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BROOD PARASITISM OF ASIAN KOEL (*Eudynamys scolopacea*) ON THE HOUSE CROW (*Corvus splendens*) IN POTHWAR REGION OF PAKISTAN

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The Koel Cuckoo or Asian Koel (*Eudynamys scolopacea*) does not build its own nest and lays eggs in the nest of the House Crow (*Corvus splendens*). The breeding season of this brood parasite (Asian Koel) coincides with that of its host (House Crow). In this study, which was conducted in Pothwar region of Pakistan, Asian Koel parasitised House Crow nests in all the three habitat types viz. urban, suburban and cropland areas. Frequency of brood parasitism was maximum in cropland nests (24.0%) followed by suburban (20.0%) and urban nests (6.0 %). In 2004 and 2005 breeding seasons, 35.7 % and 36.9 % cuckoo eggs were respectively present in the cuckoo-parasitised nests of the House Crow. No parasitised nest contained more than 3 eggs of cuckoo in a single nest. On the average, first egg of parasite appeared 1.63 days after the host had laid its first egg. No nest was found during this course of study where parasite egg was present in the nest before the host egg. First chick of the parasite appeared 2.4 days (range = 1-4 days) before the first chick of host emerged in the nest. Egg success in the cuckoo-infested nests turned out to be 2.9 for the host and 1.7 for the parasite while number of fledglings per successful brood was 1.4 for the host and 1.2 for the parasite. Occurrence of egg losses was 52.1 % in host and 39.3 % in parasite while nestling losses were 39.3 % for the host and 14.5 % for the parasite.

Keywords: Asian koel, koel cuckoo, *Eudynamys scolopacea,* house crow, *Corvus splendens*, brood parasitism, breeding, nest

INTRODUCTION

The birds which do not construct their own nests and deposit eggs in the nests of other birds are called brood parasites (Soler *et al*. 1997; Clotfelter and Yasukawa, 1999). Brood parasitism is an interesting phenomenon because of the adaptations and counter-adaptations evolved in both the host and parasite species (Davies and Brooke, 1988; Rothstein, 1990). Host provides all parental care for parasite eggs and nestlings, therefore, decreased clutch size, hatching success, nest success and fledgling success in the host species are reported consequences of the parasitism (Lack, 1968; Payne, 1977, Rothstein, 1990). The Asian Koel, *Eudynamys scolopacea,* is a familiar brood parasite of crows and mynas throughout the Indian subcontinent (Ryall, 2003). Predominant host of this brood parasite in India and Pakistan is the House Crow, *Corvus splendens.* It also parasitizes Jungle Crow, *Corvus macrorhynchos,* to a smaller extent (Lamba, 1976; Grimmett *et al*., 1998; Ali, 2002). Rare cases of parasitism of broods of Common Myna, *Acridotheres tristis* (Inglis, 1908), Golden Oriole, *Oriolus oriolus* (D' Abreu, 1927) and Magpie, *Pica rustica* (Harington, 1904) are also on record.

MATERIALS AND METHODS

This study on brood parasitism of Asian Koel, *Eudynamys scolopacea,* on the House Crow, *Corvus splendens,* was conducted from April 2004 to October 2005 in Pothwar region of Pakistan. A total of 30 randomly selected sites were sampled in three habitat types of the study area viz. urban, suburban and croplands. Fifteen sites in urban habitats while seven and eight sites in suburban and cropland habitats were sampled respectively. Coordinates of these sites were noted with Garmin Global Position System (GPS) which are given in Table 1. These sites were located within 100 km radius of 'zero point' of Islamabad (N 33^{o} 41.629 E 73^{o} 03.912), the capital of Pakistan. Sites selected for sampling were earmarked and the same were sampled during the next breeding season.

In breeding season all the trees present in the sampled area of three habitat types were checked for the presence of active nests of the House Crow. The nest where egg-laying was confirmed is referred to as 'active nest'. The trees carrying active crow nests were marked and numbered. In the two breeding seasons, a total of 248 active nests of the House Crow were focused, of which 215 were unparasitised and 33 were parasitised by the Asian Koel. To check the nest, we would climb to trees to examine the interior of nest cavity and photographs of eggs and chicks were taken with E-300 Digital Camera.

Murray (2000) was followed to calculate egg success and nest success as measures of reproductive success. Egg success is 'the proportion of eggs that produce young' and nest success is 'the proportion of

Table 1. Coordinates of urban, suburban and cropland sites sampled during the study

Site No.	North	East
Urban sites		
1	33°44.490	073°03.338
2	33°44.020	073°03.616
3	33°43.199	073°04.489
4	33°41.698	073°04.478
5	33°40.479	073°04.210
6	33°39.155	072°59.219
7	33°43.054	073°07.860
8	33°36.654	073°03.928
9	33°35.306	073°03.948
10	33°36.936	073°03.896
11	33°33.666	072°38.216
12	33°50.092	073°01.750
13	33°52.874	073°20.462
14	33°55.031	073°23.506
15	33°48.515	073°31.500
Suburban sites		
16	33°41.467	072°58.515
17	33°38.072	072°53.399
18	33°46.905	073°14.596
19	33°34.148	073°03.048
20	33°44.888	072°49.082
21	33°42.336	073°26.156
22	33°22.286	073°14.297
Cropland sites		
23	33°46.818	073°05.181
24	33°27.114	073°13.279
25	33°20.674	073°00.968
26	33°21.038	072°49.437
27	33°31.043	072°38.472
28	33°34.009	072°42.075
29	33°26.772	073°21.459
30	33°21.028	073°15.694

clutches that produce young'. Thus, number of young that leave the nests divided by total number of eggs gave egg success while number of clutches that produce young was divided by total number of clutches to obtain nest success.

Data on the climatic conditions of the area, obtained from Islamabad station of the Pakistan Meteorological Department, indicated a monsoonal climate of rainy hot summers and cool dry winters. Precipitation is characteristic of the semi-arid zone of Pakistan. The monsoon rains usually start in June, peak in August, and end by September. The four monsoon summer months always have some precipitation, but any of the other months can be completely dry. Average yearly rainfall is 1143 mm. The maximum recorded temperature was 44.8 degree Celsius in August 1972, and the minimum was - 3.9 degree in a January before 1961. The coldest month is January when the mean maximum temperature is 17.7ºC and the mean minimum temperature 2.6ºC. June is the hottest month with the mean maximum temperature near 40ºC and the mean minimum temperature 24ºC (Sheikh *et al.,* 2000). Monthly rainfall, relative humidity and mean temperature during the course of this study are shown in Fig. 1.

RESULTS AND DISCUSSION

Instead of constructing its own nest, Asian Koel, *Eudynamys scolopacea,* lays eggs in nest of House Crow, *Corvus splendens*. Breeding season of the koel coincides with that of the House Crow, which extends from late May to early September in Pothwar region of Pakistan. The koel is so adapted that it remains cognizant of newly built nests of House Crow in the vicinity and takes an early opportunity to lay its eggs in the crow nest. The koel's eggs resemble in coloration and texture with the host species with slight variations (Fig. 2). The ground colour of the crow eggs presents different shades of bluish green while that of the koel is olive green. Eggs of both host and parasite have similar brown markings in the form of blotches, specks and streaks. Which are more densely distributed towards the broader end. Although eggs of koel are smaller in size they exhibit remarkable mimicry with crow eggs (average weight of koel eggs was 8.68 g, S.E. ± 0.54; Range = 7.40 - 10.20 g while those of the crow was 12.85 g, S.E. ± 0.16, Range = 8.80 - 17.4 g).

The Asian Koel parasitised nests of the House Crow in all the three habitat types of the study area viz. urban, suburban and croplands. The frequency of brood parasitism varied greatly in these habitats. In 2004, 4.2 %, 20.6%, and 22.2% nests of the House Crow were parasitised by cuckoo in urban, suburban, and cropland areas (Table 2). In 2005, 7.9 % urban nests were parasitised while 23.3 % and 26.0 % suburban and cropland nests were parasitised respectively. Thus, maximum nests were parasitised in cropland (24.0%) followed by suburban (20.0%) and urban nests (6.0%). If we combine data of the three habitats 13.3 % crow nests contained koel eggs. Lamba (1976) documented that at least 10.0 % crow nests harboured koel nests in India while in a recent study on control of invasive House Crows in Singapore Brook *et al*. (2003) found that 9.4 % nest of the House Crow were parasitised.

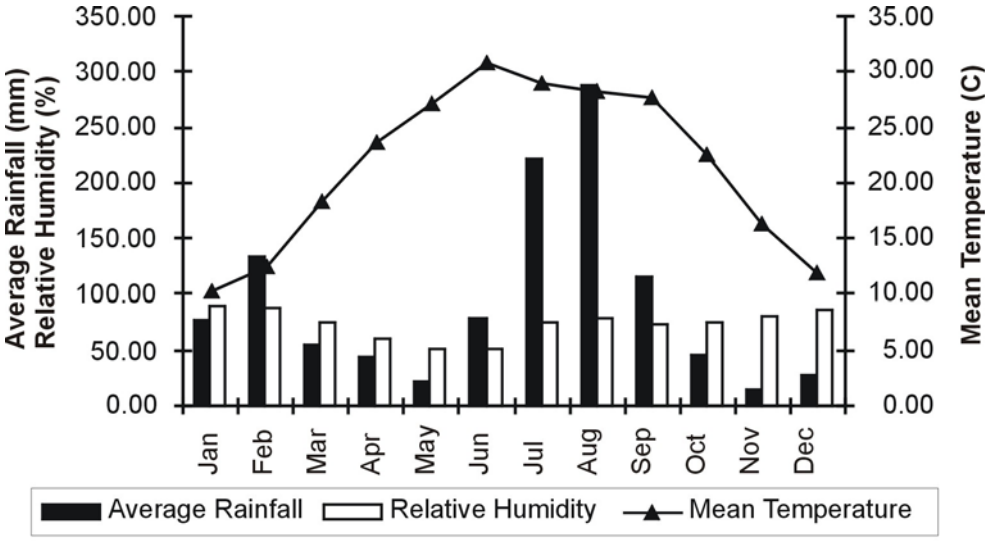

Fig.1. Monthly rainfall, relative humidity and mean temperature during the study period.

Fig. 2. Three eggs of the house crow and two of the cuckoo in a cuckoo-infested nest

The percentage of cuckoo eggs ranged from 20 to 50 % in cuckoo-infested nests of the House Crow (Table 3). Of the 15 parasitised clutches observed in 2004, one had 20 % cuckoo eggs, three had 25 %, four had 33.3%, five had 40 % and two had 50 % cuckoo eggs in them. Of the 18 parasitised clutches in 2005, two had 20 %, six had 25 %, four had 33.3 %, six had 40.0% and four had 50.0 % eggs of cuckoo. On the average, 35.7 % and 36.9 % cuckoo eggs were present in the cuckoo-parasitised nests of the House Crow in 2004 and 2005 respectively. No parasitised nest contained more than 3 eggs of cuckoo in a single nest during course of this study. Lamba (1976) reported same finding from India and did not observe more than three eggs of the koel in a single nest although some earlier workers reported as many as seven (Jacob, 1915), eleven (Abdulali, 1931) and thirteen (Jones, 1916; Baker, 1935).

Eleven cuckoo - parasitised clutches were observed from egg laying to fledgling stage. In five of them, the first egg of the parasite appeared 1 day after the first egg of host was laid. In other five nests, cuckoo laid its first egg 2 days after crow laid its first egg, and in one nest parasite egg was laid 3 days after the host laid its first egg. On the average, first egg of parasites appeared 1.63 days after the host had laid its first egg. No nest was found during this course of study where parasite egg was present in the nest before the host egg. Incubation period was found to be 12 – 13 days.

Table 2. Frequency of koel parasitism on the house crow in different habitat types of the study area.

	Urban	Suburban	Cropland	Combined
2004				
Un-parasitised nests	67	29	21	117
Parasitised nests	3	6	6	15
Proportion of parasitised nests	0.042	0.206	0.222	0.113
2005				
Un-parasitised nests	58	23	17	98
Parasitised nests	5	7	6	18
Proportion of parasitised nests	0.079	0.233	0.260	0.155
Pooled				
Un-parasitised nests	125	52	38	215
Parasitised nests	8	13	12	33
Proportion of parasitised nests	0.060	0.200	0.240	0.133

Table 3. Number of the host and parasite eggs in the parasitised nests of the house crow

Nest No.	Total No. of eggs in the nest	No. of crow eggs (%)	No. of cuckoo eggs (%)
2004			
1	4	3 (75)	1 (25)
2	4	2 (50)	2 (50)
3	5	3 (60)	2 (40)
4	3	2 (66.7)	1 (33.3)
5	5	3 (60)	2 (40)
6	6	3 (50)	3 (50)
7	4	3 (75)	1 (25)
8	6	4 (66.7)	2 (33.3)
9	5	3 (60)	2 (40)
10	5	4 (80)	1 (20)
11	4	3 (75)	1 (25)
12	5	3 (60)	2 (40)
13	3	2 (66.7)	1 (33.3)
14	6	4 (66.7)	2 (33.3)
15	5	3 (60)	2 (40)
Total	**70**	**45 (64.3)**	**25 (35.7)**
2005			
1	6	4 (66.7)	2 (33.3)
2	4	2 (50)	2 (50)
3	5	3 (60)	2 (40)
4	5	4 (80)	1 (20)
5	6	3 (50)	3 (50)
6	4	3 (75)	1 (25)
7	3	2 (66.7)	1 (33.3)
8	5	4 (80)	1 (20)
9	5	3 (60)	2 (40)
10	4	2 (50)	2 (50)
11	4	3 (75)	1 (25)
12	6	4 (66.7)	2 (33.3)
13	5	3 (60)	2 (40)
14	5	3 (60)	2 (40)
15	4	2 (50)	2 (50)
16	5	3 (60)	2 (40)
17	5	3 (60)	2 (40)
18	3	2 (66.7)	1 (33.3)
Total	**84**	**53 (63.1)**	**31 (36.9)**

The cuckoo chick emerged 1-4 days before the appearance of the first chick of host. Of 11 cuckoo-infested nests, parasite chicks in five nests appeared 2 days before the chick of the host. Parasite chick in one nest emerged 1 day before the host chick and in four nests 3 days earlier than host chick while in one nest it appeared 4 days before the host chick. On the average, first chick of the parasite appeared 2.4 days before the first chick of host emerged in the nest. Cuckoo chicks grew rapidly and were the healthiest occupant of the crow nest (Fig. 3). Moreover, chicks of cuckoo developed wings earlier although their weight was quite less than crow chicks (Fig. 4) and it enabled them to successfully fledge out earlier than crow chicks.

Fig. 3. Two chicks of the koel present in the cuckoo-infested nest are more developed than the host chick

In 2004 breeding season, 45 eggs of the crow and 25 eggs of the cuckoo were laid in 15 nests (Table 4). Full contents of the 4 nests were lost and a total of 26 chicks (13 of parasite and 13 of the host) fledged from 11 successful broods. The number of eggs per nest was 3.0 for the host and 1.7 for the parasite, whereas number of fledglings per successful brood was 1.2 for both the host and the parasite. In 2005, 53 eggs of the crow and 31 eggs of cuckoo were laid in 18 cuckoo-parasitised nests. In one nest only one chick of the cuckoo survived to fledge, therefore, number of successful broods was 12 for the host and 13 for the parasite. The number of eggs per nests turned out to be 2.9 for the host and 1.7 for the parasite while number of fledglings per successful brood was 1.4 for the host and 1.2 for the parasite in this study.

Information about the reproductive losses in the cuckoo- infested nests of the House Crow are given in Table 5. In 2004, of the 15 parasitised nests, two fell down and in other two nests the contents suddenly disappeared. Eleven eggs of the host remained unhatched whereas all the eggs of parasite hatched. Of 21 nestlings of the crow 13 chicks fledged while 13 chicks of the parasite fledged successfully out of 15 nestlings. The egg losses were 53.3 % for the host and 40.0 % for the parasite while nestling losses were 38.0 % and 13.3 % for the host and parasite respectively. Thus both egg and nestling losses were higher in the host. In 2005, two nests fell down and contents of another nest disappeared suddenly. Nine eggs of the host failed to hatch while all the eggs of the parasite hatched. Seventeen chicks of the host and 16 of parasite fledged. The eggs losses were 50.9 % for the host and 38.7 % for the parasite while nestling losses were 34.6% and 15.8 % for the host and parasite respectively. Pooled data for the two years show that 52.1 % egg losses occurred in host and 39.3 % in parasite.

Short incubation period is an advantageous adaptation in the koel. It is 12 - 13 days for koel and 16 - 17 days for the crow. Koel chicks emerge earlier and get better share of food from foster parents (Lamba, 1963a). Crow chicks may die of starvation but koel chicks do not face this problem. Egg fertility in koel is remarkably high and nestling mortality is extremely low. No egg of koel in this study failed to hatch. Dead crow chicks were often seen in crow nests but no dead koel chick was met with. Koel chicks' mortality was either due to natural calamities like winds and storms or disturbance by man. Similarly, Lamba (1976) reported 100% egg fertility in 39 cases from India and of the 24 fledglings in 21 nests, only one chick was found missing.

(a)

(b)

(c)

Fig. 4. One chick of the crow and other of the cuckoo, which were of less than two weeks weighed 97.7 g and 160.2 g respectively in one nest (a) while in another nest crow (b) and cuckoo (c) chicks of less than three weeks weighed 225.5 g and 116.0 g respectively.

Table 4. Reproductive success of the host and parasite in the cuckoo-infested nests of the house crow

Total No. of parasitised nests	Host/ parasite	No. of eggs	No. of nestlings	No. of successful broods	No. of fledglings	No. of eggs per nest	Fledglings per successful brood
2004							
15	Crow	45	21	11	13	3.0	1.2
	Koel	25	15	11	13	1.7	1.2
	Combined	70	36	11	26	4.7	2.4
2005							
18	Crow	53	26	12	17	2.9	1.4
	Koel	31	19	13	16	1.7	1.2
	Combined	84	45	13*	33	4.6	2.6
Pooled							
33	Crow	98	47	23	30	2.9	1.3
	Koel	56	34	24	29	1.7	1.2
	Combined	154	81	24*	59	4.6	2.5

* In one nest only one chick of cuckoo survived to fledge.

Table 5. Reproductive losses in the cuckoo–parasitised nests of the house crow

No of parasitised nests	Host/Parasite	No. of eggs	No. of nests losing their full content	No. of unhatched eggs	No. of nestlings	No. of fledglings	% egg losses	% nestlings losses
2004								
15	Crow	45	4	11	21	13	53.3	38.0
	Cuckoo	25	4	0	15	13	40.0	13.3
2005								
18	Crow	53	3	9	26	17	50.9	34.6
	Cuckoo	31	3	0	19	16	38.7	15.8
Pooled								
33	Crow	98	7	20	47	30	52.1	36.3
	Cuckoo	56	7	0	34	29	39.3	14.5

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