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Nest-site characteristics of Spotted Munia (*Lonchura punctata*) in Mudumalai Wildlife Sanctuary, southern India

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Abstract

Nesting and nest-site characteristics of the Spotted Munia, *Lonchura punctulata*, were studied in Mudumalai Wildlife Sanctuary, South India, during 1995–1997. In total 60 nests were located. The majority of them were built on thorny plant species. Nest-site variables were collected for 26 nests that had good accessibility. The result showed that for constructing nests, Spotted Munia selected short and small-sized trees in a microhabitat with low canopy cover.

Key words: Munia, *Lonchura*, Reproduction, Nest morphology, Nest plants, Nest-sites, Birds, India.

Introduction

Appropriate selection of a nest-site is crucial for the survival of eggs or chicks and involves discrimination between alternative sites that provide different sets of circumstances that potentially impact on survival and reproduction. Identification of factors involving in nest-site selection is crucial for the conservation of any bird species and its habitat. Here we report nest-site selection of the Spotted Munia, *Lonchura punctulata*, during May 1995 to December 1997 in the thorn and dry-deciduous forests of Mudumalai Wildlife Sanctuary, southern India. Apart from the description of the species and some behavioural information given by Ali and Ripley (1987), the ecology of this species is poorly documented except for Sharma and Bhatt (1996), who described the breeding biology.

Study area

The Mudumalai Wildlife Sanctuary is located between 11º30' – 11º39'N and 76º27' – 76º43' E in the Nilgiris District, Tamil Nadu. It is situated at an average elevation of ca. 1000m. The climate is moderate, and temperatures vary from 14–17ºC during December–January to 29–33ºC during March–May. Annual rainfall varies from 600–2000 mm, received in two periods, the first with high rainfall (June–August) from the southwest monsoon; and the second with low rainfall (September–November), from the northeast monsoon. The sanctuary is drained mainly by the perennial River Moyar and partly by several semi-perennials. Vegetation varies (corresponding to rainfall) from thorn forest in the east to semi-evergreen forest in the west. Our study was restricted to the tropical thorn and dry deciduous forests, which are dominated by *Acacia* spp. (including *A. chundra, A. leucopholea*, and *A.ferruginea*), *Ziziphus* spp., *Sapindus emarginatus*, and *Erythroxylum monogynum* in thorn forest; and *Tectona grandis, Anogeissus latifolia, Phyllanthus emblica*, and *Capparis* spp. in dry deciduous forest. In recent years, a drastic increase in the human population in and around the Sanctuary has considerably altered this vegetation type as a result of resource extraction (see also Desai, 1991).

Methods

Nesting and nest-site selection. A 10 ha plot was laid in both forest types. Searches were made on foot for nest structures by searching for substrates suitable for nesting. An active nest was confirmed if adults were seen performing breeding activities (nest building or renovation, incubation, feeding the young) in or adjacent to the nest. The method for determining nest-site selection is similar to that already established in a number of nest site selection studies (e.g., Bechard *et al.*, 1990; Hullsieg and Becker 1990). Variables were set at three levels: nest, nest-substrate and nest-patch (Table 1). The nest variables were collected to obtain information on the shape and size (physical structure) of the nest. Among these variables "nest concealment" was estimated by viewing the nest at nest-level or above or below from a distance of 2m, 5m, 7m and 10m in each of the four cardinal directions (Martin and Roper, 1988). In total, concealment of the nests was evaluated from 16 points. Based on the number of points from which the nest was not seen, an abundance rating was made (0–4 points =very low; 5–8 points =low; 9–12 points =high; and 13–16 points =very high). The nesting-tree or substrate variables were recorded to identify the key characteristics of the nest tree (plant) species supporting the nest of a particular bird species.

A 0.07 ha circular plot centred at nest-substrate was laid for every nest in order to study nest-site selection as suggested by Titus and Mosher (1981). Nest-patch variables were measured to identify the microhabitat required for nesting of a bird species. Variables, namely distance to road and disturbance on nest-substrate were included to identify whether site selection was affected by human activity. Lopping and cutting signs on the nest-tree were considered as disturbance and measured as a percentage. Distances were measured directly on the field when short, or from a topographical map. Vegetation cover (shrub and ground) was visually estimated as a percentage. Canopy cover immediately over the nest was measured using a hand mirror marked with a grid and shaded area was estimated in percentage as canopy cover (Martin and Roper, 1988). To test for nest-site selection, except for the nest measurements, all other parameters were compared with similar measurements recorded at randomly selected sites to identify the factors responsible for selecting a nest-site. Random sites were selected based on the location having potential nest sites and being sufficiently close to used sites. The 20 ha plot laid for nest-searches was divided into 80 on a 50´50m grid. Grids were plotted on an enlarged topographic map of the study area and numbered. Twenty grids were selected randomly by drawings lots and identified in the study site. Once the approximate grid or site was located, the nearest tree or shrub was designated as the centre of the random plot. Except for nest variables, all other variables (nest-tree and nest-patch) were enumerated in the plot as done for the nest-site.

Table 1. List of variables collected for nest-site selection analysis.

No.	Variables
	Nest variables
1	Nest height (m)
2	Nest length (cm)
3	Nest width (cm)
4	Nest depth (cm)
5	Nest orientation
6	Nest concealment
	Nest tree variables
7	Nest tree species
8	Nest tree height
9	Nest tree Gbh
	Nest patch variables
10	Canopy cover (%)
11	Ground cover (%)
12	Shrub cover (%)
13	Distance to water (1=close, 2=far and 3=very far)
14	Distance to settlement (Km)
15	Microhabitat (Nullah, Other)
16	Distance to road

Statistical analyses. Univariate analysis of variances (ANOVA), Mann-Whiteney U, and other routine statistics (mean and SD) were used where appropriate (Sokal and Rohlf, 1981). Results are reported as significant if they are associated with a value of $P<0.05$. SPSS software (Nouris, 1990) was used for data analyses. Principal Component Analysis was performed on the nest-site characters to determine the most important factors in delimiting the habitat niche of the species. Discriminant Function analysis was performed to identify the factors involved in separating the nest-sites from the random sites.

Results and discussion

In total, 60 nests were found within the plot. All the nests located were in thorn forest, none in dry deciduous forest.

Nest-morphology and breeding activities. In the study area, Spotted Munia nested from July to November, a period with frequent rains. Nests were globular or dome-shaped, with a lateral entrance-hole. Grass blades were used to build the nest. Nests were largely built on twigs within the canopy. The mean depth and diameter of the nests were 12.3 cm and 4.2 cm respectively. Nesting activities were shared by both the sexes and four to six eggs laid. Incubation varied from 10–15 days for 17 pairs. Ali & Ripley (1983) reported 16 days as incubation period for Spotted Munia while Sharma & Bhatt (1996) recorded 11 days. The fledging period varied from 18–22 days (n= 17,'x = 20.23 ±1.30) while Sharma & Bhatt (1996) reported 20 to 22 days as fledging period. The difference in the period can be attributed to the changes in the environment such as temperature, availability of food and predators (Vijayan 1984) and probably due to differences in the sample sizes.

Nest-orientation. By orientating the nest entrance towards the most favourable direction, birds reduce exposure to winds, avoid direct exposure to severe storms, and obtain optimal insolation conditions (Collias and Collias, 1984), thus achieving a favourable thermal environment. In the present study, nest-holes were largely orientated northeast and southwest (Figure 1). The entrance of nests found during July–August were oriented facing northeast, those found in later months being oriented facing southwest. It appears that this is in response to wind/ rain direction during these months.

Nest-plant selection. All the nests (n=60) were placed on only four plant species. The birds showed a higher preference for *Toddalia asiatica* (50%) followed by *Gymnosporia montana* (25%) and *Acacia chundra* (20%). Only 5 % of the nests were on *Zyziphus mauritiana*. Although, 50% of the nests was found on *Toddalia asiatica*, as it is a straggler, no nest was built on it when it was not associated with *Gymnosporia montana*. The birds were consistent in selecting thorny plant species as nesting substrate. We attribute the selection of densely interwoven thorny species (*Acacia* spp, *Toddalia asiatica* and *Gymnosporia montana*) to the ability of these structures to support the dome-nest. The thorny nature of the plant undoubtedly also protects the nest from predators (Collias & Collias, 1984).

Nest-site selection. Nest-site variables were collected (for only 26 nests that had good accessibility) in order to study the nest-site characteristics. The nests were placed at a mean height of 2.23 m (range 1.22–3.52m) above groun d (Table 2). Disturbance (cut or lop signs) recorded was 0 to 80% on the nesting plant species. The girth class of the nest trees varied from 20–56cm (mean, 27.4cm). The results indicate that the canopy cover ($u=78$ $p<0.01$), tree height ($F=13.876$ $p<0.01$), and tree gbh ($F=21.3914$ $p<0.01$) differed significantly between the nesting random sites (Table 3). The DFA (step-wise) showed three variables: nest-tree gbh (0.48), height (0.40), and canopy cover (0.57), as significant factors determining nest-site selection. The species showed consistency in selecting short and small-sized trees in a microhabitat with low canopy cover. Three components represent 62% of the total variance. The first was associated with canopy cover and shade over nest to the positive factors; and

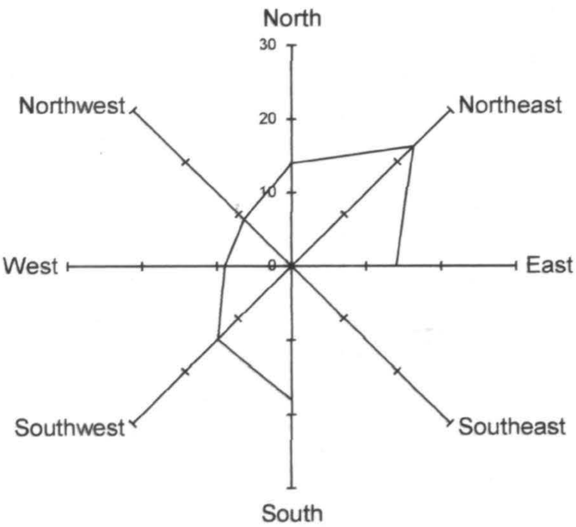

Figure 1. Nest-hole orientation of Spotted Munia.

Table 2. Nest site characteristics of Spotted Munia

Variables	mean	s.d.
Nest tree height (m)	3.14	0.78
Nest tree Gbh (cm)	27.45	11.95
Nest height (m)	2.23	0.64
Ground Cover (%)	70.91	23.89
Shrub Cover (%)	23.64	20.77
Shade over nest (%)	50.00	25.26
Nest Diameter (cm)	4.18	0.33
Nest Depth (cm)	12.32	1.39
Distance from nearest tree(m)	2.87	2.11
Distance to Road (m)	460.00	637.00
Disturbance on Nest-tree	4.32	17.06
Visibility	4.77	4.40

Table 3. Comparison of nest-site variables of Spotted Munia with random-sites. (ns = not significant.)

Parameter	Nest site	Random site	P
Tree Height	3.1 ± 0.8	7.0 ± 4.8	0.0
Tree Gbh	27.5 ± 12.0	51.1 ± 20.4	0.0
Tree Density	4.0 ± 0.9	4.2 ± 2.0	ns
Ground Cover	70.9 ± 23.9	83.5 ± 33.0	ns
Shrub Cover	23.6 ± 20.8	29.5 ± 28.6	ns
Canopy Cover	38.4 ± 19.7	78.5 ± 23.0	0.0
Distance to Road	460.0 ± 637.0	568.0 ± 636.1	ns

Table 4. Factor loading of various vegetational characteristics with the first three principal components for the nest data of the Spotted Munia .

Variables	PC I	PC II	PC III
Nest tree height	0.33	0.10	0.85
Nest tree GBH	-0.23	-0.10	0.72
Nest height	0.28	0.04	-0.04
Ground cover	-0.20	0.87	0.32
Shrub cover	0.18	0.89	-0.21
Canopy cover	0.88	-0.04	-0.02
Shade over nest	0.79	0.14	-0.16
Distance to trunk	0.19	0.07	-0.01
Distance from next tree	-0.36	0.49	0.56
Distance to road	-0.47	-0.47	-0.31
Disturbance on nest tree	-0.71	0.14	-0.20
Nest visibility	-0.63	-0.02	0.01
Eigen value	3.30	2.54	1.58
% Variance	27.50	21.20	13.20
% Accumulated Variance	27.50	48.80	62.00

disturbance on nest-tree to the negative factor (Table 4); the second was associated with ground and shrub cover; and the third component was associated with nest-tree height and gbh, and distance to the next tree. In most cases nests were constructed largely on shrub species which were densely grown with other shrub or short-tree species. It is also evident that the birds clearly preferred a combination of shrubs and trees on which to construct their nests. Murphy (1983) and Martin (1992, 1993) have suggested that predation, which is the primary cause of nest failure, should be the key factor influencing nest-site selection. The Spotted Munia constructs its nest mostly during rainy season: hence selection of a combination of tree species would provide better concealment through greater canopy cover (within the nest-plant) to protect the chicks from predators and rain.

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