

ary 21, 1992, the third on February 24, 1992, the fourth on February 27, 1992, (but discovered dead on February 29, 1992). The fifth egg was not fertile.

By this time, it was possible to check the female and the young every three days. Difficulties were encountered on checking the nest box because whenever we opened the observation window, the female would attack us.

Fledging

On April 20, 1992 at 08:00 hrs, the female broke open the sealed entrance; two of the chicks then emerged. Ten days later on April 30, 1992 the youngest chick came out of the nest box. First chick came out on day 67, second chick on day 59 and third chick on day 66.

We observed that the juvenile differed from the adult in bill and casque (white in both sexes). The casque appeared as merely a knob at the base of the calmen which was not fully developed, but the babies' plumage was similar to that of the adults.

After-hatching Diet

For the first few weeks, the amount of mixed fruits and mixture of bread fed remained the same. The other items in the diet were slowly increased according to the development of the young.

Once all the three young had hatched, the diet was increased to: crickets - 30 ps/day, mealworms - 40g (three times a week), white mice - 12 ps/once every two days.

The male continued to feed the two chicks who had come out of the nesting box as well as the chick still inside.

On April 28, 1992, we moved the male because he appeared to be weak. With the absence of the male, the female continued the responsibility of feeding the young. The young are currently still housed in the same aviary as the female. The sexes of the young have been determined as one male and two females.

After two years of operation, the main objective of breeding the hornbills at this theme exhibit was realized. This will, in turn, lead to more breeding of other hornbill species in the Jurong Bird Park. The achievement of breeding this species of hornbill is just a small step in Aviculture but a milestone in conservation. ➔

The Conservation of Hornbills in Captivity

By Wendy Worth
San Antonio, Texas

While captive propagation has played a significant part in rescuing many endangered species such as the California Condor, the Bali Myna and the Guam Kingfisher, the sad fact is that we do not yet have sufficient knowledge to use captive propagation to rescue hornbills. Developing reliable husbandry techniques should be a top priority for all of us who are interested in hornbills. This is especially true for those species found in southeast Asia where they are severely threatened by massive loss of habitat.

To date, there has been little input from the private sector as to their progress towards the development of reliable hornbill propagation techniques. We urgently need to get together all the people with knowledge on the subject and pool the information. Until now, the private sector and zoological institutions have been working separately on these issues. Collaboration could produce more success and hopefully save some species from extinction.

Large hornbills are among the most spectacular of zoo exhibits; however, they do not breed well in captivity. In fact, only five species of Asian hornbills have bred in zoological institutions in the United States, the Great Hornbill being one of them. Poor nesting success makes it imperative that more effective methods of captive propagation be developed.

This is where the private sector can make an important contribution! Here are the problems on which we need to work together:

- (1) Incomplete knowledge of nesting requirements.
- (2) Incomplete knowledge of dietary needs.
- (3) Incomplete knowledge of courtship and pair bonding cues.
- (4) No hand-rearing experience.

But problem solving alone is not enough: communicating with other individuals and institutions is also of the

utmost importance.

Hornbills have served humankind for centuries in myth and ritual throughout southeast Asia; they bring the rain for the crops in Borneo; they are the national bird of Sarawak; and their carved casques brought good luck to Chinese families for eons. And yet almost all large Asian hornbills are now seriously threatened by the logging industry which is taking away their nest sites. Recent articles tell the doleful story of the demise of the Malayan forests. Without the knowledge gleaned from captive propagation it is quite possible that these dramatic and special birds will become extinct in the wild.

The smaller African hornbills are neither as threatened in the wild nor as difficult to breed in captivity. However, their breeding strategy is similar to that of the Asian hornbills in which the female incarcerates herself in a nest hollow for several months while she incubates the eggs and raises the chicks. This makes the African species excellent candidates for breeders to work with to develop techniques that can then be applied to more endangered species.

One factor is known, and that is that the pair bonds are very important; however, the behaviors that indicate a potentially good pair are not. Another thing of known importance is the size of the nest opening as well as the placement of it in the nest log. In Thailand, Pilai Poonswad has been studying the nesting preferences of wild hornbills for ten years. She has found one shape that is chosen most frequently. Several zoos have redone the nest openings using this shape and have had immediate interest from pairs that had previously shown no nesting behavior.

Private sector breeding successes include endangered species like the Nene Goose, waterfowl in general and many pheasant species. They have also had excellent success with psittacines, most recently with parrotlets and lorries as good examples. By specializing their in-

terests, private breeders can often focus on a husbandry problem and work towards a solution with more speed than zoological institutions, which are often encumbered by bureaucracy.

Hornbills are found in Africa and Asia where competition with man for habitat is also at its greatest. There are 45 species of hornbills. Trademarks of the hornbill family are the bill and casque, both of which may be surprisingly large and oddly shaped. The casque is an extra section of the bill sitting on the upper mandible. Its function remains a mystery to biologists. The bills and casques are usually colorful shades of yellow, red, black and white. Large as the casques may be, they are usually light in weight, made up of spongy, cellular bone.

Only the Asian Helmeted Hornbill has a solid casque. The art of carving hornbill ivory, developed to a high degree by the Chinese, has, unfortunately, almost eliminated this hornbill in its range.

In the tropical Old World rain forests hornbills are among the largest and most conspicuous of birds to be seen. They feed mainly on fruits taken from a wide variety of forest trees and use cavities in large trees for nesting. As mentioned before, all have an unusual breeding biology in which the female imprisons herself inside the nest hollow with a wall that she and her mate build at the entrance, leaving just a tiny hole through which the male feeds the female.

Because hornbills are nest-site limited, it is obvious that logging must be a great threat to their survival. The Asian hornbills, because of their large size, require mature trees for the selection of nest holes; these same trees are in demand for the logging industry.

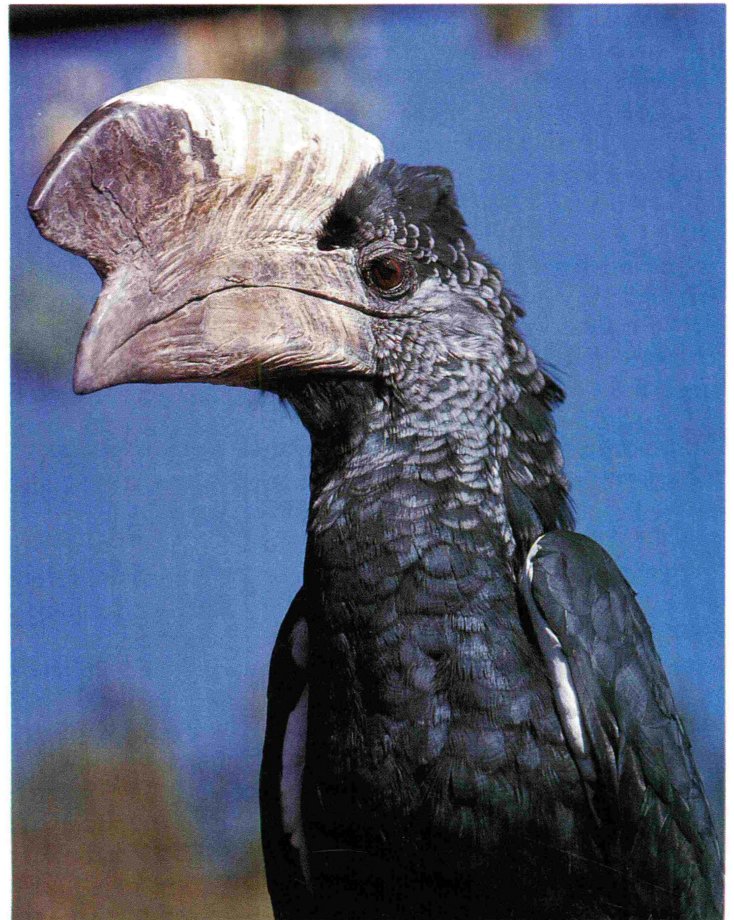
Hornbills in the wild have radiated into a wide range of ecological situations and this variety makes different demands upon their breeding biology. We have to take this into consideration when we have them in captivity. Some species, such as the Rhinoceros Hornbill and the Bushy-crested Hornbill, are "social" nesters with juveniles, mostly males, helping at the nest. Others, such as the Great Hornbill, are "solitary" nesters and it is best to remove the young when they are weaned.

An important part of the breeding biology is the "mudding" of the nest. This is the process of sealing the nest cavity, which in the wild would protect them



Photos courtesy of Dale Thompson

Bhutan's Hornbill female. This species is quite rare in captivity



Black-casqued Hornbill



Tarictic Hornbill

from predation. Most hornbills do not actually use mud, especially the Asian hornbills. Food and feces are the preferred materials! This construction is the last part of the pair bonding and it is a task usually shared by both sexes. They

use their large bills like trowels, packing and smoothing the mud-like substance which hardens quickly.

The nest opening is narrowed to a slit through which the male passes food to the female for the 90 days of her confinement. During this period she is completely dependent upon the male for food and protection. The female of many species undergoes a complete molt, the feathers then being used to line the nest. When she has a tail she keeps it folded upright, as does the growing chick.

The height of the nest hole from the floor of the nest, we have learned, is of extreme importance. Not only must it be the right height for the female to receive the food that the male provides but, also, it must be the correct height for the female to defecate out of so that she can maintain a clean nest for the three months she is incarcerated. (Native people of Southeast Asia can tell how old the chicks are by how high the plant shoots have grown from the seeds in the feces surrounding the nest tree.)

From what we can tell, diet is less significant to successful breeding as these birds are omnivorous. We have learned that Asian species emphasize more fruit in their diet and are important dispersers of seeds, while the African species are more insectivorous and carnivorous. Most zoos provide a diet of chopped fruit and vegetables; many add meatballs, pinkies or crickets. Bananas play a significant role not only in the diet but also in the mudding behavior. Grapes

(for the Asian species) and pinkies or furred mice (for the African species) are important for the presentation of food gifts as part of the pair bonding process.

The size of their enclosures in captivity must be as large as possible, for hornbills are very active. Perches must be firmly anchored for they hop and bounce as frequently as they fly. Hornbills are intelligent and inquisitive and quite capable of taking apart anything that is not well secured.

Hornbills are not at all cold hardy and at temperatures below 50° F are subject to frostbite damage to bills and toes. Many of the larger species do not have an underlayer of downy feathers for insulation and need adequate protection in cold climates.

Many of the Asian species are sexually dimorphic, showing color differences in the eyes or in the bare skin on the head and throat. All chicks hatch with male coloration and take between one and four years to mature and show differentiation.

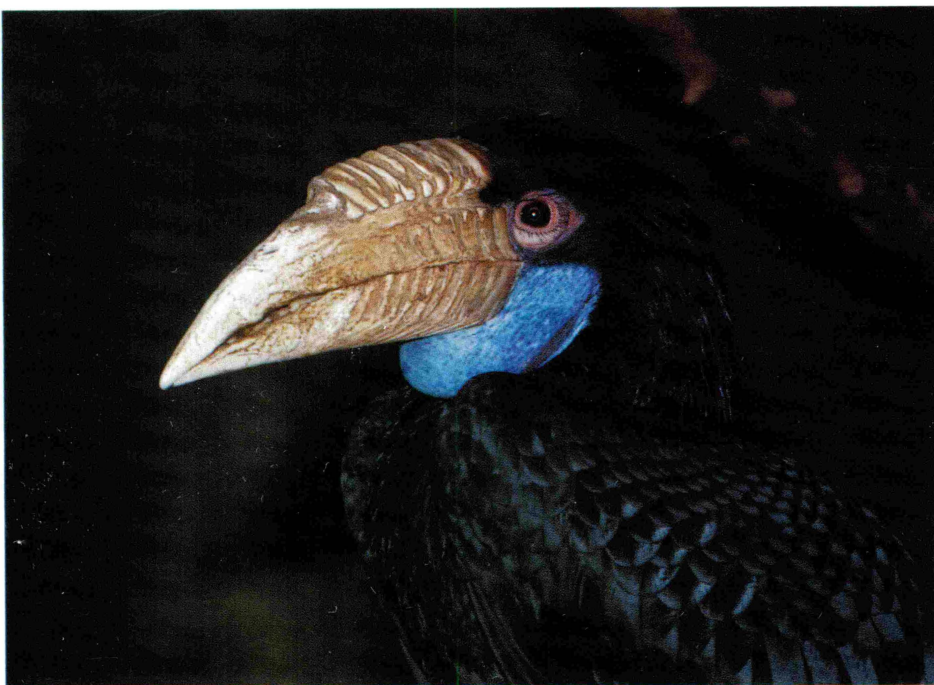
While most species of Asian hornbills are now listed as protected by CITES Appendices I & II, it seems inevitable that all large Asian hornbills will soon be more seriously threatened. Logging remains the major menace to their survival. In 1990, hornbills were declared a priority taxon for worldwide concern.

The future of these magnificent birds is dependent on the availability of large-diameter trees for nest sites. As the forests become depleted it is up to us to help hornbills propagate in captivity. Poor nesting success makes it imperative that more effective methods of captive propagation be developed. Much more information is needed on the requirements for successful breeding, and the insights of private breeders would be invaluable.

In 1991, I organized a Hornbill Conservation Workshop in Singapore for three days to study the population and status of all Asian hornbills. From the knowledge gathered there from field scientists, geneticists and captive breeding managers, a set of recommendations will be developed for the global management of hornbills. This is one of the areas wherein conservation consciences will be most tested as it will be crucial to work with the recommended species.

Rather than taking any more birds out of the wild without established breeding programs in place, we as captive managers would probably do better to solve

Photos courtesy of Dale Thompson



Wreathed Hornbill

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the problems of low reproduction within the group already in captivity. Then we can in good conscience bring in more of these wonderful birds.

I and my co-chairperson, Dr. Chris Sheppard of the CBSC Hornbill Global Captive Action Plan Group and of the AAZPA North American Hornbill Taxon Advisory Group, will be asking people to focus on key species to try and solve the apparent problems in reproduction with those species first. This Taxon Advisory Group (TAG) is responsible for all taxa of hornbills, all 45 species. We are currently working on a husbandry summary for each species. Any information you may have will be extremely helpful to us.

Six North American Zoos have had success raising the larger Asian hornbills: the Audubon Zoo, the Bronx Zoo, the Houston Zoo, the San Diego Zoo, the St. Louis Zoo and the Sacramento Zoo. A few more have been successful with the smaller African species, but the numbers drop again as we get into the larger African species. We have to do better than this if we are going to have any long-term effect on the populations

of these special birds.

As you know, I am the international studbook keeper for the Great Hornbill species. That means I publish a record of all the Great Hornbills in zoos and monitor the pairings and reproductive activity to form a database for management. I would like to be able to include any that are in the private sector in this as well. Only cooperative, organized captive management can insure that a species will reach the minimum viable population with a strong genetic make-up.

More and more zoos and breeders are encountering the conservation dilemmas and ethical questions that used to be of concern only to conservation biologists and scientists. Suddenly we are the last strongholds of many endangered species of birds. Biodiversity is tangible and achievable. This is especially true in the case of hornbills. If we work together, zoos and private breeders, we can really make a difference in the future of this fascinating and valuable species.

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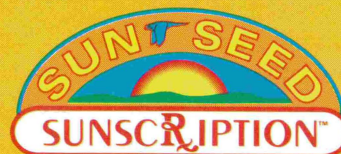
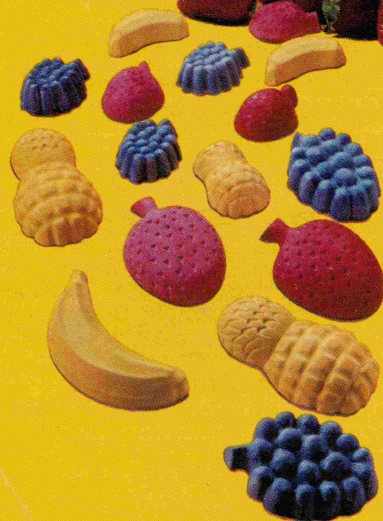
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