/crops in India (Kaur *et al*., 2017; Kumar and Sahu, 2020). The insectivorous and predatory birds are considered useful to agriculture since they play a role in suppressing the population of insect and rodent pests, but there exists a dearth of studies to explore the role of birds in agriculture (Dhindsa and Saini, 1994; Kirk *et al*., 1996; Hussain and Afzal, 2005; Kale *et al*., 2014; Garfinkel and Johnson, 2015; Laxmi Narayana *et al*., 2015; Nyffeler *et al*., 2018).

The earlier studies on Indian Robin include estimation of egg-laying times (Sethi *et al*., 2010), spectral analysis of sounds (Kumar, 2011; Rajashekhar and Vijaykumar, 2015), observations on breeding behaviour (George, 1963; Shanbhag and Gramopadhye, 1996; Nirmala and Vijayan, 2003; Kumar, 2012; Wickramasinghe *et al*., 2019) and general observations on behavior (Das *et al*., 2017). Brief notes on egg-laying in babblers nest (Field, 1902), nest fidelity (Naik, 1963), biparental feeding (George, 1961; Shanbhag and Gramopadhye, 1996), abnormal clutch size (Javed, 1990) and unusual foraging in fluorescent light (Bharos, 1997) have been documented by respective workers. The information on egg morphometry, incubation time budgeting, parental provisioning frequency, nest sanitation and photographic accounts are not adequately represented in previous studies.

The information on the critical nesting parameters (clutch size, incubation period and nestling period) is available only for one third of the all extant species of birds world over and the bird life history strategies often vary among habitat types (Xiao *et al*., 2017). Studies on the breeding behaviour of birds are vital for improving and enriching information about avian life-history theory and also for devising of effective management and conservation strategies (Maurício *et al*., 2013). During and after the period of the Green Revolution, the local environment/agricultural landscape of Punjab has undergone enormous changes due to intensification of agricultural practices, urbanization and other anthropogenic factors. Presently, it is primarily an agrarian state with only 5.20 percent area under forest cover (Grover *et al*., 2017). Like most of the other avian taxa, despite being associated with agricultural landscapes/crops as an insectivorous bird in Punjab (Kaur *et al*., 2017; Kumar and Sahu, 2020), the breeding aspects of nesting, incubation, hatching, feeding and other behavior of BIR remains poorly understood in the agricultural landscape of Punjab. Based on detailed video-records, the present study is the first ever attempt to gather information on breeding behavior of BIR in agricultural landscape of Punjab.

Materials and Methods

The nesting sites/nests were found on basis of the behavioural clues of the breeding pairs. Two of the nest sites were found in the beginning of nest building and one site was found prior to onset of the second clutch at that site. All the three nesting sites were located in the northern semi-urban outskirts of Khanna city in Punjab. The study region was thinly populated residential area with mixed vegetation in/around open unoccupied plots, community parks and adjoining agricultural fields. The climate of study area is typical of Punjab plains, quite hot in summer and sufficiently cold in winter. The insect fauna dwelling on the wild/cultivated vegetation in the habitat served as a dominant food source for successful breeding of Indian Robin. A total of seven breeding attempts were closely monitored till the nest/clutch failure or fledging for making observation on breeding behavior of the Indian Robin. Once recorded, a nest was visited at least once daily. Except for a single egg and nest data collection visit that lasted for less than 5 minutes during an inattentive period, we quickly took a glance/photograph of the nesting site spending few seconds during subsequent field visits, making our visits oblivious to the birds and care was taken not to disturb the bird/chicks in the nest (Phillips *et al*., 2007). During egg laying and hatching period the nests were vis-

ited more frequently. Field photography was done using a Canon 60d DSLR camera fitted with 70-25mm telephoto lens.

The Site-3 Nest, built in a partly opened ventilation window Latitude: 30°43'20.38" N & Longitude: 76°13'14.05" E in entry porch of a house that hosted a total of 04 clutches (Table 1) was considered as a focal nest and all the nest activities were video recorded for 316.47 hours during Clutch-II (2019). The attentive and inattentive periods (Podulka *et al*., 2004; Wang and Beissinger, 2011; Liang *et al*., 2018) during incubation, and food provisioning/ disposal of fecal sacs by parents during nestling period were video recorded using a Hikvision IR Network Camera with inbuilt-SD Card (64GB) installed at appropriate distance from the nest. Video-monitoring of nests has become a very useful tool for documenting behavioural data without causing any damage and disruption at the nest (Sabine *et al*., 2005; Cox *et al*., 2012; Jiang *et al*., 2016). Direct continuous observations are not possible in case of secretly built nests. Moreover, in comparison to direct observations, the technique records detailed, continuous and natural behavior as the birds are oblivious to the camera and data can be reviewed as desired.

Nest and egg measurements were made with Digital Vernier Caliper (Range 01-15 cm, Least Count 0.01 mm), a 12" ruler, SF-400C Digital Weighing Scale (Least Count 0.01 mg) and a Global Positioning System. Field observations on IR behavior were also made using Olympus 10X50 DPS Binoculars. Egg Weight (W) was done after completion of the clutch. From two linear egg dimensions, maximum length (L) and maximum breadth (B), Fresh Egg Weight (W_f) within 2% and Egg Volume (V) were determined using the equations, $W_f = [K_w] \times [LB^2]$ and $V = [0.51] \times [LB^2]$ given by Hoyt (1979), where $K_w = 0.530$ was the Species-Specific Weight Coefficient calculated from Schönwetter (1960-67). Egg Shape Index [ESI= (B/L) x100] was determined as per Stadelman and Cotterill (1995).

In the present study, Incubation Period (I.P) was taken as the number of days between laying to hatching of the last egg in a clutch (Kendeigh, 1963; Wesley, 2004; Wickramasinghe *et al*., 2019) and Nestling Period (N.P) as the number of days between hatching and fledging for each individual nestling in a brood (Vyas, 2010; Kumar, 2012; Kouba *et al*., 2015). We defined the Egg Laying Period (ELP), Hatching Period (H.P) and Fledging Period (F.P) as the number of successive days for completion of respective event. The Nesting Period was the interval from laying of the first egg to fledging of the last chick of a brood (Vyas, 2010). Details about nest building, egg-laying, incubation, hatching, food and feeding frequency, nest sanitation, general growth, and fledging were inferred from video-records (316.47 hours referable to 25 days), photographs and direct observations.

Observations and Results

Nest Sites and Nest Building: The nesting sites monitored during the present study (Plate 1) included the structures in the residential premises adjoining open habitat around agricultural fields and unoccupied vacant plots. Sites like the partially opened ventilation windows (02) and wall hollow meant for installation of electricity meter (n=1) in entry porch of a house were preferred for nest building. Both the sexes contributed material for building oval cup shaped nests placed in the farthest sill corners of these sites. However, the female BIR played a dominant role in bringing nest material. Many a times during nest building period, the male BIR was seen just accompanying the female to the nest site empty handed or was busy making loud calls while perching atop the electrical poles and marking their territorial claims. The nest measurements viz., maximum diameter, minimum diameter, depth and height above ground level varied from 5.5 cm-6.0 cm, 4.0 cm – 5.0 cm, 4.0 cm – 4.5 cm and 1.9 m-2.0 m respectively. The entrance of the nesting site was not oriented towards a specific direction. Building of nest cup was completed within 8-10 days before commencement of egg laying. However, the camera recordings revealed that occasional addition of nesting material by female alone (n=20) continued during the incubation period as well.

The nest material used included thin dried rootlets, grass twigs, dried leaves of *Polyalthia longifolia* and *Melia azedarch*, pliable broomcorn fibres, feathers, human hair, nylon threads, cotton pieces, snake slough pieces, ashes of burnt grass etc. Of the nest materials, the thin pliable fibres and hair were used to form the inner lining of the nest cup, whereas, the relatively coarser twigs were used in the outer layers of the nest cup and the crude platform below the cup. BIR female did not use the pieces of snake slough as a structural component of the nest cup or platform but placed these fragments along the inner lining of the cup and in between the eggs partly cov-

Fig. 1.1: Female IR with Nest Material

Fig. 1.2: Nesting Site-1 (Year: 2017)

Fig. 1.3. Nesting Site-1, Nest for Clutch-II

Fig. 1.4. Nesting Site-1, Nest for Clutch-III

Fig. 1.5. Nesting Site-3 (Years: 2019 & 2020)

Fig. 1.6. Nesting Site-3, Nest Cup for Clutch-I, II

Plate 1. Nesting Sites and Nest Materials of Brown-backed Indian Robin

ering them during or/and immediately after the egg-laying period. During initial days of incubation, sitting in the nest the BIR female was observed squatting and rotating its body in nest cup, apparently making an effort to shape the inner lining of nest cup. Showing an unusual nesting behavior, the BIR pair did not build any nest cup at Site-1 for clutches-1 and II (2017), and the eggs were laid directly on the crude platform of nest material (Fig. 1.3). However, the pair build a nest cup for the third consecutive clutch, as the nest material was removed by the owners after the clutch-II fledged successfully. Site-3 was previously occupied by a pair of Laughing Doves in 2018 and 2019 and was subse-

quently occupied by BIR pair in breeding season 2019. The contents of dove's nest were not disturbed and the BIR pair built its nest cup at the common sill platform. The pair was seen contributing fresh nest material to the old nest built in 2019 for a period of six days before the start of egg-laying in the year 2020.

Egg Laying and Incubation: In the study area the breeding season of BIR extended from March to July. A total of 08 clutches laid in 03 nests (Table 2) were monitored for making observation on egg laying, hatching, feeding and fledging of the chicks in the breeding seasons 2017 – 2020. Egg lying generally began with completion of the nest cup and the eggs were laid in the morning hours (between 5:00am to 8:00am) at a rate of one egg per day (24 hours apart). The clutch size varied from 2 to 4 eggs and accordingly, the egg-laying period also ranged from 2 to 4 successive days.

The eggs were elliptical in shape with ground colour creamish and surface variably marked with ill-defined dark brown blotches and specks (Fig. 2.1). The eggs of Clutch-II at Site-1 showed variation with regard to ground colour and distribution of surface markings (Fig. 2.2). The egg length and breadth (n=16) gave mean values of 19.77±0.86 mm and 14.57±0.30 mm respectively (Table 1). The mean egg weight (W) at completion of clutch and mean fresh egg weight (W_f) as determined by the equation $W_f = [K_w] \times [LB^2]$ were 2.24±0.18 gm and 2.23±0.16 gm respectively. The mean values of egg shape index (Stadelman and Cotterill, 1995) and volume (Hoyt, 1979) were calculated 73.84±3.04 and 2.14±0.15 cm^3 respectively.

Incubation was synchronous and uniparental. Full incubation (Wang and Beissinger, 2011) started with completion of the clutch and was solely performed by female BIR through day and night. Partial incubation was recorded on day of laying the egg in case of three or four egged clutches. The night stays of female BIR in nest started from the day of laying the second egg and continued till late in the nestling period. During egg laying period the female BIR continued to add some nest material like snake slough and feathers, and kept the eggs partly concealed and covered (Fig. 6.1) under this material (n=3). Presence of intruders like Rock pigeon *Columba livia*, Common myna *Acridotheres tristis* and Greater coucal *Centropus sinensis* within four meters of the nest faced harsh alarm calls produced by the

Table 1. Egg Measurements of Some Clutches of Brown-backed Indian Robin

Nest/Clutch/ Breeding Season	Eggs	L(mm)	B(mm)	W(g)	W_f(g)	ESI(B/L) ×100	Volume ($0.51 \times LB^2$) (cm^3)
Site-1: Electric Meter Box in	E1	18.87	14.54	1.99	2.11	77.05	2.03
Entry Porch of a House/	E2	18.36	14.71	1.96	2.11	80.12	2.03
Latitude: 30°43′17.57" N	E3	19.48	14.55	2.08	2.19	74.69	2.10
Longitude: 76°13′13.25" E							
Second Clutch-2017							
Site-3: Partly Opened	E1	20.00	14.41	2.24	2.20	72.05	2.12
Ventilation Window in	E2	20.29	14.70	2.34	2.32	72.45	2.24
Entry Porch of a House	E3	19.70	14.09	2.15	2.07	71.52	1.99
Latitude: 30°43′20.38" N							
Longitude: 76°13′14.05" E							
First Clutch-2019							
Second Clutch-2019	E1	20.12	14.51	2.22	2.25	72.12	2.16
	E2	19.19	14.04	2.07	2.00	73.16	1.93
	E3	18.74	14.26	2.11	2.02	76.09	1.94
	E4	19.51	14.21	2.21	2.09	72.83	2.01
First Clutch-2020	E1	21.53	14.84	2.42	2.51	68.93	2.42
	E2	21.18	14.80	2.55	2.46	69.88	2.37
	E3	19.77	14.98	2.5	2.35	75.77	2.26
Second Clucth-2020	E1	20.14	14.88	2.3	2.36	73.88	2.27
	E2	18.98	14.91	2.25	2.24	78.56	2.15
	E3	20.42	14.76	2.36	2.36	72.28	2.27
Mean Value		19.77±0.86	14.57±0.30	2.23±0.17	2.23±0.16	73.84±3.04	2.14±0.15

Fig. 2.1: Common Egg Colouration

Fig. 2.2: Variation in Egg Colouration

Fig. 2.3: Egg Incubation by Female BIR

Fig. 2.4: Nest attendance without Incubation

Fig. 2.5: Egg turning by Female BIR

Fig. 2.6: Male BIR in Incubation Posture

Plate 2. Egg Laying and Incubation in Brown-backed Indian Robin

BIR pair and the male BIR even dived at a common myna pair who tried to enter the nest window. Repeated human movement near the nest was perceived as a less likely threat to the nest. In incubation posture, the female body filled the nest cup fully with its breast appressed against the cup walls. It exposed its ventral feathers by lateral swaying of body and leg movements. At times, particularly during incubation in morning hours before sunrise, the female fluffed her feathers fully occupying the nest cup. The incubation period (Kendeigh, 1963) was 11 or 12 days (n=06).

During the incubation period, the earliest morning departures from nest and the latest evening arrivals in nest took place between 5:20am-5:28am and 7:29pm-7:43pm respectively. Hence a period of 15 hours daily (5:00am to 8:00pm) was available for the diurnal activities of BIR pair in the peak breeding months of May and June. At the focal nest (Site-3, Clutch-1, 2019), of the total 150 diurnal hours of full incubation spanning 10 days, video records were made for 127.83 (85.22%) diurnal hours. The review of continuous video records of 127.83 hours total observation time (TOT) recorded over 10 consecutive full incubation days revealed that the incubating female BIR adopted a diurnal rhythm of attentive periods (in the nest) and inattentive periods (off the nest). The female BIR spent 43.39% TOT (55.47 hours) and 56.61% TOT (72.36 hours) as attentive periods and inattentive periods respectively (Table 3). The minimum-maximum duration of attentive and inattentive periods ranged from 0.75-144.65 minutes (n=142) and 1.42-240.27 minutes (n=135) respectively. Contrastingly, on day of partial incubation, the female BIR spent only 19.78% OT (0.89 hours) and 80.22% OT (3.61 hours) as attentive and inattentive periods respectively. The female IBR performed a total of 104 egg turning movements in incubation. During the entire incubation period, the male BIR visited the nest only 11 times, entered the nest cup 5 times and performed 3 egg turnings while staying in nest cup for a total period of only 11 minutes.

Hatching of Chicks: Of the total 08 clutches/23 eggs, 07 clutches/20eggs hatched successfully. A clutch containing two eggs laid at Site-2 was depredated on second day of incubation and a defective egg (Site-1: Clutch-II) failed to hatch. Hatching was synchronous occurring in one or two successive days (within 24 hours) in 04 clutches containing 13 eggs (Table 2). However, in case of 02 three egged clutches (Site-1: Clutch-II; Site-3: Clutch-II, 2020) hatching of the youngest chicks was asynchronous (within more than 24 hours). In case of synchronously hatched four egged clutches (Site-3: Clutch-1 & II, year 2019) and three egged clutch (Site-3: Clutch-I, year 2020) a maximum of 02 chicks hatched on the first day. Typical asynchronous hatching (Clark and Wilson, 1981; Podulka *et al*., 2004; Ardia *et al*., 2006) occurred in case of Site-1, Clutch-II and Site-3, Clutch-II, year 2020 eggs where hatching got completed within more than 24 hours. Video data recorded at the focal nest revealed that the chicks hatched during inattentive periods and the minimum interval between successive hatching of two chicks was 30 minutes. Hatching of an egg started with appearance of a transverse split line in middle of the egg surface (Fig 3.1) that encircled the entire circumference with 9-10 pulsatile jerks made by the hatchling. Within two minutes both the egg shell halves separated from each other. The shell halves were removed from the nest by the parent/s. None of the parents consumed any piece of the egg shell.

During the hatching days, the female IBR also continued to stay in the nest for short attentive periods to attend partial incubation (Wang and Beissinger, 2011) of the 'yet to hatch egg/s' and brooding of hatchling/s simultaneously. Between the feeding visits, the female BIR also performed egg turning movements (n=14) till the completion of hatching. The review of continuous video records of 27.82 hours total observation time (TOT) recorded over 02 consecutive hatching days showed that the female IBR spent 24.74% TOT (7.16 hours) and 74.26% TOT (20.66 hours) as attentive periods and inattentive periods respectively (Table 4). The minimum-maximum duration of attentive and inattentive periods during hatching days ranged from 0.62-32.93 minutes (n=53) and 2.47-224.45 minutes (n=53) respectively. Unlike attentive periods of full incubation, during these attentive periods the female IBR did not adopt the proper incubation posture and most of the time the eggs/hatchlings were partly exposed.

Food Provisioning by Parents: With the beginning of hatching, the male and female IBR started food provisioning visits for the chick/s. The food items brought by the parents included mostly the grasshoppers, spiderlings and ants, occasionally the moths, small butterflies and caterpillars and rarely the young lizards (Fig 5.1-5.6). In fact, the IBR par-

Table 2. Egg –Laying, Hatching, Incubation and Fledging Period of Brown-backed Indian Robin

Nesting Sites	Egg Laying				Hatching				Fledging			Nesting
	Clutch	Egg/s	Date	ELP (Days	Chick	Date	H.P (Days)	I.P (Days)	Date (Days)	N.P (Days)	F.P	Cycle (Days)
Site-I Electric Meter Box in Entry Porch of a House /2017	II	E-1	14.05.17	03	C-1	26.05.17 (10:51am)	03	12	09.06.17	15	02	27
		E-2	15.05.17		C-2	27.05.17 (10:28am)			10.06.17	14		
		E-3	16.05.17		C-3	28.05.17 (6:18am)			10.06.17	13		
	III	E-1	26.06.17	02	C-1	09.07.17	01	12	22.07.17	13	01	26
		E-2	27.06.17		C-2	(9:15am)		Defective egg did not hatch				
Site-3 Partly Opened Ventilation Window in Entry Porch of a House/2019	I	E-1	22.05.19	04	C-1	04.06.19 (07:29am)	02	11	18.06.19(7:37am)	14	01	27
		E-2	23.05.19		C-2	05.06.19 (5:36am)			18.06.19 (7:42am)	13		
		E-3	24.05.19 (6:02am*)		C-3	05.06.19 (6:18am)			18.06.19 (7:53am)	13		
		E-4	25.05.19 (7:29am)		C-4	05.06.19 (7:56am)		Died on 6th dayafter hatching (11.06.19)				
	II	E-1	26.06.19	04	C-1	09.07.19	02	11	23.07.19	14	01	28
		E-2	27.06.19		C-2	09.07.19			23.07.19	14		
		E-3	28.06.19		C-3	10.07.19 (5:50am)			23.07.19	13		
		E-4	29.06.19		C-4	10.07.19 (8:30am)			23.07.19	13		
Site-3 Partly Opened Ventilation Window in Entry Porch of a House/2020	I	E-1	13.04.20 (8:03am*)	03	C1	26.04.20 (7:30am)	02	12	09.05.20	13	01	26
		E-2	14.04.20 (7:24am*)		C2	26.04.20 (9:07am)			09.05.20	13		
		E-3	15.04.20 (7:55am)		C3	27.04.20 (6:03am)			09.05.20	12		
	II	E-1	18.05.20 (3:39pm*)	03	C1	30.05.20 (10:25am)	02	11	14.06.20	15	01	27
		E-2	19.05.20 (6:12am*)		C2	31.05.20 (8:16am)			14.06.20	14		
		E-3	20.05.20 (6:35am*)		C3	31.05.20 (3:30pm)			14.06.20	14		

ELP: Egg-laying Period; H.P: Hatching Period; I.P: Incubation Period; N.P: Nestling Period; F.P: Fledging Period

ents provisioned a blend of distributable and non-distributable food items in the daily supply to the chicks. A distributable item like cluster of spiderlings, termites and ants brought in a single visit were fed to more than one chicks at a time, whereas, a non-distributable food item (a grasshopper, moth, butterfly, caterpillar etc.) was fed only to a single chick at a time. During the hatching days chicks were fed smaller and distributable food items and not the larger ones.

The scrutiny of the video records totaling 184.14 hours TOT referable to 14 days of nestling phase

Fig. 3.1. Initiation of Hatching

Fig. 3.2. One Chick Hatched (Day-1)

Fig. 3.3. Three Chicks Hatched (Day-2)

Fig. 3.4. All the Four Chicks Hatched (Day-2)

Fig. 3.5. Egg Shell Removal by Female BIR

Fig. 3.6. Egg Shell removal by Male BIR

Plate 3. Hatching of Chicks of Brown-backed Indian Robin (Site-3, Clutch-I, 2019)

revealed a total of 1652 feeding visits conducted by the IBR parents (Table 5). In the biparental food provisioning, the male and female IBR conducted 878 (53.15%) and 774 (46.85%) feeding visits respectively at a rate of 8.97 feeding visits per hour. The earliest first feeding visit by female was as early as 5:00am and the endmost visit as late as 7:40pm. The timings for corresponding visits by male IBR were 5:03am and 7:49pm respectively. During the feeding visits, the parent/s never dropped the food in/near the nest cup and never left the nest before the chick/s completely engulfed the food item. Sometimes, when both the parents simultaneously arrived at the nest, one waited for its turn to deliver the food to chicks. During attentive periods in hatching days, when the female IBR was in the nest cup covering

Table 3. Incubation Time Budgeting by Female Brown-backed Indian Robin, Site-3, Clutch-1 (2019), Diurnal Observation Time (OT): 05:00am to 8:00pm

Incubation Day	OT (hours)	Duration of Periods (hours)		Minimum-Maximum Duration (minutes), n= No. of Periods	
		Attentive	Inattentive	Attentive	Inattentive
PID: 24.05.19	4.5	0.89 (19.78% OT)	3.61 (80.22% OT)	13.17 - 23.63 (n=03)	24.70 - 165.83 (n=03)
FID-1: 25.05.19	15	8.44 (56.27% OT)	6.56 (43.73% OT)	3.00 - 93.22 (n=10)	15.07 - 122.28 (n=09)
FID-2: 26.05.19	15	8.44 (56.27% OT)	6.56 (43.73% OT)	1.00 – 144.65 (n=15)	4.82 – 58.17 (n=14)
FID-3: 27.05.19	15	6.03 (40.20% OT)	8.97 (59.80% OT)	1.00 – 43.37 (n=20)	11.48 – 60.30 (n=19)
FID-4: 28.05.19	15	6.83 (45.53% OT)	8.17 (54.47% OT)	2.12 – 49.42 (n=21)	4.68 – 58.95 (n=20)
FID-5: 29.05.19	1.83	0.95 (51.91% OT)	0.88 (48.09% OT)	6.33 – 21.18 (n=05)	5.27 – 13.68 (n=05)
FID-6: 30.05.19	12.27	4.30 (35.05% OT)	7.97 (64.95% OT)	4.35 – 42.67 (n=14)	2.68 – 154.67 (n=14)
FID-7: 31.05.19	12.58	5.91 (46.98% OT)	6.67 (53.02% OT)	1.48 – 87.42 (n=14)	17.22 – 69.45 (n=13)
FID-8: 01.06.19	11.15	2.70 (24.22% OT)	8.45 (75.78% OT)	0.75 – 35.13 (n=11)	13.95 – 240.27 (n=10)
FID-9: 02.06.19	15	6.21 (41.40% OT)	8.79 (58.60% OT)	1.78 – 119.85 (n=13)	1.42 – 84.23 (n=13)
FID-10: 03.06.19	15	5.66 (37.73% OT)	9.34 (62.27% OT)	0.92 – 57.32 (n=19)	2.47 – 64.93 (n=18)
Total 10 FIDs	127.83	55.47 (43.39% TOT)	72.36 (56.61%)	0.75 – 144.65 (n=142)	1.42 – 240.27 (n=135)
Total 11 Days	132.33 (TOT)	56.36 (42.59% TOT)	75.97 (57.41% TOT)	0.75 – 144.65 (n=145)	1.42 – 240.27 (n=138)

Table 4. Nest Attendance by Female Brown-backed Indian Robin During Hatching Days

Hatching Day	Site-3, Clutch-I (2019) Diurnal Observation Time (OT): 05:00am to 8:00pm				
	OT (hours)	Duration of Periods (hours)		Minimum-Maximum Duration (minutes), n= No. of Periods	
		Attentive	Inattentive	Attentive	Inattentive
04.06.19	12.82	3.85 (30.03% OT)	8.97 (69.97% OT)	0.62 – 32.93 (n=25)	2.47 – 52.85 (n=26)
05.06.19	15	3.31 (22.07% OT)	11.69 (77.93% OT)	0.85 - 27 (n=28)	5.48 – 224.45 (n=27)
Total 02 Days	27.82 (TOT)	7.16 (25.74% TOT)	20.66 (74.26% TOT)	0.62 – 32.93 (n=53)	2.47 – 224.45 (n=53)

the chicks under her body, the male IBR handed over the food items to the female for onward delivery to chicks (n=2).

Consumption and Disposal of Fecal Sacs by Parents: The IBR chicks also produced their excrement encapsulated in the form of whitish mucosal sacs. The release of fecal sacs by chicks followed the act of feeding by the parents. After receiving food from parent's bill, the voiding chick raised its cloacal end upwards and the parent directly grasped the fecal sac on its bill not allowing any littering of the nest interiors. In the second half of the nestling phase, the defecating chick used to reverse its position inside the nest cup to bring its vent near the parent's

Plate 4. Growth of Chicks of Brown-backed Indian Robin (Site-3, Clutch-I, 2019)

Fig. 4.1. Day-3: 06.06.2019

Fig. 4.2. Day-6: 08.06.2019

Fig. 4.3. Day-8: 11.06.2019

Fig. 4.4. Day-12: 15.06.2019

Fig. 4.5. Day-15: 18.06.2019

Fig. 4.6. Fledgling on Day-15

bill. The review of video records totaling 184.14 hours TOT referable to 14 days of nestling phase (Table 6) revealed that the IBR parents handled a total of 490 fecal sacs (male: 279/56.94% and female:211/43.06%) produced by the chicks. Out of these, 340 (69.39%) fecal sacs were disposed of the nest by the parents (male: 190/38.79% and female: 150/30.61%) and 150 (30.61%) fecal sacs were directly swallowed by the parents (male: 89/18.16% and female: 61/12.45%). Over the nestling phase the daily proportion of fecal sacs swallowed by parents decreased with a reciprocal increase in proportion of fecal sacs disposed of by parents. Fecal sacs were bicoloured structures (Fig. 6.4) having a whitish broader portion tapering into a dark end part. With growth of the nestlings, there occurred an increase in size of the fecal sacs. A parent swallowed or disposed of the fecal sacs, one at a time, irrespective of the number of chicks fed during a visit and no two chicks ever produced the fecal sacs simultaneously. The fecal sacs swallowed by parents were of smaller size than those disposed away from the nest. On an average the IBR chicks produced one fecal sac per 3.4 feeding visits conducted by parents. The feeding visits were more frequent during early morning hours (5:00am to 8:00am) but continued throughout the day.

Growth and Fledging of Chicks: The nestling period ranged between 12-15 days (n=18) and the chicks mostly fledged on the same day (Table 2) except for a single clutch (Site-1, Clutch-II) that fledged in two successive days. As the observations made on focal nest, the newly hatched IBR chicks were fully altricial having a woobly neck, large head; eyes large, dark, closed and bulging against eyelids. The skin was totally naked, thin and blackish-brown (Fig. 3.4). The mouth was marked with yellowish flanges and orange interior lining. The flat and triangular bill was broader at base and tapered towards its tip. **By day-6 day** dark feather papillae of capital, humeral and dorsal tracts made their appearance and the alar feathers started unsheathing along the wing margin (Fig. 4.2). Approaching the day-8, the eyes were fully opened, head was almost covered with unsheathing feathers and the body gained a purplish gloss (Fig. 4.3). By day-12, the chicks were fully feathered and quite active in the nest. Now they were quite alert to the arrival of parent/s in the nest and performed begging movements by extending their necks beyond the nest rim. The female IBR stayed in nest during nights till day-12. The chicks never stepped out of the nest cup till day-13 when they intermittently came out of the nest cup, stretched their wings and also self-preened the wing bases. All the three chicks fledged on day-15, minutes after each other, between 7:37am to

Table 5. Parental Provisioning by Brown-backed Indian Robin (Table 2, N-1, Site-3: Clutch-I, Fledged on 18.06.2019)

Observation Day	OT (hours)	No. of Feeding Visits			Provisioning Rate Feeding Visits/hour		
		Total	Male (% of Total Visits)	Female (% of Total Visits)	Male	Female	Combined
Hatching Days	12.33	33	17 (51.51%)	16 (48.49%)	1.37	1.29	2.57
Day - 1 (04.06.19)							
Day - 2 (05.06.19)	15	100	54 (54%)	46 (46%)	3.6	3.06	6.66
Post-hatching Days	1.78	12	07 (58.33%)	05 (41.67%)	3.93	2.80	6.74
Day - 3 (06.06.19)							
Day - 4 (07.06.19)	13.47	121	67 (55.37%)	54 (44.63%)	4.97	4.00	8.98
Day - 5 (08.06.19)	15	158	85 (53.79%)	73 (46.21%)	5.66	4.86	10.53
Day - 6 (09.06.19)	15	170	92 (54.11%)	78 (45.89%)	6.13	5.2	11.33
Day - 7 (10.06.19)	15	196	109 (55.61%)	87 (44.39%)	7.26	5.8	13.07
Day - 8 (11.06.19)	12.23	118	65 (55.08%)	53 (44.92%)	5.31	4.33	9.64
Day - 9 (12.06.19)	14	129	67 (51.94%)	62 (48.06%)	4.78	4.42	9.21
Day - 10 (13.06.19)	15	123	63 (51.22%)	60 (48.78%)	4.2	4.0	8.2
Day - 11 (14.06.19)	15	120	65 (54.17%)	55 (45.83%)	4.33	3.66	8.0
Day - 12 (15.06.19)	12.83	105	52 (49.52%)	53 (50.48%)	4.05	4.13	8.18
Day - 13 (16.06.19)	15	146	75 (51.37%)	71 (48.63%)	5.0	4.73	9.73
Day - 14 (17.06.19)	12.5	121	60 (49.59%)	61 (50.41%)	4.8	4.88	9.68
Total: 14 Days	184.14	1652	878 (53.15%)	774 (46.85%)	4.76	4.20	8.97

7:53am. The plumage of the fledglings resembled the female BIR. Throughout the nesting phase, the IBR parents maintained complete sanitation in and around the nest cup. They frequently inspected the nest cup base for any remains of food items or faeces. One of the chicks that died on 6th day after hatching was removed from the nest cup by the female BIR on the same day (Fig. 6.5). Interestingly, the BIR female even picked up white camera-card cover from near the nest site and threw it away from the nest. On sensing some danger near the nest, the chicks used to crouch down and become still in the

Plate 5. Some Main Food Items for Chicks of Brown-backed Indian Robin

Fig. 5.1. Grasshoppers

Fig. 5.2. Male IBR with a cluster of spiderlings

Fig. 5.3. Ants

Fig. 5.4. Moths

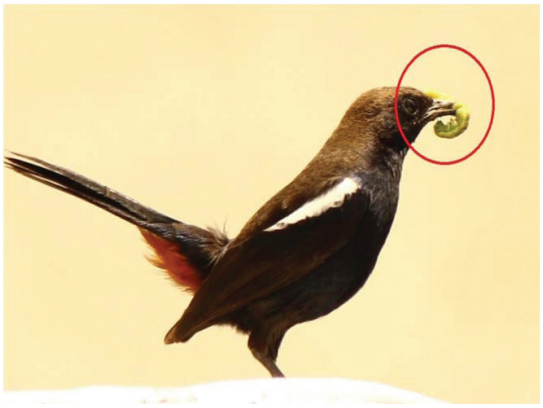

Fig. 5.5. Caterpillars

Fig. 5.6. Young Lizards

nest (Fig. 6.6).

Discussion

Despite being a common and widespread species in Punjab, no study has been made to investigate the adequate details of the breeding behavior of BIR. On a regional level, based on video records totaling 316.47 hours, direct observations, photographs and nest visits, the present study on breeding behavior of BIR brings to light the hitherto unrecorded infor-

Plate 6. Egg Protection and Nest Sanitation

Fig. 6.1. 02 Eggs concealed in Snake Slough

Fig. 6.2. Male delivering food to Female for Chicks

Fig. 6.3: Removal of Faecal Sac by Female IR

Fig. 6.4: Removal of Faecal Sac by Male IR

Fig. 6.5. Removal of Dead Chick from Nest

Fig. 6.6. Crouching behavior of Chicks

mation on nesting, egg laying, incubation time-budgeting, hatching, food provisioning frequency and nest sanitation form the agricultural landscape of Punjab. In the study area the BIR breeding extended from late March to July and is consistent with previous reports on different parts of its range: 'March to July' in Jodhpur, Haridwar and Srinagar (Kumar, 2012) and 'March to August' in North-west India (Ali and Ripley, 1987). The populations of Indian Robin dwelling in other Indian regions are recorded to breed from late February to July except in December to April in humid Kerala (Ali and Ripley, 1987). The subspecies, *Copsychus fulicatus leucopterus* in Sri Lanka breeds from late February to September (Wickramasinghe *et al*., 2019).

Nesting sites of BIR include the holes on ground, in walls and buildings, plants, rock crevices (Whistler, 1941; Ali and Ripley, 1987); iron-wastage dump near railway (Kumar, 2012) and some unusual nesting sites like an out of use tubewell pipe (Shanbhag and Gramopadhye, 1996); a scooter basket (Das *et al*., 2017) and a post box (Wickramasinghe *et al*., 2019) have also been reported. The novel nesting sites i.e., partly opened windows and wall-hollows made for electricity meters are worth recording and seem to be a nesting adaptation in the rapidly changed habitat scenario. In the agricultural landscape of Punjab, the human habitations near the agricultural lands and the adjoining uncultivated plots with wild vegetation are presenting healthy breeding sites for BIR. The BIR generally builds a cup shaped nest (Fig. 1.6) using a variety of materials including rootlets, thin and pliable grass twigs, dried leaves, feathers, broom fibres, and uses human hair, nylon threads and snake slough as lining material. Ali and Ripley (1987) mentioned a nest of Indian

Table 6. Removal of Chick Faecal Sacs by Brown-Backed Indian Robin
(Table 2, Site-3: Clutch- I, Fledged on 18.06.2019)

Observation Day	OT (hours)	No. of Faecal Sacs			Role of BIR Parents					
					Male			Female		
		Total	Consumed by Parents	Disposed by Parents	Total	Consumed	Disposed	Total	Consumed	Disposed
Hatching Days Day - 1 (04.06.19)	12.33	03	03 (100%)	nil	03 (100%)	03	nil	nil	nil	nil
Day- 2 (05.06.19)	15	24	24 (100%)	nil	18 (75%)	18	nil	06 (25%)	06	nil
Post-hatching Day -3 (06.06.19)	1.78	07	06 (85.71%)	01 (14.29%)	04 (57.14%)	03	01	03 (42.86%)	03	nil
Day - 4 (07.06.19)	13.47	39	34 (87.17%)	05 (12.83%)	27 (69.23%)	24	03	12 (30.77%)	10	02
Day- 5 (08.06.19)	15	51	31 (60.78%)	20 (39.22%)	28 (54.90%)	16	12	23 (45.10%)	15	08
Day- 6 (09.06.19)	15	54	12 (22.22%)	42 (77.78%)	31 (57.41%)	07	24	23 (42.59%)	05	18
Day- 7 (10.06.19)	15	67	17 (25.37%)	50 (74.63%)	41 (61.19%)	08	33	26 (38.81%)	09	17
Day- 8 (11.06.19)	12.23	35	07 (20%)	28 (80%)	20 (57.14%)	02	18	15(42.86%)	05	10
Day- 9 (12.06.19)	14	43	06 (13.95%)	37 (86.05%)	25 (58.14%)	04	21	18(41.86%)	02	16
Day- 10 (13.06.19)	15	32	04 (12.50%)	28 (87.50%)	18 (56.25%)	01	17	14(43.75%)	03	11
Day- 11 (14.06.19)	15	25	02 (8%)	23 (92%)	12 (48%)	01	11	13(52%)	01	12
Day- 12 (15.06.19)	12.83	31	02 (6.45%)	29 (93.55%)	15 (48.39%)	01	14	16(51.61%)	01	15
Day- 13 (16.06.19)	15	46	02 (4.35%)	44 (95.65%)	23 (50%)	01	22	23(50%)	01	22
Day- 14 (17.06.19)	12.5	33	nil	33 (100%)	14 (42.42%)	nil	14	19(57.58%)	nil	19
Total: 14 Days	184.14	490	150 (30.61%)	340 (69.39%)	279 (56.94%)	89	190	211(43.06%)	61	150

Robin made entirely of human hair. In the present study, BIR did not build a nest cup for laying first two clutches at Site-1 (2017). Rather it used a flat platform made from bulk of ashes of burnt grass, some rootlets, dried twigs and snake slough (Fig-1.3). Site-3 was previously occupied by a pair of laughing doves (*Streptopelia senegalensis*) who had raised three successful broods in years 2018 and 2019. BIR did not remove any material from the dove's nest and made a nest cup on the same site just adjacent the old nest. Field (1902) recorded the use of a Jungle Bush Babbler's nest by Indian Robin. Though the nest material is contributed by both the male and female, occasional addition of cup lining material like thin fibres and snake slough continued by the female BIR even during the incubation period. Also between the multiple broods in the same nest, the fresh lining material was added in the nest.

The previous studies (Shanbhag and Gramopadhye, 1996; Ali, 1941; Whistler, 1941; Ali and Ripley, 1987) mentions presence of snake slough in nest cup. The choice of suitable nest material is an important attribute of bird life history and it influences breeding success (Hansell, 2000). Many species of birds incorporate snake slough as a component of their nest materials (Strecker, 1926; Medlin and Risch, 2006; Trnka and Prokop, 2011). Medlin and Risch (2006) conducted an experimental study on Great Crested Flycatchers (*Myiarchus crinitus*) and asserted that the presence of a snake skin in a nest box reduces the likelihood of predation, thus flycatchers and other species may have evolved the behavior of including snake skins as 'scarecrows' to deter predation. Contrarily, Trnka and Prokop (2011) suggested that snake skins in Great Reed Warbler (*Acrocephalus arundinaceus*) nests do not influence predation rate but may serve as a post-pairing signal revealing female parental quality. During the course of present study, it was observed that BIR female placed snake slough fragments in between and around the eggs, during or/and immediately after the egg-laying period. A smooth and pliable lining of the nest cup prevented possible injury to nest contents from the coarser outer material (Hansell, 2000). The other possible role may be in thermoregulation of the nest contents. Further, the regular inspection of the nest cup revealed that most of these fragments were gradually crushed into finer particles in the course of incubation period and nestling phase due to movements of the female BIR/eggs/chicks inside the nest cup. Obviously, there may have occurred a sort of dusting of the nest contents with a thin layer of powered snake slough. The present study speculates that the snake slough is added to the nest cup by BIR not as a 'scarecrow' to deter the predators but possibly as a means to ensure chemical protection of nest contents (eggs/altricial chicks) against

Table 7. Feeding Visits and Faecal Sac Production in Brown-backed Indian Robin (Table-2, Site-3: Clutch- I, Fledged on 18.06.2019)

Observation Day	OT (hours)	No. of Feeding Visits by Parents	No. of Faecal Sacs Produced by Chicks	Feeding Visits/ Faecal Sac
Hatching Days Day - 1 (04.06.19)	12.33	33	03	11.0
Day - 2 (05.06.19)	15	100	24	4.2
Post-hatching DaysDay -3 (06.06.19)	1.78	12	07	1.7
Day - 4 (07.06.19)	13.47	121	39	3.1
Day - 5 (08.06.19)	15	158	51	3.1
Day - 6 (09.06.19)	15	170	54	3.1
Day - 7 (10.06.19)	15	196	67	2.9
Day - 8 (11.06.19)	12.23	118	35	3.4
Day - 9 (12.06.19)	14	129	43	3.0
Day - 10 (13.06.19)	15	123	32	3.8
Day - 11 (14.06.19)	15	120	25	4.8
Day - 12 (15.06.19)	12.83	105	31	3.4
Day - 13 (16.06.19)	15	146	46	3.2
Day - 14 (17.06.19)	12.5	121	33	3.7
Total: 14 Days	184.14	1652	490	3.4

the predators and pathogens more particularly during the nestling phase. The possible adaptive role of snake slough in BIR nests as a 'repellant and antimicrobial agent' and as a means of thermoregulation needs to be investigated.

The birds that reproduced successfully at a particular site are more likely to return at the same site (Powell and Frasch, 2000). At site-1, the BIR pair raised 03 consecutive clutches in 2017 and at site-3, two clutches each during the years 2019 and 2020. Located in the residential premises, these nesting sites were protected from direct sun, wind, rain and predators. Moreover, the frequent non-interfering human movement near the nest proved to be a savior against the predators. The nesting adaptations in/near residential premises apparently have survival value for the species as the chances of predation at human habitations are often much reduced (Adeyanju *et al*., 2013).

The mean clutch size (2.88±0.83 eggs, range 2-4, n=8) broadly conforms to the comparable value (2.92±0.3 eggs, range 2-4, n=12) recorded by Kumar (2012) from northern localities. The mean values of egg length and breadth were (19.77±0.86 mm, n=16) and (14.57±0.30 mm, n=16) respectively. As per Whistler (1941) and Ali and Ripley (1987) the egg measured 20.06×14.98 mm and 21.1×14.9 mm respectively. The mean values of clutch size, egg length and breadth for the Sri Lankan subspecies, *Copsychus fulicatus leucopterus*, are (2.68±1.3 eggs, range 2-4, n=13), (20.69±0.37 mm, n=13) and (14.05±0.83mm, n=13) respectively (Wickramasinghe *et al*., 2019). Conclusively, the values reflect the egg breadth as an overall consistent attribute amongst the egg parameters. The loss of water vapours from egg surface starts immediately after its laying and hence, the fresh weight of an egg can only be determined at the time of laying (Hoyt, 1979). A comparison of the mean egg weight (2.23±0.17 gm, n=16) measured a day after completion of clutch and mean fresh egg weight (2.23±0.16 gm, n=16) determined from linear dimensions indicates practically no loss of water from the eggs during the egg laying period. This may be due to the sheltered placement of the nests away from direct sun and wind.

The mean incubation period of BIR (*Copsychus fulicatus cambaiensis*) in the present study from Punjab was 11.5 days (n=6) whereas Kumar (2012) recorded mean incubation period of 10 days (n=8) from northern localities of Jodhpur, Haridwar and Srinagar. In south India, the Blackbacked Indian Robin (*Copsychus fulicatus fulicatus*) incubates the eggs for 11 or 12 days (Ali and Ripley, 1987) and in Sri Lanka, the Indian Black Robin (*Copsychus fulicatus leuscopterus*) for 14 days (Wickramasinghe *et al*., 2019). Variation in avian incubation period is caused by environmental factors and behavior of incubating parents (Álvarez and Barba, 2014; Ricklefs *et al*., 2017). During full incubation days, the female BIR spent 43.39% TOT (55.47 hours) and 56.61% TOT (72.36 hours) as attentive periods and inattentive periods respectively (Table-3).

Amongst 06 successful clutches containing 19 eggs, synchronous hatching (Clark and Wilson, 1981; Podulka *et al*., 2004) was completed in two successive days (within 24 hours) in 04 clutches containing 13 eggs (Table 2). However, in case of 02 three egged clutches (Site-1: Clutch-II; Site-3: Clutch-II, 2020) hatching of the youngest chicks was asynchronous (within more than 24 hours). Asynchronous hatching results from commencement of incubation before the completion of clutch (Ardia *et al*., 2006; Álvarez and Barba, 2014). Hatching mostly took place during cooler morning hours. Only, one of the eggs (Site-1: Clutch-III) failed to hatch and predation of a clutch containing two eggs at site-2 took place on second day of incubation. One of the chicks (Site-3: Clutch-I) died on day-6 after hatching. Consequently, the study recorded a hatching success of 85.71% and fledging success of 94.44%. Both the parents participated in removal of the shell halves from the nest cup. Presence of the egg shell evokes this behavioural response by the parent (Nethersole-Thompson and Nethersole-Thompson, 1942) and the most likely function of this behavior seemed to be the maintenance of the camouflage of the brood (Tinbergren *et al*., 1962).

In the biparental food provisioning, the male and female BIR conducted 878 (53.15%) and 774 (46.85%) feeding visits respectively at a rate of 8.97 feeding visits per hour. Shanbhag and Gramopadhye (1996) documented a higher visit rate of 16-17 visits/hour for an Indian Robin nest located in open field. Disposal of fecal sacs from nests during nestling period is an adaptive trait in the most of Passerine species (Skutch, 1976; Weather-head, 1984; Meyer *et al*., 2015) and many passerines occasionally swallow the faeces produced by their young nestlings as a source of energy (Gluck, 1988; Hurd *et al*., 1991; McKay *et al*., 2009). Out of the total fecal sacs the BIR parents swallowed 30.61% sac

and disposed of 69.39% fecal sacs away from the nest. The nestlings of BIR actively participated in direct removal of the fecal sacs by changing their position in nest cup and raising their cloacae upwards, thus facilitating the parent to grasp the fecal sac directly on its bill without causing any littering of the nest interiors. The clean nests are thought to be less likely to attract predators (Ibáñez-Álamo *et al*., 2014) and direct removal of fecal material prevents nest contamination thus decreasing time and energy consumption on nest sanitation (Ibáñez-Álamo *et al*., 2013). Protection from predators and availability of more time and energy for food provisioning by parents may help in enhancing the breeding success.

Conclusion

BIR is a common insectivorous bird and plays an important ecological role as a component of bird community associated with the cultivated and wild vegetation adjoining rural and semi-urban settlements in the agro-ecosystem of Punjab. As a biological control agent it helps in suppressing the growth of insect population. The preferred use of residential premises as successful nesting sites indicates its adaptive behavior under the influence of shrinking natural habitats. The information of its nesting, egg-laying, incubation, hatching, parental provisioning and other behavioural aspects may be utilized for devising appropriate conservation measures aimed at habitat enhancement and augmentation in the agricultural landscapes.

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