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Nest tree utilization by the Malabar Grey Hornbill *Ocyceros griseus* in the semi-evergreen forest of Mudumalai Wildlife Sanctuary (S India)

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Abstract. The study was carried out between 2000 and 2002 in a semi-evergreen forest in the south-western portion of the Mudumalai Wildlife Sanctuary, India. A total of 81 cavities in 19 tree species were used for nesting by Malabar Grey Hornbills during the study. Three tree species: *Lagerstroemia microcarpa*, *Terminalia bellirica* and *T. crenulata* together made up 69% of all the nest trees used. The mean height of the nest trees was 36 ± 6 m, girth at breast height 3 ± 1 m and nest height 17 ± 6 m. 35 (67%) nest holes were re-used in 2001 while 21 (40%) nest-holes were re-used in 2002. *Terminalia crenulata* was the tree re-used most often. Nest fidelity by the Malabar Grey Hornbill was reduced owing to competition by other cavity users.

Keywords: Malabar Grey Hornbill, *Ocyceros griseus*, nest site, hole nesting birds, India

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INTRODUCTION

Malabar Grey Hornbill is an endemic fruit eating bird confined to the moist forests of Western Ghats, India (Kemp 1995, Mudappa 2000). It does not excavate its own nests and use available cavities (Poonswad 1995, Poonswad et al. 1988). The female incarcerates itself within nest cavity throughout the breeding season, until the chicks' fledging. The species is known to select nest trees of significantly larger diameter and height (Mudappa & Kannan 1997). As a consequence of their specific breeding requirements and an essentially fruit based diet, the Malabar Grey Hornbill has evolved an intimate relationship with tree species. It is considered to be a major seed disperser in Western Ghats region, one of the keystone species and an indicator of primary moist forest habitat.

A characteristic feature of breeding behaviour of hornbills is nest fidelity — returning every year to traditionally used nest cavities (Kemp 1978). Weather (wind, storm, rain, etc.) and human activities (fire, tree cutting etc.) together govern breeding success as well as cavity use pattern in hornbills (Poonswad et al. 1988). Competitive interactions between hornbills and other cavity inhabitants are a common feature in tropical forests.

Although Mudappa & Kannan (1997) documented nest cavity requirements of Malabar Grey Hornbill in an evergreen forest site in Western Ghats, details such as nest tree species preference and nest fidelity are still lacking. Hence, the present study was undertaken to understand the pattern of nest tree utilization, preference and fidelity of Malabar Grey Hornbill in a tropical semi-evergreen forest site in Western Ghats.

STUDY AREA AND METHODS

The study was conducted in Mudumalai Wildlife Sanctuary, which is located on the foothills of the Nilgiri Mountain Ranges, in the south Indian state of Tamil Nadu (11°30′–11°39′N and

76°27′–76°43′E). The study area is located in the southwestern portion of Mudumalai Wildlife Sanctuary and extends to 52 km^2.

The altitude ranges between 625 to 1258 m. Annual rainfall varies as one move from the eastern parts (800 mm) of the sanctuary to the western region (1800 mm) and accordingly habitats also differ. Two peaks of rainfall (June–August and September–November) were observed at the Mudumalai Wildlife Sanctuary during the study period. A dry spell prevails between December to March. The climate usually is moderate with temperatures varying from 14°C–17°C during the winter and 29°C–33°C in summer (March–May).

The study site is covered by southern tropical semi-evergreen forest (Champion & Seth 1968, Varman 1993). Tree species common to this vegetation type are *Olea dioica*, *Actinodaphne malabarica*, *Persea macrantha*, *Cinnamomum verum*, *Lagerstroemia microcarpa*, and *Terminalia* sp. Ten human settlements are situated about three kilometers way from the study site. Three perennial streams traverse the study site.

Malabar Grey Hornbill is the only resident hornbill species in Mudumalai Wildlife Sanctuary (Gokula & Vijayan 1996). Active cavities of trees utilized by the species for nesting were confirmed by following breeding pairs and breeding male carrying fruit load to the nest cavity as well as from midden deposits of seeds under the nest cavity. Local tribals also assisted to locate nest holes.

Parameters recorded during the study included: tree height, nest height, length of the nest entrance, breadth of the nest entrance, depth of the nest floor below the nest hole, girth at breast height of the nest tree, girth at nest height, orientation of the nest hole, position of the nest on tree (main trunk, first branch etc.), distance from the nearest hornbill nest tree, distance from the nearest water source (streams and rivers), aspect, distance from the nearest human settlements.

RESULTS

Malabar Grey Hornbill used in total 81 trees belonging to 19 species (14 families) for nesting during the study period (Table 1). Number of nest trees studied varied from 52 in 2000 and 2001 to 33 in 2002. The number of nests recorded in the second (2001) and third year (2002) includes some nests used in the previous year(s) and hence, the total number of nest trees encountered in the study site was 81. However, nest site characteristics were studied only for 40 trees due to logistic constraints.

Table 1. Nest tree species utilized by Malabar Grey Hornbills. n — number of nest trees, D — density/ha, * — dead trees.

Tree species and family	n (%)	D
Lagerstroemia microcarpa,Lythraceae	26 (32)	18
Terminalia bellirica, Combretaceae	21 (26)	5
T. crenulata, Combretaceae	9 (11)	42
Grewia tiliifolia, Tiliaceae	3 (4)	5
Albizia lebbeck, Mimosaceae	3 (4)	2
Alstonia scholaris, Apocynaceae	2 (3)	0.33
Cedrella toona, Meliaceae*	2 (3)	1
Elaeocarpus serratus, Elaeocarpaceae	3 (4)	7
Syzygium cumini, Myrtaceae	2 (3)	12
Pterocarpus marsupium, Fabaceae	1 (1)	1
Ficus tsjahela, Moraceae	1 (1)	1
Schleichera oleosa, Sapindaceae	1 (1)	4
Aphanamixis polystachya, Meliaceae*	1 (1)	3
Cinnamomum verum, Lauraceae	1 (1)	5
Olea dioica, Oleaceae	1 (1)	93
Kydia calycina, Tiliaceae	1 (1)	6
Antiaris toxicaria, Moraceae	1 (1)	-
Melia dubia, Meliaceae	1 (1)	-
Mitragyna parvifolia, Rubiaceae	1 (1)	-

Of the 81 nest trees, 79 were live and two were dead (Table 1). The number of nest tree species used was 14, 13 and 12 for 2000, 2001 and 2002 respectively. Three species (*Lagerstroemia microcarpa, Terminalia bellirica* and *T. crenulata*), together contributed for 71% (70%–73%) of nest trees. The results summarized in the following sections are discussed in relation to *Lagerstroemia microcarpa*, *Terminalia bellirica*, *T. crenulata* and others (16 species pooled together).

Nest site and tree characteristics of 40 nest trees were studied (Table 2). Twenty two (55%) nest trees belonged to height class 30–40 m while girth at breast heights of 23 nest trees (58%) was distributed between 2.0 and 3.2 m. 20 nests (50%) were located 13–20 m above the ground level. Girth at nest height of 21 (53 %) nest trees varied from 151 to 210 cm. Nest entrance length of 28 (70%) cavities was 14–17 cm. 25 nests (63%) were oriented towards east. None of the nest cavities studied was typically round in shape.

Height of the nest trees (n = 40) positively correlated with girth at breast height ($r_s = 0.3190$, $p = 0.045$) and girth at nest height ($r_s = 0.4039$, $p = 0.01$) of nest trees. Heights at which nest cavities were located on the trees showed a positive correlation with girth at breast height ($r_s = 0.5462$, $p < 0.001$), tree heights ($r_s = 0.6245$, $p < 0.001$) and girth at nest height ($r_s = 0.4078$, $p = 0.009$).

Table 2. Characteristics of nest trees, nest cavities and nest site (n = 40 nests).

Variables	Mean ± SD	Range
Nest tree		
Girth at breast height (cm)	283 ± 101	160–727
Tree height (m)	36 ± 6	22–45
Nest cavity		
Nest height (m a.g.)	14 ± 2.2	9.1–18.8
Girth at nest height (cm)	177 ± 50	90–295
Inner depth (cm)	34 ± 8	15.5–56.5
Nest entrance length (cm)	15 ± 1.3	12.6–18.3
Nest entrance width (cm)	13.7 ± 2.2	10.2–19.8.
Nest site		
Altitude (msl)	931.4 ± 40.1	890–1040
Distance from hamlet (m)	985.7 ± 1429.8	20–5000
Distance from water (m)	90.8 ± 76.5	5–300
Distance from the nearest nest (m)	134.37 ± 171	25–1000

Re-use of nest holes was observed in all years (Table 3). In total 12 nests belonging to six tree species were used in all the three years of the study. In 2001 *Terminalia crenulata* had a 100% re-use record followed by *T. bellirica* (73%). In 2002, *T. crenulata* had maximum re-use of nest trees (67%) followed by *Lagerstroemia microcarpa* (41%).

Maximum number of new nest-trees, i.e. unoccupied in the previous year (Table 3) was recorded in 2001 for *Lagerstroemia microcarpa* (35%) followed by *Terminalia bellirica* (33%). *T. bellirica* (67%) housed maximum number of new nests in 2002.

Nest holes used by Malabar Grey Hornbill were also used by Large Brown Flying Squirrel *Petaurista philipinensis* and Honey Bee *Apis* sp. and vice versa. During the 2001 and 2002 squirrels and bees together occupied 28 nest holes that were previously used by Malabar Grey Hornbill.

Fire was not encountered in the study site in the first two years, but vast stretches within the study site were gutted by summer fire in February 2002. The time of advent of fire coincided with the early breeding period of the Malabar Grey Hornbill i.e., February. 31 nest cavities were unoccupied during 2002 and 23 of them were located in the fire affected area.

DISCUSSION

Three tree species: *Lagerstroemia microcarpa*, *Terminalia bellirica* and *T. crenulata* were most preferred nest sites in all the three years. According to Balasubramanian & Maheswaran (2002), of the 1430 trees enumerated in 3 ha of their study site in the Mudumalai Wildlife Sanctuary, 14% comprised of above three nest tree species. These three species are hard wooded trees susceptible to heart rot disease caused by fungi. Also these three species are tall and vulnerable to breaking of branches during stormy and windy conditions. These two factors increase frequency of occurrence of nest cavities.

Malabar Grey Hornbills studied used more live trees than dead stumps. This is similar to the observations at Khao Yai National Park, Thailand where hornbills used 80 cavities of live trees and only one cavity on a dead stump (Poonswad et al. 1987). Also other studies reinforced preference by hornbills for living trees (Madge 1969, Kemp 1976, Hussain 1984, Mudappa & Kannan 1997).

Malabar Grey Hornbills preferred tall trees with large girth in Mudumalai Wildlife Sanctuary. Other studies that confirm this trend include

Table 3. Nest reuse (RU) and new nest holes used by the hornbills (2000–2002). n — number of nest holes used.

Tree Species	2000 n	2001 n	2001 RU	2002 n	2002 RU
Lagerstroemia microcarpa	19	17	11	8	7
Terminalia bellirica	11	12	8	9	3
T. crenulata	7	9	7	6	6
others (16 species)	15	14	9	10	5
Total (%)	52	52	35 (67%)	33	21 (40%)

Baker (1927), Johns (1982), Marsden & Jones 1997, Mudappa & Kannan (1997), Poonswad (1995) and Balasubramanian & Maheswaran (2002). It has been reported that nests at higher positions of trees suffer lower amounts of predation in both primary and secondary cavity nesters (Li & Martin 1991, Mudappa & Kannan 1997).

The cavity dimensions of Malabar Grey Hornbill determined from the present study are small compared to similar studies on larger hornbill species in Thailand (Poonswad 1995). The use of smaller cavities is connected with the small size of this species.

There are few published information specifically on the role of fire on nesting frequency and success in hornbills. Leighton & Wirawan (1986) and Anggraini et al. (2000) observed that hornbill numbers declined dramatically after fire.

Tree species such as *Lagerstroemia microcarpa*, *Terminalia bellirica* and *T. crenulata* are vital for breeding hornbills and hence these trees require conservation attention.

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STRESZCZENIE

[Wykorzystanie drzew gniazdowych przez toko szarego w rezerwacie Mudumalai (Indie)]

Ten owocożerny gatunek dzioborożca, występujący endemicznie w wilgotnych lasach tropikalnych zachodniej części regionu Ghats (stan Tamil Nadu w płd. Indiach), jest dziuplakiem wtórnym. Wykazuje wieloletnie przywiązanie do raz wybranych drzew gniazdowych. W ciągu trzech sezonów lęgowych (2000–2002) zbadano wykorzystanie i parametry siedliskowe 81 dziupli gniazdowych. Ptaki wykorzystywały dziuple

wykute w 19 gatunkach drzew, jednak najczęściej (71% przypadków) były to drzewa należące do trzech gatunków (Tab. 1). W 40 przypadkach zbadano (Tab. 2) charakterystykę drzewa gniazdowego (wysokość, pierśnica), dziupli (umiejscowienie, wymiary) i lokalizacji drzewa (wysokość n.p.m., oddalenie od osad ludzkich, wody i najbliższego innego gniazda). Powtórne wykorzystanie dziupli w poszczególnych sezonach stanowiło 67% i 40% wszystkich obserwowanych gniazd (Tab. 3). Wykorzystanie dziupli przez badany gatunek było ograniczane przez konkurencję ze strony wiewiórek *Petaurista philipinensis* i pszczół *Apis* sp. oraz przez pożary lasu.

T. Cofta