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Nesting and breeding ecology of Asian pied starling *Sturnus contra*

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Abstract
Study was conducted on the nesting and breeding ecology of Asian Pied Starling *Sturnus contra* at Ludhiana during 2016-17. A total 48 nests were observed. Nests were dome-shaped, with a lateral entrance-hole. The most preferred nesting structure was electric poles (68.7%), followed by trees (20.8%), high voltage power transmission tower (4.1%); electrical transformer (4.1%) and iron pole (2.0%). The average height for nest ranges from 4 m - 6.5 m depending upon the nesting structure and the maximum height of nest recorded was 21.0 m on the high voltage power transmission tower. The mean width, height and depth of entrance hole of the nests were 42.6±1.20 cm, 30.4±1.66 cm and 8.1±0.49 cm respectively. The mean weight of nests (n=3) was 451.72±38.93gm. The breeding period extended from February end to August. Breeding activities were shared by both the parents. The clutch comprised of 4-5 oval, glossy blue eggs with mean dimensions of 26.36 mm X 19.55 mm. Breeding period last up to 53-78 days. It was concluded that habitat and nesting structure preferences were directly proportional to the presence of feeding materials, roosting places and nesting material available.

Keywords: Asian pied starling *Sturnus contra*, nesting, breeding, electric poles

1. Introduction
The India is known to harbor about 12.5% of world's avifauna *i.e.* a total of 1263 species of birds [1]. *Sturnus contra* play significant role as bio-control agent [2]. They are considered to be generally beneficial because they eat many insects [3]. In India, breeding season of *Sturnus contra* is ranged from March to August. With the commencement of prolonged winter rains, commencement of the breeding season may be delayed up to April. The sexes are similar in plumage but young birds have dark brown in place of black [4]. With the onset of breeding, the sizes of flocks decline and birds pair up. Courtship involves calling, fluffing of the feathers and head bobbing. The duration of pair bond in *Sturnus contra* is apparently for four to six months in a year i.e. for a single breeding season [5]. The nest is a loose mass of straw formed into a dome with an entrance on the side and placed in a large tree (often banyan, mango, jackfruit, rosewood [6]. or sometimes on man-made structures [7]. Nests were often located close to human habitation. It selects open fields of agricultural land, especially in wet or moist rice paddy field or flooded grassland. They also selected wet, marshy habitat around riparian areas. This can be due to the reason that they could easily find preferred foraging sites in such regions. Foraging occurs on wetter and softer ground, utilizing ground vegetation as long as the substrate was soft [8]. The finished nest is rough, round or elongate dome approximately 35 to 50 cm high with a circular side opening 6-8 cm in diameter. Several pairs will breed in the same vicinity. The usual clutch is made up of about four to six glossy blue eggs. Each egg is laid with a day in between and incubation begins only after the third or fourth egg is laid. The eggs hatch after 14 to 15 days. The young are brooded for two weeks, the female staying at the nest during the night. Both parents feed the chicks until they fledge. Young ones leave after three weeks. More than one brood may be raised in a season [9, 10, 11]. An instance of interspecific feeding, where an adult of a common myna fed a young *Sturnus contra* has been reported [12]. These mynas form communal roosts at night and jointly defend nesting areas [4]. Hatching success rate was high i.e. 87-92% in four years [5]. In the light of above fact and importance of *S. contra* as bio-control agents, the present study was under taken to investigate the breeding ecology of *S. contra.*

2. Materials and Methods

2.1 Study area

The study of nesting pattern, nesting behavior and breeding biology was carried out in agro-ecosystem of Punjab Agricultural University (30◦, 75◦52'E and 247 meter above mean sea level) from February 2016 to January 2017. Punjab Agricultural University campus (30◦56'N, 75◦52'E and 247 meter above mean sea level), is located in Ludhiana city (Punjab State) in north-west India. The University covers an area of 580 ha on its main campus at Ludhiana.

2.2 Materials

Binocular (8X42 Nikon) was used to study the status of the nest *i.e.* whether active or not, by examining its contents at regular intervals. Ravi altimeter was used to study the parameters like height of various nesting structures and nest height. Digital weighing scale was used for the quantitative analysis of nesting material and eggs. Vernier caliper was used to measure the dimensions of eggs.

2.3 Methods

Observations were made twice a week and during data collection each transects were scanned carefully to record the birds and identification of bird was done with the help of key given by Ali [10]. The status of the nest *i.e.* whether active or not, was recorded. The observations for nesting activities included number of nests, type of nests, structures selected for nest construction, nesting material utilized and nesting habitat were observed. Various breeding parameters from courtship display, site selection, egg laying, incubation period, feeding and fledging of young ones were observed. Dimensions of eggs were measured. Percentage hatching success was also calculated.

3. Results and Discussion

The *S. contra* is mostly seasonal breeder. In the study area, it was observed to have single breeding season of about six months from last week of February to second week of August. Here the breeding period is marked from the period of pair formation to the fledging of young ones. The pair formation started in the February end and continued till March which was followed by site selection for nest construction. The activities like site selection, nest construction and feeding to the young ones were performed by both the parents. Courtship display was started before the nest site selection, males performed head bobbing display to their partners and fluffing of feathers. On approach of the breeding season, a pair selected a nesting structure and laid straws of wheat on supporting material available on that structure. Nesting period is the time interval from the beginning of construction of nests up to when the last chick leaves the nest. It was noticed that site selection for construction of nest took 6-11 days. Both the birds were seen perching on same structures every morning for some days before construction of nest was started. The selection of site is done by both the birds in pair. Hence, the nesting site is selected with mutual consent. Some of selected sites were rejected even after construction of nest was started. This can be due to safety issues. The nests whose construction was started late in the breeding season, their frequency of material hunting trips and speed of construction was much more than those started earlier in the season [13]. Quantitative and qualitative analysis of nests (n=3) were performed (Table 3, 4). The mean weight of nests was calculated to be 451.72±38.93g. The mean value of the width, height and depth of the entrance hole of nests were 42.6±1.20 cm, 30.4±1.66 cm and 8.1±0.49 cm respectively. The *Sturnus contra* used variety of material for nest building. The nesting material used for nest construction was almost similar in all the three nests observed (Table 4). It comprised wheat straw, sticks, cotton, feathers, jute, plastic threads, plastic papers and threads. The nests looked like irregular mass of straw and sticks from outside, but it was properly built from inside. The resting place inside the nest was properly shaped. The use of plastic threads, file threads and woolen threads was done to tie sticks inside the nest in proper shape. Plastic papers and jute were also used in making the base of the nest. The cottony material was used to provide softness at the base. In spite of this, feathers of different birds were also placed inside nest. Similar finding were also reported by other workers [13, 14]. For the quantitative analysis of nesting material of three nests of *S. contra*, mean value of weight of each nesting material was calculated. The mean value of the threads was 6.83±0.68gm, plastic papers 25.23±3.00 g, plastic threads 8.76±1.80 g, jute 19.95±1.28 g (Table 4).

During the course of study a total 48 nests were observed (Table 1). *S. contra* was observed to breed from February to August at the study area. Previous studies have indicated that *S. contra* commonly breeds from March to August and they are successful prolific breeders with an average of 3-5 eggs per clutch [5]. It was noticed that nesting preference was directly proportional to the presence of feeding material, roosting places and nesting material. *S. contra* mostly establishes their nests on man-made structure like electrical poles. Nests were also found on trees like Dhek, Mulberry and Siris. Nests were also recorded on electrical transformers and high voltage transmission tower. Other worker also reported similar findings [2, 15]. The usual height of nesting structures varied from 3.00 m -7.00 m in height. The maximum height of the nesting structure recorded was 23.00 m on high voltage transmission tower (Table 2). *S. contra* has single breeding season each year. More than one broods were also noticed in a single breeding season. With the onset of breeding season, *S. contra* was observed in pairs and was territorial. During the study period it was observed that the *S. contra* was mostly active and involved in nesting activities in morning hours during the nest construction period. They were normally seen picking up sticks in their mouths, flying from field grounds to their nests and back again.

The length of the egg ranged from 28.41 to 25.54 mm with a mean of 26.36 mm while the width ranged between 19.16 mm to 19.97 mm with a mean of 19.55 mm (Table 5). The variability in length was much prominent as compared to that of width. The variation in the size was also reflected on egg weight which varied from 5.13 g to 6.55 g with an average of 5.67 g. Similar range of egg dimensions were also reported by Narang *et. al* [11]. The average clutch size was found to be 4-5 eggs. The average clutch size was found to be 4-5 eggs. The colour of the eggs of the *S. contra* is glossy blue without marking. The eggs are generally oval in shape, one end being broad and the other a little pointed. Incubation is the application of heat to eggs for the development of embryo and it was observed that during the incubation, one of the birds sits on eggs; the partner either remains present in the vicinity of nest or goes for foraging in nearby fields. The incubation period varied from 14-26 days according to observation during the study period. Incubation period of 14 days for *S. contra* in different areas of Punjab was also reported [2, 8]. A total 25 chicks hatched out of 30 eggs which resulted in the hatching success of 83%. After the hatching, feeding was started by both the parents. Feeding and rearing was done by both the parents in nest. Continuous observations on the

feeding of chicks were recorded for two complete days i.e. one during initial day of hatching and second observation after 14 days of hatching. It was observed that during initial days the birds had more visits from field to the nest. But after the successive days the no. of visits were reduced (Table 6). This could be because younger chicks require softer feeding material as compare to elder chicks and elder chicks can feed on regurgitated material also [13, 16].

Table 1: Nesting at different locations

Nesting structures	Transect I	Transect II	Transect III	Transect IV	Total
Cemented electrical poles+ Iron Electrical poles	15	4	11	3	33
Electrical transformer	-	-	-	2	2
High voltage transmission tower	2	-	-	-	2
Iron pole	-	-	-	1	1
Trees	2	6	-	2	10
Total	19	10	11	8	48

Table 2: Height of different nesting structures and nests (m)

Nesting structures	Average height of nesting structures (m)	Average height of nests (m)
Man-made structure		
Electrical poles	4.37	3.87
Electrical transformer	5.00	4.50
High voltage transmission tower	23.00	21.00
Iron pole	4.50	4.00
Trees		
Dhek (*Melia azedarach)*	6.70	5.00
Mulberry (*Morus Alba)*	6.50	4.75
Amla (*Phyllanthus emblica*)	7.00	5.25
Siris (*Albizzia* spp.)	6.40	5..50
Eucalyptus *(Eucalyptus globules)*	22.00	17.00
Mango (*Magnifera indica)*	6.20	5.75
Dye Fig (Ficus tingtoria)	6.30	6.00
Chukrasia (*Chukrasia velutina*)	9.01	8.00
Kanak champa (*Pterospermum acerifolium*)	14.09	12.00

Table 3: Dimensions of nests (n=3)

	Weight (g)	Width (cm)	Height (cm)	Depth of entrance hole (cm)
Nest 1	513.23	42.7	27.4	7
Nest 2	461.45	45.2	29.6	9
Nest 3	379.5	40.1	34.3	8.5
Average	451.72±38.93	42.6±1.20	30.4±1.66	8.1±0.49

Table 4: Weight (g) of different material used in nest building

Material used	Nest 1 (g)	Nest 2 (g)	Nest 3 (g)	Average (g)
Threads	8.39	6.08	6.83	6.83±0.68
Plastic papers	19.76	30.16	25.23	25.23±3.00
Plastic threads	11.24	5.03	8.76	8.76±1.80
Jute	17.65	22.10	19.95	19.95±1.28
Feathers	3.34	3.01	2.46	2.46±0.25
Cotton	6.08	5.06	7.06	7.06±0.57
Sticks	167.87	170.3	156.12	156.12±4.37
Wheat straw	234.33	219.71	257.83	248.81±11.10
Total	468.58	461.45	484.24	471.42±6.73

Table 5: Dimensions and weight of eggs (n=13)

Egg no.	Length (mm)	Width (mm)	Weight (in g)
1	27.25	19.97	5.49
2	28.08	19.91	5.47
3	27.11	19.16	5.74
4	28.14	19.86	6.55
5	28.41	19.85	6.53
6	26.08	19.77	5.20
7	25.84	19.75	5.13
8	27.11	19.42	5.32
9	25.77	19.48	5.19
10	26.81	19.45	5.30
11	27.04	19.63	5.65
12	26.06	19.23	6.50
13	25.54	19.89	5.76
Average	26.36±0.26	19.55±0.06	5.08±0.14

Table 6: Rearing and feeding of Chicks

	No of visits in initial days	No of visits after 14 days
No of visits (per hour)	9-10	4-5
Total no of visits in day	72-80	40-45

Table 7: Overall breeding biology of *S. contra*

Breeding activity	No of days (minimum to maximum recorded)
Site selection	6-11 days
Nest construction	10-20 days
Egg laying	4-5 days
Incubation	14-16 days
Feeding young ones	20-23 days
Fledging after feeding	2-3 days
Overall breeding activity	53-78 days

4. Conclusion

It was concluded from the present study that habitat and nesting structure preferences of *S. contra* were directly proportional to the presence of feeding materials, roosting places and nesting material available. *S. contra* preferred to roost on trees near feeding grounds. Most preferred nesting site was Electric Pole (68.7%). The average height for nest ranges from 4 m - 6.5 m depending upon the nesting structure. The breeding period extended from February end to August. Breeding activities were shared by both the parents. The clutch comprised of 4-5 oval, glossy blue eggs with mean dimensions of 26.36 mm X 19.55 mm. The incubation period varied from 14 to 16 days. Young ones were fed by both the parents in the nests for 17-21 days. Nesting period extended till August and breeding period last up to 53-78 days. As *S. contra* feeds on many insects, it can be useful as bio control agent. Further future studies on bio-ecology of this bird in different agricultural habitats will the essence of the present time.

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