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±5 days (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.

This paper was presented at the 5th International Hornbill Conference jointly organised by the National Parks Board (Singapore) and the Hornbill Research Foundation (Thailand), in Singapore on 22nd–25th March 2009.

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 (Acridotheres 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 Maharajbagh 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

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

<table>
<thead>
<tr>
<th>Nest</th>
<th>Female enters</th>
<th>Incarceration period</th>
<th>Chicks</th>
<th>Fledging period 1st Chick</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maharajbag-Mahogany</td>
<td>2 April 2002</td>
<td>66 Days</td>
<td>One</td>
<td>89 Days</td>
<td>AP</td>
</tr>
<tr>
<td>Maharajbag-Mahogany</td>
<td>28 March 2003</td>
<td>67 Days</td>
<td>Two (one die)</td>
<td>97 Days</td>
<td>AP</td>
</tr>
<tr>
<td>Maharajbag-Mahogany</td>
<td>27 March 2004</td>
<td>67 Days</td>
<td>One</td>
<td>95 Days</td>
<td>AP</td>
</tr>
<tr>
<td>Maharajbag-Mahogany</td>
<td>28 March 2005</td>
<td>67 Days</td>
<td>One</td>
<td>95 Days</td>
<td>AP</td>
</tr>
<tr>
<td>Maharajbag-Arjuna</td>
<td>24 March 2006</td>
<td>62 Days</td>
<td>One</td>
<td>98 Days</td>
<td>AP</td>
</tr>
<tr>
<td>Maharajbag-Senal</td>
<td>27 March 2006</td>
<td>68 Days</td>
<td>Nil.</td>
<td>Chicks disappear after female break out</td>
<td>AP</td>
</tr>
<tr>
<td>Maharajbag-Arjuna</td>
<td>22 March 2007</td>
<td>62 Days</td>
<td>Nil.</td>
<td>Chicks disappear after female break out</td>
<td>This study</td>
</tr>
<tr>
<td>Vet. Hospital</td>
<td>17 March 2007</td>
<td>65 Days</td>
<td>Three</td>
<td>93, 95 &amp; 106 Days</td>
<td>This study</td>
</tr>
<tr>
<td>Central Jail Old Nest</td>
<td>10 March 2007</td>
<td>64 Days</td>
<td>Two</td>
<td>91 Days</td>
<td>This study</td>
</tr>
<tr>
<td>Children’s Park</td>
<td>2007</td>
<td>NA</td>
<td>Two</td>
<td>Nest found in later phase.</td>
<td>This study</td>
</tr>
<tr>
<td>Maharajbag-Arjuna</td>
<td>Nesting failed (2008)</td>
<td>NA</td>
<td>Nil.</td>
<td>No incarceration by female.</td>
<td>This study</td>
</tr>
<tr>
<td>Vet. Hospital</td>
<td>16 March 2008</td>
<td>70 Days</td>
<td>Two</td>
<td>NA</td>
<td>This study</td>
</tr>
<tr>
<td>Central Jail Old Nest</td>
<td>9 March 2008</td>
<td>61 Days</td>
<td>Nil.</td>
<td>Chicks disappear after female break out</td>
<td>This study</td>
</tr>
<tr>
<td>Central Jail New Nest</td>
<td>15 March 2008</td>
<td>45 Days</td>
<td>Nil.</td>
<td>Female break out prematurely</td>
<td>This study</td>
</tr>
<tr>
<td>Children’s Park</td>
<td>20 March 2008</td>
<td>67 Days</td>
<td>One</td>
<td>93 Days</td>
<td>This study</td>
</tr>
<tr>
<td>Forest Colony</td>
<td>26 March 2008</td>
<td>?</td>
<td>One</td>
<td>92 Days</td>
<td>This study</td>
</tr>
</tbody>
</table>
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, 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, where the female is reluctant to fly away, the male mounts her and mates. Mounting lasts for 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 ± 12 days (Table 1). The male forages and provides the female all the required nesting material. 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 that the chicks are grown 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.

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.
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±5 days (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 male 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 Pithecellobium 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**


