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Nesting Ecology of the Globally Near Threatened Nilgiri Flycatcher *Eumyias albicaudata* in the Palani Hills, South India

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Abstract

Nesting ecology of the Nilgiri Flycatcher E*umyias albicaudata* was studied in the Palni Hills of south India during 2002-2004 by intensive search method. Altogether 35 active nests were observed in a 10 ha plot of the montane wet temperate forest and the peak nesting was observed in April. Nilgiri Flycatcher builds nest in three to five days and the peak nest-building time was 07.00 - 09.00 (4 nests). The nests were placed in a hole on a tree trunk or earth bank, mostly concealed. Eight species of trees were used for nesting and 51 % of the nests orientation was towards west. It builds nest in the dense forest with thick canopy and nearer to trek path and streams. Clutch size was two or three; incubation and nestling periods were 14 - 15 and 15 - 16 days respectively. Nesting success was 42.04%. Dense forests with good ground cover are the basic needs for breeding of the Nilgiri Flycatcher.

Keywords: E*umyias Albicaudata,* nesting ecology, Nilgiri Flycatcher**,** Palani Hills, South India

INTRODUCTION

The most important aspect of an animal's life is the act of leaving offspring to succeeding generations (Perrins and Birkhead, 1983) and contributing to its gene pool. Successful reproduction is a key for population recovery and stability of a species (Pimm *et al*., 1995; Perrins, 1996). The success of an individual in breeding is determined by two important features such as time at which it breeds (breeding season) and fecundity (Lack, 1968). Choice of nest-sites has a direct effect on individual fitness through its influence on reproductive success (Martin and Roper, 1988; Martin, 1992). Choice of particular season and nest-sites is presumably influenced by a number of abiotic and biotic factors that can affect the survival of both young and adults (Lack, 1968). Nest-sites with specific microclimates may be selected to provide protection from inclement weather as well as favourable conditions for thermoregulation of eggs and developing young (Calder, 1973; Walsberg, 1985; Matsuoka *et al*., 1997). Identification of habitat features associated with nest, nest – sites, nesting success and calculation of probability of success, are needed to develop a long-term strategy reversing a decline in population (Martin, 1992).

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A variety of factors can potentially influence nest and nest-site selection, including the availability of song perches, floristic composition, moisture regimes, amount and kind of feeding strata, amount of food, structure of plant community and risks of nest predation (Martin, 1993). Nest site selection is a key component of habitat selection by birds (Hilden, 1965), with important consequences for survival and reproduction of individuals (Cody, 1985). Conservation of species depends on knowing their breeding biology and identifying and conserving the habitat features that affect breeding productivity and survival (Martin, 1993).

The Nilgiri Flycatcher *Eumyias (Mussicapa) albicaudata* is a rare, globally near threatened bird (BirdLife International, 2001) and one of the 16 birds endemic to the Western Ghats (Ali and Ripley, 1987; Stattersfield *et al*., 1998). It has a narrow range of distribution, the upper and middle reaches of the Western Ghats (Ali and Ripley, 1987). Apart from the description of this species, no detailed information is available about the nesting ecology, and hence this study was carried out in the montane wet temperate forests (shola forests) from April 2002 to June 2004.

STUDY AREA

The study was conducted at Kukkal in the Palni Hills (10°15' N and 10°18' N and 77°20' E and 77°25' E), a hill range of the Western Ghats, Tamil Nadu, India (Fig 1). The Palni Hills consist of two well-marked topographic divisions, namely Upper Palnis and Lower Palnis. The intensive study was conducted in a 10 ha area in the Kukkal shola in the Upper Palni hills. The Upper Palnis

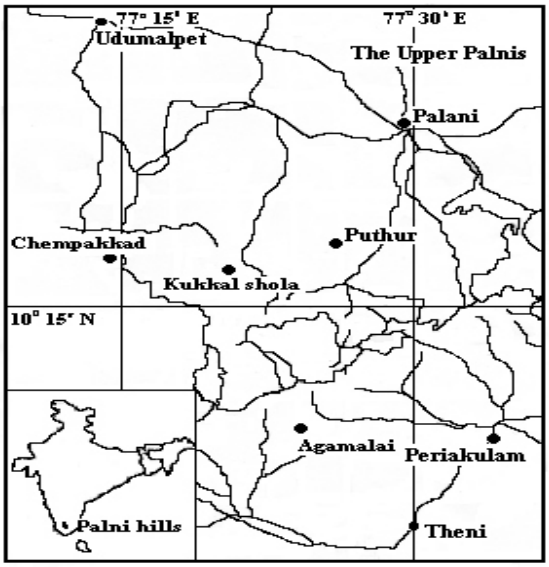

Figure 1. Map of the Palni Hills with the location of Kukkal shola (scale 1:250,000).

with the elevation ranging between 1500 - 2450 m has a moderate climate with mean temperatures ranging between 12 and 23°C in summer. In winter the temperature was 8.3 and 17.3°C. The average annual rainfall was 165 cm. The vegetation is predominantly of the montane wet temperate forest type commonly called as "Shola forest". Common plants in the area include species of *Syzygium*, *Ternstroemia*, *Sideroxylon*, *Meliosma*, *Elaeocarpus*, *Symplocos*, *Eurya*, *Litsea* and *Rhododendron*. The shola forests have adjacent exotic plantations of Wattle, Eucalyptus and Pine (Fyson, 1915; Champion and Seth, 1968; Matthew, 1996).

METHODS

Intensive search for nests was made on foot in the entire sample area (10 ha) by examining substrates suitable for nesting (tree holes, cavities and earth banks etc.). A nest was corroborated if adults were observed performing breeding activities such as nest building, incubation, feeding the young at or adjacent to the nest. Regular observations were made on the nest to record various aspects of the nesting cycle.

Table 1. Nest variables of the Nilgiri Flycatcher *E. albicaudata* in the Palani Hills, South India.

Variables	Mean	SD	Range
Nest height (m)	2.97	3.07	9.2-1.0
Nest depth (cm)	9.07	3.49	16.0- 5.0
Shade over the nest (%)	92.02	3.49	100-85
Nest concealment	10.24 (high)	3.60	-------
Nest tree height (m)	7.64	11.28	25-5.8
GBH of nest tree (cm)	42.51	7.07	75.1-23.2

Nest-site selection was studied with the following established methods (Titus and Mosher, 1981; Bechard *et al*., 1990; Hullsieg and Becker, 1990) Variables were set at three levels, namely nest, nest - substrate and nest - patch with the following details:

(1) Nest: height, depth, shade over the nest, concealment;

(2) Nest tree: species, height, GBH, cover over the nest;

(3) Nest patch: canopy cover, ground cover, number of trees, number of shrubs, distance to nearest tree, distance to trek path or road and distance to water

Nest concealment was estimated by viewing the nest at a distance of 2m, 5m, 7m and 10m in each of the four-cardinal directions (Martin and Roper, 1988). Based on the number of points where the nest was not seen, the concealment was evaluated as low (1-4 points), medium (5-8 points), high (9-12 points) and very high (13-16points).

A 0.07 ha circular plot (15 m radius) centered at nest location was laid for every nest and recorded all the details suggested by Titus and Mosher (1981). Nest-patch variables were measured to identify the microhabitat required for nesting. Distance to road or trek path was included to identify whether the site selection was affected by the human activity. Vegetation cover (ground and shrub) was visually estimated in percentage. Canopy cover immediately over the nest was measured visually in percentage. To test the nest-site selection, except for the nest measurements, all nest-patch variables were compared with similar measurements recorded at randomly selected sites. Random sites were selected based upon the place having potential nest-sites and also close enough to the used sites. The 10 ha plot established for nest searching was divided into 100-grids (20 ´ 50 m). Grids were plotted on an enlarged topographic map of the study area and numbered. 20 grids were selected randomly by using lot system and were identified in the study site. Once

Figure 2. Nest orientation of the Nilgiri Flycatcher.

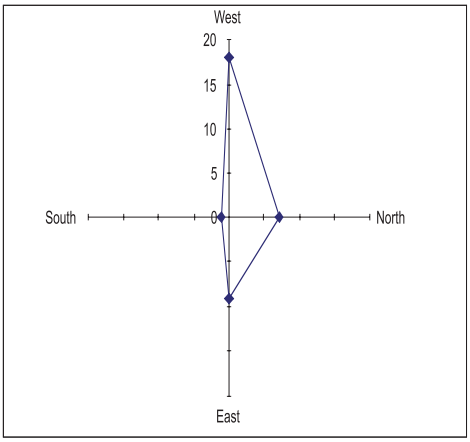

Table 2. Comparison of nest-site of the Nilgiri Flycatcher *E. albicaudata* with random site variables in the Palani Hills, South India.

Parameter	Nest-site (mean ± SD)	Random site (mean ± SD)	U	P
Canopy cover (%)	79.99 + 17.80	63.2 + 18.4	119.50	0.00
No. of trees	11.13 + 2.63	11.68 + 10.84	223.00	0.80
No. of shrubs	19.43 + 14.22	32.96 + 26.42	219.50	0.06
Ground cover (%)	41.11 + 15.67	25.84 + 14.23	162.50	0.00
Distant to trek path (m)	10.53 ± 14.36	36.8 + 29.60	63.50	0.00
Distant to water (m)	26.27 ± 25.46	47.48 + 19.79	185.00	0.01
Distant to nearer tree (m)	4.87 ± 3.17	6.36 + 3.45	145.50	0.00

Table 3. Factor loading of nest-site variables of the Nilgiri Flycatcher *E. albicaudata* in the first three principal components.

Variables	PC I	PC II	PC III
Nest tree height	0.39	0.58	-0.65
GBH of nest tree	-0.78	0.57	0.17
Canopy cover	**0.88**	0.33	-0.20
Concealment of the nest	-0.01	0.52	0.55
No. of trees	**0.92**	0.25	0.27
No. of shrubs	0.57	0.52	0.04
Shade over the nest	-0.01	**0.85**	-0.44
Ground cover	0.24	0.64	**0.67**
Distance to trek path	-0.83	0.46	0.14
Distance to water	0.76	0.35	0.49
Distance to nearer tree	0.44	-0.72	0.45
Eigen value	4.26	3.41	2.00
% Variance	38.80	31.01	18.20
% accumulated variance	38.80	69.81	88.02

the approximate grid or site was located, the nearer plant or shrub was made as centre of the random plot.

Statistical Analyses

ANOVA, Mann-Whitney U and other statistics (Mean and SD), wherever appropriate, were done (Sokal and Rohlf 1981). Results are reported as significant if they are associated with a value of $P < 0.05$. Principal component analysis was performed on the nest-site characters to determine the most important factors delimiting the habitat niche (nest site selection) of the species. Discriminate function analysis was performed to identify the factors involved in separating the nest sites from the random sites. The SPSS software (Nouris 1999) was used for data analysis.

RESULTS

Nilgiri Flycatcher was breeding from March to June. Totally 35 nests were observed, in which twelve nests were in the year 2002 and 2003 and remaining in 2004. Five pairs of the Nilgiri Flycatcher were ringed; out of these three pairs occupied the same territory in successive years (2003-04). Nest was a shallow cup of moss lined with rootlets. A large number of nests (19) with eggs were observed in the first week of April. Nilgiri Flycatcher builds their nest in three to five days and the peak nest-building time was 07.00 - 09.00 (4 nests). It laid two or three eggs with a mean of 2.52 ± 0.50 (n = 35). Reuse of the same nest in successive years was observed in six nests and out of which one of the nests, which failed in the previous year, was also used in the subsequent year.

During incubation period, male fed the female. Only the female incubated eggs. Other nesting activities such as feeding the chicks, nest sanitation were shared by both the sexes, the mean incubation and nestling periods were 14.6 ± 1.5 and 15.36 ± 1.25 days, respectively. Totally 88 eggs were laid in 35 nests (I year: 30; II year: 31; III year: 27 eggs) from which 37 chicks fledged out. The hatching success was 67.04 %, fledging success 62.71 % and nesting success 42.04 % during this study.

Nest Orientation

Our study on orientation revealed that totally half of the nests faced towards west (51.4 %) followed by east (25.7 %) and only one towards south (Fig 2). Nest orientation towards west provides reduction of powerful morning light falling on the nest but it gives best insulation to the eggs and nestlings from the evening light.

Nest - Tree Selection

Nests were placed mainly in the holes (n = 25) on trees with closed canopy cover and on the roadside earth banks (n = 10). Eight species of trees were used for nesting. Nilgiri Flycatcher showed maximum use of *Xantolis tomentosa var. elengioides* (48%) followed by *Cinnamomum sulphuratum* (20%) and *Turpinia nepalensis* (12%). *Syzygium densiflorum, Acacia spp., Symplocos foliosa* and *Psychotria nilgiriensis* contributed equally with a single nest each.

Nest-Site Selection

Nest–site variables of 35 active nests were analyzed. Mean nest height, tree height and nest depth were 2.97

± 3.07 m, 7.64 ± 11.28 and 9.07 ± 3.49 cm respectively (Table 1). Canopy cover (79.99 %) and ground cover (41.11 %) were denser and statistically significant at the nest-sites (Table 2). Nest concealment was high in 50 % followed by medium in 20 % of nests. Distance to water 26.27 ± 25.46 m ($U = 185$, $p < 0.01$), distance to trek path 10.53 ± 14.36m ($U = 63.50$, $p < 0.000$) and, distance to nearer tree 4.87 ± 3.17 m ($U = 145.50$, $p < 0.001$) differed significantly between the nesting and random-sites (Table 2).

The first three principal components accounted for 88.02 % of the total variance (Table 3). The first component was closely associated with canopy cover, number of trees in the nest-site, distance to trek path and water. The second component was associated with shade over the nest, distance to nearer tree and the third component with nest tree height and ground cover. Discriminate Function Analysis (stepwise) showed two variables, namely distance to trek path (0.68) and ground cover (0.50) are the crucial factors determining the nest-site selection in this species.

DISCUSSION

Nesting ecology of Nilgiri Flycatcher was studied in the montane wet temperate forest of Palni hills. During the study three pairs were occupied in the same territory in successive years and this may be because of its site fidelity and it was reported that site fidelity is advantageous to the birds as familiarity with the area may enhance foraging success, predator avoidance, defense and other behaviors, which contributes to reproductive performance (Newton and Wyllie, 1992). Reuse of the same nest in successive years was observed in six nests. Nest – site choice would also depend upon the behavioral plasticity as a function of previous success (Martin 1988) and also breeding pairs try alternative nest sites in their territories based on the success of the last breeding attempt (Marzluff, 1988; Antonov and Atanasova, 2002).

Nest orientation towards west provides reduction of powerful morning light falling on the nest but it gives best insulation to the eggs and nestlings from the evening light. By placing nest or its orientation towards the most favorable direction, birds reduce their exposure to prevailing winds, avoid direct exposure to severe storms, or get the best insulation conditions (Collias and Collias 1984), thus achieving a favorable thermal environment (Gokula 2001).

Nilgiri Flycatcher nests in wide varieties of trees and there was no species specific preference was observed. The use of wide variety of nesting trees by these birds may be a strategy against predator search tactics (Furrer 1975, Gokula 2000). Several studies have reported that increased amount of foliage (canopy cover) immediately concealing nests was associated with reduced nest predation (Wary and Whitmore 1979, Martin and Roper 1988, Kelly 1993). In this study also we have observed nests under closed canopy had more success. High densities of foliage, when used for nesting can decrease predator efficiency by increasing the number of potential nest sites a predator must search (Martin 1988, Martin and Roper 1988, Matsuoka *et al*. 1997).The canopy cover and number of trees were the factors related to one another, when more trees with closed canopy gave high concealment to the nests. So, nests could escape from predators and avoid the inclement weather. Similar results were reported by Calder (1973), Walsberg (1985) and Matsuoka *et al*. (1997). As predation is a powerful selective pressure, birds have evolved various antipredator strategies, which may reduce nest losses (Bures and Pavel 2003). The strategies include selecting a closed canopy for high concealment of the nest and nearness to trek path for escape from predator.

The total number of shrubs within a nest patch is a good indicator of the vegetation complexity but it had no effect on our result because montane wet temperate forests have more number of shrubs in all the areas. The Nilgiri flycatcher is mainly a lower canopy species using similar areas for feeding and nesting. Dense forests with good ground cover are the basic requirements of the successful breeding of the Nilgiri Flycatcher.

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