Captive Breeding and Management of the Jackson's Hornbill

(Tockus jacksonii)

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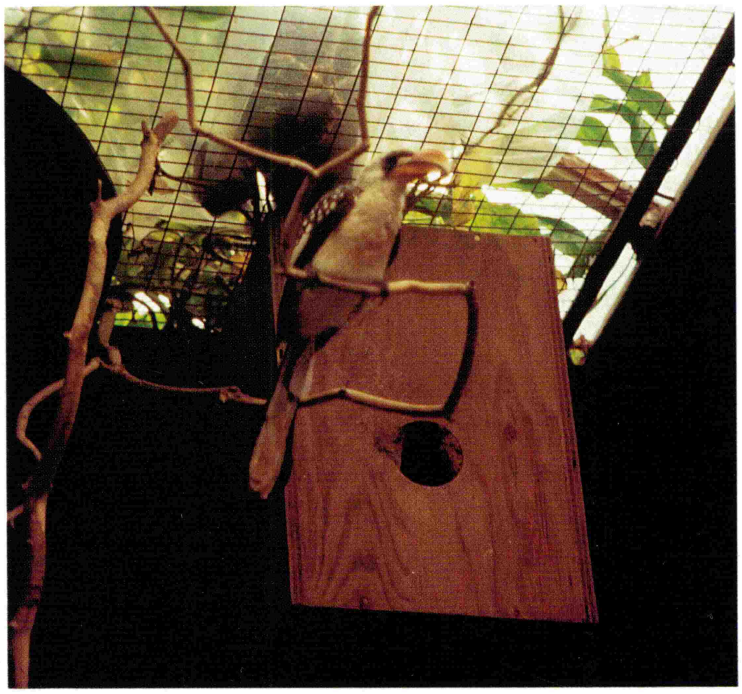
A juvenile male Jackson's hornbill with a southern yellow-billed hornbill.

A young male with bill almost completely colored out.

"Hornbill" — now that's an interesting, descriptive term. Hearing of such an animal without some sort of visual reinforcement would only set my imagination free to concoct all kinds of weird, anatomical shapes and forms. Further, I'd bet the not-so-gullible residents of Missouri (the "show me" state) would, with suspicious skepticism, dismiss the existence of such a creature as they might a "jackalope" or a "devil chicken." Well, hornbills indeed exist, and their appearance, as well as reproductive natural history, are probably more bizarre than most people may imagine.

Hornbills are representative of the family Bucerotidae, within the order



A male near the nest box. Note the beginnings of a plug at the nest entrance.

Coraciiformes, which also includes hoopoes and the more familiar kingfishers. The hornbill family alone consists of twelve genera, some forty-five species, various subspecies and races, all of which are indigenous to the Old World. A variety of different forms are found in Africa, India, throughout southeast Asia, and on many islands of the Indo-Australian region. It's not surprising that the greatest number of subspecies and races have evolved among island groups such as the Philippines which, by their very nature, facilitate geographic isolation.

Relative sizes range from the small red-billed dwarf hornbill *(Tockus camurus)* at 33 cm. (13 in.), to the great Indian or concaved-casqued hornbill *(Buceros bicornis)* that can be as large as 140 cm. (56 in.) from the tip of the bill to the end of the tail. As their name implies, the most prominent feature of their anatomy is the bill, which is usually very large in relation to their overall body size. In some species the bill is topped by an ornate casque that is situated centrally along the median of the upper mandible.

Understandably, some people get hornbills confused with toucans which are definitely rivals with respect to bill size, but the resemblance is only superficial.(Taxonomically, toucans are more closely related to woodpeckers and are, therefore, categorically placed within the order Piciformes.) Though the bill and casque appear heavy and unwieldy, it's actually surprisingly light! In construction, the outer shell is supported by a network of "struts" composed of cellular, sponge-like, bony tissue. As with most generalizations there are always exceptions, and so is the case regarding the Malayan helmeted hornbill *(Rhinoplax vigil).* This species has a casque of solid bone, which is known to be transformed into carvings and other art forms by the humans that inhabit its range.

Many species exhibit virtual monomorphism between sexes (male and female identical in appearance). In others, however, sexual differences (dimorphisms) are evident in various degrees.

Hornbills nest within the hollow cavities of trees and, with the exception of ground hornbills, the female becomes literally "walled" or "sealed" within the nest cavity after the entrance is almost completely plugged with an amalgam of mud, detritus, feces, and saliva. When completed, only a narrow, vertical slit remains through which she will receive sustenance from the male, and to allow for the ejection of excrement. Primarily due to this aspect of their natural history, hornbills are regarded as the most highly evolved of cavity-nesting birds. Once sealed within the nest, the hen remains long enough to lay and incubate her eggs, molt, and care for her young until they have developed enough to be left behind on their own. The total amount of time may range from 60 to 100 days, depending on the species. Further, with a particular species, the number of young in a brood may also influence the timing of the hen's emergence. In the case of a large brood, the female may leave the nest earlier due to spatial constraints, and to form with the male, a division of labor necessary to accommodate the increasing nutritional demands of the young.

Regardless of their preferred food type, these birds are superb opportunists. Some species forage primarly for fruit, while others mainly go after small animals. Still, other species may be more generalized in their feeding habits and, subsequently, hunt and forage for both.

"Jeepers, creepers! Where'd you get those peepers?" Upon first observing one of these creatures, I'm fairly certain that's what I may have mumbled to myself; however, if not, it definitely sums up the inital effect. Unlike most birds, with the exception of ratites (ostriches, rheas, etc.), hornbills have human-like eyes accentuated with long eyelashes that express confidence and inquisitive intelligence.

Jackson's hornbills *(Tockus jacksonii),* named for the British explorer, naturalist, soldier and author Sir Fredrick George Jackson (1860-1938) — whew! — are indigenous to the dryer regions of central east Africa where they are known to feed predominantly on insects, other small animals, and some fruit.

In the aviary, Jackson's hornbills are very active, become quite tame, and will usually get along well with other species of birds — except other hornbills. Even though they seem to have a less aggressive nature than many other species, more than one pair of hornbills in the same aviary would be a most uncomfortable and, at times, nerve-racking situation. The pair that's predominantly referred to

herein have a pair of actively breeding Tarictic hornbills *(Penelopedes panini)* for neighbors. The male Jackson's has never expressed aggressive behavior towards the Tarictic male, even during a nesting cycle. On the other hand, the Tarictic male will rarely miss an opportunity to intimidate the Jackson's and, indeed, does so by flying into, or against, the wire partition between the flights like a cannonball. If this aggressive display is responded to at all, it's merely a token gesture mixed with an amalgam of curiosity and saving face ("Henry! Don't just sit there. Do something!").

Obviously, the outcome of placing these two species together is a foregone conclusion. I have had a pair of Jackson's co-exist peacefully with an actively breeding pair of plush-crested jays *(Cyanocorax chrysops),* which would dive bomb them at the slightest provocation or whenever they ventured too near their nest or fledglings. The hornbills only reacted with puzzled alarm and, even if it contradicted their curious nature, did their best to remain clear of the jays' business. An actively breeding pair of Jackson's will have no problem co-existing with assorted quail, pigeons and doves, jays, mynahs, pheasants, turacos, and many other species where competition is not a problem. Indifference seems to be the rule.

The core of their daily diet consists of Wayne's bite-size kibble soaked in water (or a mixture of Aqua-Vitae), chopped fruit, and both raw and cooked vegetables. They also receive hard-boiled egg, bird-of-prey diet (Central Nebraska), and an assortment of live foods such as crickets, mealworms, and even goldfish. When feeding hard-boiled egg, it's a good idea to crush them beyond recognition so that the birds make no connection about what they are eating and inadvertently learn to start eating their own. Further, a 48-hour supply of mynah pellets, dry dog kibble, and raisins is always available. This mixture, which can be coated with Super Preen powder if necessary, is less susceptible to spoilage and, therefore, works well as a backup or "fail-safe" measure in case other foods run out.

With hornbills, it should be emphasized that the only source of moisture a nesting hen will receive is contained within the food the male brings to the nest. In captivity, foods containing adequate moisture must be available and offered regularly. Another source of moisture may be water retained and utilized as the result of carbohydrate metabolism — an adaptive physiological mechanism exhibited by many species of animals that are indigenous to arid habitats. Still, in the aviary, a constant supply of fresh water is always present.

The aviary these hornbills share with many other birds is approximately 20 feet on each side and about 25 feet in height. A facility of this size is not absolutely necessary for breeding this and many other species, but I believe spacious accommodations may enhance reproductive success. Further, a large area does allow for adequate exercise, permits a greater variety and number of bird populations to establish their respective territories, and provides each individual with the opportunity to maintain an adequate social force field ("their own space").

The flight, located on a hillside, is constructed of 4x4 inch square steel tubing framework, covered with 1x1 inch mesh weldwire fabric. Palos Verdes stone has been set into the concrete foundation to form terraces in the hillside and to enhance the flight aesthetically. Tough, hardy plants such as camelias, clivias, rubber trees and bamboo are planted liberally throughout, and a continually recycled and filtered stream flows through the center, for drinking and bathing. The sound of water splashing over a series of "mini-waterfalls" is a special ingredient enhancing the aviary in a natural way.

The nest is best positioned high in a sheltered area of the flight to allow for as much security as possible, and perches have been placed in close proximity to the entrance hole to provide a comfortable access for mudding and feeding. In the wild, such accommodations are rare or non-existent and probably impractical as they would only reduce nest security. The nestbox is constructed, in part, of a hollowed out 1/2 slice of a tree trunk, with plywood on the back, top, and bottom. Overall dimensions are 18 in. in height, 18 in. wide, and about 12 in. deep. The entrance hole is 3-1/2 in. in diameter, and placed just above center between the top and bottom.

Undoubtedly, the introduction of the nestbox was an essential catalyst stimulating, almost overnight, behavior patterns that had not been previously observed. The female responded almost immediately by sticking her head in the entrance and

investigating its contents. Soon thereafter, she began pulling out pine needles, leaves, and other similar organic items that I placed inside for nest bedding. It was soon obvious that all details about the nest environment were to be left to her.

As little as 15 days later, the first signs of "smearing" were found on some areas of the entrance hole. "Smearing" is the term I use to describe the cementing of mud, feces, saliva, and fine detritus on the edges of the nest entrance. Some smearing may occur on other areas of the nestbox as well, especially the top and sides. Interestingly, I have observed juveniles smearing mud along the edges of rails and other objects that offered no nest possibilities whatsoever. In this case, they were probably only exercising instinctual behavior so important in preparation for their role as adults later in life.

Even though both sexes participate in the entrance sealing process, at times it appears as though the male may be the instigator. With the tip of his bill he will take an object such as a leaf or chip of wood to the entrance and rapidly waggle his head from side to side — seemingly in attempt to induce the female into taking an interest. As the actual sealing of the entrance hole begins, there emerges a distinct pattern in its construction. A glob of moist mud and detritus is taken to the entrance where it is deposited on the inside edges of the entrance with a fast, vibrating movement of the bill, which is truly an animated trowel. Only some of the material will actually stick to become part of the plug but, growing bit by bit from the sides inward, the plug gradually increases in size until the female can just barely squeeze through. Also, it is not uncommon to see the female working from the inside while the male is working from without. Although they occasionally do, males are rarely observed actually entering the nest cavity. White urates visible in the plug's matrix usually indicate the presence of feces utilized in construction. When older members of a brood chip away the plug sufficiently to leave the nest, younger siblings will instinctively reseal the entrance with their own feces.

At times when it became necessary to break into a nest, I always experienced an allergic reaction on my forearm where it came in contact with the nest plug ingredients. I now believe it may be due to the remains of meal-

worms in the feces, to which I suddenly developed an allergy several years ago.

During the sealing process, the female is frequently observed going in and out of the nest, carrying leaves and other similar material to be used as bedding. While doing so, she understandably behaves as though she'd prefer not to be seen in close proximity to the nest most likely out of fear that her clandestine operation may be discovered. Eventually, she will fill the nest to just below the bottom edge of the entrance so that feces and other trash may be easily ejected. In order to eliminate, the female and young literally back up to the hole with their tail feathers pointed up, place their cloacal opening in line, and eject their feces outward with considerable force as though under pressure. Distances of three to four feet aren't unusual. Since their reproductive strategy requires they remain in confinement for two to three months, this instinctual matter of good housekeeping is not simply for comfort but, indeed, imperative to survival and reproductive success.

During this period the pair also engage in an interesting display of courtship. In unison, they slowly begin to make "clucking" sounds. As the clucking increases in volume and pitch, they simultaneously bow their heads down, spread their rectrices wide, and lift their wings spread-eagle fashion. At the point where the clucking noise begins to reach a crescendo, it suddenly ceases. They may, or may not, face each other during the entire display which lasts approximately seven to ten seconds. The genus name *Tockus* is said to be derived from the vocalizations of these animals: "tok, tok, tok, . . ." however, the vocalization of the Jackson's hornbill is, instead, very similar to the clucking sound of a chicken. Vocal patterns vary considerably between different species of this genus.

Once courtship and mating are complete, and after the nest has been properly prepared, the female then enters the nest and begins to fulfill the next phase of the reproductive process. This is when the nest entrance is finally sealed so only a narrow vertical slit approximately 1/2 inch wide remains. Later, examination of the entrance plug indicates that both the male and female share in the final process. With the female completely sealed inside and hopefully safe from predators, it becomes the male's sole, undying purpose to continuously provide his mate with sustenance and chase invaders from the nest territory. It is this aspect of the hornbill's behavior that has gained a place in African folklore as a symbol of fidelity. And fortunately, because of such beliefs, killing these birds has become a cultural taboo.

The Jackson's, unlike many hornbills such as the Tarictic *(Penelopedes panini),* do not regurgitate many pieces of food in succession per feeding at the nest. Instead, the male takes his mate one item at a time, offering the food with the tip of his bill. In captivity, I provide a convenient perch for this purpose; however, from the standpoint of predation in the wild, this may not be an intelligent arrangement. In their natural habitat, the male characteristically clutches the tree trunk below or around the nest entrance with zygodactylous feet (two toes forward and two toes back), not exactly but much the same way woodpeckers do. And, like woodpeckers, they will use their tail feathers to prop themselves into position. Sometimes it's necessary for the male to get the female's attention by waggling food in front of the nest entrance. Usually she is quick to respond and, depending upon how hungry she is, will often make a squealing noise as she snatches the food away. The young also do this when hungry. Several hungry, young chicks begging for food from within the nest is best characterized by a high pitched chorus of "chirp-like" noises that remind me of a "squeaky wheel." After appetites of the female and young have been satisfied, the male will try and tempt them into taking one more morsel. If they fail to respond he eventually gives up and, after tossing the morsel to the back of his throat, he'll gulp it down hornbill-style.

Egg laying commences approximately six days after the female is completely incarcerated and, according to data taken from field studies, a clutch size of two to five eggs is expected. In captivity two to four eggs is the range I've learned to expect. As is the case with other cavity-nesting birds, the eggs are solid white, which is a characteristic most likely due to the lack of environmental pressures within the nest. As one may expect, birds that nest in the open generally produce mottled and pastel colored eggs that rely more on crypsis instead of a "fortress" to avoid predation. The average egg is 2.35 cm. (15/16 in.) in diameter and 3.75 cm. (1.5 in.) in length. Typically, an egg of this species is elongated, and fairly similar in shape and size to that of a common ring-necked dove.

Judging from the marked increase in food consumption inside the nest, incubation seems to last about 25 days. This figure coincides closely with field studies that cite 24 days as the average. Because the young of the same clutch emerge from the nest at different times — sometimes weeks apart — and considering their relative state of development when broken out artificially, I would conclude that all eggs do not hatch simultaneously. Instead they hatch days, and even up to a week, apart. The chicks are altricial (naked and virtually helpless at birth) and must depend on their mother, as well as their own instincts, until they are able to deal with the more serious matters of life on their own. During the time the female is sealed in the nest cavity she also molts. In fact, by the time the clutch is complete, the female will lose all flight and tail featers at once, but all are regenerated by the time she breaks herself from the nest. Since the hen would not be able to fly during this time, she would most certainly be doomed if the nest were invaded by a predator. Discarded feathers from her molt are not only found in the nest bedding, but also become plastered in a matrix of feces and saliva within the periphery of the nest plug, probably by young that reseal the new "nest exit" after the female or older siblings have left.

Since space is bound to be a premium in an arrangement such as this, like other long-tailed cavity nesters such as Piciformes (toucans, aracaris, etc.), the hen and developing chicks are able to conserve space by propping their tail feathers up in a vertical position. Further, when really pressed or threatened, they will instinctively face into a corner of the nest box, and "freeze" with their bill and tail pointed upward, similar to how a bittern would be found attaining crypsis among the reeds.

From my observations, there seems to be a direct correlation between brood size and the overall time a female remains in the nest. Probably due to spatial constraints, a large brood will force the hen out of the nest sooner. Further, a large brood requires more food and, in turn, will

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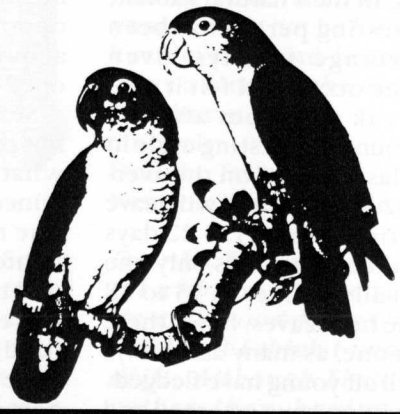

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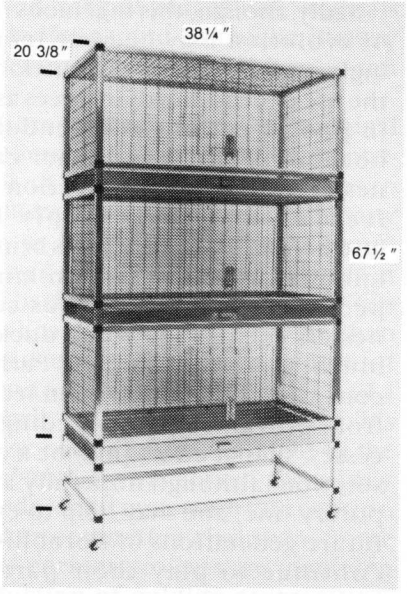

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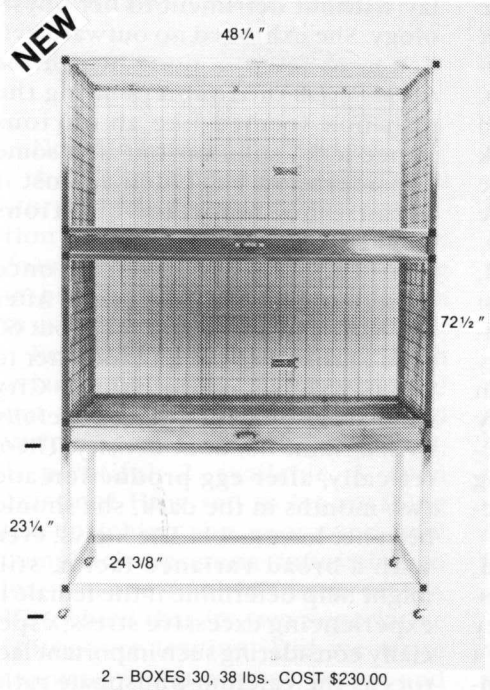

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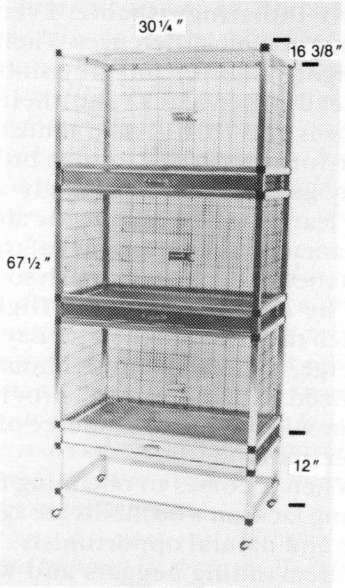

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necessitate a division of labor between her and the male in order to keep up with the ever increasing nutritional demands of the young. The usual time period for the hen to remain in the nest is anywhere from 65 to 85 days. In their natural habitat, the overall nesting period has been found to average 45 days. Even though on one occasion I felt it necessary to break a hen out after 85 days, I have found the nesting cycle in captivity to last 73 days on the average. When ready, the young will leave the nest anytime from 15 to 22 days after their mother. If there is only one young, it usually fledges in 15 to 18 days after the hen leaves, but if there is more than one, as many as 22 days may pass until all young have fledged.

When all young have emerged and start to become accustomed to their new environment, both parents will continue feeding and will always remain close at hand. Though the male does assert some dominance over the young, he usually does so by gently squeezing the fledgling's neck with his bill if they pester him too much, or pick the wrong spot on which to perch. He has never demonstrated injudicious aggression or an intention of harming the young in any way.

When they leave the nest, the young are about the size of an adult female and, at a distance, may be virtually indistinguishable. Even so, there are some differences. Their bill is slightly shorter and greyish-black instead of jet black, and their eye color is grey. It will take almost one year for their irises to turn brown. They get around surprisingly well, and learn quickly despite the almost instantaneous environmental transition they undergo — so much so, they can be removed from the flight in which they fledged the very day they emerge, and will do fine without specialized care, except for providing them with an obvious source of recognizable food.

When it comes to obtaining food, young Jackson's hornbills are aggressive and natural opportunists. They are demanding beggars and won't hesitate stealing food from an unsuspecting parent or sibling. As the intended target is customarily preparing its meal by tossing and manipulating it at the end of its bill, the youngster will characteristically hop right over and snatch it away with a squeal. The victim seems unaffected, as though it were perfectly normal. This situation may be a good example that illustrates the sometimes duality of nature. Specifically, the hornbills' *instinctive* tendancy to play with their food for prolonged periods may be more than preparatory. It may also be, in part, a strategy to provide the opportunity for young fledglings to acquire food until they have developed their own hunting skills.

Sexual dimorphism in the young is not readily apparent but, if you learn what to look for, sex can be determined at the time they leave the nest. The male is usually larger and has a lighter area at the base of the bill. It will take approximately 45 days for a male's bill to start turning the reddish-orange color, and around nine months for it to completely color out. Sexual maturity is complete just after one year and nesting can occur between the first and second year.

I have had the opportunity to observe a pair of these birds engage in an inexhaustible marathon endeavor. This pair began to recycle continually throughout the year, and were seemingly unaffected by external conditions such as temperature and photoperiodism. I became increasingly concerned and began to wonder how often could the female lay without detriment to her physiology. She exhibited no outward evidence of fatigue, poor health, or other signs of trouble. Pulling the nest box seemed like an obvious "knee-jerk" solution, but after some consideration I decided against it because no important questions would be answered.

Instead, I let her go to nest once more, but this time I had a plan. After she had been in the nest for about 60 days I broke her out and took her to Dr. Clyd Pitts of the Studio City Animal Hospital for x-rays, hopefully to determine her bone density. Theoretically, after egg production and two months in the dark, she should be at her lowest ebb. The x-rays, even with a broad variance factor, still might help determine if the female is experiencing excessive stress, especially considering such important factors as the calcium-phosphate ratio and the interaction with vitamin D-3. The resulting x-rays indicated that her bone density appeared normal. Again, considerable amount of calcium deficit must occur before detection can be confirmed, and there were no other obvious health problems either. Apparently she had been receiving at least the necessary minimum requirements during her stay in the nest.

Later, three weeks after the female had been out in natural sunlight and on a good diet, another x-ray was taken. When the two were compared, no difference in bone density was detectable. With this information, Dr. Pitts concluded that even though the x-rays could offer no absolute proof that continual nesting was *not* detrimental, they did confirm that there were no obvious, or easily detectable ill side effects either.

Many of the young produced by pairs I have been maintaining have long since been traded off to other breeding programs including the San Diego Wild Animal Park, where Mary Lehris was having great success as well. Such trades have enabled us and others to establish more unrelated breeding pairs, and further serve to strengthen the existing breeding projects.

Primarily due to their ability to fly, we earthbound humans associate birds with freedom. For a female hornbill to give up freedom for 60-plus days would seem the antithesis. From the standpoint of survival, however, it makes perfect sense as her nesting behavior enhances nest security, and with it the promise of future successful generations, *and that is the point.*

Sadly, though, this ingenious result of evolution may become increasingly useless. Habitat destruction and the use of dead and dying trees as fuel in poorer nations may render the hornbill's, and many other cavity nesters, mode of reproduction ineffectual. They will simply have nowhere to reproduce. This brings to mind efforts conservation-minded people have made towards cavity nesters such as the wood duck and bluebird in this country. Perhaps, considering what has been learned from proven captive breeding successes, similar efforts may be a viable solution (although hopefully a temporary one) and may help to ensure future generations of hornbills will continue to play their part in a balanced ecosystem.

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