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Breeding and Territorial Behaviour of Indian Black Robin (*Copsychus fulvicata leucoptera*) in Mihintale, Sri Lanka

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ABSTRACT

Indian Black Robin (*Copsychus fulvicata leucoptera*) (Lesson, 1840) is one of the territorial birds often found in all climatic zones in Sri Lanka. Territory size of this birds species is vary according to the breeding season and habitats that they occupy. The present study was carried out to understand the breeding ecology and territorial behavior of Indian Black robin both in breeding and non-breeding periods. The study was carried out at the Mihintale sanctuary and the Faculty premises of Rajarata university of Sri Lanka. Eleven breeding pairs of Black robins were observed to collect using scan and focal animal sampling methods from 2014 to 2017. Territory mapping was done using ArcGIS 10.3 and % behavioral act was calculated using Microsoft excel. Two breeding seasons were identified during March to September. The average nest building period was 13.25 ± 0.96 days. Total of 10 nests were recorded, seven were successful nests but chicks were observed from only three of them while in other four of them were damaged due to several reasons. Three nests were abandon by the female bird with eggs which may considered as pseudo nests. The eggs were whitish in colour with small brownish blotches. The clutch size ranged from 2-4. The average incubation period was 11 ± 3.4 days. The identified foraging sites are nearby roads, human settlements and live foliage. Fifteen territories were recorded during the study period in the open land areas, sparse grasslands or scrublands. The territory sizes of non-breeding season ranged from 617 to 5504 m² while territories of breeding season ranged from 1335 to 8736 m².

1. Introduction

Breeding is an important phase in bird's life as birds spend more time and energy for the various breeding activities (Singh, *et.al.*, 2016)^[1]. The breeding populations of birds depend on the availability of resources such as food, nesting sites, safety etc. Proper understanding of breeding behavior and

ecology can be useful in implementing in conservation plans of birds (Dowlins 2003)^[2]. Information on the breeding, territorial behavior and the factors influencing breeding success is necessary for better conservation and population management of the species. Studies on breeding behavior of birds in Sri Lanka are almost negligible. Recently few studies have documented the importance of breeding biology (Sarchchandra & Wick-

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ramasinghe 2012^[3], Wijeratne & Wickramasinghe 2018^[4]) of some bird species in Sri Lanka.

Indian Black Robin (*Copsychus fulicata leucoptera*) (IBR) is a subspecies belongs to the order passerines, family Muscicapidae (Old world Flycatchers, Henry, 1998). These birds are common residents of lowlands of Sri Lanka and preferentially inhabit in open scrubland or gardens (Henry, 1998)^[5]. This sparrow sized bird feeds on insects and other invertebrates. The morphological characteristics of the male black robin are glossy blue-black, with white lesser wing-coverts and chestnut under tail-coverts. The female is dark grayish brown, with chestnut under tail-coverts, and no white in the wing (Henry, 1998)^[5]. This bird species is a seasonal breeder and the peak breeding season in Sri Lanka lasts from March to June and July to September.

The Black Robin is one of the few birds that hold year round territories. The territory includes a male and female during the breeding season with the male defending the territory but each sex may have different territories when they are not breeding. Studies on intra specific fights especially in defending territories have long history, particularly some passerines. Some researchers have studied territorial behavior of birds in open areas and forests (Dissanayake & Wickramasinghe 2011^[6], Dilhari & Wickramasinghe 2013^[7]). Ornithologist have revealed that maintaining territories provide information on resources availability & healthiness of an unfortunately there were very few studies which have been carried out on territory mapping of the bird species. Though the territorial behavior is important for conservation of the species, less information is available for the region. Recently a few studies on territorial behavior of Black Robin (Perera, 2013^[8], Dissanyake & Wickramasinghe, 2011^[6]), and White Rumped Shama (Dilhari & Wickramasinghe, 2016^[7]) were carried out in Sri Lanka. The findings of the study is useful in understanding effect of anthropogenic activities on the territorial behavior and the breeding success of IBR.

2. Material and Methods

2.1 Study Area

The study was conducted during the successive breeding season of black robin in the premises of the Faculty of Applied Sciences of the Rajarata University of Sri Lanka and adjacent to the Mihintale Sanctuary (8° 21' 0" North, 80° 30' 0" East) (Figure 1). The climate is tropical and the average annual temperature is 27.0 °C. The average annual rainfall is about 1427mm (Wimalasekara and Wickramasinghe, 2014^[9]). The

vegetation represent dry mixed evergreen forest dominated with *Azadirachta indica*, *Manilkara hexandra* and *Drypetes sepiaria* (Unantenna and Wickramasinghe, 2014^[10]).

2.2 Data Collection

Systematic field visits were done in alternate days as required for observing the breeding activities (nest site selection, nest building, egg laying incubation and provisioning of young) and territorial behaviour. Eleven bird pairs were ringed during the beginners workshop conducted by Field Ornithology Group of Sri Lanka (FOGSL). Ecotone Mist nests (716/9) were used to catch these birds. The C- shaped plastic rings were used in ringing the right leg of the bird. The instructions of FOGSL were followed for the color banding for the given color code. Add Libitum samplings described by Altman (1974)^[11] were done throughout the research in order to construct ethogram. Scan and Focal animal sampling method was also used to support the above data. Monitored the nesting success and breeding behavior of color - banded 11 breeding pairs during the study. 10 nests were found throughout the study. Most of the nests were inaccessible due to their position. Out of the 10, only two nests were checked every three days (Frequently on egg laying days, expected hatching & feeding days) to determine their hatching rate. Clutch size was noticed as the number of eggs laid by a female in a single breeding attempt. Incubation period was determined to be the time spent between the laying of the last egg of the clutch and hatching of the last chick (Nice, 1954^[12]). Egg measurements (breadth and length) were taken from 13 eggs of abandon nests by using a venire caliper.

Territory mapping was done according to the Bibby et al (1992)^[13]. Every time a territory was visited the location of each bird within the territory was recorded. Throughout the breeding and non-breeding season, the boundaries of each territory were mapped using a dummy of black robin and GPS coordinates. Territorial boundaries were marked where males were observed singing and male-male conflicts took place. A dummy of black robin kept these territory boundaries and GPS locations were noted in order to determine the territories of ringed birds. Two breeding seasons from late February to early June and late July to mid-September were recorded during the study.

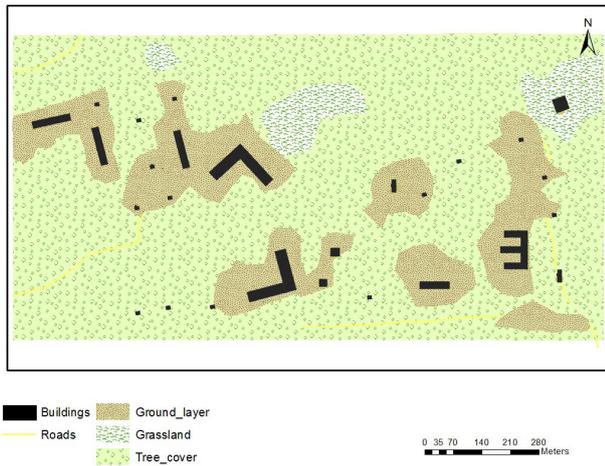


Figure 1. Map of the study site covering 25040m²

3. Data Analysis

The Minimum Convex Polygons (MCP) was used to measure the territory size with the use of ArcMap version 10.3 (ESRI) software. Survival rate was measured by the number of eggs and the number of chicks that survived from the each nest.

$$\text{Survival rate} = \frac{\text{Number of surviving chicks}}{\text{Number of eggs}} \times 100$$

4. Results

4.1 Breeding Season and Nesting Behavior

Total of 85 individual birds were observed to record the territorial behavior and breeding behavior of these birds. A total of 11 pairs were ringed from 2014 to 2017. Fifteen major territories were reported including nine in breeding season and six in non-breeding season. The breeding activities of the Indian Black Robin commenced in late Feb-

ruary and continued till September covering both breeding seasons. Nest site selection and nest construction were done by both male and female birds in a breeding pair. The total time spent for nest building ranged from 6 to 14 days which was in line with Indian Robin (*Copsychus fulvicaus*) (Das *et al.* 2017) [14]. Male bird was dominated and played the main role in nest construction period (Figure 6). The identified nesting sites are rocky areas, rock fragments, and joists of resident places, inside post box and inside bushes (Figure 2A). Courtship behaviour was observed at the end of nest formation period. The courtship activities included, touching beaks of male and female (40%), lifting up male’s tail (40%) and lowering male’s head (20%) were main courtship behaviour observed in this study. The first eggs of each season were observed in March and last nestling fledged in September.



Figure 2. Nests of Black Robin in different places (A) post boxes, (B, C) joists of buildings

4.2 Nesting Success

In total ten nests were identified during the study period (Table 1). Maximum numbers of nests were recorded in 2014 and 2015 (3 nests) while in other years only 2 nests were recorded. Two of those nests were abandoned after completion while one nest was broken due to high raining 2014 (Feb – April). In 2015, one nest was predated during egg laying and incubation period. The identified predators are squirrels and grey mongoose. Seven successful nests were observed; however, only three nests were positive for chicks. The survival rate of the black robin was 25%

Table 1. Number of nests and territory sizes in each period during breeding season

Territory No	Total number of nests observed	Number of Successful nests	Number of abandoned nests	Number of observed eggs	Number of chicks hatched	Size of the territory in breeding season (m ²)
2014						
01. Feb - April	1	-	1	-	-	3347
02 March - April	1	1	-	4	2	4914
03. April – May	1	1	-	4	-	4949
2015						
04. Feb - April	1	-	1	-	-	8763
05. Feb - April	1	1	-	4	2	3246
06. August - Sept	1	1	-	2	-	1758
2016						
07. August-Sept	2	1	1	1	-	2751
2017						
08 March - April	1	1	-	2	2	1335
09. August - Sept	1	1	-	4	-	1964

in 2014 and 33.3% in both 2016 and 2017. Three of those nests were abandoned by the birds even with eggs due to unknown reasons. These nests were remained without being visited by the IBR. These nests could possibly be pseudo nests prepared by these birds in their breeding behaviour.

5. Clutch Size and Egg Characteristics

The female laid 2-4 eggs (means: 2.6 ± 1.3 eggs, $n=13$) in a nest which was made of thin twigs found from old brooms, coconut bristles and plant materials, dead leaves and feather parts in the structure of a cup. A clutch is composed of four or two eggs with a probability of 40% each while there was a 20% chance of finding 1 egg. (Figure 3) Eggs were whitish in background with specks and small brownish blotches. Average egg dimensions were: length, 20.69 mm (SE = 0.37, $n=13$); breadth, 14.05 mm (SE = 0.83, $n=13$).



Figure 3. Eggs of Indian Black Robin

5.1 Incubation Behavior

Only female incubated the eggs and male guarded the nest. It took about one or two days to complete egg laying after the first egg has been laid; and incubation commenced on the same day the last egg has been laid. The male robins were feed females during incubation. Total incubation period recorded from the clutch completion to hatching was 14.0 ± 2.0 days ($n=.3$).



Figure 4. Incubation behaviour of female Indian Black Robin

The entire breeding cycle including the nest construc-

tion, egg laying and developmental periods completed within 39.0 ± 2.18 days. After hatching both sexes participated in parental care.

5.2 Behavior of Fledglings

Soon after hatching the parents started feeding the young. For about four days after hatching the young remained silent in the nest and responded to the parental arrival just by opening their beak (Figure 5). Later on days they started producing begging calls 3-5 times per 20 minutes. During observation of nests, there was one fledgling who frequently receive food from parents by lifting up more than the other one. Most of the times male bring foods than female (Figure 6). The parents fed the offspring for at least two weeks.



Figure 5. Fledglings fed by male black robin

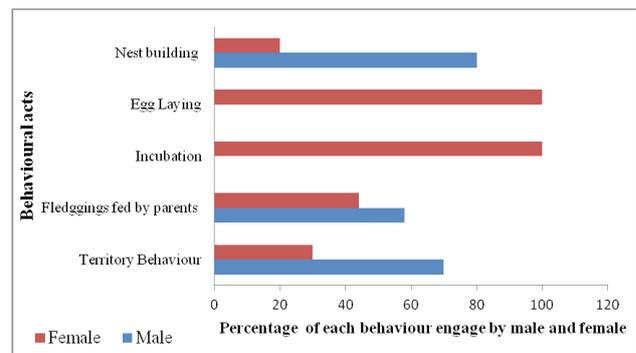


Figure 6. Behavioral patterns of male and female during the breeding period

5.3 Territorial Behavior

The non-breeding territory sizes ranged from 375 m² to 5504 m² (Figure 7) while breeding season territory sizes ranged from 1335 to 8736 m² (Table 1). All the territories during the breeding season were recorded from ringed IBR while only two territories from ringed IBRs were recorded during the non breeding season. The territories were restricted to those areas without dense vegetation, usually in open grassland, scrubland and sparse woodlands without high undergrowth (Perera, 2013^[8]) and near human vicinity. Fifteen territories were identified in both breeding and non-breeding season during the study

period. Both male and female were in the breeding territories while male was dominated non-breeding territories. Indian Black Robin display territorial behaviour in both breeding and non-breeding season and they have larger territories in breeding seasons than in non-breeding seasons. This is clearly shown in ringed IBR's sizes of territories no 4,5 and 8 during breeding season and 11, 15 and 14 were non breeding season in same years (Figure 7, Table 2). In previous study there were only four territories recorded and were range from 3480 m² to 7425 m² (Disanayake and Wickramasinghe, 2011 [6]) while sizes of the territories in both breeding and non-breeding periods were not much different. Total of 38276 m² land area covered from 2014 to 2017 as territories of black robin. According to the Table 1 it is clearly showed that the Black Robin territory sizes are declining gradually.

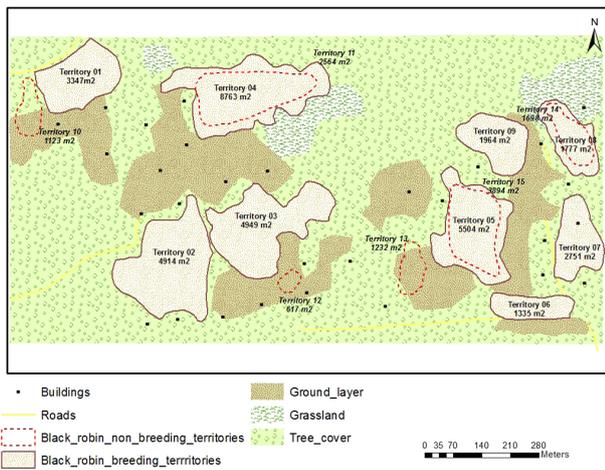


Figure 7. Non-breeding and breeding territories of Indian Black Robin

Table 2. Non – breeding and breeding territories of IBR in different years

year	Non-breeding territories number	Breeding territories number
2014	10, 12	1, 2, 3
2015	11, 15	4, 5, 6
2016	13	7
2017	14	8, 9

Male robins perform territorial song, which plays a major role in marking their territory. Male black robin mark their boundaries by singing continuously for a long period perching on selected trees (n=10), rocks (n=5) and posts (n=12) within their territory boundaries. These calls were intensive in the morning and evening. Male black robin performs different types of songs in front of females by lifting up its tail (40%) and lowering head (20%) during

the courtship period. In addition to their songs when two males, of overlapping territories they showed very peculiar territorial display. This was observed in territories no 2 and 3 which were overlapped at their boundaries. Territorial disputes spanned from minimum 10 seconds to 1 minute. Erecting tails (45%), showing off (25%) and elevating and lowering stretch necks (20%) were the main behavioral patterns observed during the territory defends of Indian black robin. Fighting was not commonly observed but a series of agnostic events were observed during the study. Chasing on grounds was the most common agnostic behavior observed among females within their territory.

Two territories were seen overlapping at their boundaries they prefer open or space woodlands and grass or scrub lands where there is a good supply of termites, insects and other food materials they look for.

5.4 Time Budget for Other Behaviour of Black Robin

Except breeding behavior higher portions of the black robins time budget was occupied by locomotion (38%). The active behavior of the black robin which moves from place to place very quickly can be clearly described. The distribution of time spent on feeding varies with the time of the day. Highest feeding recorded Morning (6.00 am to 8.00 am) than the Midday (11.30 am to 13.30 pm) and evening (17.30 pm to 18.30 pm) (Figure 8). Resting behavior was one of the major behaviors patterns of black robin. When looking at the overall time budget of black robin it can be suggested as a very active bird, that spends much of the time in feeding and locomotion.

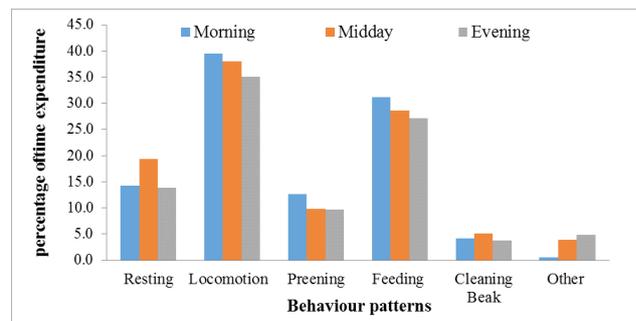


Figure 8. Percentage time expenditure for different behaviour of Black Robin during the study period

6. Discussion

Indian Black Robin is a common, territorial insectivorous bird found in home gardens, boundaries of cultivations, dry rocky areas and shrub areas (Ali & Ripley, 1983) [15]. It mainly associates with human resident places during

the breeding and non breeding seasons. This may be due to safe from predatory attract specially by the mongoose and snakes. Previous studies have reported that breeding season start in March to June and July to September (Henry, 1998^[5], Phillips, 1951^[16]). Similarly present study also showed that the breeding season of IBR started early March to Late September. Breeding season of Indian black robin starts with the calls of male robin (Kumar, 2011)^[17]. The studies of songs of Indian robin reveal that they have complex pattern of songs at the commencement of breeding season and in the presence of females (Kumar, 2011)^[17]. In this study Indian black robin also performs complex songs in front of females by lifting up its tail and lowering head during the courtship period. Five or 4 male robins produce songs together for females can be seen in the dusk of early breeding season. Both male and female participate in selecting a nesting site.

According to previous studies, the nesting places of IBR are hanging bags, post boxes, old machinery, cracks of walls and groves of rocks (Das *et al.*, 2017)^[14]. However, in the present study most of the nests were recorded in rocky areas, rock fragments, and joists of resident places, inside post box and inside bushes. Human activities are not seemed to become a disturbance to nest building but abandon nests also were observed during the study period. They are sensitive to the disturbed movements of the nesting place as any other bird and tend to leave their nest with unhatched eggs. We observed these abandon nests with unhatched eggs even though the site is not disturbed, indicating the preparation of pseudo nests. The numbers of recorded pseudo nests suggest that these birds are not satisfied with the nest building sites and may identified the future risks once they used them as nest building site. The main causes of nest failure were predation, hatching failure and rejection of nests. These findings were very similar to Singh *et al.* (2013)^[1]. Nest construction period was ranged from 6 to 14 days. Duration of nest construction is very similar to Indian Robin (Das *et al.*, 2017)^[14]. Nest is a cup shaped and has made using thin twigs found from old brooms, coconut bristles and plant materials, dead leaves and feather parts. This is very similar to finding of previous studies done by Perera (2013)^[8] and Kumar (2012)^[17]. According to the clutch size peak breeding period ranged from February to April. Male robin is in the vicinity of the nest while female robin incubating. Female robin is used to fly away in search of food during the incubation period.

Both the male and female feed the newly hatched ones. The loud and rapid begging calls of nestling birds signal their hunger and stimulate parental provisioning. Kilner *et al.* (1999)^[18] and Ottoson *et al.* (1997)^[19] showed that

the parents generally respond to begging calls by directing feeding to the most intensively begging nestling in their brood by increasing their provisioning rate to the brood. Similarly in this study we observed the loud begging calls during the feeding time. Incubation period takes longer time than other activities in their breeding cycle. Bosque and Bosque (1995)^[20] suggested that food abundance may be related to differences in incubation period within different habitats.

Similar to study of Perera (2013)^[8], this study also showed that the territory size was relatively increased during the breeding season showing that breeding territories are larger than non-breeding territories. This may be due to availability of food during the fledging period. The results of the time budget showed that, black robin is relatively more active birds than other passerines. When look at the distribution of Indian black robin territories (Figure 7) with the land use patterns most of the territories were restricted to open grasslands and areas where low undergrowth. Their distribution was mostly limited to the areas which were continuous maintained by human. This may due to easiness of catching insect from land. According to distribution patterns of territories we can conclude that key features of the distribution of Indian black robins are the open of land, density of vegetation and the human influence on maintenance of the vegetation.

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