



## Breeding Biology of the House Crow *Corvus splendens* at Hazara University, Garden Campus, Mansehra, Pakistan

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### Abstract

A study on the nesting biology of the House Crow *Corvus splendens* was conducted at Hazara University, Garden Campus (50 hectares), Mansehra, during the 2013 breeding season (June to September). Details about nest locations, tree characteristics, nest and egg characteristics were recorded. The mean nest density of House Crow was 0.9 nests/ ha. Mean tree and nest heights were 14.8±6.30 and 11.8±5.42m. The mean tree canopy spread 9.5±2.48m. The mean maximum and minimum nest diameters were 42.3±2.08 and 39.0±1.73cm respectively, while maximum and minimum diameters of nest cup were 15.6±1.52 and 13.3±1.15cm respectively. Nest depth and nest cup depths were measured as 19.3±2.08 and 8.3±1.15cm respectively. The mean nest weight was 1.4±0.24 kg while the mean clutch size was 4.0 (range 1–6). The mean egg length was 38.6±0.69mm, breadth 26.0±0.69mm, egg volume 13.3±0.83cm<sup>3</sup> and egg shape index 1.42±0.83. The mean egg weight was 12.3±0.70g. Egg and nest success were calculated to be 55.1% and 69.0%. Hatchlings and fledglings produced per nest were 2.20 and 1.44 respectively. The main reasons for reproductive failures were unhatched eggs, poor nest construction, bad weather conditions and observer's disturbance.

### 1. Introduction

The House Crow *Corvus splendens* is a bird species resident in the Indian subcontinent including Myanmar, Nepal and Sri Lanka (Ryall 2002, Ali 2008). It is one of the common bird species in Pakistan where it spreads across the lower coastal areas of Baluchistan in Makaran and all the way through the Indian basin to Swat, Mansehra plains and Abbottabad but does not occur in the Murree hills (Roberts 1992).

This species is monogamous and the pair-bond remains unbroken for successive seasons (Archer 1998). The House Crow breeds throughout the year (Lamba 1963, Akhter *et al.* 1994) although breeding mainly occurs during the hotter and drier months (Nordin & Yousuf 1980). In Pakistan, including Sind and Punjab,

the breeding season of the House Crow coincides with the start of the monsoon which extends from late June to August and is the hottest time of the year (Grimmett *et al.* 1998).

The House Crow is a tree nester and is usually associated with human surroundings (Goodwin 1976, Ryall 1990); it favours nesting in high trees with a large crown in order to avoid human harassment and to spot food sources from afar (Dutta 2007). The nest of the House Crow is mainly composed of two types of substances, wood and metal which includes pieces of wire used to bind twigs together (Behrouzi-Rad 2010). The normal clutch size of the House Crow is 4–5, and rarely 6–7 (Whistler 1986).

The aim of this paper is to present some quantitative measurements of the breeding biology of the House Crow, including tree and

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nest heights, nest characteristics, egg traits and breeding success and failure.

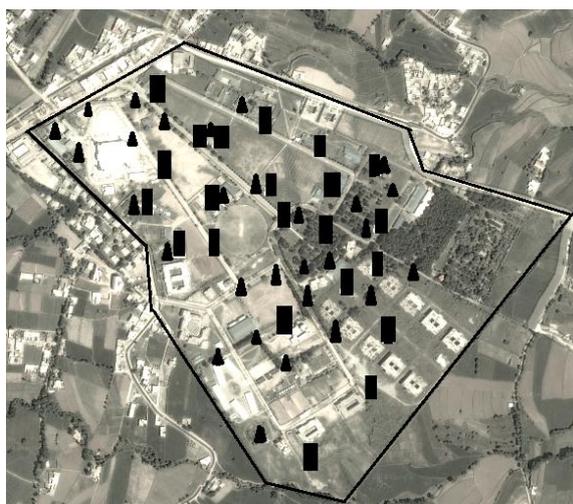
## 2. Materials and Methods

### 2.1. Study Area

Hazara University, Garden Campus (Fig. 1) is located (34°25'N, 73°15'E) in the District Mansehra, Dhodial Town (1,020 m a.s.l.). The patches of the green pines across the sprawling campus enhance its natural site. The vast plain of Pakhal with its agricultural wealth is irrigated by the River Siran and tea gardens surround the campus. Towards the north-east the hills are covered with dense forest while the lofty peaks of the snow-covered mountains of the Kaghan Valley form a backdrop. On the western, southern and the northern sides are the rolling ranges of the Siran, Konsh and Agror valleys. The climate of the area is severe i.e. hot in summer up to 40°C and 5°C in winter while at higher altitudes the temperature drops below -20°C during the months of January and February (SMEDA 2009). The main tree vegetation of the study area consists of *Populus euphratica*, *Grevillea robusta*, *Platanus orientalis*, *Pinus roxburgii*, *Melia azedarach*, *Eucalyptus camaldulensis*, *Ficus palmate*, *Broussonetia papyrifera* and *Acacia nilotica*.

### 2.2. Methods

The duration of this study spanned six months (April–September 2013). Nest finding began in April when trees like *P. euphratica*, *P.*



**Fig. 1.** Aerial image of Hazara University, Garden Campus, Mansehra, showing locations of House Crow nests, black triangles (active nests) and black rectangles (inactive nests).

*orientalis* and *M. azedarach* were still without foliage. All the nests were found during this time and located while walking the study area. A total of 42 trees containing 51 nests of the House Crow were found. Each tree containing a nest or nests was numbered and plotted on a map (Fig. 1). Each nest was inspected twice a week during the whole breeding season; all the trees were climbed to check the interior of nests for presence of eggs although on some occasions a ladder was also used where climbing was not possible. Photographs were taken using a Traveller XS-4000 digital camera with 4X optical zoom and 5.0–20.0mm lenses. The canopy spread was defined as the distance of branches away from its main trunk. Nests were also examined from the ground with the help of binoculars to see signs of incubating adults and for presence of nestlings.

The tree height (ground level to the top of the tree), nest height (nest to the ground level) and nest characteristics (diameter and nest depth) were measured by a measuring tape. Egg and nest weights were taken on a weighing bar. Egg length and breadth were measured using a Vernier Calliper with 0.1mm accuracy. Egg volume was calculated using the Hoyt (1979) formula:  $V=0.51 \times L \times B^2 / 1000$  where V is the volume in  $\text{cm}^3$ , L is the length and B is the breadth in mm. An egg shape index (ESI) was calculated by using the formula:  $\text{ESI} = L/B$ . Statistical analyses were performed by using One Way ANOVA and student *t*-test.

The incubation period is defined as the period between laying of the first egg at nest and hatching of the first egg within the clutch. The nestling period is defined as the interval of the period from hatching of the first egg until the last chick of the brood remained at the nest. Murray (2000) was followed to calculate egg and nest success rates as the measures of reproductive success. Egg success is “the proportion of eggs that produces young” and nest success is “the proportion of clutches that produce young”. Thus, the number of young that leave the nests divided by the total number of eggs gave egg success while the number of clutches that produce young was divided by total number of clutches to obtain nest success. At the end of the breeding season, ten of the nests were detached from the trees in the middle of the day so as to avoid possible air humidity and weighed on a weighing bar.

### 3. Results

#### 3.1. Breeding period and nest density

The breeding period of the House Crow extends from June to September. The mean nest density of the House Crow was 0.9 nests/ ha. A total of 51 old nests were found and later 29 nests become active which suggests that the study area supported 29 breeding pairs (Fig. 1).

#### 3.2. Characteristics of nest trees

The nests were found on four tree species *M. azedarach* (1), *P. roxburgii* (5), *P. euphratica* (16) and *P. orientalis* (20) (Fig. 2). Forty-three trees harbored one nest, seven trees – two nests, and only one tree harbored three nests. The mean distance between two or more nests on the same tree was  $3.0 \pm 0.3$  m (Table 1). The mean tree canopy spread was  $9.5 \pm 2.48$  m; with largest canopy spread of 12.5 m at *P. roxburgii*, 10.2 m at *P. orientalis*, 8.7 m at *P. euphratica* and 6.6 m at *M. azedarach*. The mean nesting tree height was  $14.8 \pm 6.30$  m and the nest height was  $11.8 \pm 5.42$  m. The mean tree height was measured greater in *P. roxburgii* 23.2 m than other tree species (*P. euphratica* 15.2 m, *P. orientalis* 12.9 m) and the lowest in *M. azedarach* 8.1 m. The mean nest height was measured greater in *P. roxburgii* 19.4 m, *P. euphratica* 11.3 m, *P. orientalis* 10.2 m and the lowest was in *M. azedarach* 6.5 m (Fig. 3). Student *t*-test showed a positive correlation between tree and nest height ( $P < 0.05$ ).

#### 3.3. Nest characteristics

Nests of the House Crow were made of different types of contents, mainly twigs and pieces of discarded metallic wires; other contents included plastic materials and plant contents such as grass, leaves, tendrils and rhizomes. Nest dimensions including mean maximum and minimum nest diameters, nest cup diameters, nest depth and nest cup depth are given in Table 2. The mean weight of the House Crow nests was  $1.4 \pm 0.24$  kg (Table 3). The ANOVA analysis showed no significant difference ( $P > 0.05$ ) among nest weights on different tree species.

#### 3.4. Clutch size and egg traits

The mean clutch size of the House Crow was recorded as 4.0 (rang 1–6). Most of the clutches contained 4–5 eggs. One of the clutches contained 1 egg, 2 with 2 eggs, 7 with 3 eggs, 8 with 4 eggs, 8 with 5 eggs and 3 clutches contained 6 eggs (Fig. 4). Egg dimensions were taken from 18 of the clutches. The mean length and breadth of the eggs were  $38.6 \pm 0.69$  and  $26.0 \pm 0.65$  mm respectively, the mean egg volume was calculated to be  $13.34 \pm 0.83$  cm<sup>3</sup> and the egg shape index was  $1.42 \pm 0.17$ . The ANOVA analysis showed no significant ( $P > 0.05$ ) difference between the length and breadth of the House Crow eggs. The mean egg weight was recorded  $12.30 \pm 0.70$  g (Table 4). The ANOVA analysis showed significant difference of egg weight among different clutches ( $P < 0.05$ ).

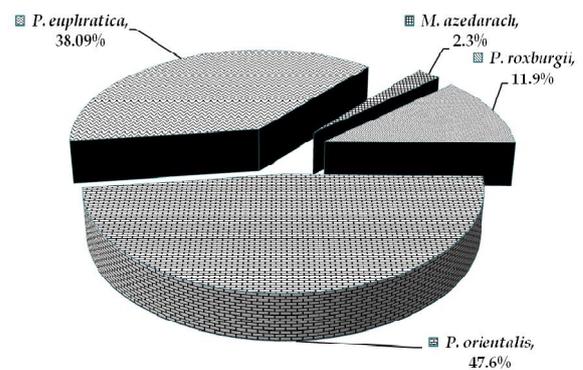


Fig. 2. Percentage of nests of House Crow on different tree species.

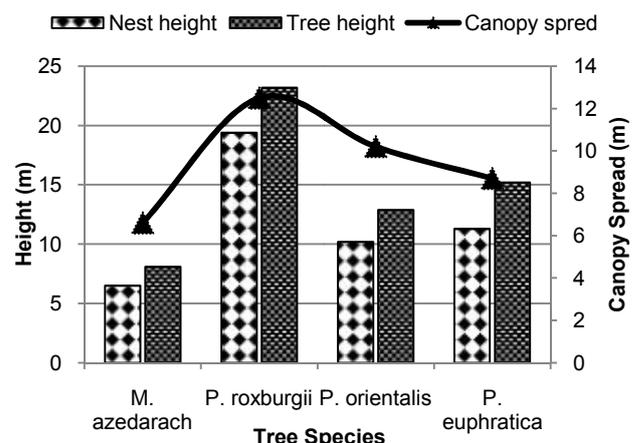
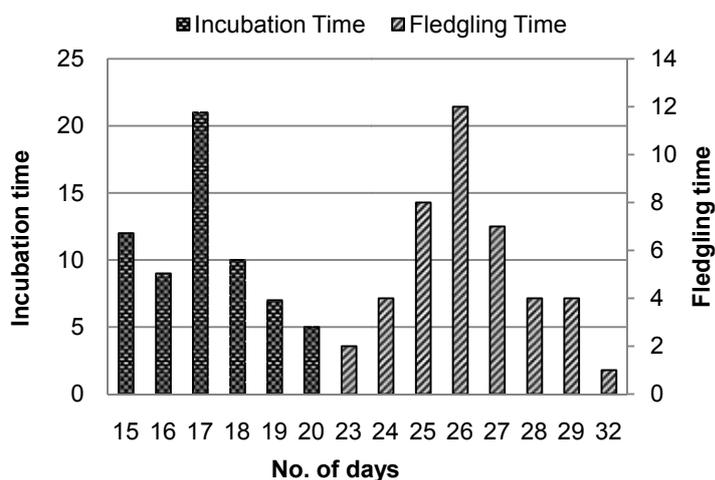


Fig. 3. Mean tree and nest heights from the ground along with canopy spread presenting separately for nest tree species.



**Fig. 4.** Different clutches of House Crow; (a) clutch with 3 egg, (b) clutch with 4 eggs, (c) clutch with 5 eggs, (d) clutch with 6 eggs.



**Fig. 5.** No. of days taken by House Crow to incubate eggs and new born to fledge from nests.

### 3.5. Incubation and nestling period

According to our observations, the incubation period of the House Crow was 15–20 days. Most of the eggs hatched on the 17<sup>th</sup> day. Fledging occurred in the study area between 23–32 days and the maximum number of nestlings fledged on the 26<sup>th</sup> day (Fig. 5).

### 3.6. Breeding success and failures

A total of 116 eggs were recorded from the 29 clutches; out of these, 64 chicks were hatched, giving an egg success of 55.1%. The number of hatchlings produced per nest was 2.2. Of 29 nests only 42 nestlings were produced from successful broods and the number of fledglings produced per nest was 1.44 (Table 5). Of the

total 116 eggs, 52 remained unsuccessful, the total egg failure being 44.8%. The reasons for egg failures were: 32.8% remained unhatched, 5.1% disappeared from the nests during the incubation period, 2.5% were accidentally destroyed during the inspection, 2.5% of the eggs were found broken and 1.8% had fallen from the nests due to poor positioning of the nests. Total nestling failure in the study area was 34.3%. Of the total of 64 hatchlings, 22 remained unsuccessful due to the following reasons: seven chicks were found dead due to bad weather after rain, three chicks had fallen from the nests, seven chicks disappeared from the nests and five chicks were found dead due to unknown causes (Table 6).

## 4. Discussion

In the Indian sub-continent, nests of House Crows are rarely found from November to December - reported by Whistler (1986). The breeding period (June to September) recorded in the present study was somewhat similar to the breeding period (May to August) reported by (Ali 2008) in Islamabad-Rawalpindi and the breeding season (May to September) reported by Behrouzi-Rad (2010) in Iran on Kharg Island. In Durban, Sinclair *et al.* (1981) reported a breeding period from October to November. From Kenya, Ryall (1990) reported that the breeding season starts in mid-September with a peak in November and December. In Calcutta, nests are found in February which is very early, reported by Dharmakumarasinghi & Lavkumar (1972).

**Table 1.** Number of two or more nests located on same tree and distance between them. SD= Standard Deviation

Tree Species	Trees with 2 nests	Trees with 3 nests	Distance between nests (m)
<i>M. azedarach</i>	-	-	-
<i>P. roxburgii</i>	-	-	-
<i>P. orientalis</i>	4	-	3.3
<i>P. euphratica</i>	3	1	2.7
<b>Mean±SD</b>			<b>3.0±0.3</b>
<b>Range</b>			<b>2.7-3.3</b>

**Table 2.** Nest dimensions including nest diameter, nest cup diameter (maximum and minimum), nest depth and nest cup depth (in cm). SD= standard deviation, N= number of nests.

Nest characteristics		Range	Mean±SD	N
Nest diameter	Maximum	40-44	42.3±2.08	51
	Minimum	37-40	39.0±1.73	51
Nest depth		17-21	19.3±2.08	51
Nest-cup diameter	Maximum	14-17	15.6±1.52	51
	Minimum	12-14	13.3±1.15	51
Nest-cup depth		7-9	8.3±1.15	51

**Table 3.** Weight of House Crow nests on different tree species. (SD= Standard Deviation, N= No. of nests).

Tree species	Nests weight (kg)	N
<i>M. azedarach</i>	1.2	1
<i>P. roxburgii</i>	1.1	3
<i>P. euphratica</i>	1.6	3
<i>P. orientalis</i>	1.7	3
<b>Mean±SD</b>	<b>1.4±0.24</b>	<b>10</b>

**Table 4.** Egg dimensions and weight in relation to clutch size of House Crow.

Clutch size	Nest (N)	Eggs (N)	Mean length (mm)	Mean breadth (mm)	Mean volume (cm <sup>3</sup> )	Egg shape index	Egg Weight (g)
1	1	1	38.0	26.0	13.1	1.46	12.1
2	3	6	39.5	26.5	14.1	1.49	12.3
3	3	9	38.0	25.0	12.1	1.52	11.0
4	3	12	39.0	27.0	14.4	1.05	12.5
5	5	25	39.5	26.0	13.6	1.51	12.7
6	3	18	38.0	25.5	12.6	1.49	13.1
<b>Mean</b>	<b>18</b>	<b>71</b>	<b>38.6</b>	<b>26.0</b>	<b>13.3</b>	<b>1.42</b>	<b>12.3</b>

Breeding density in our study area was 0.9 nests/acre. In contrast, Ali (2008) recorded 6.7 active nests/acre and was possibly higher than that recorded by us due to a larger study area comprising Islamabad and Rawalpindi Districts.

In our study, all the nests of the House Crow were present on four tree species *M. azedarach*, *P. roxburgii*, *P. euphratica* and *P. orientalis* whereas none of the nests were found on man-made structures. Both tree nesting and nesting on man-made structures were observed by other researchers who proposed that the House Crow is predominantly a tree nester (Ryall 1990). Ledges on buildings are rarely selected for breeding purposes (Robert 1992). In Mauritius, nests were mainly situated in *Ficus bengalensis*, *Tebeuia pentaphylla*, *Callistemon* spp and *Mangifera indica* trees (Feare & Mungroo 1989). The House Crow has also nested in 12 dissimilar species in Durban, South Africa (Allan & Davies 2005). In Calcutta, House Crows used 13 different tree species to build their nests (Dutta 2007).

**Table 5.** Reproductive parameters of the House crow *C. splendens* in the study area.

Factors	Reproductive Achievement
No. of nests	51
No. of active nests	29
Total no. of eggs	116
No. of hatchlings	64
No. of fledglings	42
Clutch size	4.0
Egg success	0.55
Nest success	0.69
Hatchling/nest	2.20
Fledglings/nest	1.44

**Table 6.** Causes of egg and nestlings failures.

Causes of failures	Egg failures (N)	Percentage %	Nestling failures (N)	Percentage %
Unhatched eggs	38	32.8	-	-
Disappeared from nests	6	5.1	7	10.9
Eggs destroyed accidentally	3	2.5	-	-
Broken eggs found from nests	3	2.5	-	-
Bad location of nests	2	1.8	3	4.7
Mortality (unknown causes)	-	-	5	7.8
Mortality (bad weather)	-	-	7	10.9
<b>Total failures</b>	<b>52</b>	<b>44.7%</b>	<b>22</b>	<b>34.3%</b>

This species also used 23 species of trees for nest construction in Islamabad-Rawalpindi (Ali 2008). In cities where large trees are rare, House Crows make their nests on man-made structures such as lamp posts and pylons (Anvery 2002). According to Soh *et al.* (2002) trees forks, building and street lights serve as nesting sites. Both solitary and colonial nesting were found in the study area but solitary nesting was more frequent, leading us to propose that solitary breeding is common (Godwin 1976, Madge & Burn 1993, Fry *et al.* 2000, Goutam & Kushwaha 2012). However some researchers suggest that colonial breeding is more typical (Lamba 1963, Feare & Mungroo 1989, Cramp & Perrins 1994). Ryall (1990) observed colonial nesting but suggested that these nests were basically independent of each other. Colonial nesting was also observed by Behrouzi-Rad (2010) and Chongomwa (2011) but they declared that colonial nesting was always found on trees with large and dense canopies. In the study area, the mean canopy

spread was 9.5 m but 80.9% of the nests solitary which suggest that colonial breeding is rare in the study area. Colonial breeding has been related in at least one occasion to a shortage of suitable nest trees (Madge & Burn 1993). According to Ali (2002), numerous nests may sometimes be present on a particular tree. In Mauritius, nesting is mainly colonial; Feare and Mungroo (1989) recorded 24 nests in a single large banyan tree. Lamba (1963) recorded up to nine nests in one tree. According to Ryall (1990), large trees in Kenya contained up to six nests but these were always well separated. Allan & Davies (2005) recorded ten nests in a single tree in Durban, South Africa. Behrouzi-rad (2010) also reported more than five nests in a *Ficus bengalensis*. In our study area, we recorded a maximum of three nests on a *P. orientalis* tree.

The House Crow constructs its nest 3.0m or more above the ground level (Brooks & Ahmad 1990, Grimmett *et al.* 1998). The mean tree height recorded in our study area was 14.8m while Ali (2008) recorded a tree height of 12.2m. The mean height of nests in Durban was 13.5m (Allan & Davies 2005). In Mauritius, nests were usually at the height of 10m above the ground and in tall trees (Ryall 1990) while in our study, nests were positioned at a height of 11.8m. In contrast to the present study, in Kenya nests were placed at an average height of 7.3m and 6.4m at two different sites (Ryall 1990). Ali (2008) reported that the mean height of nests was 9.5m in Islamabad-Rawalpindi. Nests were located at a height range of 4–18m in Calcutta (Dutta 2007).

In our study, the nest contents were mainly composed of wood pieces, twigs and wires similar to nests contents used by House Crows in Islamabad-Rawalpindi reported by Ali (2008) and on Kharg Island (Behrouzi-Rad 2010). The nest diameters and depths recorded in our study were greater in size than Islamabad-Rawalpindi (Ali 2008). In India, nests had a diameter of 25–30cm, a cup diameter of 12–15cm and a cup depth of 7–10 cm (Lamba 1963, Cramp & Perrins 1994). The weight of House Crow nests was 1kg in Islamabad-Rawalpindi (Ali 2008). Behrouzi-Rad (2010) recorded a nest weight of 2.5kg on Kharg Island while Allan & Davies (2005) recorded a nest weight of 1.3kg in Merewent. Nests also weighing 2.5kg were recorded by

Dutta (2007). Nest weights up to 6kg were recorded by Altevogt & Davis (1979). In India, some nests weigh up to 8kg and some communal nests even weighed up to 25kg (Cramps & Perrins 1994).

The clutch size of *C. splendens* is usually four eggs but 3–6 are also found with a varying in shades of bluish green, blotched, speckled with red and sepia browns and grey under markings (Roberts 1992). Whistler (1986) states that the normal clutch is 4–5 but 6–7 are rarely met. On Kharg Island, the usual clutch was 4 (4.1; Behrouzi-Rad 2010), in Islamabad-Rawalpindi 3.8 (Ali 2008), and in Merewent, South Africa the clutch size was recorded 4.1 (Allan & Davies 2005). Mombasa mean clutch size reported 3.9 by Ryall (1990). Allan & Davies (2005) recorded egg dimensions of House Crow 37.0 and 26.9mm, at Islamabad-Rawalpindi 37.5 and 26 mm (Ali 2008), and on Kharg Island 39.0 and 27.6mm (Behrouzi-Rad 2010). In Merewent, eggs weighed 13.2g (Allan & Davies 2005), in Islamabad-Rawalpindi 12.8g (Ali 2008) and on Kharg island 12.6 g (Behrouzi-Rad 2010).

An incubation period of 16–17 days was recorded by Ali *et al.* (2007) while Ali (2008) mentions 15–17 days - this was similar to the incubation period recorded in the present study (15–18 days). The nestling period (22–36 days) recorded by Ali (2008) was slightly greater to the nestling period recorded by us (23–32days). The breeding success in a population was recorded by means of egg success (34.6%) and nest success (61.8%) Ali (2008) - these were slightly lower than our records. Reproductive failures were also lower in the study area as compared to Ali (2008). Further studies using advanced methods (Video Surveillance Monitoring) are required to identify nest predators and other activities in the nests of House Crow.

Asian Koel *Eudynamys scolopacea* does not build its own nest. They are brood parasites and have been reported to parasitize House Crows (Lamba 1963). In the Pothowar region of Pakistan, Asian Koel *E. scolopacea* is known to parasitize House Crow nests (Ali *et al.* 2007). However, there were no records of parasitizing the House Crow nests by the Asian Koel in the present investigation, although the species exists in the area.

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**References**

- Akhter S., Husain K.Z. & Rahman M.K. (1994). Breeding records of House Crow *Corvus splendens splendens* Vieillot. *Bangladesh Journal of Zoology*, 22: 243–245.
- Ali H. (2008). Behavior and Ecology of the House Crow (*Corvus splendens*) in Islamabad-Rawalpindi and Adjoining Area. PhD Theses in Zoology, University of Agriculture Faisalabad, Pakistan.
- Ali H., Hasan S.A., Rana S.A., Beg. M.A. & Hassan M.M. (2007). Brood parasitism of Asian koel (*Eudynamys scolopacea*) on the House Crow (*Corvus splendens*) in Pothowar Region of Pakistan. *Pakistan Journal of Agricultural Sciences*, 44(4): 627–634.
- Allan D.G. & Davies G.B. (2005). Breeding Biology of House Crow *Corvus splendens* in Durban, South Africa. *Ostrich*, 76: 21–31.
- Altevgot R. & Davis T.A. (1979). Urbanization in Nest Building of Indian House Crow. *Journal of the Bombay Natural History Society*, 76: 283–290.
- Anvery F.A. (2002). The Crows Menace. *Wildlife and Environment*, 11(3): 30–31.
- Archer A.L. (1998). The Indian House Crow *Corvus splendens*: a control programme recommendation for the Republique de Djibouti. A consultant report to National Biodiversity Action Plan Project (NABSAP) and IUCN, 14 pp.
- Behrouzi-Rad B. (2010). Population Estimation and Breeding Biology of House Crow *Corvus splendens* on Kharg Island, Persian Gulf. *Podoces*, 5(2): 87–94.
- Brooks J.E. & Ahmed E. (1990). A training manual of vertebrate Pest Management. *Pakistan Agricultural Research Council, Islamabad*, pp. 174–175.
- Chongomwa M.M. (2011). Mapping locations of Indian House Crows in Mombasa. *Journal of Geography and Regional Planning*, 4(2): 87–97.
- Cramp S. & Perrins C.M. (1994). *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic, Vol. 8*. Oxford University Press.
- Dharmakumarasinghi R. S. & K. S. Lavkumar. (1972). *Sixty Indian Birds*. Ministry of Information and Broadcasting, India, 100pp.
- Dutta S.K. (2007). Nest site selection of House Crows on Diamond harbour road in Kolkata, India (Online). <http://voices.yahoo.com/nest-site-selection-house-crows-diamond-harbour-573390.html>
- Feare C.J. & Mungroo Y. (1989). Notes on House Crow *Corvus splendens* in Mauritius. *Bulletin of the British Ornithologists' Club*, 109: 199–201.
- Fry C.H., Keith S. & Urban E.K. (Eds) (2000). *The Birds of Africa. Vol. 6*. Academic Press, London
- Goodwin D. 1976. *Crows of the world*. Cornell University Press.
- Goutam R. & Kushwaha P.K. (2012). Study on the Breeding Ecology of the *Corvus splendens*, *Acridotheres tristis* and *psittacula krameri* in Parsa District, Nepal. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences*, 83(1): 27–30.
- Grimmett R., Inskipp C. & Inskipp T. (1998). *Birds of the Indian Subcontinent*. Oxford University Press.
- Lamba B.S. (1963). The identification of some common birds of Indian birds. *Journal of the Bombay Natural History Society*, 21: 121–133. Lynx Edicions.
- Madge S. & Burn H. (1993). *Crows and Jays*. Christopher Helm, London.
- Murray J.B.G. (2000). Measuring annual reproductive success in birds. *The Condor*, 102: 470–473.
- Nordin M. & Yousuf A. (1980). Reproductive biology of House Crow. *Malaysian Applied Biology*, 9: 89–93.
- Robert T.J. (1992). *The Birds of Pakistan, Vol. II*. Oxford University Press.
- Ryall C. (1990). Notes on the nest construction by Indian House Crow *Corvus splendens* and other aspects of its breeding biology in Mombasa, Kenya. *Scopus*, 14: 14–16.
- Ryall C. (2002). Further record of range extinction in the House Crow *Corvus splendens*. *Bulletin of the British Ornithologists' Club*, 122(3): 231–240.
- Ryall C. (2003). Mimicry of House Crow chick by an Asian koel *Eudynamys scolopacea*, as a defense against attack by House Crow *Corvus splendens*. *Journal of the Bombay Natural History Society*, 100: 136–137.
- Sinclair J.C., Mendelsohn J. & Chittenden H. (1981). Breeding of the Indian House Crow in South Africa. *Albatross*, 262: 8–9.
- SMEDA. (2009). Small and Medium Enterprises Development Authority. Ministry of Industries and Production. Khyber Pakhtoonkhwa, Pakistan.
- Soh M.C.K., Sodhi N.S., Seah R.K.H. & Brook B.W. (2002). Nest site selection of House Crow *Corvus splendens*, an urban invasive bird species in Singapore and implications for its management. *Landscape and Urban Planning*, 59(4): 217–226.
- Whistler H. (1986). *Hand Book of Indian Birds*. Cosmo Publications, New Delhi.

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