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Preliminary Investigations on Diet and Breeding Biology of the Indian Roller *Coracias benghalensis* in a Portion of Cauvery Delta, Tamil Nadu, India

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Abstract: Diet composition and breeding biology of the Indian Roller *Coracias benghalensis* was studied between 2005 and 2006 in a portion of Cauvery delta, Nagapattinam District, Tamil Nadu, India. The diet composition of the Indian Roller was described based on the regurgitated pellets (n=712). The results revealed that the Indian Roller preys mainly on Coleoptera (26.6%), followed by Orthoptera (19.5%), Hemiptera (16.7%), Hymenoptera (14.2%), Diptera (9.1%), Odonata (6.7%) and Lepidoptera (6.5%). A total of 11 nest-sites were studied and the Indian Roller highly preferred holes/ cavities found in Coconut trees *Cocos nucifera* (45.5%). For Indian Roller, nest tree height averaged 14.6 ± 6.51m above ground, nest tree DBH averaged 66.7 ± 8.16cm and nest hole location height averaged 5.8 ± 5.04m above ground. The mean length, circumference and depth of nest holes/cavities were 14.3 ± 2.52, 33.8 ± 4.39 and 68.6 ± 6.41cm, respectively. Clutch size varied from 2 to 5 with a mean of 3.2 ± 0.75. The maximum and minimum length and width of eggs were 39.0 x 33.0 and 31.0 x 27.0mm, respectively. Weight of the eggs varied between 12.0 and 16.0g. The newly hatched nestlings were 10.8 ± 1.39g in weight and reached a maximum of 291.0 ± 7.96g on day 24. A reduction in weight was observed during the last few days and nestlings weighed on average 248.1 ± 5.85g before leave out the nest. The other body parts attained their adult size before fledging. The hatching and fledging success of the Indian Roller were 78.9 and 80.3%, respectively.

Key words: Indian roller % Diet %Nest-site % Eggs % Nestling growth

INTRODUCTION

Indian Roller *Coracias benghalensis* (Linnaeus, 1758) is the most common avian species in Southern India. It is a stocky bird about 26-27cm long and inconspicuous when resting. But, as it takes flight the primaries and secondaries show bright shades of blue [1]. During breeding season, the mates perform ornate sexual displays as they fly upward, then roll and fall through the air wildly flapping their wings and screaming harshly. This is how they earned the name roller. It inhabits all types habitat mainly in cultivation, thin forest and grassland and in cities at lower elevations but avoids heavy jungles. The distribution of Indian Roller extends across Iraq and Iran through Pakistan, India, Burma, Southeast Asia, Tibet and parts of China [2]. Two subspecies are usually recognized viz., *Coracias benghalensis benghalensis* and *Coracias benghalensis affinis*. The nominate form is found from west Asia (Iraq, Arabia) to Bangladesh and north of the Vindhyas ranges. The race *affinis* is found in northeastern India and Southeast Asia (Thailand, Yunnan and Indochina). Indian Roller are highly beneficial to agriculture since it's destroys vast quantities of agricultural insect pests [3]. Relatively little is known about the behaviour the Indian Roller [3, 4-6], so there are huge gaps in our knowledge about the ecology of the Indian Roller in India. Hence, this paper presented information on diet composition based on the results of pellet analysis and breeding biology of the Indian Roller in a portion of Cauvery delta region, Tamil Nadu, India.

MATERIALS AND METHODS

Study Area: The study was conducted in the Cauvery delta regions *viz*., Mannampandal, Mangainallur and Thiruvalanagadu (18°18' N, 79° 50' E) of Nagapattinam

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District, Tamil Nadu, India between 2005 and 2006. The region is generally referred to as the 'granary of South India' because of large scale agricultural operations take place for in the cultivation of paddy, sugarcane, cotton, groundnut, banana, pulses and other cereals. Woody vegetation is sparse and in the form of groves and roadside trees. Predominant woody plant species found in the study area are: *Cocos nucifera, Borassus flabellifer, Madhuca indica, Mangifera indica, Enterolobium saman, Tamarindus indicus, Ficus benghalensis, Ficus religiosa, Thespesia populnea, Phoneix psuilla, Acacia arabica, Odina wodier* and *Azadirachta indica*. Important shrub species are: *Prosopis juliflora, Jatropha glandulifera, Adhathoda vesica*. Plantations of *Casuarina equisetifolia, Tectona grandis* and *Bamboosa arundinacea* are also found in the study area.

Diet Analysis: The regurgitated pellets were collected opportunistically at perch and roost and nest-sites around the agricultural lands. The collected pellets were bagged, labeled and dried in hot air oven at 60°C for identification of prey remains [7]. The prey fragments were identified by using a dissecting microscope and reference books. The prey taxa was identified by means of analyzing various body-parts in the remains of the diets as follows: Coleoptera (mandibles, elytra and leg fragments), Hemiptera (H-shaped tergal plates, mouthparts and leg fragments), Hymenoptera (mouthparts, leg fragments and wing fragments), Orthoptera (raptorial leg fragments and mandibles), Diptera (antennae, eyes and wings), Odonata (wings, leg fragments and head capsules) and Lepidoptera (wing scales and proboscis).

Nest-sites and Nests: The total height of the nesting tree and nest hole/cavity location in meters from the ground was measured using an altimeter. Diameter at breast height (DBH) was measured using a standard measuring tape. Distance to the nearest agricultural land, water source, grove, human habitation, road, perching tree and electric line were measured in meters using a standard tape or marked rope. The length, circumference and depth of nest hole/cavity were measured by a meter scale or measuring tape.

Eggs and Incubation: The length and width of each egg was measured by Vernier Calipers with 0.1mm accuracy. Each egg was weighed by a 100g spring balance of 500mg accuracy. The incubation period was determined as the time between the first egg laid and the first egg hatched. The eggs were numbered with a felt-tipped marker, for finding the hatching order of the eggs.

Nestling Growth Patterns: Growth changes in the Indian Roller nestlings were measured using method described by Pettingil [8]. All the nests were visited after every 3 days, to take morphometric measurements of the body parts. Disturbances were minimized by handling the nestlings very carefully during the measurements. All the nestlings were allocated individual identification marks. A total of eight measurements were made 1) *body weight*, using a spring balance of 1g accuracy; 2) *body length*, from the tip of the bill to the tip of the longest rectrix; 3) *bill length*, from the tip of the upper mandible to the base of the culmen; 4) *bill depth*, distance between the upper and lower mandible; 5) *wing length*, as the straight length from the bend of the wing to the tip of the longest primary; 6) *wing span*, the distance from tip to tip of the longest primaries of the outstretched wings; 7) *tarsus length*, measurement from the base of the tarsometatarsus to the base of the middle toe and 8) *tail length*, the distance from the tip of the longest rectrix to the base of the middle rectrices.

Hatching and Fledging Success: The hatching and fledging success were calculated by using the following formulas:

$$\text{Hatching success (\%)} = \frac{\text{No. of eggs hatched}}{\text{Total No. of eggs laid}} \text{ X } 100$$

$$\text{Fledging success (\%)} = \frac{\text{No. of nestlings fledged}}{\text{Total No. of eggs laid}} \text{ X } 100$$

RESULTS

Diet: Between January 2005 and December 2006, 712 regurgitated pellets of Indian Roller were collected and analyzed. Pellets were usually dark brown when fresh and contained masses of undigested insect remains. On an average, a complete pellet measured 26.2 ± 0.53mm in length (range: 9-55mm), 10.3 ± 0.30mm in width (range: 2-20mm) and weighed 1.29 ± 0.75g (range: 0.08-4.16g). A total of 8,038 individual insect prey remains belonging to seven insect orders were recovered from the pellets. Number of prey per pellet ranged from 5 to 22 with a mean of 11.3 ± 1.21. Among seven insect orders identified, Coleoptera were the principal food resources, constituted more than 26% of the total diet. The most important prey after Coleoptera were Orthoptera (19.5%), Hemiptera (16.7%), Hymenoptera (14.2%), Diptera (9.1%), Odonata (6.7%) and Lepidoptera (6.5%) (Table 1).

Table 1: Diet composition (percentage ± SD) of Indian Roller *C. benghalensis* in Cauvery delta region of Tamil Nadu, India, 2005-2006

Prey species	2005	2006	Combined
Coleoptera	26.6 ± 1.11	26.7 ± 0.74	26.6 ±0.61
Hemiptera	16.6 ± 0.30	16.9 ± 1.60	16.7 ± 0.82
Hymenoptera	14.2 ± 1.34	14.1 ± 0.21	14.2 ± 0.45
Orthoptera	20.0 ± 0.61	19.0 ± 0.40	19.5 ± 0.32
Diptera	9.0 ± 0.33	9.2 ± 1.11	9.1 ± 0.84
Odonata	6.7 ± 0.52	6.7 ± 0.37	6.7 ± 0.33
Lepidoptera	6.1 ± 0.87	6.8 ± 0.33	6.5 ± 0.21
Others	0.7 ± 0.10	0.6 ± 0.11	0.7 ± 0.20
Total prey items	3988	4050	8038
Total No. of pellets	367	345	712
Mean prey / pellet	10.8 ± 1.28	11.7 ± 1.35	11.3 ± 1.21

Table 2: Seasonal share of insect prey groups in the Indian Roller *C. benghalensis* diet (shown as percentage and number of prey items). Data for 2005 and 2006 pooled

	% frequency of occurrence (n)			
Prey items	Post-monsoon	Summer	Pre-monsoon	Monsoon
Coleoptera	27.2 (558)	32.0 (743)	22.5 (441)	23.2 (397)
Hemiptera	15.7 (321)	14.6 (338)	20.5 (402)	16.6 (284)
Hymenoptera	10.9 (224)	15.4 (357)	15.4 (301)	15.1 (258)
Orthoptera	24.3 (497)	16.1 (374)	19.8 (387)	18.2 (311)
Diptera	9.6 (197)	8.7 (201)	9.2 (181)	9.0 (154)
Odonata	5.6 (114)	6.3 (147)	5.5 (108)	9.8 (168)
Lepidoptera	6.1 (124)	6.3 (146)	6.5 (127)	7.2 (123)
Unidentified insects	0.7 (14)	0.6 (14)	0.6 (12)	0.9 (15)
Total prey items	2049	2320	1959	1710
No. of pellets	174	189	178	171
Mean prey / pellet	11.7 ± 1.17	12.2 ± 0.98	11.0 ± 1.36	10.0 ± 1.20

Table 3: Nesting tree and nest characteristics of the Indian Roller *C. benghalensis.* Values are mean ± SD

Variables	Min.	Max.	Mean ± SD
Nest tree characteristics			
Nesting tree height (m)	6.5	23	14.6 ± 6.51
Nest hole location height (m)	5	7.5	5.8 ± 5.04
DBH (cm)	24	120	66.7 ± 8.16
Nest characteristics			
Hole / cavity entrance length (cm)	12.5	18	14.3 ± 2.52
Hole / cavity circumference (cm)	30	38	33.8 ± 4.39
Hole / cavity depth (cm)	40	100	68.6 ± 6.41
Habitat characteristics			
Distance to agricultural lands (m)	8	21	8.3 ± 4.90
Distance to groves (m)	75	150	97.7 ± 3.62
Distance to water bodies (m)	135	500	234.1 ± 9.11
Distance to human habitations (m)	175	450	327.3 ± 8.42
Distance to road (m)	175	500	367.1 ± 9.16
Distance to perching tree (m)	1	3	1.8 ± 1.45
Distance to electric line (m)	2	5.5	2.7 ± 1.52

Seasonal Diet: The major insect groups consumed by the Indian Roller were Coleoptera, Orthoptera, Hemiptera and Hymenoptera all the year round (Table 2). The highest rate Coleoptera consumed by Indian Roller was found in summer (32.0%) and the lowest in monsoon (23.2%). The second dominant insects, Orthoptera was greatly consumed during post-monsoon (24.3%) and lower during summer (16.1%). The other dominant insect groups, Hemiptera (20.3%) and Hymenoptera (15.4%) were higher in pre-monsoon and lower in summer (14.6%) and post-monsoon (10.9%) respectively. For the orders other than those mentioned above, their percentage composition was low, about <10% for all the year round (Table 2).

Nest-site and Nests: Indian Roller pairs started laying eggs in late April and breeding activities ended in June. Eleven nesting attempts indicated that nest cavities/holes were found in four tree species and were most frequently found in Coconut trees *Cocos nucifera* (45.5%) followed by Palm trees *Borassus flabellifer* (27.3%), Banyan trees *Ficus benghalensis* (18.2%) and Rain tree *Enterolobium saman* (9.1%). The Indian Roller preferred nesting trees with a mean height of 14.6 ± 6.51m and DBH of 66.7 ± 8.16cm. Nest cavities were located with a mean height of 5.8 ± 5.04m from the ground (Table 3). Habitat analysis around each nest tree revealed that Indian Roller selected nest site close to agricultural lands (8.3 ± 4.90m) and groves (97.7 ± 3.62m). Based on data for 11 nests, the dimensions of an average nest hole was 14.3 ± 2.52cm long, 33.8 ± 4.39cm circumference and 68.6 ± 6.41cm depth (Table 3).

Eggs and Incubation: A complete clutch consisted of 2-5 eggs with a mean of 3.2 ± 0.75 eggs per clutch. The average size of the egg was 36.4±0.14 x 29.7±1.11mm (length x width). The average weight of an egg was 14.0±0.90g for 35 eggs (Table 4). The eggshell was smooth, glossy and bright-white in colour. During the incubation period when only one bird remained inside the nest, another bird was seen perching outside the nest. The incubation period was approximately 17-20 days.

Nestling Growth and Plumage Development: Body length, bill length, bill depth, wing length, wing span, tarsus length and tail length increased asymptotically while weight reduction was noticed in the last few days (Table 5). Nestlings grew from 10.8 ± 1.39g at hatching to peak weight of 291.2 ± 7.96g at day 24 then slowly declined and reached 248.1 ± 5.85g on day 30.

At hatching, nestlings were flesh coloured with closed eyes. The bill was dull yellow and with a small white egg tooth. The claws were soft. The gape was yellow and the mouth lining was bright yellow. Six days later their appearance changed little, but the eyes remain closed. The bill changed from yellow to grey with light yellow colouration at the tip of the bill. The gape was then considerably brighter yellow. The nestlings still had no visible contour feather development but primaries and rectrices had just begun to emerge through the skin. At 12 days, the contour feathers emerged through the skin. After this point, nestling feathers development progressed much more rapidly. The eyes were opened fully. At around 18th day, most contour feathers had broken their sheaths. Those of the ventral cervical tract were just breaking sheaths, whereas, those of the capital tract remained unbroken. The bill was black colour without the yellow tip. The nestlings were able to produce various call sounds. By day 24, breast and belly feathers w ere now distinctly coloured as in adults.

Table 4: Egg parameters of the Indian Roller *C. benghalensis*

Variable	Min.	Max.	Mean ± SD
Length (mm)	33	39	36.4 ± 0.14
Width (mm)	27	31	29.7 ± 0.11
Weight (g)	12	16	14.0 ± 0.90
Clutch size (n = 11)	2	5	3.1 ± 0.75

Table 5: Growth patterns of different body parts of Indian Roller *C. benghalensis* nestlings. Values are mean ± SD

Age in days	No. of chicks	Body weight (g)	Body length (cm)	Bill length (cm)	Bill depth (cm)	Wing length (cm)	Wing span (cm)	Tarsus length (cm)	Tail length (cm)
0	26	10.8 ± 1.39	20.65 ± 0.21	0.29 ± 0.09	0.13 ± 0.06	9.93 ± 0.29	5.40 ± 0.12	1.00 ± 0.06	0.12 ± 0.04
3	24	19.0 ± 2.35	5.00 ± 0.17	0.66 ± 0.08	0.30 ± 0.07	2.02 ± 0.27	7.70 ± 0.27	1.30 ± 0.10	0.28 ± 0.06
6	20	36.9 ± 2.30	6.62 ± 0.19	0.95 ± 0.05	0.60 ± 0.05	2.95 ± 0.13	9.07 ± 0.36	1.68 ± 0.08	0.45 ± 0.06
9	20	53.1 ± 4.36	8.62 ± 0.21	1.13 ± 0.13	0.80 ± 0.07	3.87 ± 0.21	14.00 ± 0.37	1.92 ± 0.06	0.75 ± 0.08
12	21	61.1 ± 3.50	10.04 ± 0.33	1.63 ± 0.11	0.93 ± 0.05	5.74 ± 0.19	16.56 ± 0.75	2.33 ± 0.07	0.98 ± 0.05
15	21	103.3 ± 9.66	11.88 ± 0.46	1.81 ± 0.06	1.00 ± 0.06	6.82 ± 0.19	22.96 ± 1.02	2.63 ± 0.10	1.41 ± 0.12
18	17	151.1 ± 5.16	13.37 ± 0.30	2.02 ± 0.04	1.01 ± 0.24	8.63 ± 0.30	24.59 ± 0.29	2.95 ± 0.06	1.53 ± 0.09
21	16	226.5 ± 8.35	15.08 ± 0.55	2.11 ± 0.10	1.14 ± 0.05	13.24 ± 0.46	36.06 ± 1.30	3.35 ± 0.10	2.01 ± 0.06
24	16	291.2 ± 7.96	16.53 ± 0.24	2.29 ± 0.05	1.16 ± 0.05	18.18 ± 0.35	42.33 ± 1.11	3.64 ± 0.05	2.70 ± 0.14
27	14	257.8 ± 9.97	17.59 ± 0.28	2.31 ± 0.03	1.19 ± 0.05	20.41 ± 0.24	44.03 ± 0.65	3.81 ± 0.05	3.72 ± 0.38
30	11	248.1 ± 5.85	20.54 ± 0.28	2.35 ± 0.07	1.20 ± 0.04	20.50 ± 0.17	44.75 ± 1.27	3.85 ± 0.05	5.49 ± 0.10

Table 6: Hatching and fledging success of Indian Roller *C. benghalensis*

Nest No.	Clutch size	No. of eggs hatched	Hatching success (%)	No. of nestlings fledged	Fledging success (%)
1	3	3	100	2	66.7
2	3	3	100	2	66.7
3	3	2	66.7	2	100
4	5	3	60	2	66.7
5	3	1	33.3	1	100
6	3	3	100	2	66.7
7	4	3	75	3	100
8	2	2	100	2	100
9	3	3	100	2	66.7
10	3	2	66.7	2	100
11	3	2	66.7	1	50
Mean ± SD	3.2 ± 0.75	2.5 ± 0.69	78.9 ± 22.64	1.9 ± 0.54	80.3 ± 9.46

The back and wings were pale with dark blue combinations. The breast was dull rufous-brown and the abdomen was buffy pale blue. At 27 days old, nestlings began to appear fully feathered. The belly and breast feathers appeared similar to adult plumage. The brilliant dark and blue bands on the wings had fully developed. The tail was fully developed shaded with blue feathers. There was no sexual dimorphism. On day 30 to 32 the nestlings flew out of the nest. By the time of fledging, nestlings were similar in appearance to adults.

Hatching and Fledging Success: Of the 35 eggs laid in 11 clutches, 27 eggs were hatched (2.5 ± 0.69 eggs / nest) giving a mean hatching success of 78.9%. A total of 21 nestlings were fledged (1.9 ± 0.54 nestlings / nest) making a mean fledging success of 80.3% (Table 6).

DISCUSSION

The present data on the food of the Indian Roller in the Cauvery delta region revealed that over 99% make up various insect groups. Among them, Coleoptera, Orthoptera, Hemiptera and Hymenoptera were most dominant prey items than the other insects. Earlier, heavy consumption of Coleoptera (45.7%) and Orthoptera (24.5%) by Indian Roller has been recorded by Sivakumaran and Thiyagesan [6] in Cauvery delta region. The above authors recorded only four insect orders *viz*., Coleoptera, Orthoptera, Hymenoptera and Lepidoptera in the pellets, but herein seven insect orders have identified. Another study in South India from stomach analysis contents of the Indian Roller by Mathew *et al*. [3] indicated that a variety of insect species mainly belonging to the beetles, grasshoppers and a few vertebrates like frogs, toads and *Mabuya* in their diet. In the present study there is no trace of vertebrate remains in the pellets. The higher and lower proportion of various insect orders consumed by Indian Roller in different seasons is mainly due to the availability and abundance of insects, weather conditions, species competitions and agricultural practices in the study area. However, the findings of the present study indicated that a wide variety of insects are consumed by Indian Roller and thereby they act as very active bio-control agents against agricultural insects pests. Mason and Maxwell-Lefroy [9] and Hussain and Bhalla [10] stated that Indian Roller was highly beneficial to agriculture, its food mainly consists destructive insects of crops. Parasharya *et al*. [11] recorded that the Indian Roller to be an important bio-control agent against the White Grub *Holotricha* sp. which is an important subterranean pest damaging root system of several crops.

In the study area, the Indian Rollers started their breeding activities in April and ended with June. Earlier, Panicker [4] reported that breeding season of the Indian Roller in Tamil Nadu ranged from April to July. Food availability is a one of the important factors to determine the breeding season of birds as reported by Lack [12] and Thomson [13]. In present study area, the ripening of paddy crops and subsequent preparation of the field for the next crop resulting in flushes of insects from March to July coincided with the breeding activities of the Indian Roller. In the present investigation, the Indian Roller nested in *Cocos nucifera*, *Borassus flabellifer*, *Ficus benghalensis* and *Enterolobium saman*. Indian Rollers are secondary hole nesters, they dependent on natural tree holes/cavities or the abandoned nest of the primary hole builders for breeding (example Rose-ringed Parakeet *Psittacula krameri* and Golden-backed Woodpecker *Dinopium benghalense*). Thiyagesan [5] reported that over 69% of the Indian Roller nests in *Cocos nucifera* and

also *Enterolobium saman*, *Madhuca indica* and man-made building holes in and around Mayiladuthurai, South India. An interesting note that about 92% of the nests did not contains any nest materials. Lamba [14] and Panicker [4] stated that no nest material was used by Indian Roller and the eggs are laid directly on the decayed debris of wood at the bottom of the hole.

The mean height of nesting tree, DBH and nest hole location height was 14.6m, 66.7cm and 5.8m respectively in the present study. This value was different when compared to certain previous workers. According to Panicker [4], the nest holes were occurred more frequently 3.6 to 8m (average of 6.16m). Thiyagesan [5] recorded that mean of 11.03m nest tree height, 9.95m nest hole location height and 37.58cm tree DBH. It is felt that the level where nest is placed varied from the tree species and the available nest site. The present investigation indicated that Indian Roller nest sites tended to be close to potential hunting areas such as agricultural lands and electric lines. The agricultural lands provide a variety of arthropods and other sources of food items to the growing nestlings as well as parents [15]. Hence, the bird would have preferred the electric wires for perching and this could be the reason for having the electric line nearer the nesting trees. The average measurements of hole length, circumference and depth was 14.3cm, 33.8cm and 68.6cm respectively, which is moderately larger than the average dimensions reported by Panicker [4] and Thiyagesan [5]. Bai *et al*. [16, 17] stated that cavity / hole selection was interrelated to overall biology of the species and further stated that cavity quality rather than quantity appeared critical. Further studies relating the cavity quality with the breeding success might throw more light on this aspect.

Regarding eggs and incubation, the mean clutch size as observed in the nests of Indian Roller was 3.2 ± 0.07 (range: 2-5), this is higher value to that reported (2.5 eggs / clutch) by Panicker [4]. Mean length, width and weight of egg was observed to be 36.4 ± 0.14mm, 29.7 ± 1.11mm and 14.0 ± 0.90g respectively, this is almost similar to that earlier reported by Panicker [4]. The incubation period ranged from 17 to 20 days. Panicker [4] has reported the incubation period has 18 days in three nests of Indian Roller.

As regards to nestling growth patterns, the weight of chicks on the first day was 10.81g which increased to 291.25g at 24 day of age. However, there was a drop in the mean weight of nestlings at last few days and reached 248.18g at the time of fledging. Many authors have noted a decrease in rate-of-gain in weight as feathers were being produced or as temperature control was being established. Banks [18] reported that the decrease in actual and relative gain in weight of the final three days of nestling life in the White-crowned Sparrow *Zonotrichia leucophrys* was probably due to a shift in the energy budget, as more food was utilized in production of feathers and heat. Welty [19] stated that many nestlings loose body weight few days before leaving the nest. This loss was supposed to be due to the utilization of fat deposits and skeletal muscles for the energy to leave the nest. This body weight reduction is helped to the advantage for moving out the nest [20, 21]. Development of the different structure of the nestlings was not uniform throughout the nestling period. The body length, bill length, wing length, wing span, tail length and tarsus length attained the maximum maturity at the time of fledging stage. The Indian Roller used above body parts immediately after fledging for successful survival. These kinds of growth allometry in the adaptive parts had been observed in several avian species [15, 21-23].

The hatching (78.9%) and fledging (80.3%) success of present study was very higher when compared to previous work of Panicker [4], who have studied very limited number of nests. However, presence of predators, quality of parental protection, unequal distribution of food and temperature, were the main reasons of nesting failure of hole nesting birds [4, 24-26].

In conclusion, due to their potential role as biological pest control agents, Indian Roller have been identified as agriculturally beneficial birds. Breeding records of the species hence need to be maintain throughout the globe so as to know the population status. If at all a dramatic decline in the population of Indian Roller is observed, then a preliminary or baseline data of such kind will be helpful in investigating the factors attributed to the decline in the population of Indian Roller. By enhancing such agriculturally beneficial organism in the field we can definitely look forward to minimizing the use of chemical pesticides which have toxic effects on the biota.

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