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BREEDING BEHAVIOUR OF INDIAN GREY HORNBILL IN CENTRAL INDIA

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***ABSTRACT.* –** The breeding behaviour of the Indian Grey Hornbill (*Ocyceros birostris*) was studied for two consecutive breeding cycles during 2007 and 2008 in an urban environment in Nagpur city in Central India. In 2007, four nests were located and in 2008, two additional nests (thus a total of six nests) were located. Previous data of six nesting attempts in the same habitat was also considered for this paper. The date of incarceration of the female was between 9 March and 2 April (mean date 20 March±12 days) (n=16). The average duration of incarceration of the female inside the nest was 65.5±4.5 days (n=12). The nesting cycle completed in 93.5±5days (n=9). Only 15 chicks fledged from the 16 nesting attempts, thus the number of chicks fledged per brood was less than one. In three nesting attempts, the chicks disappeared during the period of a few days after the female had left the nest and the nest cavity had yet to be sealed back by the chicks. This appeared to be the most vulnerable period of the hornbill's breeding cycle.

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***KEY WORDS*. –** breeding behaviour, Indian Grey Hornbill, urban environment, India.

INTRODUCTION

The Indian Grey Hornbill (*Ocyceros birostris*) is a fairly common hornbill species found throughout India. It is a clumsy brownish grey bird with a heavy curved blackish bill surmounted by a peculiar protuberance or casque; and with a long black-and-white tipped graduated tail, the pattern particularly conspicuous when the tail is spread on alighting (Kemp, 1995). Sexes are similar but the casque is smaller in the female.

Indian Grey Hornbills breed from March to July (Ali & Ripley, 1983) thus covering the entire summer months and early monsoon. The remarkable nesting habits of Asian hornbills are such that the female seals herself in a large cavity of a living tree, leaving only a narrow opening slit for her mate to pass food to her and the chicks (Kemp, 1995).

The Indian Grey Hornbill is found in open but well-wooded country with a scattering of *Ficus* trees. Very scanty information is available about its breeding behaviour. Few notes are available about the life cycle of the species (Osborn, 1904; Hall, 1918; Finlay, 1929; Hutchison, 1943; Ellison, 1992), about its food (Newham, 1911; Neelakantam, 1953; Patil, et. al., 1995 and Kasambe & Pimplapure, 2007) and about the nesting behaviour (Sant, 1995; Rastogi, 2001; Singh, 2003).

We conducted a study of the breeding behaviour of the Indian Grey Hornbill in Nagpur, in Central India, during two breeding cycles in 2007 and 2008. The geographical location of Nagpur is 21°08'N and 79°04'E. The climate of Nagpur city is hot and dry and is characterised by hot summers and mild winters. The mean average temperature is 25–27°C and a maximum of 45°C in summer. The annual rainfall ranges between 650 mm to 1,000 mm.

MATERIALS AND METHODS

To study the breeding behaviour, time budgeting was done for one focal nest during each of the two breeding cycles.

The total study included daily monitoring of ten nesting attempts by the hornbills. This included observations on four active nests during 2007 and observations on six active nests during 2008. However, for some calculation purposes, previous data on six nesting attempts in the same habitat from Dr. Anil Pimplapure were also taken into consideration. During 2007, the focal nest was in an ancient Arjuna tree (*Terminalia arjuna*). During 2008, the focal nest was in a Saptaparni tree (*Alstonia scholaris*) in the Children's Park in Maharajbagh garden. The observations were made using Olympus 10×50 and Nikon 7×20 binoculars or a spot-scope from the ground, from a vantage point which offered a good view of the nest as well as the surrounding area. The vantage point was away from the tree and did not disturb the observed hornbills.

OBSERVATIONS

The data on the important nesting schedule dates are summarized in Table 1. The observations are divided into: courtship, nest preparation, mating, incarceration of the female, female breaking out after incarceration, and fledging of the chicks.

***Courtship.* –** The male peeps deep inside the nest cavity many times in a day to inspect the interior of the cavity. The female also inspects the cavity on many occasions. If the pair is new, the birds wander, inspecting various nest cavities in the area. If the pair is already nesting, they start defending the cavity from other cavity nesters like Common Mynas (*Acridotheres tristis*), Rose-ringed Parakeets (*Psittacula krameri*) and other birds. They defend it vigorously and the male removes any material lying in the cavity.

The courtship starts three months before the actual date of incarceration. During courtship, the male keeps offering the female fruits, garden lizards (*Calotes versicolor*) and pieces of bark and mud pellets. The male as well as the female puts the nesting material into the nest cavity. The male always carry a fruit in its bill ready to be delivered to the female. Even when the female does not accept anything being offered, the male keeps offering the food to the silent female. The pair indulges in play behaviour, such as just passing food to each other without consuming, passing bark pieces to each other, bill grappling, touching bills and even pulling each other's tail.

As the date of incarceration approaches, the female spends most of her time preening her body feathers and basking in sunlight. The female stops foraging for herself and she is taken care of by the male. The female becomes less and less active and stays in the nest tree or follows the male to nearby trees when the male is foraging. The male keeps feeding the female. The male also offers her pieces of dry bark, which she tosses, juggles with her bill and then breaks it into pieces.

The male mock-feeds into the nest cavity many times when the female is nearby. The male shuttles between nest cavity and the female perched nearby with some food item held in his bill. The male produces typical urging calls "shi…shi… shi…" when the female arrives near the nest cavity. The call is accompanied by longitudinal tail movements with up and down movements of the head. This behaviour is as if the male is urging the female to enter the nest cavity.

***Bringing mud for cavity wall preparation.* –** The mud is supplied solely by the male in the form of mud pellets or lumps. The male picks up the mud pellets in the bill and directly delivers them singly to the female without swallowing them. The mud is generally collected from a nearby stream or tank within a periphery of 100m. The female never brings any mud pellets before incarceration.

***Cavity wall preparation.* –** The cavity wall is prepared by the female alone while she is sitting within the nest cavity. It was observed that the female completes the plastering of the cavity entrance from left to right direction. The female keeps her bill sliding over the cavity entrance with the mud lump being smeared into layers of semi solid soil. Analysis of the nest wall plaster suggested that it is composed of mud, powder of wood derived from pieces of bark, and excreta of the female. The excreta content is clearly visible as it contains *Ficus* seeds.

***Collecting lining material.* –** It was found that the female seals half of the cavity entrance before she is finally incarcerated, beginning from her left side and proceeding towards the right side of the nest. The cavity wall is made from thin uniform layers of mud finely mixed with excreta. The male keeps supplying her with mud pellets during the courtship when she enters the nest for brief periods. The female starts preparing the cavity wall during these small stints in the cavity. Her tail becomes skewed because of her short stints inside the nest cavity before the final incarceration.

The male Indian Grey Hornbill alone performs the task of bringing mud pellets and keeps up the supply even when she is incarcerated. This presumably is to continuously repair the nest wall and keep it intact as it may become damaged during the process of supplying food.

***Cleaning the nest cavity before nesting.* –** Every day the male peeps deep inside the nest cavity many times and takes out any loose material lying inside the cavity. This is probably to remove the nesting material collected by the Common Mynas (*Acridothere tristis*) and Rose-ringed Parakeets (*Psittacula krameri*) in the cavities. These are common birds in the study area and occupy the cavities of the hornbill's nests as soon as they vacate it after the fledging of the chicks.

***Repairing the nest.* –** The hornbills repair the nest cavity for nesting purposes. The hornbill pair in Maharajbag on an Arjuna tree repaired the cavity entrance for many days in both the nesting seasons of 2007 and 2008. For repairing the cavity entrance the male contributed most, whereas the female looked on from a nearby perch. They powerfully banged on the cavity opening probably to make the entrance

Table 1. Observations on the nesting schedule of the Indian Grey Hornbill.

Nest	Female enters	Incarceration period	Chicks	Fledging period 1st Chick	Remark
Maharajbag-Mahogany	2 April 2002	66 Days	One	89 Days	AP
Maharajbag-Mahogany	28 March 2003	67 Days	Two (one die)	97 Days	AP
Maharajbag-Mahogany	27 March 2004	67 Days	One	95 Days	AP
Maharajbag-Mahogany	28 March 2005	67 Days	One	95 Days	AP
Maharajbag-Arjuna	24 March 2006	62 Days	One	98 Days	AP
Maharajbag-Semal	27 March 2006	68 Days	Nil.	Chicks disappear after female break out	AP
Maharajbag-Arjuna	22 March 2007	62 Days	Nil.	Chicks disappear after female break out	This study
Vet. Hospital	17 March 2007	65 Days	Three	93, 95 & 106 Days	This study
Central Jail Old Nest	10 March 2007	64 Days	Two	91 Days	This study
Children's Park	2007	NA	Two	Nest found in later phase.	This study
Maharajbag-Arjuna	Nesting failed (2008)	NA	Nil.	No incarceration by female.	This study
Vet. Hospital	16 March 2008	70 Days	Two	NA	This study
Central Jail Old Nest	9 March 2008	61 Days	Nil.	Chicks disappear after female break out	This study
Central Jail New Nest	15 March 2008	45 Days	Nil.	Female break out prematurely	This study
Children's Park	20 March 2008	67 Days	One	93 Days	This study
Forest Colony	26 March 2008	?	One	92 Days	This study

Table 2. Contribution of parent hornbills in feeding the chicks; observations of one full day on 10 June 2007.

Activity	Male	Female	Total feeding
Visits to nest	18 (54.5%)	15 (45.5%)	33
Figs	49 (63.6%)	28 (36.4%)	77
Beetles	16 (84.2%)	3 (15.8%)	19
Garden lizard	0	1 (100%)	1
Bark fragments	1 (100%)	0	1

wider. This particular pair had another problem of sealing a second opening in the tree trunk leading to the same cavity. As the hole was quite wide, the pair could not decide on which entrance should be sealed completely and which entrance should be used for retaining a slit. Finally they continued with both the entrances kept open for many days (in the 2007 season). Then in the final stages of nesting they sealed the upper cavity entrance and continued with the lower cavity entrance that was directed nearly towards the ground.

During the nest preparation, the pair remains near the nest and visits the nest many times during the day. The female enters the cavity many times before the final incarceration. Each evening, she emerges and flies off with the male to roost at their conventional roosting site. Each morning she returns, and towards the end of the nest building she has to struggle hard to pass through the narrowed entrance, until the day comes when her day's work has made it impossible for her to get out again without breaking the plaster away. Then she settles down in the cavity for the next two months of incarceration.

***Mating.* –** The male mates with the female many times before she is finally incarcerated into the cavity. The mountings take place near the nest in the nest tree or within a distance of 100 meters on branches high up in the trees. The male moves towards the female with a food item held in its bill. The female moves away towards the end of the branch. The male hops near to her and at the end of the branch, when the female is reluctant to fly away, the male mounts her and mates. Mounting lasts for from a few seconds up to 106 seconds.

***Incarceration of the female.* –** The earliest date in 2008, of incarceration of the female was found to be 9 March and the latest was found to be 2 April. Considering the dates of incarceration of 16 nesting attempts in Nagpur the mean date of incarceration was 20 March $\pm$ 12 days (Table 1). The male forages and provides the female all the required nesting material. The male brings mud pellets and bark pieces when she is inside the nest cavity. The female starts preparation of the wall by plastering the mud from inside. The female takes three to four days to complete the wall plastering. The female comes out every evening and roosts with the male at their conventional roosting site. The female in the Veterinary Hospital campus nest took four days from 16 to 19 March 2008 to complete the plastering of the nest wall after she was incarcerated. On the final day of incarceration, the cavity wall prepared prevents the female from coming out. On 20 March 2008, the female in the Children's Park nest tried her best by squeezing to come out, as the male waited, in vain, for the female to come out till it was very dark. Finally the male alone flew to roost alone at the roosting site.

As the female enters the nest cavity many times and comes out the tail feathers become ruffled and some of them start moulting. On 17 March 2007, we observed one female in Maharajbag garden campus which had moulted all the tail feathers. This particular female appeared very clumsy without any remaining tail.

***Female breaking out after incarceration.* –** The female breaks out of the nest probably dependent upon the three factors, that is, first the chicks are big enough that their accommodation within the nest cavity together with the female is problematic; secondly the chicks are grown enough to receive food direct from the parents outside; and thirdly they can defecate externally out from the nest by ejecting the excreta from the nest slit.

Furthermore by instinctive behaviour, the chicks are able to accept mud pellets from the parent hornbills and start plastering the cavity entrance with the mud from inside, after the female has broken out. Here it is important to note the most of the mud pellets are again provided by the male hornbill. The female has little role in providing mud pellets to the chicks. The cavity wall prepared by the chicks is rough and not as finely done by the female. The chicks take three or four days to complete the cavity wall. This period between the female leaving the nest cavity and the completion of cavity wall by the chicks is the most vulnerable period in the life cycle of the Indian Grey Hornbill. The minimum duration of incarceration was 61 days and the maximum 70 days. Average duration of incarceration by the female hornbill inside the nest was 65.5 $\pm$ 4.5 days considering 12 nesting attempts in the study area (see Table 1). In May 2003, the monsoon arrived early; it rained continuously for four days. Simultaneously, the female broke the cavity wall. Due to continuous rains, the chicks could not complete the cavity wall. Subsequently, one chick fell down from the cavity to the ground. It was fed by the parent hornbills for two days on the ground. On the third day it was found dead. The remaining chick built the cavity wall three days after it stopped raining.

On 22 May 2007, one of us (RK) was present at the Arjuna tree nest in Maharajbag garden when the female started banging on the nest cavity wall with her bill. The noise of

her banging was loud and audible at a distance of 100m. She broke the nest cavity wall within 10 minutes and came out. She flew clumsily and looked thin and weak. The remnants of the nest cavity wall were collected. In another observation (Anil Pimplapure, pers. comm.) the female broke out of the nest on 24 May 2006 from the Mahogany tree nest cavity in Maharajbag garden. The female threw away chunks of debris of the cavity wall 30 to 40 times while breaking off the wall.

***Fledging of the chicks.* –** The chicks then break the cavity wall themselves and fledge. In 2007, in the nest in Veterinary Hospital, the chicks fledged on the 93rd, 95th and 106th days. In this instance, the third chick re-built the cavity wall after the second had fledged. The nesting cycle was completed in 93.5±5days (n=9). Only 15 chicks fledged from the 16 nesting attempts by the hornbill species. Thus the number fledged per brood was less than one chick.

In three nesting attempts, the chicks disappeared during the period of a few days when the female had left the nest and the nest cavity was yet to be sealed back by the chicks. This implied that this was the most vulnerable period of the hornbills' breeding cycle.

***Role of the male in the breeding cycle.* –** The male has the sole responsibility of feeding the female and chicks while the female is incarcerated. After the female breaks out from the nest, the female shares the responsibility to feed the chicks to some extent. However, for the first few days after she breaks out it was found that the male was still feeding the female as she is weak and cannot forage properly.

On 10 June 2007, a full day's observations were taken from 0515 hours to 1915 hours for 14 hours. From these observations (Table 2), it became evident that the female took a small share in feeding the chicks, presumably due to her physical weakness from being incarcerated.

The male keeps providing a continuous supply of inedible objects, mostly pieces of bark to the inmates of the nest practically every day of the breeding cycle. The bark pieces probably serve to maintain nest sanitation and to maintain the humidity inside the cavity. The male delivers mud pellets (lumps of soil) to the female. All the actual plastering of the nest slit is done by the female, sitting inside the cavity using these mud pellets and her own excreta.

The male alone defends the nest from nest intruders and predators during the incarceration period of the female. The male never allowed another male of the same species to venture near its nest.

Remarkably, during the whole period of observations, no male ever entered the nest cavity itself. The male attends to the chicks and also has great affinity to the deserted nest cavity after the breeding cycle. The hornbill family including the chicks stays in the vicinity of the nest even after the breeding cycle is over. The roosting site of the male during the breeding season is within a periphery of 200 meters (n=4) from the nesting tree. Twice we observed the hornbills taking dust bath. Dust bathing has also been reported by Santharam (1990).

***Food during the breeding cycle.* –** The keystone food species of the Indian Grey Hornbill during the whole year remains *Ficus religiosa* and *F. benghalensis*. However, two more species of *Ficus*, i.e. *F. glomerata* and *F. lacor* also contributed to some extent to the hornbill's diet. The fruits of *Pithecelobium dulce, Manilkara hexandra, Syzygium cumini* and *Zizyphus mauritiana,* and Yellow Oleander *Thevetia nerifolia* were also served to the nest inmates. Animal protein was served mainly in the form of garden lizards (*Calotes versicolor*), beetles, grasshoppers and snails (*Pila* spp.). Only twice were bird chicks provided to the incarcerated female. Leaf matter was provided from various species of trees (Kasambe & Pimplapure, 2007). We never observed the Indian Grey Hornbills drinking water during the study period. The male never deserted the female during the nesting period.

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LITERATURE CITED

Ali, S. & S. D. Ripley, 1983. *Handbook of the Birds of India and Pakistan, Together with those of Bangladesh, Nepal, Bhutan, and Sri Lanka: Compact Edition*. Oxford University Press, New Delhi. 488 pp.

Ellison, B. C., 1923. Notes on the habits of a young Hornbill. *Journal of the Bombay Natural History Society*, **29**(1): 280–281.

Finlay, J. D., 1929. The nesting habits of the Northern Grey Hornbill *Lophoceros birostris*. *Journal of the Bombay Natural History Society*, **33**(2): 444–445**.**

Hall, E. F., 1918. Notes on the nidification of the Common Grey Hornbill (*Lophoceros birostris*). *Journal of the Bombay Natural History Society*, **25**(3): 503–505.

Kasambe, R., & A. Pimplapure, 2007. Communal foraging of Indian Grey Hornbill *Ocyceros birostris* on leaves of *Ailanthus excelsa* tree. *Zoos' Print Journal,* **22**(12): 2939.

Kemp, A., 1995. *The Hornbills: Bucerotiformes*. Oxford University Press, Oxford. 302 pp.

Osborn, W., 1904. Nesting of the hornbills. *Journal of the Bombay Natural History Sociey*, **15**(4): 715–716.

Neelakantam, K. K., 1953. Common Grey Hornbill (*Tockus birostris*) eating fruits of the Yellow Oleander *Thevetia nerifolia*. *Journal of the Bombay Natural History Society*. **51**(3): 738**.**

Newham, A., 1911. Hornbills *Ocyceros birostris* devouring young paroquets. *Journal of the Bombay Natural History Society*, **21**(1): 263–264**.**

Patil, N., N. Chaturvedi & V. Hegde, 1997. Food of Common Grey Hornbill *Tockus birostris* (Scopoli). *Journal of the Bombay Natural History Society*, **94**(2): 408–411**.**

Rastogi, A. K., 2001. Nesting of Common Grey Hornbill *Ocyceros birostris* (Scopoli). *Newsletter for Birdwatchers*, **41**(1): 6.

Santharam, V., 1990. Common Grey Hornbill *Tockus birostris* (Scopoli) dust bathing. *Journal of the Bombay Natural History Society*, **87**(2): 300–301.

Sant, N. R., 1995. Strange behaviour of Common Grey Hornbill *Tockus birostris*. *Newsletter for Birdwatchers*, **35**(4): 77.

Singh, B., 2003. Nesting and breeding of the Grey Hornbill. *Newsletter for Birdwatchers*, **43**(5): 75.