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Change in landuse patterns and habitat alterations affecting Indian Robin (*Saxicoloides fulicata*) in Punjab

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Abstract
Studies on change in landuse patterns and habitat alterations of Indian Robin were carried out for one year from January 2017 to December 2017 in the campus of Punjab Agricultural University (PAU), Ludhiana considered as location I, village Baranhara (district Ludhiana) as location II and village Ladiankhurd (district Ludhiana) as location III. The breeding season of Indian Robin extended from March to July at studied locations. The observation at transect I, II, III, IV and V has been found in contrast to the eleven nesting sites found in transect VI, VII, VIII and IX. Both the parents participated in the nest formation. The clutch size varied from 2 to 4, but clutches of 3 eggs were more frequent. Eggs were pale greenish in the background with specks and small reddish brown blotches. The morphometerical characteristics of eggs in different clutches were observed at all the studied locations. The female was noted to incubate the eggs while the male were observed to guard the nests against the predators. Indian Robin was found close to human habitation and perched on the rooftops, water tanks, wooden poles and electric wires. It was noted that the the average incubation period was 11.5±0.22 days. The hatching and fledging success of eggs of Indian robin was studied in 16 clutches at the studied locations. A total of 51 eggs were laid during the breeding season, out of which only 44 eggs hatched. It could be inferred from the present study that Indian Robin showed adaptive nesting preferences at the buffer zone of developing colonies and village outskirts.

Keywords: Clutch size, eggs, incubation period, Indian robin

1. Introduction
The abundance of insectivorous birds is closely associated with the vegetation structure and composition of an agroecosystem [29]. Intensification of agriculture has resulted to the development of agroecosystem as highly important and managed terrestrial ecosystem. Bird species prefer some habitats over others as the resources in the environment are not evenly distributed [20]. Variation in habitat determines the presence, abundance of a species at one location and absence or scarcity at another location [11]. Bird species actively select their habitat on the basis of proximate factors such as features of the landscape, terrain substrate, arrangement of the vegetation and vegetative structure [31].
Differential habitat selection in bird species is one of the principal relationships, which permits various species to co-exist [22]. Indian Robin is a terrestrial insectivorous bird species and belongs to the family Muscicapidae [24]. It exhibits prominent sexual dimorphism with males being black and females mainly brown [9]. It inhabits grassy, open stony and scrub forest which are closely associated to human habitation [2]. Nesting season of Indian Robin mainly extends from May to July. The nest is well concealed on the ground made up of a cup of moss, dry grass lined with fur and hair [1].
They are good bio-indicators in the agro-ecosystem and check the buildup of insect pest species [21]. The breeding season is the most fascinating phase in the socio-biology of birds in which a number of interesting events take place [6]. Several aspects of avian biology have been poorly studied for most of the passerine bird species [19]. The present study was designed to observe the change in land use patterns and habitat alterations affecting Indian Robin in Punjab.

2. Materials and methods

2.1 Study area

The present study on the nesting and breeding activities of Indian Robin was carried out for twelve months 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 situated in the west Ludhiana and has a large stretch of agricultural fields. A total of five transects (namely 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 a medium sized village located to the west of Ludhiana city. The village Baranhara lies to the left side of the Hambran road, at a distance of 7.0 kilometers from PAU campus. Two transects were selected in the village Baranhara i.e. transect VI and transect VII. Transect VI was selected in the residential area starting from main road to village interior. Transect VII was selected from village interior upto 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 a village located in the west tehsil of Ludhiana district. The village Ladiankhurd is at a distance of 4.2 km from village Baranhara. Two transects were selected in the village Ladiankhurd i.e. transect VIII and transect IX. Transect VIII was selected in residential area of the village interior. Transect IX was selected in the agricultural area around village pond, on the outskirts of the village. In the selected transects, breeding behaviour of Indian Robin was studied in detail.

2.2 Methodology

Direct observations on the breeding activities of Indian Robin were noted twice a week in the morning and evening hours during the study period from January 2017 to December 2017 at all the studied locations. Observations were made to note different breeding activities such as nest site selection, clutch size, incubation period and behaviour of hatchlings. Point count method was followed to note the nesting sites utilized by Indian Robin. Clutch size was considered as the total number of eggs laid by a female in a single breeding attempt. Incubation period was considered to be the time period between laying of last egg of the clutch and hatching of the last young one. Nestling period was defined as the time period between hatching of the first young one and fledging of all the hatched young ones in the nest [26]. Observations were also made to determine the cause of egg/hatchling loss. Breeding behaviour of the individuals was observed using Bushnell binocular (magnification 8X and objective lens of 42 mm) without disturbing them. Photography was done with the Nikon coolpix B500 camera (16.0 Mega Pixels) having an Optical Zoom of 40x. Results are reported as Mean ± SE.

2.3 Measurements

The total height of the nesting tree and nest location in meters from ground was measured using an altimeter. Length and breadth of the eggs of Indian Robin was measured with the help of digital vernier calliper. The length of the eggs was measured across the line where the distance was maximum and the width was measured between the selected widest points. Weight of the eggs was taken on a common weighing balance. Egg volume was determined from length and breadth using an empirical formula given by Galbraith [7]:

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

An egg shape index (ESI) was determined using the following formula given by Stadel man and Cotte rill [28]:

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

Specific gravity of the eggs was determined using the formula given by Stadelman and Cotterill [28]:

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

The hatching and fledging success of Indian Robin was calculated by using the following formula:

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

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

2.4 Statistical analysis

Student's t-test (for 2 egg clutches) and 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. To determine statistical difference Tukey B Test was applied in the mean values. All the values are presented in Mean ± SE.

3. Results

Indian Robin has been found to be a solitary mover and formed pairs only during the breeding season from March to July at studied locations. Both the parents participated in the nest formation. In the present study, five nesting sites were observed in PAU campus out of which three ground nests were located in the undergrowth of hedges near roadside (transect I, II and III) and two ground nests were found in wild bushes (transect IV and V). Five nesting sites were observed in the village Baranhara (transect VI and VII) on the terrace of the under constructed buildings. A total of six nesting sites were observed at village Ladiankhurd (transect VIII and IX) in the crevices of under constructed buildings. The observation at transect I, II, III, IV and V has been found in contrast to the eleven nesting sites found in transect VI, VII, VIII and IX (Table 1).

At four nesting sites located in transects VI, VII, VIII and IX, the buildings were under construction and work was under progress. The parent birds were busy in performing different breeding activities like collection of nesting material and incubation of eggs inspite of human disturbance and construction activity. At number of places, the observer had to convey to labourers working at construction sites not to disturb the nesting sites of Indian Robin. At all the studied locations, buildings under construction were having the presence of wild shrubs in the immediate vicinity. The ubiquitous feature of shrub vegetation seemed to provide necessary insect food to parent birds as well as shelter from stray dogs.

Table 1: Type of nests and nesting sites of Indian Robin at studied transects

Transects	Number of nests	Type of nests		Nesting sites
		Ground nest	Cavity nest	
I	1	√	-	In undergrowth of hedge near roadside
II	2	√	-	In undergrowth of hedge near roadside
III	1	√	-	In undergrowth of hedge near roadside
IV	2	√	-	On ground in wild bushes
V	1	√	-	On ground in wild bushes
VI	3	-	√	On the terrace of under constructed buildings
VII	2	-	√	On the terrace of under constructed buildings
VIII	4	-	√	In crevices of under constructed buildings
IX	2	-	√	In crevices of under constructed buildings

In the present study, clutch size of 3–4 eggs was commonly observed; eggs were pale greenish in background with specks and small reddish brown blotches. The female was noted to incubate the eggs while the male was observed to guard the nests against the predators. Both the male and female Indian Robin performed the parental duties after hatching of the eggs.

The morphometerical characteristics of eggs in different clutches were observed at all the studied locations. Eggs were measured from various transects of three selected locations namely location I, location II and location III. The clutch size varied from 2 to 4, but clutches of 3 eggs were more frequent. Out of 16 clutches 2, 9 and 5 clutches were of 2, 3 and 4 eggs respectively. The mean egg length (in mm) ranged between 19.5±0.59 to 20.87±0.53, 19.53±0.37 to 20.37±0.39 and 19.48±0.41 to 20.00±0.39 at location I (Table 2) , location II (Table 3) and location III (Table 4) respectively. The mean egg breadth (in mm) ranged between 14.5±0.59 to 15.43±0.44, 14.60±0.42 to 15.40±0.42 and 14.93±0.25 to 15.50±0.27 at location I, location II and location III respectively. The mean egg weight (in g) ranged between 5.55±0.19 to 5.85±0.18, 5.43±0.33 to 5.60±0.37 and 5.00±0.27 to 5.73±0.23 at location I, location II and location III respectively. The egg volume (in cm^3) ranged between 1.87 to 2.25, 1.90 to 2.19 and 2.00 to 2.19 at location I, location II and location III respectively. The egg shape index ranged between 72.35 to 75.53, 73.76 to 76.12 and 74.91 to 78.57 at location I, location II and location III respectively. The specific gravity of eggs (gm/cm^3) ranged between 2.52 to 2.97, 2.52 to 2.91 and 2.46 to 2.75 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 IV and VIII respectively. Maximum and minimum values of mean egg breadth were noted at transect IX and I respectively. Maximum and minimum values of mean weight were noted at transect III and IX respectively. The highest egg volume was recorded at transect IV while lowest was noted at transect I. The highest and lowest egg shape index was noted at transect VIII and IV respectively. The highest and lowest egg specific gravity was noted at transect I and IX respectively. It could be inferred that the presence of abundant and wide range of food types available at canteens in the transects. 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 IV and III respectively as compared to other transects.

Table 2: Morphometrical characteristics of eggs in different clutch es during breeding season in 2017 at location I

Egg characteristics → / Transects ↓	Number of nests located	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	1	1	2	19.5±0.59	14.5±0.59	5.55±0.19	1.87	74.36	2.97
II	1	2	4	20.19±0.41	15.25±0.40	5.68±0.27	2.14	75.53	2.65
III	1	3	4	20.4±0.60	15.28±0.50	5.85±0.18	2.18	74.90	2.68
IV	2	4	3	20.73±0.55	15.43±0.44	5.67±0.23	2.25	74.43	2.52
		5	3	20.87±0.53	15.10±0.48	5.60±0.26	2.17	72.35	2.58
V	-	-	-	-	-	-	-	-	-

Table 3: Morphometrical characteristics of eggs in different clutches during breeding season in 2017 at location II

Egg characteristics → / Transects ↓	Number of nests located	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	3	6	3	19.53 ± 0.37	14.60±0.42	5.53 ± 0.29	1.90	74.76	2.91
		7	3	19.93±0.41	14.70±0.46	5.60±0.37	1.97	73.76	2.84
		8	3	20.23±0.39	15.40±0.42	5.53±0.37	2.19	76.12	2.52
VII	3	9	4	19.50 ±0.35	14.73±0.26	5.43±0.33	1.93	75.54	2.81
		10	3	19.90±0.35	15.07±0.36	5.53±0.29	2.06	75.73	2.68
		11	4	20.37±0.39	15.13±0.29	5.50±0.35	2.13	74.27	2.58

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

Egg characteristics → / Transects ↓	Number of nests located	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	3	12	4	19.48±0.41	14.98±0.31	5.50±0.25	2.00	76.90	2.75
		13	3	20.00±0.39	15.27±0.20	5.73±0.23	2.13	76.35	2.69
		14	2	19.60±0.19	15.40±0.27	5.65±0.23	2.12	78.57	2.66
IX	2	15	3	19.93±0.35	14.93±0.25	5.00±0.27	2.03	74.91	2.46
		16	3	19.93±0.41	15.50±0.27	5.53±0.28	2.19	77.77	2.52

In the present study, Indian Robin was found close to human habitation and perched on the rooftops, water tanks, wooden poles and electric wires. The average incubation period was 11.5±0.22 days. Both the parents were observed to share the parental duties during incubation. Both sexes took care of the young ones but the eggs were incubated by the females. The male Indian Robin was always observed guarding the nest, while female Indian Robin collected the food to feed the young ones. The hatching pattern and hatching success of eggs of Indian robin was studied in 16 clutches at the studied locations. A total of 51 eggs were laid during the breeding season, out of which only 44 eggs hatched. Hatching success was observed 100% in nest number 1, 5, 6, 7, 10, 11, 12, 13, 14 and 15. Fledging success was noted 100 % in all the nests except nest number 2 and 7 (Table 5).

Table 5: Hatching and fledging success of Indian Robin at studied location

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	2	11	2	100	7	2	100
II	2	4	12	3	75	8	2	66.67
III	3	4	10	3	75	9	3	100
IV	4	3	11	2	66.67	6	2	100
	5	3	12	3	100	8	3	100
V	-	-	-	-	-	-	-	-
VI	6	3	10	3	100	11	3	100
	7	3	11	3	100	11	2	66.67
	8	3	12	2	66.67	10	2	100
VII	9	4	12	2	50	9	2	100
	10	3	13	3	100	9	3	100
	11	4	13	4	100	12	4	100
VIII	12	4	12	4	100	12	4	100
	13	3	11	3	100	10	3	100
	14	2	12	2	100	11	2	100
IX	15	3	11	3	100	11	3	100
	16	3	11	2	66.67	9	2	100

4. Discussion

The breeding season of Indian Robin was noted to extend from March to July. The results were similar with the previous studies that the breeding season of Indian Robin began in March [8]. Ali had reported that the nests of Indian Robin were mainly found beneath the stone, in hole of the tree stump or within an earthen pot [1]. During present investigation, it was found to inhabit the undergrowth of hedges and crevices/terrace of under constructed buildings for nesting purposes. It seemed that changing land use practices like the emergence of new colonies in the periphery of cities encroaching on agricultural areas of villages which have added constraints on the nesting. Some degrees of that change have been observed in case of Indian Robin as it has to colonize under constructed buildings in the buffer zone between developing colonies and village outskirts. It has been discussed in the literature that the nesting preferences of Indian Robin are in various habitats such as on a wall covered

with dense creeper plant, in iron dumping, in wild bushes, near roadside, in mud hole and in lantana bushes [17]. Conversion of the agroecosystem into another landuse will make these sites limited in number for avian insectivorous bird species [20]. Birds use a number of strategies for successful execution of their breeding activities by investing a lot of energy to find a suitable mate, safe nesting site and pair bond-formation [17]. In present work, the nests of Indian Robin were located in the crevices and terrace tops of under constructed buildings. Similar types of requirements for nesting had been mentioned by the author. Habitat alteration may be considered as most dominant and potent factor which seemed to limit the preferred nesting sites of Indian Robin at studied locations. Similar findings were stated by Kler [14]. Kaur *et al.* had found relative abundance of Indian Robin ranging from 1.27% to 4.38 % in and around village ponds of district Barnala, Punjab. It was further mentioned that Indian Robin had occupied insectivorous trophic level [13]. Sidhu and Kler had stated that low relative abundance of Indian Robin was recorded in total bird population studied in orchards of Ludhiana district, Punjab [25]. In our study, conflicts had been recorded at feeding sites between Common Babbler and Indian Robin. Similar results were noted by the author, in which Brownbacked Indian Robin had been observed to aggressively defend its territory [14].

In our present study, it was noted that both the parents of Indian Robin shared parental duties during nest formation. Weatherhead stated that female Indian Robin was usually accompanied by their mates in nest building [30]. It was found that the average clutch size of Indian Robin varied from 2 to 4. Similar results were noted by Das *et al.* [4]. Variation in clutches is often related with food abundance in many bird species [10]. It is well documented that eventual clutch size in birds is determined by the availability of protein rich food [16] or nutrient reserves of the female [3]. The egg of Indian Robin was incubated by the female while the male was observed close to the nest during egg laying. Similar results were given by Weatherhand *et al.* [30]. Kumar stated that the average incubation period and nestling period of Indian Robin was 11.86±0.03 days and 13.25±0.27 days respectively [17]. Lack (1968) stated that the incubation period of birds breeding at higher latitudes was shorter than those breeding at lower latitudes [18]. Das *et al.* stated that Indian Robin was a human loving bird and are very sensitive to any disturbance during nest building and egg laying as they leave the nest if disturbed [4].

Indian Robin was often seen hunting for insects and caterpillars in wild bushes, agricultural areas at all the studies locations. Indian Robin was also found to feed on the grains and bread crumbs which indicated that it has omnivorous type of habits to survive and flourish in urban areas. It could be inferred from the present study that Indian Robin is undeterred by human presence and construction activity. Similar results were reported by Kler [14]. Author has emphasised need to study foraging and nesting ecology of common bird species like House Sparrow and Brownbacked Indian Robin in the residential areas so as to study habitat alterations accompanied by interspecies avian competition in urban areas [14]. A total of 64 species of birds (11 orders and 29 families) in different villages falling in 6 districts were recorded [15]. Indian Robin constituted a group of 20 bird species that had cumulative abundance ranging from 10% to 15 % of total bird population. The present results are similar with those reported by Kler that Brownbacked Indian Robin is one of the more familiar and confiding bird species found around towns and villages in addition to other bird species like Purple Sunbird *Nectarinia asiatica*, Blue Rock Pigeon *Columba livia* and Little Brown Dove *Streptopelia senegalensis* [14]. Sangha and Naoroji had mentioned that birds made their nests at odd places (at top of buildings, gas pipes, sewage and inter space among girders) [23]. Workers had stated that human presence also affected the nest placement of avian species [5]. Johnson and Mangalaraj had mentioned that changes in habitat area lead to adaptation in bird species [12]. Sohi and Kler had mentioned about adaptation in nesting behaviour of bird species namely Baya Weaver Bird, House Crow, Red-vented Bulbul and Spotted Munia in shrubs, cultivated crops, indigenous trees, exotic trees and manmade structures [27].

5. Conclusion

In the present study, three ground nests were located in the undergrowth of hedges near roadside (transect I, II and III), two ground nests were found in wild bushes (transect IV and V), five nests were observed on the terrace of the underconstructed buildings and six nests were observed in the crevices of underconstructed buildings (transect VIII and IX). Maximum and minimum values of mean egg length were noted at transect IV and VIII respectively. Hatching success was observed 100% in nest number 1, 5, 6, 7, 10, 11, 12, 13, 14 and 15. Fledging success was noted 100 % in all the nests except nest number 2 and 7. Shift in the nest site selection and nesting behaviour of Indian Robin in relation to habitat features like available nesting sites and habitat cover have been observed at border line of developing colonies and village outskirts. Detailed studies are required to assess the development in the breeding activities of common bird species in response to anthropogenic activities at the margin line of rural and urban habitat so as to give remedial location species conservation measures in an agroecosystem of Punjab.

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7. References

1. Ali S (ed). The Book of Indian Birds. Oxford University Press, Bombay, 2002, 1-402.
2. Ali S, Ripley SD. Handbook of the Birds of India and Pakistan. Oxford University Press, New Delhi, India, 1998.
3. Ankney CD, Macinnes CD. Nutrient reserves and reproductive performance of Female Lesser Snow Geese. Auk. 1978; 95:459-471.
4. Das K, Maheshwari R, Mandrik I. Some behavioural observations of the Indian Robin, *Saxicoloides fulicata*. Indian Journal of Scientific Research. 2017; 12(2):107-110.
5. Eggers S, Griesser M, Nystrand M, Ekman J. Predation risk induces changes in nest-site selection and clutch size in Siberian jays. Proceeding of Royal Society of Landon series B. International Journal of Biological Sciences. 2006; 9:5-12.
6. Faaborg J, Chaplin SB. Ornithology: An Ecological Approach. Prentice Hall, Englewood Cliffs, New Jersy, USA, x+470, 1984.
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. George JC. Some observations on the breeding behaviour of the Indian Robin, *Saxicoloides fulicata* (Linnaeus). Pavo. 1963; 1:71- 78.
9. Grimmett R, Inskipp C, Inskipp T. Birds of the Indian subcontinent. London: A & C Black/Christopher Helm, 1998.
10. Hussell DJT, Quinney TE. Food abundance and clutch size of Tree Swallows. Imprint of the Haworth Press Inc, New York, London, 1987.
11. Javed S, Kaul R. Field methods for bird surveys. 1st ed, New Delhi: Bombay Natural History Society; Department of Wildlife Sciences; Aligarh Muslim University; World Pheasant Association, South Asia Regional Office (SARO) 2003; i–ix:1-61.
12. Johnson, Mangalaraj J. On little Grebes *Tachybaptus ruficollis* breeding near Karunanidhi Nagar, Tiruchirapalli, Tamil Nadu. The Journal of the Bombay Natural History Society. 2001; 98:441-442.
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. Decline in the populations of House Sparrow *Passer* domesticus indicus and buid-up in the populations of Brownbacked Indian Robin *Saxicoloides fulicata* cambaiensis in urban residential areas. Pestology. 2003; 27(8):9-12.
15. Kler TK. Endangered status of Birds of Prey in agricultural habitats. Pestology. 2005; 29(9):26-29.
16. Krapu GL. The role of nutrient reserves in Mallard reproduction. Auk. 1981; 98:29-38.
17. Kumar A. Physical characteristics, categories and functions of song in Indian Robin *Saxicoloides fulicata* (Aves: Muscicapidae). The Journal of Threatened Taxa. 2011; 3:1909-1918.
18. Lack D. Ecological adaptations for breeding in birds. London: Htethuen, 1968.
19. McMaster DG, Neudrof LH, Sealy SG and Gill SA. Timing of egg laying in Yellow Warbles. Auk. 1999; 116: 236-240.
20. Osborn FV. Habitat selection by bull elephants in central Zimbabwe. Pachyderm 39 (July–December). 2005; 63-66.
21. 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.
22. Rosenzweig ML. A theory of habitat selection. Journal of Ecology. 1981; 62 (2):327-335.
23. Sangha HS, Naoroji R. Nidification of the Common Raven *Corvus corax* in the Thar Desert. The Journal of the Bombay Natural History Society. 2004; 101:321-323.
24. Sethi VK, Bhatt D and Kumar A. Dawn singing behaviour of Pied Bush Chat *Saxicola caprata*. Journal of Applied and Natural Science. 2012; 4:241-246.
25. 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.
26. Skutch AF. The nest as a dormitory. Ibis. 1960; 103:50-70.
27. Sohi GK, Kler TK. Adaptations in avian nesting behaviour in relation to indigenous trees and housing structures in Punjab. Journal of Entomology and Zoology Studies. 2017; 5(5):1045-1051.
28. Stadelman WJ, OJ Cotterill (ed). Egg Science and Technology. An Imprint of the Haworth Press Inc, New York, London, 1995, 1-590.
29. Stratford JA, Robinson WD. Gulliver travels to the fragmented tropics: geographic variation in mechanisms of avian extinction Front. Journal of Ecology and Environment. 2005; 3:85-92.
30. Weatherhead PJ, Montgomerie RD, McRae SB. Egg-laying times of American Robins. Auk 1991; 108:965-967.
31. Wiens JA. An approach to the study of ecological relationships among grasslanbirds. Ornithological Monographs # 8, American Ornithologists' Union, Ithaca, New York, 93, 1969.