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Cover Photograph: A pair of Narcondam Hornbills. © Prasenjeet Yadav

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Characteristics of Narcondam Hornbill *Rhyticeros narcondami* nest trees

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Abstract

The global distribution of the Narcondam Hornbill is restricted to the small Narcondam Island spread over an area of 6.8 sq. km in the Andaman Sea. In this study, we describe the nest site characteristics and abundance of the Narcondam Hornbill nest tree species based on 33 nests (active and potential) that we observed during our study period. We describe nests that we found in 13 tree species including some species which have not been reported in the past literature. The nest trees varied in girth from 103 – 380 cm, and the nest height varied from 4 – 31 m. Abundance of most of the nest tree species was highest in the low (0 – 200 m above mean sea level (ASL)) and mid (200 – 400 m ASL) elevations. The overall density of large trees decreased from lower to higher elevations pointing towards potential reduced nesting opportunities in higher elevations. While more than 57% of cavities were between north-west and north-east facing, 21% of the cavities were south-west and west facing. We have also compiled the list of known Narcondam Hornbill nest tree species based on this and previous studies.

Keywords: Andaman and Nicobar Islands, oceanic island, cavity nesting, *Tetrameles nudiflora*

Introduction

Narcondam Hornbill is a point endemic hornbill species restricted to the Narcondam Island (area: 6.8 sq. km) in the Andaman Sea, India. It has been classified as a Schedule 1 species in the Wildlife Protection Act (1972). The estimated population of the Narcondam Hornbill is 1026 (95% CI: 751 – 1402) birds and the population density of the hornbills is 151 hornbills per sq. km, which is among the highest reported hornbill densities in the world (Naniwadekar *et al*. 2020). Like other hornbills, Narcondam Hornbills nest in secondary tree cavities (Hussain, 1984; Kemp, 1995). No woodpeckers or barbets have been reported from Narcondam Island (Raman *et al*. 2013), so the secondary cavities on trees are likely formed because of branch break-offs may be due to storms and/or wood rot.

Several previous studies have reported the breeding biology of the Narcondam Hornbills

(Hussain, 1984; Sankaran, 2000; Yahya and Zarri, 2002; Vivek and Vijayan, 2003; Manchi, 2017). While most studies report encountering bulk of the nests in the lower elevations (Abdulali, 1974; Sankaran, 2000; Yahya and Zarri, 2002; Manchi, 2017), hornbills have been reported to nest till very close to the Narcondam peak at an elevation of 645 m ASL (Yahya and Zarri, 2002). Height of the nest cavities have been reported to range between 0.6 m to 30 m (Yahya and Zarri, 2002; Manchi, 2017). Girth of nest trees have been reported to range between 132 cm and 1350 cm (Manchi, 2017). Previous studies have reported cavity entrance orientations to be between south-west to south-east directions (Sankaran, 2000; Vivek and Vijayan, 2003; Manchi, 2017).

In this study, we report our observations of Narcondam Hornbill nests. We add new nest tree species hitherto not reported from previous studies. We also report active nesting of hornbills from the third week of January, which has not been reported before. Given that hornbills require large trees for nesting, we also report the densities of large trees (girth ≥ 100 cm and ≥ 270 cm) across the elevation gradient.

Method

Study Area

Narcondam Island is an extinct volcano that erupted less than 7,00,000 years ago and was active till the Holocene (~10,000 years ago) (Bandopadhyay, 2017). It is a remote oceanic island ~ 135 km east of the North Andamans in the middle of the Andaman Sea. The island above the surface of the sea is about 6.8 sq. km in area. The elevation of the Narcondam peak is 710 m ASL. Most of the island has evergreen forest except north-east portion of the island that is dominated by deciduous tree species like *Bombax*, *Gyrocarpus* among others. In 1968, a police outpost was established in the north-eastern part of the otherwise uninhabited island (Raman *et al*. 2013). The camp has barracks and plantations of coconut, arecanut, banana and other fruiting trees around the camp. The estimated size of the disturbed area around the camp was estimated to be around 20 ha in 2010 (Raman *et al*. 2013). While fishing boats have been reported from around the island in the past (Raman *et al*. 2013), we did not see any fishing boats during our time on the island. Cargo ships are regularly seen plying in the waters around the island.

We conducted field work on Narcondam Island to understand the ecological role of Narcondam Hornbill between December 2019 – February 2020. Our stay on the island overlapped with the starting of the breeding season of the Narcondam Hornbill which has been reported to breed between February and May (Sankaran, 2000). During our field work, we found several nests of the Narcondam Hornbill. Hornbill nests were identified based on hornbill presence and activity (nest cleaning, examination or active nesting) near a cavity. Nests were confirmed during revisits to the area unless the nest was in a remote location. Mostly one observer sat at the nest site to minimize disturbance. Nesting was confirmed by observing the nests from a distance (at least 20 m) by suitably hiding in the undergrowth or using camouflage cover. During the revisits, the observer spent several hours to determine hornbill pair activity at the nest. Only when hornbill activity was seen at the nest during the revisit was the nest assumed to be confirmed. Revisits confirmed hornbill activity in all 31 nests and 20 nests had become active (female sealed herself in the nest cavity) by the time we left the island on 10 February 2020. Not all the females had entered and hornbill pairs were observed cleaning the nests till the time we left the island. We measured tree height, nest height, girth at the breast height (1.4 m from the ground), orientation of the cavity entrance and the position of the cavity (main trunk, secondary branch,

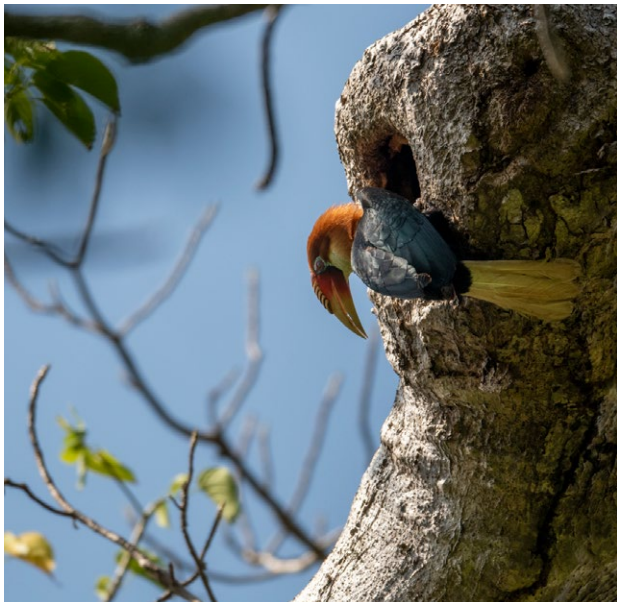

Fig. 1. Adult male Narcondam Hornbill at its nest on *Tetrameles nudiflora*. Photograph by Prasenjeet Yadav.

tertiary branch). Nest and tree height were measured using a range finder unless the tree was on a steep slope and inaccessible, in which case it was visually estimated. Girth was measured using a tape unless it had buttresses (e.g. *Tetrameles nudiflora*). For a buttressed tree, girth of the tree was visually estimated above the buttress. Orientation of the cavity was determined using a field compass or a GPS (Garmin eTrex® 30x). We used the R package 'circular' (Agostinelli & Lund, 2017) to perform the non-parametric Rao's spacing test for determining differences in proportions of nests in the different directions (Rao, 1972). Rao's spacing test was found to perform well for small sample sizes and particularly for investigating the nest cavity orientation in birds (Bergin, 1991). We laid 50 m × 10 m (n = 49) plots across the entire elevation gradient to estimate the abundance and diversity of plants on Narcondam Island. Given the steep gradient as is characteristic of volcanic oceanic islands, it was not possible to randomly lay the plots. However, we ensured that the plots were spread across the different accessible stretches of the island. We recorded all woody plants ≥ 10 cm GBH (girth at breast height). Here we report densities of 15 known Narcondam Hornbill nest tree species across the three elevation zones (low: 0 – 200 m, mid: 200 – 400 and high: 400 – 700 m ASL). We laid 18 plots in the low elevation zone, 14 in the mid and 17 in the high elevation zone. The elevation zones were identified based on topography and vegetation structure and composition. Given that hornbills can nest in other tree species that may have suitable cavities for nesting, we also report overall densities of trees ≥ 100 cm GBH (minimum girth of the observed hornbill nest tree was 103 cm) and ≥ 270 cm GBH (the mean girth of Narcondam Hornbill nest trees based on our data).

Results

We found 33 Narcondam Hornbill nests in 13 tree species (Table 1). Eleven of the 33 nests were in *Tetrameles nudiflora* (see Fig. 1). New records of nest tree species for the Narcondam Hornbill include *Neonauclea gageana*, *Zanthoxylum* sp., *Aphanamixis polystachya*, *Artocarpus lacucha*, *Casearia andamanica*, *Dysoxylum crytobotryum*, *Garuga pinnata* and *Oroxylum indicum* (Table 1). Two *Ficus* species where we found hornbill nests included *Ficus nervosa* and *Ficus glabberima*. The *Oroxylum* nest and one nest in *Aglaia* sp. were at a remote location and we could not revisit the nest. But during the first visit, we had seen a pair at the entrance of both these cavities inspecting and cleaning the cavity. In the *Ficus glabberima* nest, while extensive Narcondam Hornbill activity (cleaning and female entry) was seen in the cavity during two visits (video available on request), no activity was seen on the third visit. All the active Narcondam Hornbill nests were in live trees but for one that was in a dead *Tetrameles nudiflora* tree.

Hornbills started nesting in the third week of January. We found nine active nests of Narcondam Hornbills in last week of January. On 23 January

Table 1. Consolidated checklist of Narcondam Hornbill nest trees and nest tree characteristics (mean and range).

Species	Number of nests	GBH (cm)	Nest height (m)	Tree height (m)
Tetrameles nudiflora+	11	351 (300-380)	22.6 (15-31)	35.4 (30-42)
Aglaia sp.	3	207 (190-235)	12.3 (9-16)	23 (22-25)
*Neonauclea gageana**	3	270 (220-310)	10 (6-14)	24.7 (18-29)
Zanthoxylum sp.*	3	248 (198-293)	13 (8-16)	28 (22-32)
*Aphanamixis polystachya**	2	340 (330-350)	19 (14-24)	22.5 (17-28)
*Artocarpus lacucha**	2	245 (190-300)	10 (8-12)	30 (26-34)
Ficus nervosa	2	260 (220-300)	17.5 (15-20)	33.5 (33-34)
Planchonella longipetiolatum#	2	200 (200-200)	21.5 (18-25)	28 (28-28)
*Casearia andamanica**	1	175	8	21
*Dysoxylum crytobotryum**	1	103	4	16
Ficus glabberima	1	160	29	42
*Garuga pinnata**	1	270	12	30
*Oroxylum indicum**	1	111	6	18
Sterculia rubiginosa	Reported by Hussain (1984)			
Canarium euphyllum	Reported by Sankaran (2000) and Vivek and Vijayan (2003)			
Myristicaceae	Reported by Yahya and Zarri (2002)			
Aglaia hiernii	Reported by Manchi (2017)			
Aglaia andamanica	Reported by Manchi (2017)			
Erythrina indica	Reported by Vivek and Vijayan (2003) and Manchi (2017)			
Dillenia indica	Reported by Manchi (2017)			
Terminalia bialata	Reported by Manchi (2017)			
Pajanelia longifolia	Reported by Manchi (2017)			
Hopea odorata	Reported by Manchi (2017)			

* Species have not been reported as nest tree species prior to this study.
+ Reported as nest tree by Sankaran (2000), Yahya and Zarri (2002), Vivek and Vijayan (2003), Shankar Raman *et al*. (2013), Manchi (2017).
# Reported as nest tree by Hussain (1984). Sankaran (2000), Vivek and Vijayan (2002) and Manchi (2017) have reported hornbill nests in *Ficus* but specific species have not been reported.

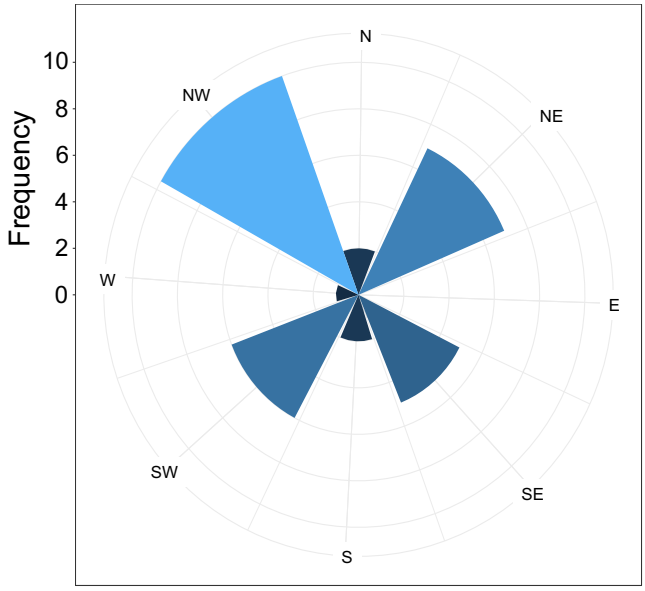

Fig. 2. Circular plot showing frequency of the 33 cavities in different cardinal directions (N – North, E – East, S – South, W – West).

2020, we found three active nests of Narcondam Hornbills on a single trail between 225 – 300 m ASL. We knew of two of the nests (nest in *Casearia* and *Artocarpus*), the third nest (*Zanthoxylum*) was found on 23 January 2020. The *Artocarpus* nest was partially sealed indicating that the female must have entered at least a day before if not more. Nest cavities entrance of *Casearia* and *Zanthoxylum* were not visible.

The mean girth of the nest trees was 271 cm (range: 103 – 380 cm). The average nest height was 16.7 m (range: 4 – 31 m). The average tree height was 30 m (range: 16 – 42 m). Species-wise details of nest tree characteristics are outlined in Table 1. Out of the 29 cavities for which the position of the cavity was recorded, 51.7% of the cavities were on the main trunk of the tree, 44.8% of the cavities were in the secondary branch and a single cavity was in the tertiary branch of a *Tetrameles nudiflora* tree. Out of the 33 cavities, 30.3% were north-west facing, 21.2% were north-east facing, 18.2% were south-west facing, 15.2% were south-east facing, 6.1% cavities were north and south facing and a single cavity was west facing (Fig. 2). Rao's spacing test indicated that the orientation of nests was not uniformly distributed in all the directions ($U = 283.6$, $p < 0.05$). The circular mean of the nest cavity orientation was in the north-west direction.

The density of most of the tree species that have been recorded as hornbill nest trees was higher in the low and middle elevation zones (Table 2). The mean density of trees with GBH ≥ 100 cm was similar across the low and mid-elevation zones and marginally lesser in the high elevation zone (Table 3). However, large trees (≥ 270 cm GBH) occur in almost eight times higher densities in low elevation zone as compared to the highest elevation zone (Table 3).

Table 2. Densities (per ha) of the nest tree species across the three elevation zones (low: 0-200 m, mid: 200-400 m, high: > 400 m). Zone with highest tree densities are shown in bold.

Species	Density (ha^{-1})low elevation	Density (ha^{-1}) mid-elevation	Density (ha^{-1}) high elevation
Tetrameles nudiflora	2.2 ± 1.5	**4.3 ± 2.3**	0 ± 0
Aglaia sp.	11.1 ± 4	**18.6 ± 6.1**	4.7 ± 2.72
Neonauclea gageana	**7.8 ± 4.9**	4.3 ± 3.1	1.2 ± 1.2
Zanthoxylum sp.	1.1 ± 1.1	**4.3 ± 2.3**	0 ± 0
Aphanamixis polystachya	18.9 ± 6.8	**20 ± 8.2**	14.1 ± 5.1

Species	Density (ha^{-1})low elevation	Density (ha^{-1}) mid-elevation	Density (ha^{-1}) high elevation
Artocarpus lacucha	0 ± 0	**2.9 ± 1.9**	0 ± 0
Ficus nervosa	3.3 ± 2.4	**8.6 ± 4.6**	7.1 ± 2.9
Planchonella longipetiolatum	**17.8 ± 10.1**	1.4 ± 1.4	0 ± 0
Casearia andamanica	0 ± 0	0 ± 0	**5.9 ± 23**
Dysoxylum crytobotryum	**73.3 ± 35.6**	7.1 ± 3.4	1.2 ± 1.2
Ficus glabberima	1.1 ± 1.1	2 ± 1.9	**10.6 ± 2.5**
Garuga pinnata	4.4 ± 3.5	4.3 ± 2.3	**8.2 ± 3**
Oroxylum indicum	**12.2 ± 4.6**	5.7 ± 3.3	5.9 ± 5.9
Sterculia rubiginosa	**5.6 ± 3.9**	0 ± 0	0 ± 0
Canarium euphyllum	**6.7 ± 4**	5.7 ± 2.5	1.2 ± 1.2

Table 3: Density of trees per hectare with girth at breast height (GBH) ≥ 100 cm and ≥ 270 cm. The minimum and average GBH of an active Narcondam Hornbill nest tree was 103 cm and 271 cm, respectively, which prompted us to use these two size classes.

Elevation zone (m ASL)	Mean tree density/ha (SE) (≥ 100 cm GBH)	Mean tree density/ha (SE)(≥ 270 cm GBH)	Number of plots
Low: 0 – 200	128.9 (12.0)	18.9 (5.5)	18
Mid: 200 – 400	134.3 (13.8)	10.0 (2.8)	14
High: 400 – 700	118.8 (14.0)	2.4 (1.6)	17

Discussion

Unlike some of the previous studies (Sankaran 2000; Yahya and Zarri, 2002; Vivek and Vijayan, 2003; Manchi, 2017), this was not a study focussed on the breeding biology of Narcondam Hornbill. However, we provide some new information of this point endemic hornbill species. Narcondam Hornbills have been reported to start nesting in February onwards (Poonswad *et al*. 2013). However, we found active nests of Narcondam Hornbill from around the third week of January. Long-term monitoring data on hornbill nesting revealed that hornbills started nesting early in certain years in the recent past in north-east India and central India (Datta *et al*. unpublished data). This is suspected to be an outcome of climate change. Most of the studies on breeding biology of Narcondam Hornbill have been from February onwards (Hussain, 1984; Sankaran, 2000; Yahya and Zarri, 2002; Manchi, 2017) except Vivek

and Vijayan (2002) which has not reported hornbills nesting in January. Based on this study it cannot be ascertained whether hornbills usually start nesting in January or not. This will need corroboration over multiple years. Interestingly, hornbills were reported to not have started nesting in March (Cory, 1902). However, this was based on a single day's visit.

While hornbills have been reported to nest even close to the Narcondam peak (Yahya and Zarri, 2002), previous studies have indicated that hornbill nests are relatively more common in the lower elevations as compared to higher elevations (Sankaran, 2000; Yahya and Zarri, 2002; Vivek and Vijayan, 2003; Manchi, 2017). Most of the hornbill nest trees are abundant in the low and the middle elevation zones. We documented higher density of larger trees in the lower elevations as compared to the higher elevations. This is a likely reason for potentially higher nest densities in lower elevations. While average girth of nest trees is around 270 cm, hornbills were found to nest in trees as small as 103 cm GBH thus highlighting that in spite of fewer opportunities, hornbills could continue to nest in higher elevations. Interestingly, density of hornbill food plants was found to be higher in the higher elevations (Naniwadekar *et al*. 2020). Thus, while there might be limited nesting opportunities in higher elevations, fruit resource availability is unlikely to be a constraining factor. Also, Narcondam Hornbills can be frequently seen flying between the top and the base of the peak, and any variation in fruit availability across the elevation gradient is less likely to affect hornbills because of their vagility. A significant proportion of nests were south-west facing. Given that hornbills nest in relatively dry periods and the chicks are likely to fledge by the onset of the monsoon, cavities oriented in south-west direction are less likely to be affected by rain. Additionally, given the south-west monsoon that brings much of the storms on the island, more cavities are likely to form in the south-west direction. Given the high Narcondam Hornbill densities on the island, it is likely that they might take up sub-optimal cavities like the cavities facing in the south-west direction as nests.

We found additional nest tree species which have hitherto not been reported (Table 1). Suitable cavities in any tree species are likely to be taken over by hornbills as nests. *Tetrameles* is known to be an important hornbill nest tree species (Datta and Rawat, 2004). *Tetrameles* is a softwood, and are usually large, emergent trees. Therefore, *Tetrameles* is more likely to have cavities and are more commonly recorded as a hornbill nest tree. There are few tree species that have been reported as nest tree species in the past, including *Hopea odorata*, *Dillenia indica*, *Pajanelia longifolia* and *Terminalia bialata* (see Table 1) which were not found on the island despite exhaustive floristic sampling (Page *et al*. 2020). *Dillenia indica* has been reported as hornbill food plant (Yahya and Zarri, 2002). This is likely to be an error as *Dillenia indica* is widely found in different hornbill habitats in north-east India but nowhere has it been found to be in the diet of the hornbills (Datta, 2001; Naniwadekar *et al*. 2015). One of the objectives of the study was a systematic plant species inventory of the Narcondam Island that resulted in almost 100 new plant species records for Narcondam Island (Page *et al*. 2020) but the aforementioned four species were not found on the island. These species have also not been reported by Prain (1893) who carried out the first floristic survey of Narcondam Island. Either these tree species are rare and the present survey missed detecting them or they have been misidentified in the past. This needs to be resolved in future studies.

It is indeed remarkable that despite the absence of cavity makers like barbets and woodpeckers, hornbills and other cavity nesting birds like the Alexandrine Parakeet *Psittacula eupatria* and Common Hill Myna *Gracula religiosa* find nesting opportunities on the island. While the Narcondam Hornbill

is super abundant, the other two species are not (Naniwadekar *et al*. 2020). Narcondam Hornbills have been observed to chase away the Alexandrine Parakeets from at least two different nest cavities in 2002 (VR pers. obs.). The competition between the three species for the cavities and its outcome on populations of these birds on the island needs to be investigated in the future. Given that the island has hyperabundance of figs and other food plants, the relative rarity particularly of the Common Hill Myna, a frugivore, could be a consequence of limited nesting opportunities (Naniwadekar *et al*. 2020). This also highlights the role of other natural processes (storms and/or wood rot) in cavity generation and they by themselves can create substantial numbers of cavities which potentially contributes to high hornbill densities on the island. In the past, there were reports of tree felling for fuelwood (Sankaran, 2000). However, the police have been provided with gas cylinders and stoves. Given the presence of degraded forests around the barracks (area: ~ 4-5 ha), there is potential for restoration of degraded patches around the police barracks in the near future. Given the island's small size and it being home to the only population of the Narcondam Hornbill, the past conservation interventions of goat removal from the island and drastic reduction in fuel wood use are positive steps towards safe-guarding the hornbill habitat and thereby the hornbills in the long-term.

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Data Availability Statement

Data associated with nest characteristics of the Narcondam Hornbill are available from the Dryad Digital Repository https://doi.org/10.5061/dryad.5mkkwh73p.

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Sexual dimorphism in eye coloration of Philippine Rufous Hornbills (*Buceros hydrocorax* and *Buceros mindanensis*)

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Abstract

Eye color, particularly iris, plays a role in social signaling such as in mate recognition and sexual selection. In the Asiatic lineage of large frugivorous hornbills, genus Buceros are known to exhibit sexual dichromatism in iris coloration that manifests upon reaching definitive adult stage; except for the Philippine endemic Buceros hydrocorax and Buceros mindanensis, which is yet to be confirmed. Institutions (n = 8) known to have Rufous Hornbills (Buceros hydrocorax) in captivity were surveyed for the subspecies, age, sex, iris coloration. Supplementary materials such as digital images of Rufous Hornbills uploaded on the Internet Bird Collection (https://www.hbw.com/ibc) were also sampled. Combined, a total of 23 individuals were sampled and identified as Buceros hydrocorax (n = 13), Buceros mindanensis mindanensis (n = 8), and Buceros mindanensis semigaleatus (n = 2). Of the 23, 10 (n = 5:4:1) were males while 13 (n = 8:3:2) were females. Images of Rufous Hornbills with complete information from IBC (n = 6); Buceros hydrocorax (n = 4), B. m. mindanensis (n = 1), and B. m. semigaleatus (n = 1). 100% of the males expressed brown coloration in iris (n = 12). Likewise, all females had pale blue iris (n = 17) regardless of the subspecies. Fisher's exact test results ($p < 0.0001$) suggest an association between sex and iris color even with confidence level set at 95%, indicative that the iris colors are mutually exclusive. By selecting images per subspecies, RGB values plotted in Euclidean color space indicate subspecies differentiation between male species.

Keywords: *Buceros hydrocorax*, *Buceros mindanensis*, Rufous Hornbill, dichromatism, RGB values

Introduction

In avian ecology, variation in eye coloration has been explained by consensus hypotheses an essential trait in signaling as a social function per se (Bortolotti, Smits, & Bird, 2003; Goodwin, 1984; Snyder & Snyder, 1974; Trauger, 1974), such as in mate recognition and sexual selection (Davidson, Thornton, and Clayton 2017). Avian iris demonstrate great variability in terms of coloration, displaying a rich color palette from inconspicuous, melanistic hues to vivid tones of red and blue (Erichsen 1985, Oliphant, 1988, Oliphant, Hudon, and Bagnara 1992). Oehme (1969) crudely described the physiology

of this as something associated to the biochemical compound Pteridine, which he posited as the most common of the pigments responsible for eye coloration; later on confirmed by Oliphant (1987) (Dias, Goedert, and Macedo 2009). This prominent phenotypic trait, while varying interspecifically, can also express intraspecific variation whereas it could be attributed to maturation with age (Crook 1964, Pearson 1966, Ervin 1975, Picozzi 1981, Stutterheim 1981, Newton and Marquiss 1982, Wilkinson 1982, Craig 1984, Wilkinson 1988, Peterson 1991, Sweijd and Craig 1991, Craig and Hulley 2004), subspecies differentiation (Negro, Blázquez, and Galván 2017), and sexual dimorphism (Hardy 1973, Hudon and Muir 1996, Pyle 1997, Craig and Hulley 2004). As such, there have been previous studies that used iris coloration as a determinant of age class, as well as a rapid and practical indicator of sex in sexually dimorphic species (Wood and Wood 1972, Trauger 1974, Rosenfield and Bielefeldt 1997, Smith *et al.* 2005, Nogueira and Alves 2008).

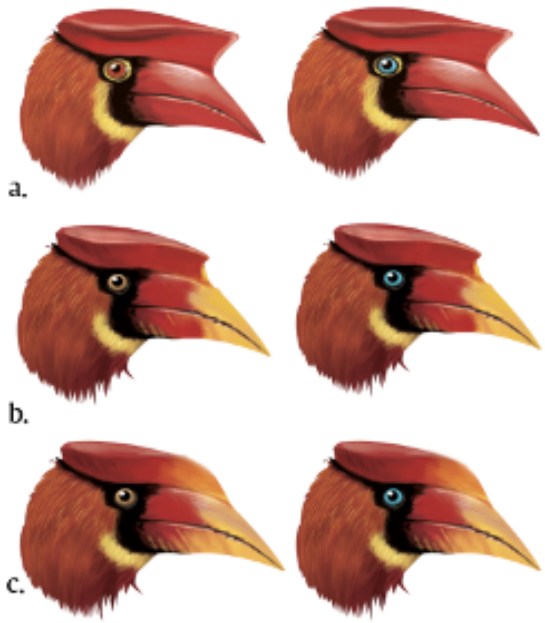

Figure 1: Proposed iris colorations for each taxa of Rufous Hornbills (left, male; right, female): a. *Buceros hydrocorax*, b. *Buceros mindanensis mindanensis*, and c. *Buceros mindanensis semigaleatus*.

The Asiatic lineage of large frugivorous hornbills, genus *Buceros*, are known to exhibit sexual dichromatism in iris coloration that manifests upon reaching definitive adult stage (Trauger 1974, Chamutpong, Ponglikitmongkol, Charoennitikul, Mudsri, and Poonswad 2013); except for the Philippine endemic *Buceros hydrocorax*, which is yet to be confirmed. Both of its congeners *Buceros bicornis* and *Buceros rhinoceros* have red and white iris for males and females, respectively. It remains unreconciled for the Rufous Hornbill as reports have been inconsistent and varying. According to Kemp and Woodcock (1995), *B. hydrocorax*'s iris colors are purportedly exhibiting the same dichromatism as its congeners, although it was noted that further confirmation was necessary. Its conspecifics, the Mindanao and Samar Rufous Hornbills, were described to have different manifestations. Witmer (1988) noted that the male's iris is not red for the *Buceros mindanensis mindanensis,* and were rather pale blue-grey or green in both sexes. On the other hand, Tweeddale (1877) noted that an adult the *Buceros mindanensis semigaleatus* male specimen from Southern Leyte, Philippines had a light-yellow iris, while another of the same sex from the island of Panaon, Southern Leyte had pale blue. To add to the complexity, recent records of digital photographs published on online media databases depict colors differently from these aforementioned studies (Figure 1). Furthermore, if there exists a dimorphism, no observations have been made on the age the trait onsets.

Whether or not the Rufous Hornbill and its conspecifics truly express sexual dichromatism in iris coloration is yet to be clarified, and if there is actually subspecies differentiation in this phenotypic trait as described by previous studies.Therefore, to settle this longstanding issue, the objectives of

this study are to (i) determine and formalize the iris coloration; (ii) clarify whether there really is subspecies differentiation; (iii) and establish the age range the trait manifests in both sexes. By tapping on zoological institutions known to have captive Rufous Hornbill(s), this study proposes that sexual dimorphism exists among the conspecifics, and that there is subspecies differentiation in iris coloration. If proven correct, iris coloration as a criterion will be a rapid and convenient method for sexing, especially for field applications.

Methods

Survey on zoological institutions

Institutions known to have Rufous Hornbills (*Buceros hydrocorax* and *Buceros mindanensis*) (Handbook of the Birds of the World and BirdLife International, 2019) in captivity were surveyed and queried for the subspecies, age, sex, iris coloration. Supplementary materials such as digital images and species reports were also requested upon availability.

Additional images

Digital images of Rufous Hornbills uploaded on the Internet Bird Collection (*https://www.hbw.com/ibc*) were selected according to the completeness of the information supplemented by the author; key details were subspecies, sex, and iris color.

Data analysis

Test for independence

Individuals were classified according to sex, and iris coloration which were defined based on crude observations of the photographs provided. Data were arranged into a contingency table fit for bivariate analyses. Analyses to test for independence was conducted by using a combination of tests; chi-square test and Fisher's exact test. Since there were structural zeroes in the data, the chi-square test was applied with Yates continuity correction for the structural zero values, while Fisher's exact test was recommended for such cases in previous studies (West and Hankin 2008). All analyses were conducted on *R* software ver. 3.5.2 (R Core Team 2013).

Color extraction for subspecies differentiation

In order to visualize the subspecies differentiation between iris coloration, available digital images from samples were used to measure RGB (red, green, blue) values of cropped iris region using R package `colordistance' (Weller, 2019). By selecting images per subspecies, randomly selected pixels (n = 10000) from each of the cropped irises were plotted in a Euclidean color space separately to capture all possible colors since the images did not undergo any essential image calibration methods such as white balancing and radiance normalization. Color clusters were extracted from pixels (n = 20000) by k-means clustering to minimize the Euclidean distance in RGB space and to parse common color motifs. The resulting k-means color clusters from each sample were plotted in a Euclidean color space to represent the closest matching colors of iris color for each subspecies. All analyses were conducted on *R* software ver. 3.5.2 (R Core Team 2013).

Results

A total of eight institutions were surveyed (Table 1). Combined, a total of 23 individuals were sampled and identified as *Buceros hydrocorax* (n = 13), *Buceros mindanensis mindanensis* (n = 8),

Table 1. List of surveyed zoological institutions and their captive Rufous Hornbills.

Institution	Location	Taxa	Sex	Age [a]	Iris color
Attica Zoological Park	At Yalou Spata, **Αθήνα** 190 04, Greece	*Buceros hydrocorax*	♂	9.8	Brown
		Buceros hydrocorax	♀	8.7	Pale blue
		Buceros hydrocorax	♀	N/A	Pale blue
Colchester Zoo	Maldon Road, Stanway, Colchester, Essex, United Kingdom	*Buceros mindanensis mindanensis*	♂	10.5	Brown
		Buceros hydrocorax	♀	10.5	Pale blue
Lagos Zoo	Barão de São João, Portugal	*Buceros mindanensis mindanensis*	♂	7.6	Brown
		Buceros mindanensis mindanensis	♀	8.9	Pale blue
Manila Zoo	M. Adriatico Street, Malate, Manila, Philippines	*Buceros hydrocorax*	♂	N/A	Brown
Novosibirsk Zoo	Ulitsa Timiryazeva, 71/1, Novosibirsk, Novosibirsk Oblast, Russia, 630001	*Buceros hydrocorax*	♂	8	Brown
		Buceros hydrocorax	♀	8	Pale blue
		Buceros hydrocorax	♀	7.4	Pale blue
Ouwehands Dierenpark	Rhenen, Utrecht, Netherlands	*Buceros hydrocorax*	♂	12.4	Brown
		Buceros hydrocorax	♀	8.8	Pale blue
Talarak Foundation	Kabangkalan City, Negros Occidental, Philippines	*Buceros mindanensis semigaleatus*	♂	N/A	Brown
		Buceros mindanensis semigaleatus	♀	N/A	Pale blue
		Buceros mindanensis mindanensis	♂	N/A	Brown

Institution	Location	Taxa	Sex	Age [a]	Iris color
Talarak Foundation	Kabangkalan City, Negros Occidental, Philippines	*Buceros mindanensis mindanensis*	♂	N/A	Brown
		Buceros mindanensis mindanensis	♀	N/A	Pale blue
		Buceros mindanensis mindanensis	♀	N/A	Pale blue
		Buceros mindanensis mindanensis	♀	N/A	Pale blue
Vogelpark Avifauna	Alphen aan den Rijn, South Holland, Netherlands	*Buceros hydrocorax*	♀	8.8	Pale blue
		Buceros hydrocorax	♀	14	Pale blue
		Buceros hydrocorax	♀	27	Brown
			Total	23	Brown = 12 Pale blue = 17

[a] Age in years.

and *Buceros mindanensis semigaleatus* (*n* = 2). Of the 23, a total of 10 (*n* = 5:4:1) were males while 13 (*n* = 8:3:2) were females. All sexes were confirmed through molecular sexing based on the species reports provided by the institutions. Mean age was 11.0, calculated from the samples whose age were provided by the institutions (*n* = 14). For males alone, mean age was 12.6 (*n* = 6) while female mean age was 9.8 (*n* = 8). As such, all individuals were classified as adults based on age, in addition to the morphological traits described by Kemp and Woodcock (1995). In addition, images of Rufous Hornbills with complete information from IBC (*n* = 6) were regarded as supplementary samples (Table 2); *Buceros hydrocorax* (*n* = 4) (Gonzalez 2010a, Doron 2011, Wentworth 2013a, 2013b), *Buceros mindanensis mindanensis* (*n* = 1) (Gonzalez 2010b), and *Buceros mindanensis semigaleatus* (*n* = 1) (Gonzalez 2010c) were obtained from the website. Of these were 2 males (*n* = 1:1:0) and 4 females (*n* = 3:0:1). Exact ages, however, were not provided by the authors.

Based on the digital images obtained from both the institutions and IBC, two iris colorations were observed from the samples; Pale blue and Brown. 100% of the males expressed brown coloration in iris (*n* = 12). Likewise, 100% of females had pale blue iris (*n* = 17) regardless of the subspecies. Pearson's chi-squared test

with Yates' continuity correction resulted to a strong association of the variables ($p < 0.0001$), suggesting the null hypothesis (H_0) be rejected (Table 3). Similarly, Fisher's exact test results ($p < 0.0001$) suggest an association between the variables sex and iris color even with confidence level set at 95%, indicative that the iris colors are mutually exclusive. It is important to emphasize, however, that of the observed brown trait, two sub classifications were recorded from the samples, as two shades of brown were observed; a dark, amber occurring in all *Buceros hydrocorax* species and a lighter beige occurring in all *Buceros mindanensis mindanensis* and *Buceros mindanensis semigaleatus*. However, since sexual dimorphism was being tested, all browns were classified under a single variable as it only occurred in male species. Although no post hoc analysis was carried out, subspecies differentiation between all the males is evident from the observed colors of brown; dark amber ($n = 6$) and beige ($n = 6$).

The sub classifications in brown iris coloration observed in males were analyzed by selecting three images each for *Buceros hydrocorax* and *Buceros mindanensis mindanensis* (See Appendices). Although the trait was observed in *Buceros mindanensis semigaleatus*, it was excluded from the analysis due to insufficient image sample ($n = 1$). Coordinates and quantified RGB values of pixels were plotted in a Euclidean color space to illustrate the closest approximation of the actual colors of iris of the Rufous Hornbill and its subspecies (Figure 2).

Euclidean distances between the pixels were minimized by *k*-means clustering and the closest matching colors were plotted in separate histograms for each image sample

Table 2. List of digital images of Rufous Hornbills sampled from the Internet Bird Collection database.

Institution	Location	Subspecies	Sex	Author *	Iris color
Biodiversity Conservation Centre (NFEFI)	Bacolod City, Negros, Philippines	*Buceros mindanensis mindanensis*	♂	Gonzalez (2010b)	Brown
DENR-PAWB Wildlife Rescue Center	Quezon City, Philippines	*Buceros hydrocorax*	♀	Gonzalez (2010a)	Pale blue
Parc Pairi Daiza (Paradisio)	Cambron-Casteau, Brugelette, Hainaut Province, Belgium	*Buceros hydrocorax*	♂	Wentworth (2013a)	Brown
		Buceros hydrocorax	♀	Wentworth (2013b)	Pale blue
USLS Ecopark	Bacolod City, Negros, Philippines	*Buceros mindanensis semigaleatus*	♀	Gonzalez (2010c)	Pale blue
Vogelpark Walsrode	Walsrode, Lower Saxony, Germany	*Buceros hydrocorax*	♀	Doron (2011)	Pale blue

*Authors from the Internet Bird Collection.

Table 3. Summary of tests of independence.

Test	p-value
Pearson's Chi-squared test (with Yates' continuity correction)	5.662e-07
Fisher's Exact Test	1.927e-08

(Figure 3). Parsed common color values extracted from each samples were combined and visualized in a single Euclidean color space, individually for each sample groups.

Discussion

Of the total 29 individuals, 41% were males while 59% were females. Nearly half of the sample group was constrained in definitive adult stage as evident from the mean age (11.0). The other half whose ages were not specified can be classified as adults as well without having to determine the actual ages from a morphological perspective based on Kemp and Woodcock (1995)'s description. Both tests of independence yielded extreme p-values that can be expected since the observed character states of iris coloration, pale blue and brown, were mutually exclusive to the corresponding sex, females and males respectively, across all samples. Even at 95% confidence level, the significance of correlation was still extremely high with a p-value of 1.927e-08, providing a strong support to claim that sexual dimorphism in iris coloration does indeed manifest in Rufous hornbills. However, since the only age group of the samples are adults, the age at which the trait manifests has not been delineated, and whether it is similar among all the conspecifics. In a report about the development of soft parts, beak, and feather by C. Barwick (pers. comm., May 27, 2019) from Colchester Zoo, he

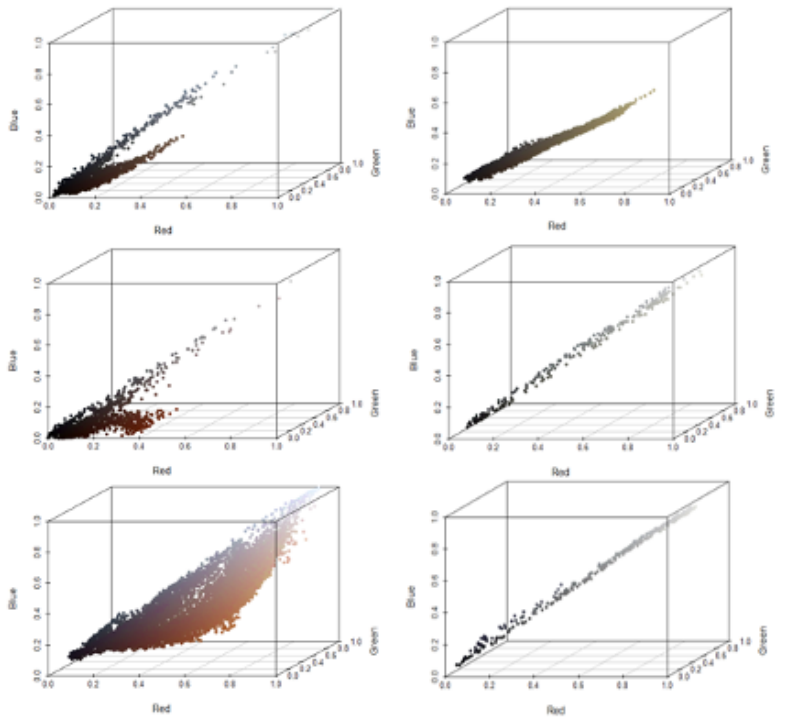

Figure 2: RGB values of iris from pixels of cropped images in Euclidean space of Rufous Hornbills; (a-c) *Buceros hydrocorax* and (d-f) *Buceros mindanensis mindanensis*.

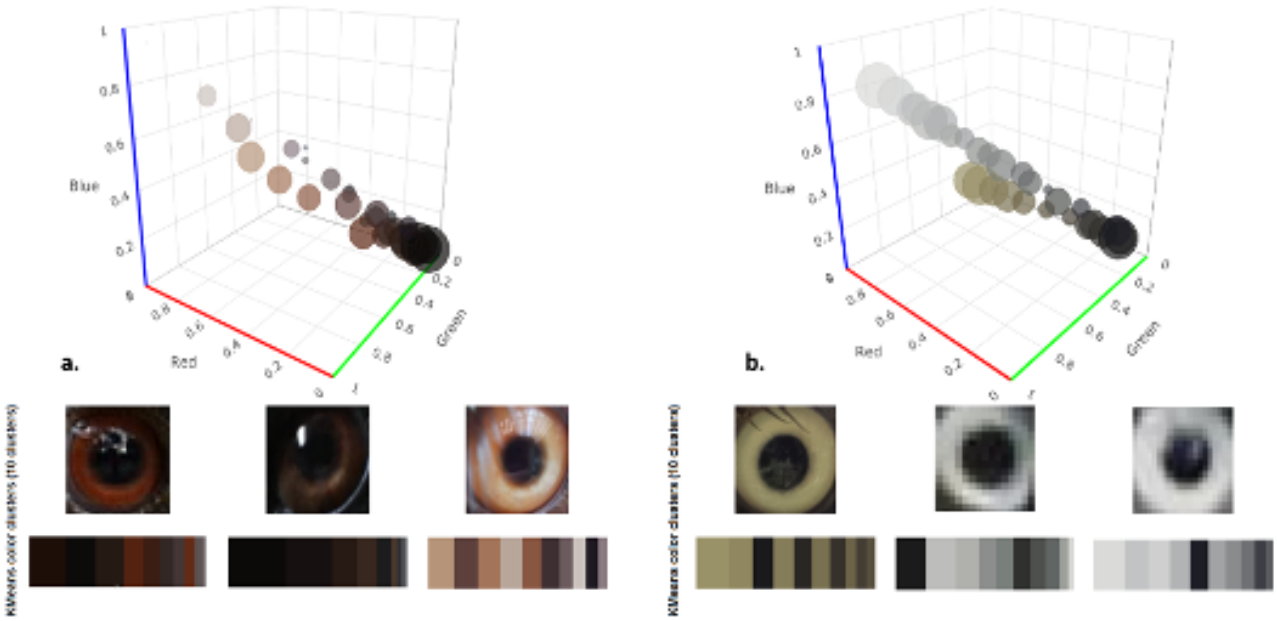

Figure 3: RGB *k*-means clustering in histograms along with cropped images of iris from adult ;/.'Rufous hornbills. Extracted color clusters from k-means clustering were combined and plotted in Euclidean color space: a. *Buceros hydrocorax* (respective ages in years: 8, 12.4, 9.8), b. *Buceros mindanensis mindanenis* (NA, 10.5, 7.6).

observed that the female *Buceros mindanensis mindanensis* had red iris at age 1.5 years while its pair, a male *Buceros mindanensis semigaleatus* of the same age, had a pale brown iris. He noted the subsequent change in iris color of the female to 'milky white' at approximately 5 years of age until it finally turned pale blue at 6 years. On the contrary, the male had a consistent color. The data from this study was unable to confirm this because the lowest age sampled for a female was 7.4, and had already manifested such color. However, no interspecific variation has observed across all female samples as they all possessed pale blue eyes. Males, on the other hand, seem to have subspecies differentiation as it has been observed that the brown iris color has two states, a darker hue found in *Buceros hydrocorax* and lighter for its conspecifics. Plotted RGB values illustrated in Figure 2 display the color composition of pixels from cropped iris images to approximate the actual colors and the difference thereof. From a visual standpoint, the distinction is obvious between the two sets of plots where *Buceros hydrocorax* demonstrated clusters of brown while its conspecific had light to pale color clusters. However, it is important to emphasize that the images were of different sources, so lighting conditions during image capture are unknown. Furthermore, the region of interest, iris, was not refined from the cropped image of the eye and included the pupil on RGB extraction. This might explain the significant proportion of black color clusters in either sets of Euclidean color space. To account for this noise, *k*-means clustering minimized the Euclidean distance by clustering analogous color pairs, illustrated as histograms in Figure 3. These represent the major color clusters because *k*-means capture even the redundant colors as it excludes the breaks in each channel. Therefore, the colors in the histograms illustrate the major actual color composition of the iris images. Shades of brown are noticeably more common in *Buceros hydrocorax* iris across all three samples as compared to its conspecific, *Buceros mindanensis mindanensis*, whose iris colors are apparently lighter at ranges of shades of beige to greyish white. The Euclidean color

space included in Figure 3 illustrates the summary of RGB values with minimized distances from *k*-means clustering.

In the quantitative criteria for species delimitation by Tobias *et al*. (2010), a difference involving contrasting hues (e.g. white/yellow; red/brown; green/blue) in plumage and bare parts has a magnitude of major (score = 3). However, it is not mentioned whether iris coloration is included under the definition of these specified criteria, or if it applies on every covariance in color-related traits. Witmer (1988) and Tweeddale (1877) were not mistaken from their observation that there is indeed a subspecies differentiation among the male species of Rufous hornbills. Although the descriptions were not accurate, the iris color of the Luzon Rufous hornbill is indeed distinct from its conspecifics based on the results.

Conclusion

The results provide a strong support on sexual dimorphism in iris color, and is true for all the conspecifics. In addition, color extraction provided meaningful insights about the subspecies differentiation in male species, and warrant further study. In any case, recognition of this intraspecific dimorphism in the eye color and relative intra-subspecies difference in eye color could prove useful especially in field applications where rapid identification is of great necessity. Furthermore, the results suggest for updates on the description of iris color in Rufous hornbills.

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Notes from the field

Conserving Central Panay Mountain's Dulungan (*Rhabdotorrhinus waldeni*), Panay Island, Philippines

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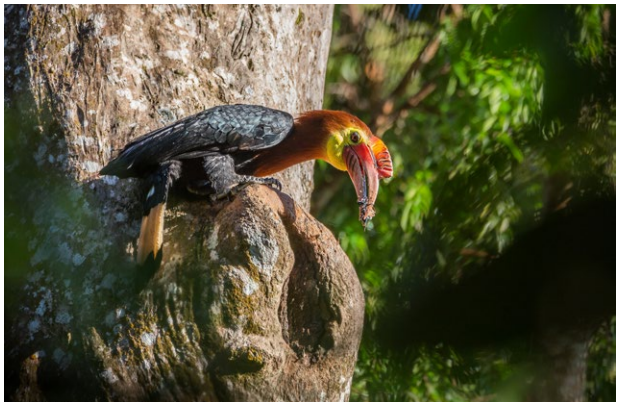
Locally known as *Dulungan*, the Rufous-headed Hornbill, an Evolutionarily Distinct and Globally Endangered (EDGE) species, is one of the rarest hornbills. It can only be found in Western Visayas Biogeographic Region in the islands of Panay and Negros in Philippines. Based on previous studies, the northern parts of Central Panay Mountains Key Biodiversity Area (CPM KBA) is considered as the stronghold of Rufous-headed Hornbill's remaining population. In 2016, IUCN and BirdLife estimated their population to about 1000–2499 individuals. However, Rufous-headed Hornbill population is threatened by unsustainable human activities like slash and burn farming, forest conversion, and timber poaching. At present, only about 8% of Panay's forests remain in good condition.

In 2017, Haribon Foundation started working for Rufous-headed Hornbill conservation in the north-western (Antique) part of CPM KBA. With support from National Grid Corporation of the Philippines and in partnership with the Department of Environment and Natural Resources, Haribon has worked with communities in Sebaste and Culasi in Antique to conduct research on ecology and population of Rufous-headed Hornbill's and to protect its remaining habitat. In 2019, BirdLife International and the Zoological Society of London provided support to Haribon to expand in the north-eastern part of the KBA, with the local governments of Malinao and Madalag in the province of Aklan. Haribon Foundation conducted studies on diet and nest preferences to identify important fruit and tree species for Rufous-headed Hornbill in almost the entire northern forest of the KBA. Different sectors and groups were involved, from the provincial and municipal local governments, teachers, youth, and local communities. Forest protection teams from communities surrounding the forests were formed and trained to assist in monitoring and protection of Rufous-headed Hornbill and its habitat. About 50 forest protection team



A male Rufous-headed Hornbill at a nest.

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School and community projects to establish native tree species nurseries for habitat restoration.

members were taught about the importance of biodiversity and the Rufous-headed Hornbill, wildlife laws, importance of forest habitat, and its connection to humans and their communities. They were deputized by the Department of Environment and Natural Resources as Wildlife Enforcement Officers. Teachers and students were also trained to be biodiversity and Rufous-headed Hornbill champions through Haribons' Eco-Guardians and Eco-Rangers program. The education sector played a huge role in creating awareness to the younger generation as well as their communities and families. They developed small environmental projects in their own schools and communities such as native tree nurseries composed of "*Dulungan-friendly*" trees, murals, posters, and tree planting activities. Local policies were also developed to safeguard the Rufous-headed Hornbill population and their habitat through establishment of Critical Habitats, a type of other effective area-based conservation measures (OECM). The municipalities of Sebaste and Malinao has identified and declared portions of their forest lands as a Critical Habitat for the Rufous-headed Hornbill and other threatened species. The province of Antique has declared the Rufous-headed Hornbill as their flagship species or as the provincial bird and was highlighted in local annual celebrations in several municipalities. Another legislation was passed by the provincial government of Antique declaring the month of August as Rufous-headed Hornbill month. A lot is still to be done, research and partnership with communities works hand-in-hand and plays a big role in this conservation effort.

Josiah David G. Quimpo

A Note on Sulu Hornbill Research Project (July 2018 – June 2020) in Tawi-Tawi, Philippines

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Background

In order to study and help conserve the Sulu Hornbill *Anthracoceros montani* or *Tawsi* in local Tausug language, Dr. Pilai Poonswad and Bee Choo Strange visited Panglima Sugala, Tawi-Tawi in January 2018 together with Nicky Icarangal and Rene C. Zaballa (who helped us with aerial pictures using a drone). The site visit to the Sulu Hornbill habitat on Panglima Sugala was assisted by the former Mayor Rejie Sahali of Panglima Sugala, Colonel Romulo "Bim" Quemado, and the marine soldiers of Marine Battalion Landing Team 9 (MBLT–9) of Philippines Marine Corps. During our two-day visit to the site, we sighted a total of five Sulu Hornbills. One individual was seen leaving a potential nesting hole, most likely a cavity previously excavated by the White-bellied Woodpecker *Dryocopus javensis*. During the visit, Dr. Pilai Poonswad gave a talk at the town centre to inform the officials of the municipality, head of villages and villagers about hornbills and why they should conserve them. She agreed to help train Nicky and the rangers in Panglima Sugala on hornbill research.

Dr. Poonswad commented after visiting the site in January 2018 that there are very few potential nest trees, and trees are still being cut by the villagers in the area. She recommended the installation of artificial nest boxes. She also emphasised to the former Mayor Rejie Sahali that the approximately 10 km^2 site has to be protected for the survival of this species (Fig. 1).

Fig. 1: A view of the the forests of the Sulu Hornbill.

Field training and research in 2018

We had planned to train Nicky and four Tawsi rangers in Field Techniques for Hornbill Studies in Khao Yai National Park, Thailand from 1 – 7 May 2018 (Fig. 2). However, the Tawsi rangers were not able to get their passports ready

in time and were unable to go. Nicky went and was trained by researchers and lecturers from Thailand Hornbill Project and Kasetsart University on the following aspects of hornbill research and conservation:

- Hornbill habitat evaluation and monitoring
- Hornbill population survey and monitoring; sampling techniques, occupancy, line and point transects
- Trapping of hornbills for radio and satellite tracking; measuring the hornbills, data management and analysis
- Tree climbing technique
- Nest search and nest trees study including nest cavity management
- Breeding ecology
- Hornbill food plant study including phenology study

In June 2018, Nicky Icarangal together with the Tawsi rangers discovered an active Sulu Hornbill nest on location. Hornbill Research Foundation then sent a senior hornbill researcher, Narong Jirawatkavi, to Tawi-Tawi in mid-July 2018 to train the rangers in monitoring the nest and data collection. Nicky planned to visit the nest in late July and August but was unable to go due to security issues in Tawi-Tawi. The nest was reported empty during a subsequent visit in September 2018 by one of the rangers. It is unfortunate that the monitoring of the nesting event was inconclusive due to security reasons.

Research plan and field trips in 2019

In view of uncertain security conditions in Tawi-Tawi, Bee Choo discussed with Nicky about installing camera-traps mounted near the nest tree to monitor the breeding behaviour of the hornbills during the breeding season. The breeding season of Sulu Hornbill seems

Fig. 2: Training of hornbill field researchers from Southeast Asian countries at Khao Yai National Park.

to start in April and end in July. However, at present we are unable to determine the start of female entering the nest and the date of female/fledgling leaving the nest due to difficulty accessing the location. Three Bushnell camera-traps and one set of tree climbing gear were purchased and delivered to the Philippines in early June 2019. Nicky and Colonel Bim Quemado went to Panglima Sugala in late June 2019 for six days. Two camera-traps were set up on a tree about 30 m from the nest (see picture of the male Sulu Hornbill leaving the nest hole in Fig. 3). See video of the feeding https://www.youtube.com/watch?v=zZvwUE82sXI&feature=youtu.be&ab_channel=BeeChooStrange

The Tawsi rangers found a second nest on the last day of their field trip. Nicky had no time to put up another camera-trap there and assigned two Tawsi rangers at each nest to monitor the nests every day and record information about feeding and behaviour of the male Sulu Hornbills at nests. Nicky and the Tawsi rangers have found three nest holes since 2018.

We purchased two more sets of tree-climbing gears in 2019 for the Tawsi rangers and left them in Panglima Sugala. Nicky hired two tree-climbing trainers from Manila to train the Tawsi rangers in Panglima Sugala on tree-climbing techniques in August 2019. Some of the

Fig. 3: Camera-trap picture of male Sulu Hornbill leaving nest after feeding. Note the nest cavity on the main tree trunk.

villagers joined the training as they were keen to join the research team. The team arrived on 18th August 2019. The two trainers started with basic single rope technique (SRT) training at the gymnasium of Panglima Sugala the next day. Actual outdoor tree-climbing practice was held on 23rd August 2019 at the research site. Nicky, one of the trainers and Tawsi rangers went to the nest site to retrieve the two camera -traps that were set up in June 2019 and measured the dimensions of the nest hole. This is to ensure that the rangers and villagers can assist Nicky to check and repair nest holes and to install artificial nest boxes in 2020 – 2021.

We are grateful to Colonel Bim Quemado and MBLT-9 of the Philippines Marine Corps for continuing to assist with on-the-ground support, by providing transport vehicle and ensuring the safety of the research team (Fig. 4).

Training and research project in 2020

Nicky reported in January 2020 that the municipality of Panglima Sugala had constructed a big structure outside the town showcasing Panglima Sugala as "Home to Sulu Hornbill". It is a good sign indeed that the government is adopting the Sulu Hornbill as an icon of the place.

The research project in Panglima Sugala has been on-hold since March 2020, and we hope to continue at the end of this year.

Fig. 4: The marines from MBLT-9 ensuring the safety of the research team.

Hornbill Research Foundation had planned to conduct a research training session on nest observations and nest searching from 27th April–4th May 2020 at Khao Yai National Park, Thailand for the Tawsi rangers. However, due to Covid-19, it has to be postponed to 2021.

Progress and future plan

The mayor and Colonel Bim Quemado are working with Philippines authorities to gazette the site as a watershed and wildlife sanctuary. The municipality currently employs sixteen Tawsi rangers from the villages near the forest to survey and safeguard the local hornbill population.

The Hornbill Research Foundation (with coordination from Bee Choo) will continue to help Nicky with his work in Panglima Sugala. There are plans to install artificial nest boxes for the Sulu Hornbill next year as there is still on-going tree felling at the site. The villages (illegal settlers) use the wood for building. There are also plans to set up a native trees nursery near the site, and the Tawsi rangers will be recruited to plant native trees.

Acknowledgements

Bee Choo is grateful for the support by friends from Singapore, Mr. Richard Hale in 2018 and 2019 for the purchase of equipment for the field work and travel expenses of Nicky and two trainers to Tawi-Tawi; she would also like to thank Dr. Vilma D'Rozario for a last-minute support with funds to send our Thai field researcher to Tawi-Tawi in July 2018. Nicky would like to thank Mr. Tonji and Mrs. Sylvia Ramos for financing the purchase of one set of tree-climbing equipment.

We would both also like to thank the former mayor Ms. Rejie Sahali and the current mayor Mr. Nurbert Sahali, as well as Colonel Bim Quemado together with the marine soldiers of the MBLT-9 Philippines Marine Corps, for providing the ground support of Nicky's research work in Tawi-Tawi.

Bee Choo Strange

Nicky Icarangal

An incident of a hornbill that 'fell from the sky' in the Royal Belum State Park, Perak State, Peninsular Malaysia

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The Asian hornbill *Rhyticeros* spp. are generally strong fliers, enabling them to roam large parts of the forest landscape and even migrate long distances (Arthayukti 2015; Kemp 1995). Although incidences of hornbills falling to the ground or water bodies while flying are rare or perhaps go undocumented as far as our literature search goes, there have been occasional reports of other bird species (both passerines and non-passerines) "falling from the sky" (Choi 2011). These incidences have been attributed to a variety of reasons i.e. adverse weather conditions (wind, snow, hail, lightning, storm), disease (avian botulism, avian influenza), human-induced noises (e.g. fireworks), post-collision trauma with physical structures (e.g. powerlines) or even freak accidents (Choi 2011; Yeap and Roslan Carang 2013).

In this paper, verbatim an incident of a 'fallen hornbill' was narrated by two Orang Asli (indigenous people) of Kampung Sungai Tiang in the Royal Belum State Park. The photos were taken by a smartphone.

"*On 7th July 2019, we decided to go to Banding jetty so we used my fiberglass boat. As we journeyed downstream Sungai (= river) Tiang and was about to reach the state park's base camp, we noticed something in the water. Curious, we slowed the boat and approached the "thing". To our surprise, it was a hornbill trying to swim to shore. We rescued the hornbill and brought it onboard. The hornbill was quite feisty, tried to bite us with its beak, so Abie held it tight. From its behaviour and body condition, we assumed that the hornbill had fortunately not been too long in the water. We do not know how or why*

Fig. 1: Abie holding the juvenile hornbill after rescuing it from the water.

Fig. 2: The juvenile hornbill was dropped off at the lake's edge.

it fell from the sky. We brought the hornbill to shore and placed it on the lake shore. On the shore, the hornbill spread its wings with open beak while observing my movements as we boarded our boat. We left the bird by the shore and continued our journey. The incident probably happened between 0900 and 0930 hrs. (See Figs. 1–3)."

Based on the photos taken, the rescued hornbill appeared to be a juvenile Plain-pouched Hornbill (PPH) *Rhyticeros subruficollis* judging from the absence of black markings, or faints ones, on its pouch (Kemp 1995; Poonswad *et al*. 2013). The location where it was rescued is a known flight path of the PPH within the Belum-Temengor Forest Complex (BTFC), where they have been observed heading upstream of Sungai Tiang after leaving its roost site(s) in another part of the forests at dawn. This incident also coincides with the early onset period of PPH arrivals to BTFC which is between May

Fig. 3: The juvenile hornbill with its open beak and spread wings posture, as the rescuers depart from it.

and July before peaking in August or September (Yeap *et al*. 2015). Annual monitoring of the PPH flocks in BTFC have revealed that the movements consist of both juvenile and adult birds. Recently fledged juveniles and their parent birds 'migrate' south together after the nesting season in Thailand.

During the time of the rescue, the morning weather was cloudy and hazy. We believed sudden wind change caught the juvenile off guard while in flight due to its inexperience. This conclusion was made based on previous experience on 11 September 2015 (1810-1850 hrs), while documenting the movements of PPHs to their roost site(s) upstream of Sungai Temin (Royal Belum State Park), the weather changed dramatically with sudden bursts of strong winds as heavy storm clouds gathered (Yeap *et al*. 2016). A group of at least 30 PPHs flew against strong headwinds that rendered them almost 'stationary' in mid-flight. It was clear that they were struggling to make headway but some individuals did experience a sudden drop in flight altitude but managed to regain balance and continue their flight, once the winds subsided. The actual reason for the downed juvenile PPH in the water may never be known and will remain as conjectures.

Incidences of downed hornbills, if/when it occurs, are likely to go unreported in mainstream scientific journals. Our literature search in journal publications via Google Scholar search engine did not yield results. Unsurprisingly, some reports were detected in grey/popular literature and YouTube between 2012 and 2019 for Malaysia. Six cases (two in Peninsular Malaysia, one each in Sabah and Sarawak respectively, and two unknown places) were reported and are summarized in Table 1. Cases involving the Rhinoceros Hornbills *Buceros rhinoceros* (four cases) were the most common while the rest involved Black *Anthracoceros malayanus* and White-crowned *Berenicornis comatus* Hornbills.

The exact reasons leading to the 'downed' hornbills, especially for the Rhinoceros Hornbills but the Sungai Kinabatangan (Sabah) incident offer possible clue. Rhinoceros Hornbill pairs are territorial (Kemp 1995; Poonswad *et al*. 2013) and would defend their territory against other *Buceros* hornbills (Yeap Chin Aik, pers. obs.). Physical altercations while in flight between different individuals (or pairs) could result in 'downed' bird(s) although such incidences are rare. The White-crowned Hornbill incident provided a glimpse into their spatial memory of their forest habitat in Bakun (Dagang *et al*. 2012). The hornbill group were rescued after they 'flew into the water' which perhaps indicated that the hornbills had yet to 'realise' that once-forested habitat was being impounded at that time. Birds have been shown to exhibit high levels of spatial learning and memory in search of food resources and movements within their habitat or territories (Healy and Hurly 2004). The near collision case between Black and Oriental Pied Hornbills was clearly a freak accident as witnessed by Yeap C.A. and Roslan Carang and has not recurred to date.

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Table 1. "Hornbill falling from the sky" cases in Malaysia (2012-2019).

Date of occurrence	Location/state	Species	Notes	Source
2010-2011 (No mention of actual day/ month.)	Bakun Hydro Electric Project (HEP) Reservoir / Sarawak	White-crowned Hornbill *Berenicornis comatus* (one female and three undetermined sex)	Group were rescued from the lake during the impoundment process and released in a location identified by Sarawak Forestry.	Dagang *et al.* (2012)
7 April 2013 (0830 hrs)	Sungai Halong, (BTFC) / Perak	Black Hornbill *Anthracoceros malayanus* (one male and two females)	A group in near collision while in flight with an Oriental Pied Hornbill. Two females fell into the lake. One managed to 'swim' to shore while the other was rescued and released on land.	Yeap and Roslan Carang (2013)
26 April 2015 (Evening)	Sungai Kinabatangan / Sabah	Rhinoceros Hornbill *Buceros rhinoceros* (two adult male)	The Rhinoceros Hornbills collided in mid-air resulting in one falling into the river. The fallen hornbill was rescued and released.	Chong (2015)
13 March 2015*	Tasik Kenyir / Terengganu	Rhinoceros Hornbill *B. rhinoceros* (young adult)	Anglers reported it in the water and released it on land by anglers without footage of individual in the water.	Aizudinz1 (2015)
11 June 2019*	Malaysia?	Rhinoceros Hornbill *B. rhinoceros* (adult male)	Anglers rescued a half-submerged individual in the lake and released on land. It is unclear if the location was in Malaysia. The first person in the video spoke in Bahasa Indonesia and the video title used the word "Temengang" while the others spoke Bahasa Melayu (Malaysia).	VidChan dimar (2019)

Date of occurrence	Location/state	Species	Notes	Source
2 August 2019	Tasik Temengor (BTFC) / Perak	Rhinoceros Hornbill *B. rhinoceros* (adult)	Nature guides rescued an individual in the lake at *ca.*18:30 near the jetty and passed it to the Gerik district wildlife officers. It died in captivity a day after and its carcass was transferred to the wildlife department's headquarters in Kuala Lumpur for post-mortem.	(Suhaimi Zainol and Hasdi Hassan, pers. comm.)

*It is unclear if the date and month reflects the exact date of the incident or refers to the date of upload onto YouTube. The year is likely correct.

Yeap Chin Aik

Breeding Successes of Hornbills of the West Visayan Faunal Region at the Talarak Foundation Inc.

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The Philippines is a biodiversity hotspot and megadiverse country, with high endemicity in terrestrial fauna and flora. All 11 species of hornbills within the Philippines are endemic, but within the archipelago, some species are endemic to specific island groups. The West Visayan Islands have two endemic hornbill species, the Visayan Hornbill (*Penelopides panini*) and Rufous-headed Hornbill (*Rhabdotorrhinus waldeni*); amongst the 3 most endangered hornbills in the Philippines. Both of these species faced threats from habitat loss and poaching (for food, sport and, trade) for several decades, leading to drastic declines and island extinctions; both species are now found only on the islands of Negros and Panay, with the *R. waldeni* functionally extinct on Negros.

In conjunction with the Negros Forest and Ecological Foundation Inc. (NFEFI) there has been captive breeding of these species for over 20 years. NFEFI, a precursor to the Talarak Foundation, had been breeding *P. panini* since 1997 up to the Talarak Foundations facility takeover in 2016. Including the Talarak Foundation breeding center, there were 17 successful fledglings between 1997 and 2015. Between January 2019 and July 2020 there have been 21 successfully fledged *P. panini;* the *R. waldeni,* previously without breeding success for almost

Fig. 1: Mother Visayan Hornbill and chicks inside the artificial nest box.

10 years, have now had 2 successful breeding years with 3 fledged chicks. This boom in breeding success increased the captive population within the Talarak breeding centers to 47 *P. panini* and 18 *R. waldeni* . There are currently 5 proven breeding pairs of *P. panini* and 2 proven breeding pairs of *R. waldeni*.

Fig. 2: Family of Visayan Hornbills in the Talarak Foundation breeding centre.

Fig. 3: Family of Rufous-headed Hornbills in the Talarak Foundation breeding centre.

This breeding success may be down to the strict dietary schedules; a general diet of fruits, vegetables, animal protein with low iron pellets fed twice daily, changed to three times daily during the breeding period with increased animal protein sources. At the time of hatching, this diet is further modified to include double portions of the regular food, increased crickets, and soaked dog food. Alongside the diet, the nest boxes, and level of privacy during breeding can be influential in breeding success. The nest boxes for the *P. panini* are hand made from wood fibre with dimensions of 84 (height) x 51 (width) x 58 (depth) centimeters and a diamond entry hole measuring 35.5 cm vertical entry and 10 cm horizontal entry. The successful nest boxes for *R. waldeni* have been constructed from hollowed palm trunks measuring at least 76 (height) x 51 (diameter) centimeters and diamond entry holes measuring 20 cm vertical with 10 cm horizontal opening. During the breeding period, the active enclosures are isolated from public display and disturbance limited to only feeding times.

These breeding successes could prove crucial in the future conservation efforts for both species. The status of *P. panini* within the breeding centers, coupled with protected reserves absent of the species, promote future reintroductions being used to boost wild populations. The *R. waldeni* captive population and limited breeding success indicate that captive management is still a priority conservation activity, with continued reforestation, habitat protection, and searching for extant populations the best course of conservation actions.

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A Plywood Nest Box for Hornbills and Other Large Cavity-nesters

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Here I describe a nest box design I have developed after studying *Tockus* hornbills in Namibia in recent years. Although my collaborators and I originally used a standard vertical box, I have since switched to horizontal boxes. One problem with vertical boxes is that hornbills tend to fill them with nest material so that the chicks can easily reach the slit in the nest plug. If the box is tall and the entrance hole is relatively high, this will require the birds to bring in large quantities of nest material. Not only is this a great deal of work for the hornbills, this material eventually decomposes into very heavy soil. This is particularly problematic if the soil facilitates the decomposition of the bottom of the box. Less nest material means drier nest material which also prolongs the life of the box. Horizontal boxes are also safer for hornbills than are vertical boxes. Although tall vertical boxes provide many cavity nesters with protection from predators, such boxes are probably more dangerous for hornbills. In vertical boxes, the female and the eggs/chicks are generally right under the entrance hole/plug; most of the volume of the box is taken up with nest material and the female has nowhere to hide if the nest plug is breached by a predator. I have found in Namibia that in vertical boxes, if a Honey Badger (*Mellivora capensis*) breaks through the nest plug, the female/eggs/chicks inevitably die. With a horizontal box, the female and/or chicks can move to the back and be out of reach of the predator.

Our original nest boxes were constructed from dolf wood (aka African teak; *Pterocarpus angolensis*), as this wood is rot- and termite-resistant. However, I have found that local carpenters can be expensive and their products can vary dramatically in quality. Here I describe how to construct seven hornbill nest boxes using two sheets (122-cm x 244 cm) of 22-mm thick exterior plywood (Fig. 1). These boxes are relatively large (perhaps larger than necessary), but the advantage of the design lay in its simplicity. At my study site in Namibia, these boxes are readily used by smaller hornbills such as the Damara Hornbill (*T. damarensis*) as well as the larger Monteiro's Hornbill (*T. monteiri*). A circular entrance hole of 60 mm accommodates these species as well as other cavity-nesters such as Burchell's Starlings (*Lamprotornis australis*), Hoopoes (*Upupa africana*), Lilac-breasted Rollers (*Coracias caudatus*), and Pearl-spotted Owlets (*Glaucidium perlatum*).

Producing these boxes is easiest if one has access to a table saw. If a table saw is not available, a circular saw will suffice. A jigsaw may have to do in a pinch, but is not recommended because of the difficulty in cutting perfectly straight lines.

Cut the plywood in lengths shown on Fig. 1. Once the pieces are cut, separate them into piles for each box.

Each box will have:

Top and bottom: 25 x 61 cm
Front and back sides: 25 x 61 cm
Left and right ends: 25 x 30.5 cm

Note that the left and right ends are one-half the size of the top/bottom/side pieces. This means that the ends "cap" the box and are attached to the top/bottom/sides with horizontally placed screws. If one has good carpentry skills and access to a table saw, another option would be to inset the ends into the box. Note that this would require substantial alteration of the plans below. Note also that six of the seven access door covers have measurements of 22 cm x 20.3 cm. One access door cover will be 19 cm x 30 cm.

Once the pieces are cut, refer to Fig. 2 for assembly. Use a pencil to mark where the 12 cm x 14 cm access door will be cut (this door will be wider than it is tall). Being right-handed, I put the door right of the center of the front side of the box. In other words, closer to the end of the box with the entrance hole (the right edge of

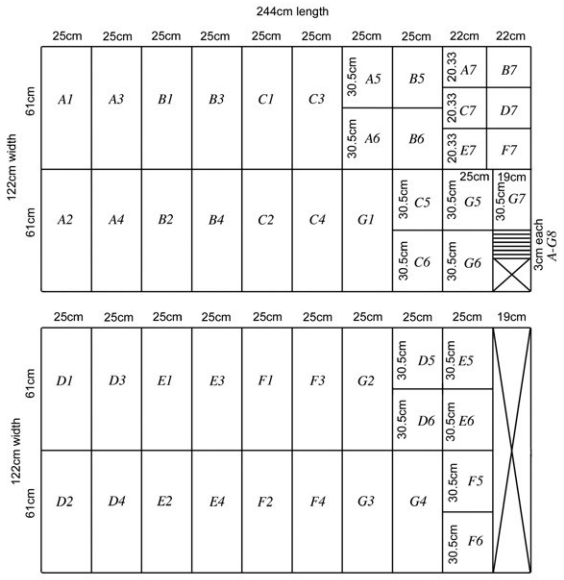


Fig. 1. Marks and cuts on plywood.Each letter refers to one of the seven boxes (A-G).

the access door should be 14 cm from the right end of the front side; the left edge of the access door should be 33 cm from the left edge of the front side; the top of the access door should be 5 cm from the top edge of the front side and 8 cm from the bottom edge). Because the female will probably place her eggs near the nest plug (if the box is level), this placement of the access door will ensure easy access to eggs/chicks. Additionally, because the female will typically move to the back (left) end of the box when the access door is opened, one can access eggs and chicks without having to reach over the female (females can get defensive/aggressive). However, if it is necessary to capture the female for measurements, one can easily reach one's right arm through the access door to grab the female as she hides at the far end of the box. Note that if the box is installed so that the entrance hole is at the higher end, the female will probably put her nest at the farther (less accessible) end of the box; so try to keep it level.

Before cutting out the access door, mark a 6-cm diameter circle in the center of where the 12 x 14 access door is drawn (it's much easier to cut a circle in a big piece of wood than a tiny piece of wood). To cut the 6-cm hole, use a small bit (~.5 cm) in a power drill to make a hole at the edge of the circle. Then use a jigsaw to cut out the circle. Once the circle has been cut, you can drill holes in two corners of the 12 x 14 cm rectangle you drew. Use a jigsaw to cut along the lines, creating the 12 x 14 cm doorway. The block created by cutting this access door can now be used to "thicken" the entrance hole at the end of the nest box. A thicker entrance will not only make it harder for reaching predators, but will also provide more surface area for a hornbill to attach its plug. Use screws (~40 mm long) and glue to attach the entrance hole block to the INSIDE of the end of the box (do this before you assemble the box). These screws

should be shorter than the ones used for the rest of the box; 5 cm screws will emerge out the end of the box and could cause an injury. If the block is on the outside, a honey badger is likely to simply chew it off.

Note that the entrance hole is located at or near the center of the end of the box. Because the chicks need to be able to reach the nest plug slit to get food, a high hole requires the adults to bring in a great deal of nest material to raise the floor of the nest. As mentioned earlier, this is not only more work for the birds, but is also more likely to eventually result in the presence of damp "soil" in the box. A shallower layer of nest material is more likely to remain dry … and reduce decomposition of the nest box wood. An additional advantage of centering the entrance hole is that honey badgers will have a difficult time gaining any sort of purchase on the entrance hole to chew at it.

To attach the top, bottom, sides, and ends, use wood glue and 5 cm deck or drywall screws. Have the top and bottom sandwich the sides, making the distance from the floor to the ceiling of the box 25 cm. This means that the screws connecting the top to the sides and the bottom to the sides will be vertical. The screws connecting the ends to the sides will be horizontal.

Connect the top to the sides with 8 screws (4 on each side). Do the same for the bottom. For the end with the entrance hole, use 2 screws on each side (8 screws), while on the opposite end use 2 on each side and one on top and bottom (6 screws).

Although the male hornbill will typically stand on the top of the box to feed the female or bring nest material, the female typically hangs vertically below the entrance when inspecting or entering the box. Consequently, I generally

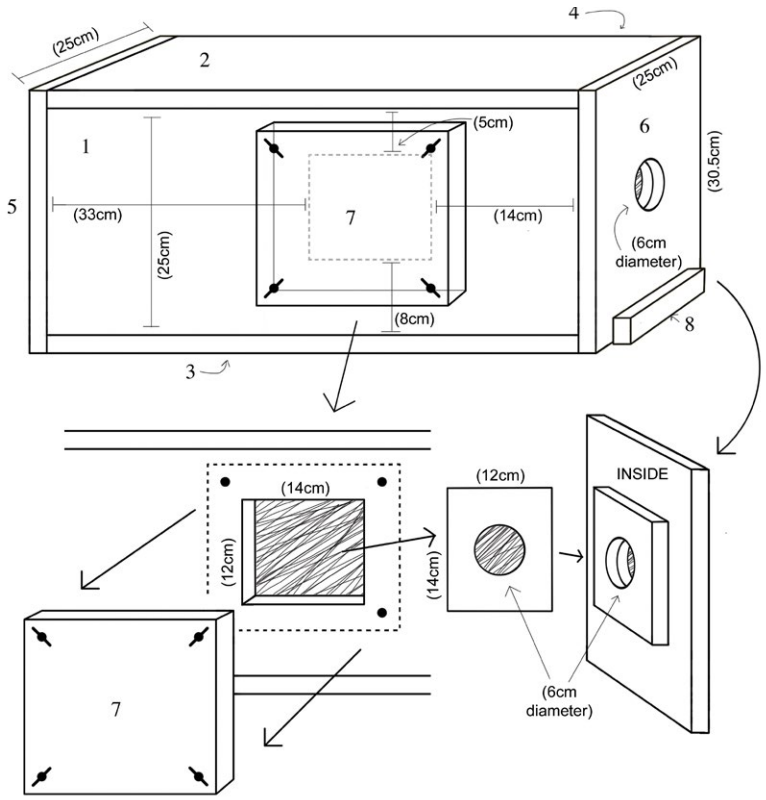


Fig. 2. Schematic of the box produced from pieces produced from Fig. 1.

add a small perch (19 cm x 3 cm) on the bottom edge of the end of the box below the entrance hole. If the bottom of the perch is flush with the bottom edge of the box end, you can screw it into the end of the box and through it into the bottom of the box using 5 cm screws. The perch will thus stick out 22 mm from the box and extend 3 cm up toward the entrance hole. Center the perch below the entrance hole and make sure that the screws that connect the perch to the box are not too close to the two screws that are connecting the bottom edge of the box end (with the entrance hole) to the bottom of the box. If you prefer the perch to be closer to the hole, use shorter screws.

Because termites are a serious problem where I work in Namibia, I coated the boxes I constructed in 2020 with motor oil (3 coats, each 3 days apart). After the final coat of oil soaked in, I gave each box two coats of tan paint. Because the access door cover is unlikely to be the target of termites, it does not need oil. However, be sure to allow the paint on the access door cover to dry before attaching the cover to the box.

Once all the paint has dried, hold the access door block over the access door opening. Make sure the opening is centered behind the block. Use a pencil to mark the position of the block on the box itself. Make sure you also know which edge (and side) of the access door cover is up. Now make 4 marks at the corners of the access door cover. These dots should be approximately 2 cm in from the top and side of the cover at each corner. They mark where the bolts will go that will hold the access door cover to the box. To drill these holes (through the access door cover and through the box), it is best to use a drill press. If not available, simply use a power drill held as vertically as possible. The holes should be the same diameter as a standard carriage bolt (approximately 6 mm). The access door cover will fit over the carriage bolts and be held on using wingnuts.

Once you've drilled the holes through the side of the box around the access door, you will thread the carriage bolts through those four holes (from the inside out). The bolts should not slide through those holes easily. If they do, then the bolts are likely to get pushed in when you try to attach the access door cover. Hand twist the carriage bolts through the holes in the side of the box until the bolt peeks out. At this point you can use a wingnut (turning clockwise) to bring the bolt the rest of the way through. If the holes are such that the bolt does slide through easily, you will need to put a dollop of caulk around the base of the bolt before you shove it through the hole (from the inside toward the outside). Once the caulk dries, the box will have 4 well-anchored bolts emerging outward around the access opening.

The holes in the access door cover will need to be slightly larger than those drilled through the side of the box around the access door opening. This will allow the access door cover to slide over the bolts easily. One way to do this is to re-drill the holes in the access door cover with a slightly larger bit. Alternatively, you can use the same bit to ream out the holes multiple times (while angling the drill).

Installing the nest box

Where I work in Namibia, trees tend to be small in stature and girth. Consequently, I generally install my nest boxes at a height of about 1.5 m. Although the installation instructions that follow assume installation at a modest height, these boxes could presumably be installed much higher and in taller trees.

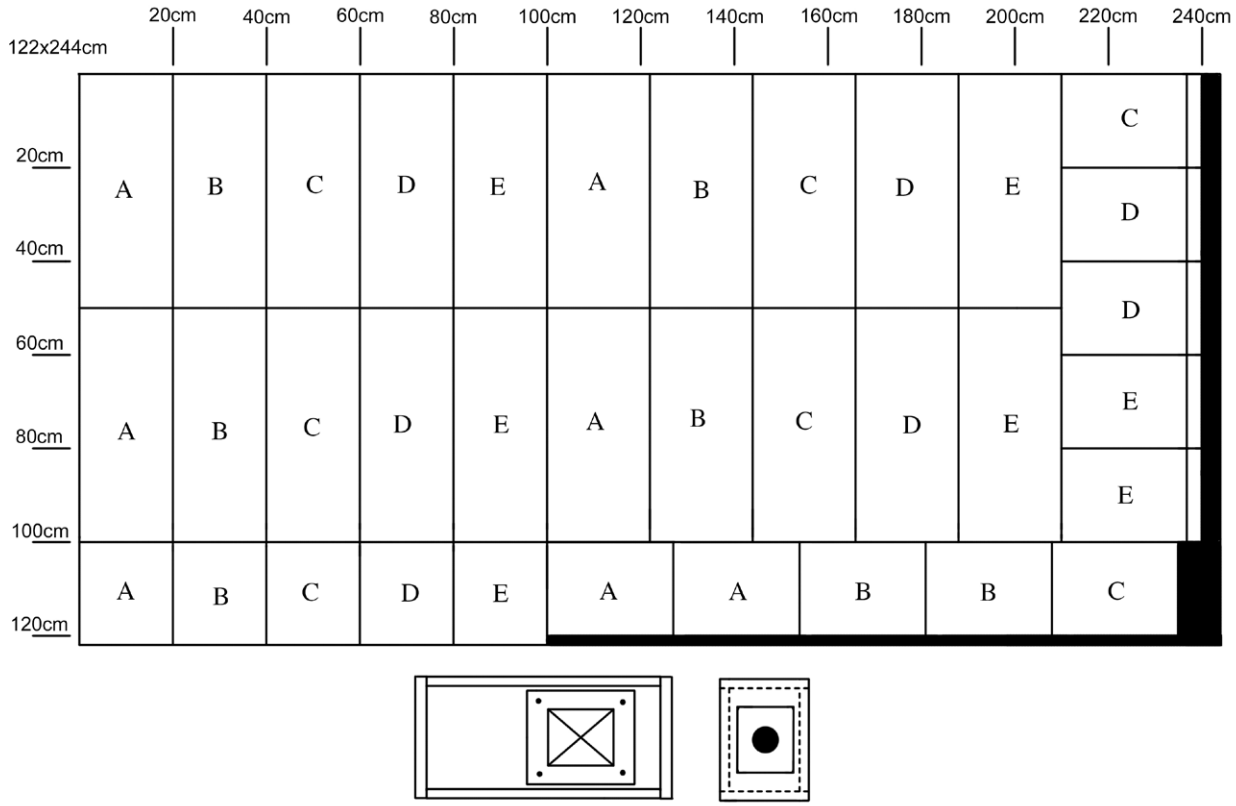


Fig. 3. Plans for a slightly smaller nest box (five from a sheet of plywood).

Find a tree in which the box will be supported by more than just the wires. In other words, the wires should secure the box to the tree, but not hold all the weight of the box. In fact, the more branches that support the box, the better. This also makes installation easier if you're by yourself (you won't have to hold the box up while you're drilling and such). Make sure that neither the entrance hole nor the access door is obstructed by a branch. Actually, it's fine if there is a branch near (but not blocking) the entrance hole. Having such a branch nearby typically makes it more difficult for honey badgers to find leverage to chew on the entrance. But make sure the access door is completely free from obstructing branches. You will need to reach your whole arm into the box through this door, so make sure there is room for that to happen.

Three anchor points makes for a very secure box. Ideally at least two of these will be a vertical branch. Use a pencil/pen to make two marks on the box on either side of the branch to which you plan to secure the box. Use a power drill with a 5-6-mm bit to drill holes into the box through which you will thread pole wire. For example, if the back of the box is resting snugly against a vertical branch that is 8 cm in diameter, mark the back of the box with two dots about 9 cm apart (on either side of the branch). Now drill holes at the marks. Now cut a piece of pole wire to a length of about 0.5 m. Near the middle, make a 90-degree bend. Make another 90-degree bend 9 cm away. Now take the bent piece of wire and stick it through the access door. Stick one end of the pole wire through one of the holes you just drilled and the other end through the other. If you measured the distance between the holes and made the bends at the appropriate spots, you should now have your pole wire sticking out through the back side of the box (on either side of the branch) and the wire should be flush with the back of the box

on the inside. Bend the two emerging pieces of wire towards each other around the branch and cinch them on each other. Use heavy pliers to twist them tight. Ideally, if you placed your box snugly against the branch in the back and the other contact points, the box should not wobble much at this point. As I mentioned above, 3 anchor points seems to be key. If you have a vertical branch that will allow for two wires, that's fine. And remember, try to mount the box so that it is perfectly level (front/back as well as left/right). It may be necessary to make one of your contact points through the bottom of the box, but I've found it best to use the sides/ends. If the hornbills want to seal up these holes, they will. If they don't, the holes will provide some ventilation. Do not drill holes through the top of the box. Drilling holes through the bottom of the box could allow for drainage (and help keep the nest material dry), but it could also allow a site of entry for termites.

Once the box has been attached to the tree, put about 2 liters of wood chips/shavings inside. Attach the access door cover, tighten the wingnuts, write the box number on the access door with a permanent marker (this ensures that the cover is always on correctly). Record the GPS of the box and you're done.

For a slightly smaller nest box, see the design in Fig. 3. Although these boxes share many features with the box just described, their smaller external dimensions (27 cm x 20 cm x 50 cm) allow for five nest boxes to be produced from a single sheet of plywood.

Acknowledgements

Thanks to the hornbill enthusiasts with whom I have discussed hornbill nest box design over the years, especially H. Bohme, C. Brown, H. Kolberg, J. Mendelsohn, and D. Millican. Figs. 1, 2, and 3 produced by S. Stanback.

Mark Stanback

The Hornbill's Lament

What do you photographers see?
And what do your photographs tell?
Do you only see a bird on a tree?
Are you just glad the images came out well?

Do you only care for a good vantage?
And do you ever feel for our daily grind,
Or even see how far we fly to fetch
Some figs and just whatever we can find?

By now I think you should know -
That it takes three hours (could be four) -
For us hornbills to fly to and fro;
And we always have to go back for more.

If only there were some fruit trees nearby,
We'd come rushing back to our nests.
But there aren't any - and that's no lie -
So our foragings are no less than quests.

Each day I soar down to the valley,
And to the woods beyond the river,
Where I came upon a few fig trees recently
That the others have yet to discover.

Sealed inside that birch tree is my mate
And so will she remain till May.
For she has her clutch of eggs to incubate -
And she'll it do the age-old way.

I've got two beaks to feed now,
So I'm up and away at the crack of dawn.
All through the day I keep at it somehow,
And as dusk falls my day is done.

We eke out a living, but just barely -
But the villagers don't bother us none.
We do see the odd woodcutter, but only rarely,
And they leave as soon as they're done.

Our forbears came from the west -
Fleeing from man - so the old ones say.
It's said that here they stopped to rest -
And then this is where they decided to stay.

This has been our sanctuary, our home,
And it's a safe haven for others too.
But there are also predators that roam -
Martens, hawks and eagles, to name but a few.

Times are getting harder each year
In this here neck of the woods.
And each day could be the last, we fear -
For the lot of us and for our broods.

As the season changes in spring
The woods turn into battlefields for the gods.
And thunder and lightning will they bring
As their spears, shields and their swords.

Then the howling wind becomes a gale,
Rain batters the trees all through the night.
And as darkness reigns over the vale
We all hunker down to wait for first light.

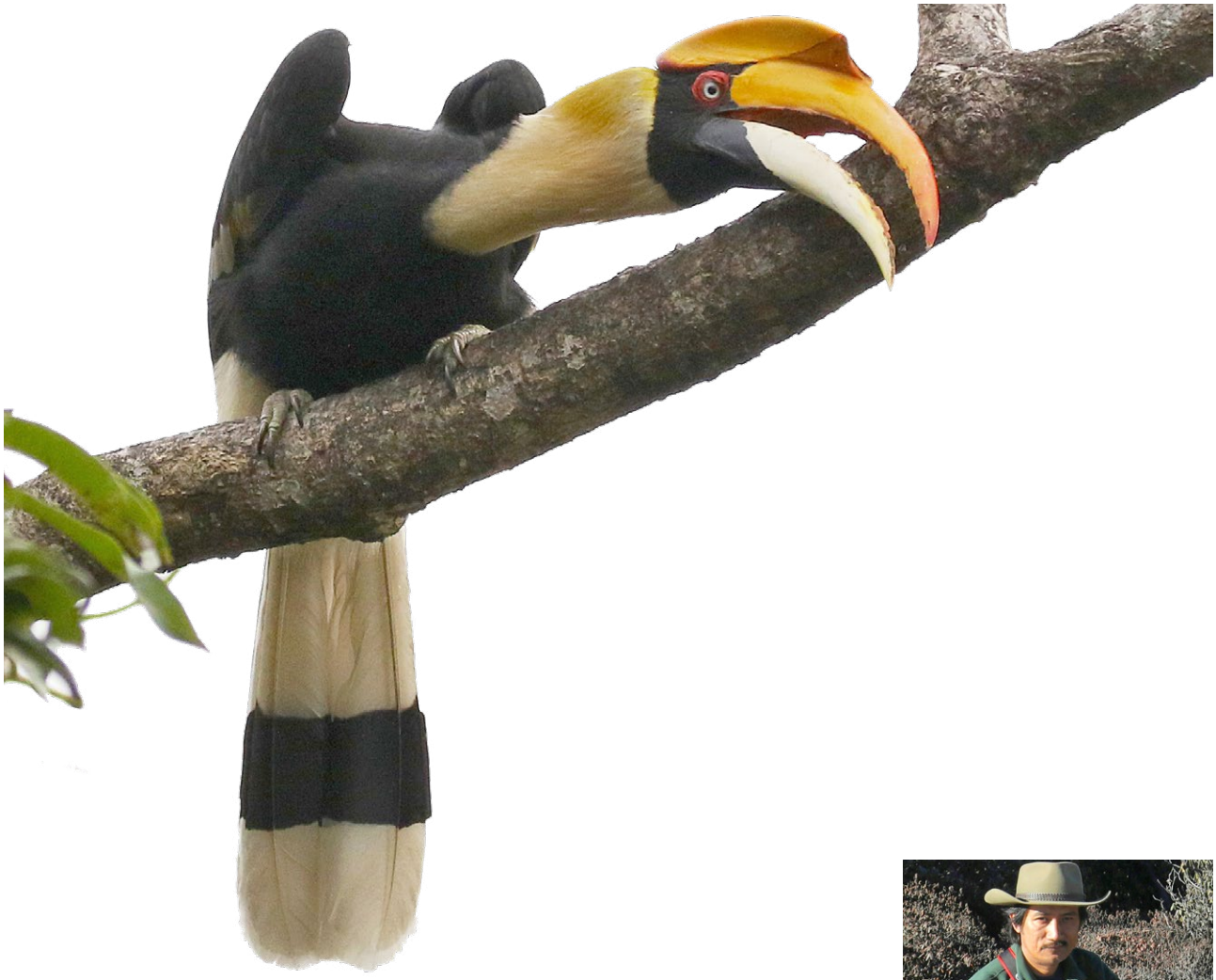
The forest counts its losses in the morn,
After the battling gods have long left.
And it's never clear who's won -
But the demise of a few leaves us bereft.

A tall needlewood, aged and gaunt,
On that ridge like a sentinel had stood.
The tree used to be a favourite haunt
And home for many a bird and their brood.

The old giant was among those that fell;
And some of us will not be there
To tell the night's harrowing tale -
But the forest will move on - as if unaware.

Did nobody tell you about our ordeal?
That some of us didn't survive?
Maybe your photographs won't reveal -
You're here only for those that are alive.

Will your photographs ever reveal?
And will no one ever stop and ask -
If there's more to a hornbill
Than its feathers, beak and its casque?



Suraj Gurung (hillrivers@gmail.com) is a Gangtok-based travel writer and bird-photographer. He is with the Sikkim State Civil Service, currently posted as Managing Director, Government Fruit Preservation Factory, Singtam in East Sikkim.

Hornbill news

Red List status of hornbill species: ensuring updated species factsheets and review of threat assessments

Twenty-four of the 62 hornbill species are currently threatened. Many species are due for a review of their threats status listing based on more recent or better data/knowledge. The existing factsheets often lack adequate or updated information on the species.

One of the tasks of the IUCN SSC Hornbill Specialist Group (HSG) is to ensure a thorough and informed assessment of the status (threat category) of all hornbill species along with making sure all factsheets are up to date and more comprehensive. While the primary aim of the Red Listing process is determining the threat status, it is also important that the factsheets up on the IUCN Red List website (that are referred to by people all over the world) also has more accurate, updated, detailed information on the hornbill species.

BirdLife International (official authority for all bird assessments) is working with the HSG to make sure the assessments are ready for the November 2020 IUCN update.

This project was carried out with the help of two interns working with Dr. Aparajita Datta and Dr. Lucy Kemp (HSG co-chairs) with funding support from Chester Zoo.

The process followed was different for the Asian and African hornbills as there is much more information and data available for most Asian species. The key priorities for the Asian hornbills was to update and improve the existing factsheets and re-assess the threat categories for some species where new data/information suggested that a change was needed. This had to be done within the deadline set by BirdLife for receiving these inputs so that these changes could be incorporated in the November 2020 assessment. For the African hornbills, for which there is much less collated information available, the process followed was to conduct a thorough literature and desktop review and to re-evaluate the current threat categories.

Asian hornbills

Ishaan Patil and Aparajita Datta

We report on the steps/process followed for Asian hornbills. The first step was to reach out to various experts (part of the HSG or otherwise) and ask them to go through the existing latest version of the species factsheet (shared by BirdLife) and make additions/edits to it based on their knowledge/data. Sixty-three experts from 15 different countries who had worked on either one or more Asian hornbill species were contacted via email. We received inputs from 37 experts including ex-situ data from North American and European zoos from 2 HSG members. All 32 Asian hornbill factsheets were updated and on an average each factsheet was reviewed by 5 individuals (range 0 – 18). Individuals from the Philippines, Indonesia, USA, Netherlands, Bangladesh, Bhutan, Myanmar, China, Thailand, Malaysia, Singapore and

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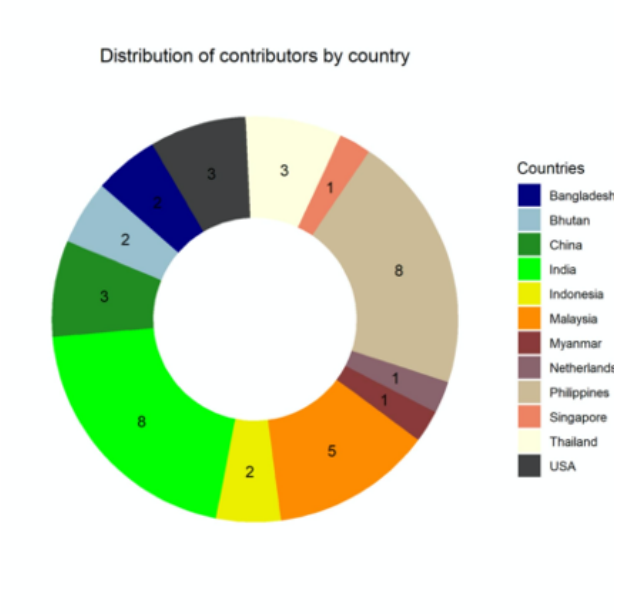

India contributed to the assessment.

Four species (Sri Lankan Grey hornbill, Tickell's Brown hornbill, Mindoro Tarictic hornbill and Mindanao Tarictic hornbill) did not receive inputs despite several requests, so they were updated by us by referring to available literature.

Four species were suggested for a threat level update. The Austen's Brown hornbill or White-throated Brown hornbill *Anorrhinus austeni* was suggested to be moved from Near threatened to Vulnerable. The suggested uplisting for the Austen's Brown hornbill could not be considered by BirdLife as the inputs for the species were made at a later date and will be considered in the future.

The Sumba hornbill *Rhyticeros everetti* was proposed to be moved from Vulnerable to Endangered. The Malabar Grey hornbill *Ocyceros griseus* was suggested to be uplisted to Vulnerable from Least Concern. The Narcondam hornbill *Aceros narcondami* was also proposed for a review of its status given new data on its population suggesting that it could be downlisted from Endangered to Vulnerable under certain criteria.

BirdLife had also earlier suggested uplisting of the Tickell's Brown hornbill from Near Threatened to Vulnerable but it had been kept on hold due to lack of current data on populations within its range. Since there was no new information available on population status in the 2 range countries, the threat category of this species remains unchanged pending more current data.

The revised factsheets for all 32 Asian species were shared as and when they were completed from February to May 2020. BirdLife put up the topics with assessments for the species based on new information available with the suggested category changes on the Global bird forum in May for public inputs and comments. The topics were open till 28 June for comments. Preliminary decisions were taken based on all inputs received. The decisions are to be found as comments at the bottom of each relevant topic, with all topics here: https://globally-threatened-bird-forums.birdlife.org/. The topics were re-opened for any further comments until 19th July 2020, when topics are closed and final decisions to be submitted to IUCN will be made by BirdLife.

The project was carried out from December 2019 to May 2020. Although we tried to do the assessment as extensively as possible, there are some species which have not been thoroughly reviewed. We are also lacking data on some species from some range countries like Sri Lanka, Myanmar, Vietnam, Cambodia and Laos. The next update and assessment will have to be more extensive than this one. For accurate threat level assessment, we will require greater participation from hornbill researchers/scientists working in all range countries. This update is just a beginning. A more extensive update/desktop review will be carried out by compiling information based on certain criteria/parameters that would be listed on a database format.

African hornbills

Lucy Kemp and Kath Forsmann

Thanks to funding from Chester Zoo, Dr Kathryn Gamble and Milwaukee County Zoo, we could hire a full-time intern, Dr Katherine Forsmann, to collate all information available about all of the African hornbill species. Currently, none of Africa's hornbill species are listed on any of the CITES appendices despite evidence of concerning declines of certain species numbers across the continent. Designating research efforts and funds is made particularly difficult due to a lack of data and information on many species. To properly understand the conservation status and needs of these species a complete reassessment of the IUCN status of Africa's hornbills was needed. We aimed to reassess all species under the IUCN Hornbill Specialist Group banner to make informed future decisions regarding research and conservation. The reassessments were conducted through intensive online literature research. All records of sightings, calls, evidence of each species, databases and local reports were recorded in a pre-constructed species matrix. These data were collated to determine which species' status should be updated and, where the conclusion was that the status is 'Data Deficient' future efforts will focus on local, on site research into assessing these species in more detail. The ultimate goal is to establish protocols for studying and monitoring hornbills in the wild that will enable accurate abundance estimates, nest and roost monitoring, breeding biology, diet and behavioural studies and seed dispersal and restoration behaviour and to produce a reliable current handbook that can be used by biologists, students and local communities alike.

A species matrix for all African hornbills (including new taxonomic split) was constructed as follows:

For each and every available data point (published literature, sighting, audio recording, track or sign, historic record) the following was be recorded:

- Species
- Record date
- Location details – country, province/district/state
- Coverage – global, regional, national or site specific
- Record category – breeding ecology, feeding ecology, distribution and population, movement and home range, fragmentation, research method, habitat, seed dispersal, ecotourism, genetic, ethno-ornithology, threats, use and trades, ongoing conservation action or captive breeding and husbandry
- Record source – scientific journal, thesis or dissertation, popular article, sighting or personal communication
- Record details (for all except sighting) – authors, publication name, publisher, year, volume, edition, pages

With this we were able to assess each species to inform a reassessment of IUCN conservation statuses. These data were collated to identify the species that had enough data to be accurately assessed and whether their current IUCN listings were correct, which species should be changed from Least Concern to Data Deficient, where (which species) attention should be focused in the short-term and where, both nationally and regionally, future funds should be directed for implementation of conservation training, capacity building and community engagement.

We succeeded in constructing a complete matrix for all African hornbill species (except *Bucorvus leadbeateri* which was recently re-evaluated and is considered ***Vulnerable*** internationally throughout their sub-equatorial range in Africa and *Endangered* in South Africa and Namibia). Based on the literature, sightings, audio recordings, tracks or signs and historic records that we collated, we

were able to re-assess 32 African hornbill species. We have recommended that 27 of these be re-classified as ***Data Deficient***. These recommendations were based on a severe lack of data on so many species as well as a lack of recent (within the last 10 years) literature. The updated IUCN factsheets are currently with the relevant specialists for review and final revisions will be submitted to BirdLife International for their appraisal for the next assessment. By then we hope to have all the relevant data available to support any queries regarding the change in IUCN Red Listing.

Hornbill Specialist Group

Aparajita Datta

Ishaan Patil

Lucy Kemp

Kath Forsmann

Helmeted Hornbill Working Group (HHWG) 2019-20 update

Jessica Lee[1,3] & Anuj Jain[2,3]

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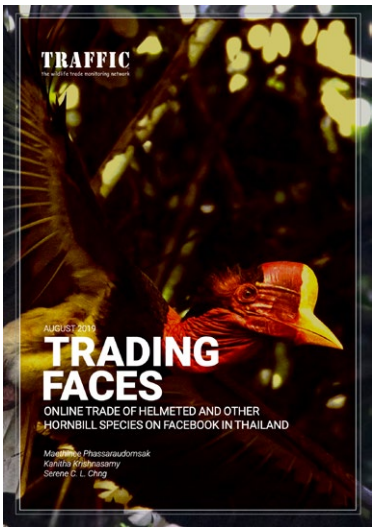
This update was prepared with inputs from IUCN SSC Hornbill Specialist Group and HHWG sub-group leads and members. The Helmeted Hornbill (*Rhinoplax vigil*): Status Review, Range-Wide Conservation Strategy And Action Plan (2018 – 2027) identifed three goals to tackle the trade, but also the conservation of the species – these are linked to specific objectives (and actions). This document will report on the various updates under each objective. This report has also been shared with CITES for their information and action.



1. Recent Notable Trade Reports

1.1 Thai Hornbill Trade

TRAFFIC launched a report on the online trade in Thailand in August 2019 (https://www.traffic.org/publications/reports/hornbills-losing-their-heads-to-online-trade-in-thailand/). The six-month online survey found a minimum of 236 online posts offering a minimum of 546 hornbill parts and products in 32 of the 40 groups surveyed on Facebook. These were posted over a period of 64 months, spanning June 2014 to April 2019. Helmeted Hornbill parts and products constituted 452 (83%) of all hornbill commodities recorded. 94 whole heads of eight other hornbill species—all native to and protected in Thailand—made up the rest of the hornbill commodities recorded in the survey.

1.2 Golden Triangle and Greater Mekong area Physical Market Surveys by TRAFFIC

Two physical market surveys were carried out. The first survey was from May to July 2019 across 11 locations in three countries – Lao PDR, Myanmar and Thailand, while the second survey was from September to December 2019 across 29 locations in four countries – Lao PDR, Myanmar, Cambodia and Thailand. The results are summarized in the table.

1.3 Mainland China HH Surveys – Physical and Online Surveys by TRAFFIC

Physical market surveys of HH products in mainland China took place across four years from 2016-2019. The results of the survey are presented in the table.

Results of Golden Triangle and Greater Mekong area Physical Market Surveys

Taxa/item type	Survey 1	Survey 2
Type of Helmeted Hornbill products	Bracelet (1) and necklace (1)	Bracelet (3) and necklace (1).
Locations found	Luang Prabang	Luang Prabang and Vientiane
Pricing info	CNY 3,000 each	LAK 800,000 (bracelet) THB 40,000 –THB 42,000 (bracelet) THB 58,000 (necklace)

Online market surveys in mainland China, however, showed that almost no dealers sold HH products through traditional websites. Instead, HH product dealers mainly use social media platforms such as Wechat, Tieba, etc. which are more covert than websites. The current average price of HH was recorded to be ~ CNY 150/g.

1.4 Online & Antique Shops Survey in Hong Kong SAR (HK)

Online market survey of HH products in the HK by the University of Hong Kong (HKU) comprised a one-off survey in Dec 2019 Jan 2020 (8h/day across four days). It was focused on HK and mainland China traders. The survey recorded eight HH items sold over WeChat or Facebook:

- Beaded bracelet x 1
- Beaded necklace x 1
- Pendant + beaded necklace x 2
- Carved figurine (small) x 3
- Uncarved bill x 1
- A lot of fake products were identified, with some of high quality

Results of Mainland China HH Surveys

Year	Cities visited	Outlets selling HH	HH products (pieces) found in market
2016	7	32	138
2017	10	51	110
2018	11	43	82
2019	10	26	56

1.5 Combating Illegal Wildlife Trade in Sarawak – Sarawak Forestry Cooperation (SFC), Malaysia

As the state government department for the protection of wildlife, the SFC actively carries out a range of activities with regards to tackling the illegal wildlife trade. These include monitoring illusive wildlife trade in the town areas, illegal wildlife trade across border, wildlife cybercrime and bio-piracy. The SFC applies a four-pronged approach in their intervention: Monitoring (e.g. urban area and cyber patrols, border patrols), Enforcement (e.g. market areas, clubs, national/international operations), Awareness (e.g. Conservation Education Public Awareness CEPA, volunteer wildlife ranger programs with NGOs, engaging local councils) and Publicity (e.g. signages, brochures and radio programs). The SFC has also undertaken joint SMART patrols with the Royal Malaysia Police and Wildlife Conservation Society. In October 2019, an arrest of a trader and confiscation of 148 pieces of HH parts was carried out. The estimated local market value of the casques was RM296,000.00 or close to USD70,000.

The SFC have plans to review laws, regulations and standard operating procedures, as well as intensifying enforcement at state/national/international levels, but to also work with relevant partners on demand reduction and capacity building initiatives.

Seized Helmeted Hornbill casques. Photos by Anuj Jain.

2. Trade-related Training

2.1 Law Enforcement Training

For law enforcement purposes, in February 2020, a guide for frontline border officers was produced by TRAFFIC. This was to improve the detection of illicit wildlife parts and products in trade. The guide is available in Burmese, Lao, Thai and English. It may be downloaded here: https://www.traffic.org/news/new-guidebook-to-help-enforcers-spot-illegal-wildlife-products/

Some snippets from the guide are provided below:

2.2 Enforcement Education - The Development of a HH Education Kit for Enforcement and Courts (HEKEC) in HK

This is led by a team from HKU's School of Biological Sciences and Faculty of Law, along with Gaia, a wildlife conservation NGO from Malaysia. The key objectives are to raise awareness via:

- Photos of casques for enforcement agencies use
- Short documentary including HK-seized casques & footage from Kinabatangan
- Presentations to enforcement members of THE HK Agriculture, Fisheries and Conservation Department (AFCD) and Customs and Excise Department
- A poster for the education centre in AFCD
- This will be coupled with evaluations using audience surveys, and seizure monitoring post-education activities.

2.3 Bringing forensics to the courts using "Victim Impact Statements" (VIS)

Another project led by HKU's School of Biological Sciences and Faculty of Law, as well as Kadoorie Farm and Botanic Garden in HK. These VIS are statements prepared for HK's most smuggled species, to make them recognized

as victims of crime. These statements establish the impact of wildlife crimes and can be utilised by prosecutors in their presentation of cases at court. Armed with knowledge of the role of animals as individuals and species victims of crime, sentences may be passed that take appropriate regard of wild animal suffering, their monetary and conservation value, and the impact of their loss on biodiversity. The use of these statements is allowing for better-informed sentencing decisions in individual cases and improved environmental justice. They are based on information around:

- IUCN Red List category
- Ecosystem impact through exploitation
- Population depletion and food chain effects
- Current monetary value on the black market
- Welfare concerns in transport
- Invasive species, disease and pathogen concerns
- Forensic information and analyses

Two Case Studies applying VIS for CITES Appendix I species:
In May 2018, an amendment in HK legislation was made which raised the maximum penalty for importing Appendix I species to 10 years imprisonment. Five rhinoceros horn cases have since been prosecuted in the District Court (previously they were always tried in the inferior magistrates' courts). In each case, the defendant smuggled between 1.32 and 3.1 kg of horn into HK. Prior to the VIS for AFCD, along with over 6 hours of online training for judiciary on how to use the statements to inform their sentencing decisions, the last rhinoceros case heard had a 2-month minimum sentence. However, each of the defendants this time were imprisoned for between 8-12 months.

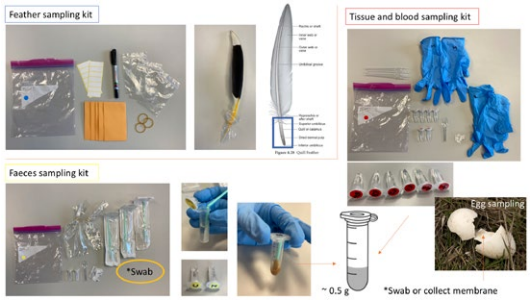
In July 30, 2019 a man was convicted for attempting to smuggle HH beaks using express air parcels. He received 32 months imprisonment = the highest sentencing received for a wildlife trade case in HK.
* Significant increase in sentencing * Judiciary feedback has been positive

3. Genetics Update

The key aim is to create a "genoscape" to determine the origin of casques, which will aid law enforcement and conservation by providing more in-depth information on: poaching hotspots, trade routes and populations most at risk.

This is a multi-step process that includes the collection and sequencing of samples from seized casques and wild (but also museum) samples to ultimately create a genetic map – linking seizures to reference samples.

The genetics team led by HKU partners are currently in the process of applying for the various sampling permits for each range state. Sampling from seized casques in HK has already began. We hope to commence museum sampling within the next six months, and field sampling once all the paperwork has been processed and approved. In preparation for this, feather, faeces and tissue/blood sampling kits and a guide have been prepared and standardised. The team will be supported by a Nat Geo Grant, and have applied for an additional Wild Genomes Grant to extend the work.



Genetics sampling kit by Hong Kong University

Separately, using confiscated casques stored in a museum in Indonesia, the Indonesian Institute of Sciences (LIPI) carried out a number of genetic enquiries, and these include:

- Diagnostics (e.g. species identification)
- Sex determination using HH casques
- Genetic diversity and intraspecific variation among HH population, as well as geographic origin

As there is a need for efficient protocols for working with casques of varying conditions, a secondary aim of these studies is to optimize the laboratory protocol for keratinous material.

We understand that the Department of National Parks (DNP) Thailand as well as Perhilitan in Peninsular Malaysia have also developed expertise in carrying out a number of genetic enquiries on consfiscated hornbill casques.

4. Stockpile Management (Seized Casques)

As per the action plan, a morphological assessment of confiscated casques has commenced in Indonesia. This includes looking at characteristics such as beak conditions across confiscations, as well as sex and age differences. This will allow us to better understand the features of the trade but also impact on wild populations.

A preliminary assessment was carried out on 248 out of 259 beaks seized in 2013 and currently held in Jakarta (possibly from West Kalimantan), as well as a 2016 Samarinda confiscation with 101/150 beaks from East Kalimantan. Much information could be inferred and deduced from these seized specimens prior to stockpile destruction. The proposed management protocol led and drafted by Rangkong Indonesia is displayed in the image above.

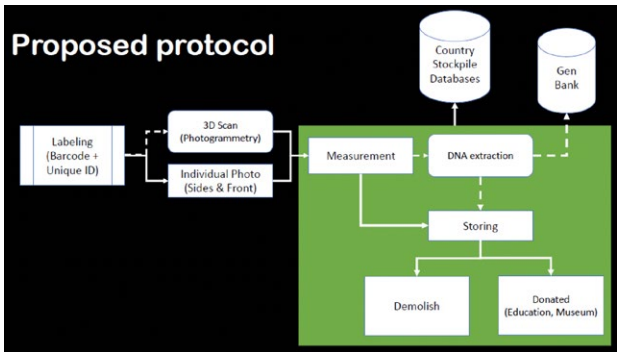
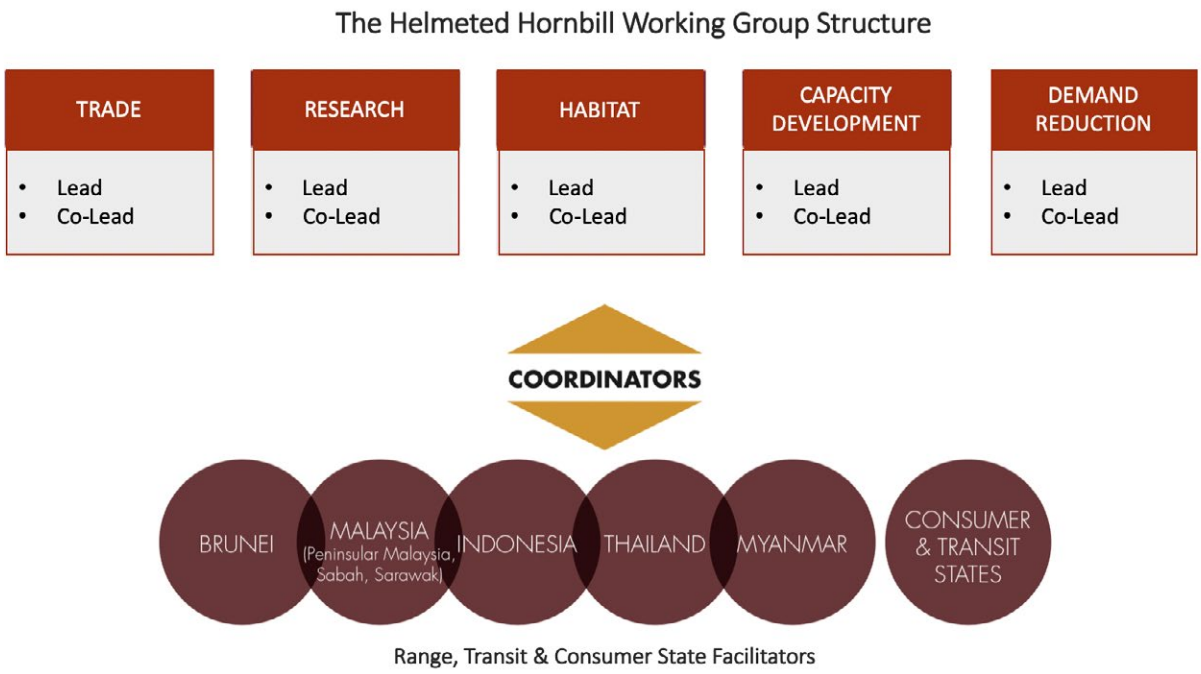


Image by Yok Yok Hadiprakarsa.

5. Notable Poaching Incidents in 2019

Malaysia (Sabah) - Across a number of months from May to October 2019, while carrying out field activities as part of the Kinabatangan Hornbill Conservation Project, members from local NGOs - Gaia and HUTAN–Kinabatangan Orangutan Conservation Programme encountered poachers at one of the field sites in Kinabatangan, Sabah, Malaysia. During this time (October 2019), a female HH was noted to have gone missing, it is still unknown if the forest intruders and disappearance of the female hornbill are linked. The situation intensified as these intruders were armed and aggressive to field staff. Reports were made to the Malaysian authorities in November, and the police force as well as the Special Armed Forces PGA accompanied field wardens and researchers into the field site – the intruders appeared to have disappeared. Subsequently, through the assistance of Gaia, five arrests were made at the site, and Gaia were forced to postpone near-future field activities.

Malaysia (Sarawak) – Recent seizures in Kapit, Sarawak include a massive seizure in October 2019 in which 800 animal parts were confiscated (https://www.freemalaysiatoday.com/category/nation/2019/10/10/sarawak-forestry-discovers-hornbill-ivory-in-massive-wildlife-seizure/). Of these, 148 were helmet-like blocks believed to be from the HH. It has been learned that the



SFC has sent the samples for genetic analysis to Perhilitan, Peninsular Malaysia. The results of the analysis to confirm whether these helmeted like blocks were HH parts are pending.

Thailand - HH poaching incidents were reported from Thailand in the media in 2019. (https://www.bangkokpost.com/thailand/general/1759979/urgent-action-called-for-over-hornbill- hunting). DNP's Wildlife Conservation Office Director Ms. Kanchana Nittaya stated that – "In three previous crackdowns on HH hunting, five hunters were arrested while three live HH and one carcass were seized". There has also been news about HH products being sold in Thailand but fortunately, monks and celebrities have spoken against their superstitious use.

Indonesia – 72 HH casques were seized in Jakarta on 17 July 2019. The WCS Indonesia team supported the Government of Indonesia with the seizure, while Rangkong Indonesia supported the government with the identification of casques.

6. Demand Reduction

The HHWG has unanimously agreed to the establishment of a fifth subgroup for demand reduction (see proposed group structure in the image) in March 2020. The nominated and accepted Subgroup Lead is Mr. Jack Lam who is an independent researcher based out of HK.

The proposed subgroup's plan to address behavior change, and therefore demand reduction is summarized briefly below in a series thought processes and pre-existing work:

1) Prevalence of Trade and Market Trends
- What is the prevalence of trade online and in physical shops?
- What are the key outlets (e.g. online forums, social media, e-commerce platforms and physical shops) of HH products?
- What type of HH products (e.g. carvings, jewelry, cultural collectables) are

in demand?

2) Consumer Profiling

- Is there a core group of consumers that buy/collect regularly? Or are consumers one-off/opportunistic buyers? Which group represents a stronger driver of demands for HH products?
- Consumer demographics, such as gender, age groups, socio-economic and cultural backgrounds.

3) Consumer Motivations, Values & Triggers that drive purchase

- What physical traits, descriptions and values are being attached to HH products?
- Identifying potential motivations and purposes of consumption, including:
- Personal collection (cultural value—association with products such as elephant ivory and rhino horn, artistic value, historic value, rarity value).
- Self-expression (status symbol, fashion statement).
- Gifting (pertaining to cultural occasions such as new year, weddings, or other forms of networking).
- Material investment.

4) Current (perceived) deterrents to buyers

- Legislation – IUCN status, CITES regulations, and local protection statuses.
- Law enforcement and penalties – perceived risk of arrest, conviction, and severity of punishment.
- Animal welfare concerns – considerations for the cruelty of poaching.
- Conservation values – consideration for the ecological significance, intrinsic value, and rarity of helmeted hornbills.
- Social pressure against the consumption of wildlife products.

5) Co-occurrence with other high value wildlife collectibles

- Does tightening of elephant ivory legislations have positive or negative impacts on HH purchase?
- How do campaigns on other relevant wildlife products affect the consumption of HH products?
- What is the expected trend over time?

7. Other matters

The HHWG members conducted several projects on field surveys and community engagement at key HH to better understand distribution gaps and encourage and empower local communities to protect and conserve their resident HH populations.

7.1 Field Surveys of the HH

Several rapid field assessments and detailed population surveys for hornbills were undertaken in the range countries to update knowledge gaps. These include activities in **Indonesia** (Kapuas Hulu in West Kalimantan, Indonesia conducted by Rangkong Indonesia; a protected area in West Kalimantan, Indonesia by Planet Indonesia; Harapan forest, Sumatera by Burung Indonesia and BirdLife International; Gunung Leuser National Park and Bukit Barisan Selatan National Park, Sumatera, Indonesia by the National Park authorities and WCS), **Malaysia** (Belum-Temengor forest complex in Peninsular Malaysia by Malaysian Nature Society and BirdLife International; Rimba and Terengganu Nature Guides; Perhilitan & Pelindung; Sarawak Forestry Corporation with Thailand Hornbill Foundation; HUTAN, GAIA and 1StopBorneo with Sabah Wildlife and Sabah Forestry), **Myanmar** (by Biodiversity and Nature Conservation Foundation and BirdLife International),

Thailand (Bang Lang National Park and Budo mountain by Hornbill Research Foundation; and Khao-Sok and Khlong Saeng landscape by Bird Conservation Society of Thailand and BirdLife International), Brunei (new field surveys carried out by Universiti Brunei Darussalam, and part of a wider collaboration with Birdlife International Asia, United Arab Emirates University and Wildlife Reserves Singapore (WRS)).

7.2 Community Engagement

Several projects on the community's perceptions of hornbill conservation were completed at several locations in 2019 such as in Indonesia (Kapuas Hulu District, West Kalimantan by Rangkong Indonesia, West Kalimantan by Planet Indonesia); Myanmar by Biodiversity & Nature Conservation Foundation (BANCA) & BirdLife International); in Malaysia by the Malaysian Nature Society, BirdLife International and Sarawak Forestry Corporation, HUTAN, GAIA and 1StopBorneo; in Thailand by the Thailand Hornbill Project.

The Community Engagement subgroup of HHWG has a created a list of guidelines that will help standardize the documentation of Hornbill Guardian programs across the range-states.

7.3 Ex situ discussion

- To-date, one bird is known to be held at Penang Bird Park – a male individual. As very few HH exist in captivity, there is an immediate to short-term aim of running a husbandry workshop on general hornbill-keeping for relevant stakeholders (e.g. zoos/rescue centres in Indonesia). This would be in preparation for a situation where a live HH is rescued from the wild or confiscated from the trade. This will be combined with the production of guidelines for the husbandry/health of HH under human care – Jurong Bird Park, part of WRS has been tasked to take the lead on this.
- Ex-situ needs assessment – To look at carrying out a species-specific ICAP - The Integrated Collection Assessment and Planning (ICAP) workshop brings in situ and ex situ communities together to apply the decision process of the IUCN ex situ guidelines to the task of regional or global collection planning.

Recommendations for CITES

Context - The HH conservation strategy and action plan (2018 – 2027) outlines the key actions needed to tackle the trade in and conservation of the species. Whilst the strategy was developed and endorsed by several organizations including some range state governments, NGOs and research institutions and adopted by IUCN, it does not mandate a process through which governments and non-government stakeholders (such as NGOs) can collaborate in the joint implementation of the conservation action plan.

Given HH's sensitivity to poaching, data sharing agreements amongst key stakeholders (particularly governments and non-government actors) have been difficult to establish since the launch of the action plan in 2018. For example, HHWG members often do not have access to the results from the DNA analysis conducted by governments on confiscated seizures to ascertain the identity of HH products. Lack of such data is hindering the establishment of a robust range-wide "genoscape" to determine the origin of casques from the wild which can aid law enforcement in future (see section 2.2). Equally, several range state government patrols have in the past collected (or continue to collect) HH population data during large-scale mammal census but HHWG does not have access to such datasets, which hinders range-wide analyses including

developing an accurate distribution map and global population estimate. This has important conservation implications.

Below we outline recommendations to aid collaboration among stakeholders and the importance of pushing for urgent implementation of CITES decisions on the Helmeted hornbill in range, consumer and transit countries.

- Data access and sharing - through CITES encourage governments to work together and facilitate data sharing with relevant experts such as HHWG where required. Relevant platforms and mechanisms with controlled access may need to be setup as these are species sensitive to poaching activities.

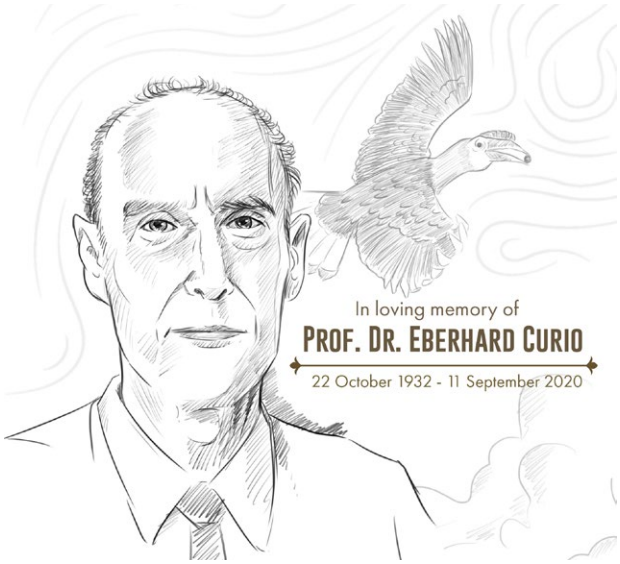
- Government focal points – through CITES encourage more active engagement between governments in range, transit and consumer countries/states and relevant experts (such as HHWG) by the appointment of a government representative in each concerned state/country with which HHWG can liaise with.

- Concern about increasing trade in more range countries - There are new concerns with the recent seizures and trade in more range countries (such as Thailand and Malaysia) and possible consumer countries (such as Laos and Vietnam). CITES needs to urge range countries to push for implementation of CITES decisions.

- Discussion with consumer and transit countries - It is important that CITES have discussions with consumer and transit country officials (e.g. China and Laos) at high-levels to push for implementation of CITES decisions on controlling/reducing the trade in HH.

Anuj Jain & Jessica Lee

Obituary: Prof. Eberhard Curio



The Philippine Initiative for Environmental Conservation (PhilinCon) team and the civil society community in the Philippines and Germany mourn the passing of Prof. Dr. Eberhard Curio on 11 September 2020 in Bochum, Germany.

Prof. Curio had spent most of his life conducting biological research work in Southern Macedonia (1958), Spain (1960), Galapagos (1962–1963), Jamaica (1969), Panama (1979), Tonga (1990), Fiji (1990–1991), and in the Philippines where he conducted the remainder of his scientific work starting in 1993.

He taught at Ruhr University Bochum (Ruhr-Universität Bochum) in Germany and became a visiting professor at the University of the Philippines .

Prof. Curio had been instrumental in pioneering conservation work and research in the Northwest Panay Peninsula Natural Park for more than 20 years.

His work resulted in the protection of several endangered species such as the Walden's Hornbill (*Rhabdotorrhinus waldeni*) and the discovery of the Panay Monitor Lizard (*Varanus mabitang*) in cooperation with herpotologist Dr. Maren Gaulke and Filipino co-worker, N. Paulino and of several new species of flora and fauna in Panay Island, Philippines. He is credited with more than 90 scientific publications.

He was the Founder, Scientific Adviser, and President of PhilinCon, which started as the Philippine Endemic Species Conservation Project (PESCP) in 1995 with support from the Frankfurt Zoological Society. The creation of PESCP laid down the work to preserve the remaining lowland rainforests in the Visayas region.

Since 1998, he was a member of the IUCN Survival Service Commission and its Re-introduction Specialist Group.

In May 2003, the International Biographical Center in Cambridge, United Kingdom, awarded him the title "Scientist of the Year". The same organization awarded him "International Educator of the Year Award". Around the same year, he was declared an "adopted son" of Brgy. Centro Norte, Pandan, Antique through a resolution.

He is best remembered as a dear colleague, a friend of the people of Pandan, Antique, and a person with a firm belief in the preservation of our natural heritage.

We will forever remember the legacy of Prof. Curio and will continue to pursue the work that he started for the future of our last natural frontiers and for the future generations to come.

Statement Released by https://philincon.org/ on 18 September 2020. On behalf of the HSG members, we share the feeling of loss but are hopeful that his exemplary work will be carried forward on the strong foundations he has laid for the conservation of endemic species including the hornbills in the Philippines.

Obituary: Eric Kowalczyk

6 February 1951 to 2 October 2020

Eric with Blueberry, the Knobbed hornbill that was under his care – an example of a lovely bond between a human and a bird.

The IUCN SSC Hornbill Specialist Group mourns the passing of Eric Kowalczyk, a champion for hornbills, focused on helping their conservation in the wild, in creating awareness and encouraging many people to do that work. It is with much sadness that we share that Eric Kowalczyk passed away on October 2, 2020. He was at his home in Seattle with his wife Sheila and surrounded by close friends.

Many of you in this group would know him and his contribution.

Eric joined the Woodland Park Zoo in 1978 and "retired" in 2017, spending most of those years working in the Conservation Aviary. Eric was devoted to animal care, especially of birds (and most especially, hornbills), and had a long and remarkable career at the Zoo, and his work was notable for its impact on field conservation programs. He retired a few years ago from his position at the Woodland Park Zoo, but remained active and passionate in other ways for hornbills. Eric continued to volunteer for the Woodland Park Zoo's Wildlife Conservation Division managing the Hornbill Nest Adoption program among other activities.

Eric had many interests and passions but was best known for his tireless work on behalf of Asian hornbills. For many years, he served as the SSP coordinator and studbook keeper for *Aceros* hornbills. He also built a long and fruitful partnership with noted conservationist Dr.

Pilai Poonswad to preserve hornbill habitat and promote education programs in Thailand's forests. Their path-breaking Hornbill Nest Adoption program has protected hornbills and their nesting trees, engaged with local communities, and provided supplemental income for local people living in and around the forests.

Everyone who knew Eric will remember him for his wit, his friendly nature and sense of humour and generosity. We have lost a wonderful and generous person and a strong and dedicated supporter for hornbill conservation.

Our heartfelt condolences to his wife Sheila Williamson, family and friends. Eric and Sheila had recently celebrated their 28th wedding anniversary. They had a shared love for travel and seeing new places and had been to more than 30 countries around the world.

Remembering Eric

"The flocks of hornbills roaming in the Budo mountain range of southern Thailand owe their survival in large part to the efforts of Woodland Park Zoo's Eric Kowalczyk. Heavily poached for young chicks prior to 1996, the six hornbill species: Great, Rhinoceros, Wreathed, Helmeted, Bushy-crested, and White-crowned, can now be seen throughout the Budo-Sungai Padi National Park as a result of the 24 year-long "Hornbill nest adoption" program involving villagers from 13 villages surrounding the Budo-Sungai Padi National Park working with the Hornbill Research Foundation affiliated with Mahidol University and in collaboration with other relevant government agencies.

The "Hornbill nest adoption" program is mostly funded by donations from individuals, the majority of whom live in the United States and Europe. Most of these generous donors who have adopted hornbill nests have done so at the invitation of Eric Kowalczyk and many of them continuously renew their yearly contributions to the program. The program has effectively led villagers and their children to appreciate the beautiful hornbills in their midst, and they are steadfast in their determination to save these beautiful birds for future generations of villagers to enjoy. The program has also been upgrading natural nest cavities found in the area to lengthen their useful lives as hornbill nests, thereby increasing the rate of hornbill propagation in their natural habitat. Eric Kowalczyk has been a primary player in this project, in addition to having been an important advisor to Thailand Hornbill Project team. He will be greatly missed."

~ Dr. Woraphat Arthayukti (President), Dr. Vijak Chimchome (Secretary-General) and committee of Hornbill Research Foundation

"Eric Kowalczyk was a true naturalist who really cared about saving endangered wildlife, especially hornbills. His dedication to help Thailand Hornbill Project save the magnificent birds have been and will be memorable to all. His easy going and lively character when talking about hornbills and wildlife is a vivid memory to me. I would like to extend my condolences to his family and loved ones for his passing."

~ Dr. Anak Pattanavibool, Hornbill Research Foundation/Wildlife Conservation Society (Thailand)

"Eric had been supporting Thailand Hornbill Project's (THP) work since 1999. He had mentioned that THP had been his favourite non-governmental organisation for research, education and conservation work. He had met and known many of the field researchers and staff of THP during his visit to Thailand and at the International Hornbill Conferences, he was genuinely keen to help us conserve hornbills in

Thailand and we are very grateful. Our deepest condolences to his wife, Sheila and family. He will be forever remembered by all of us."

~Thailand Hornbill Project team

I know that many of my friends in the zoo and conservation world and especially those in hornbill conservation will have enjoyed the company of Eric Kowalczyk. I recently heard the sad news that Eric had passed away on October 2nd. Till then he remained active on hornbill websites and kept in touch with me through e-mail. Eric was a really lovely guy who I had the privilege to know for over 20 years. Eric was committed to hornbills and focused not only on their conservation but in developing interest in young people who could take that forward. I met him at Hornbill meetings worldwide and through him we forged a partnership between Woodland Park and Chester Zoo supporting hornbill field conservation in Thailand and Sabah. I have great memories of staying with Eric and his wife Sheila Williamson at their home in Seattle. Their kindness and hospitality was exceptional. I will really miss Eric and know so many others will too."

~ Roger Wilkinson, Formerly Conservation Project Manager/Head of Field Conservation & Research, Chester Zoo, UK.

"I first met him as a student at the 2001 International Hornbill Conference in Phuket, Thailand and ever since then he became a friend and a supporter of our hornbill work as he had been of other Asian colleagues, especially in Thailand, Malaysia and Indonesia. We met over the years in other hornbill conferences and in Seattle where he showed me around the zoo to see his beloved *Aceros* hornbills and for dinners together with his wife Sheila. We remained in touch often over Facebook and email.

Given his interest, I requested him to be an admin of our public Facebook Group (IUCN Hornbill Specialist Group for Public Engagement) and he immediately agreed and was posting regularly for the group. We will not have someone as dedicated and interested to post on that group. He also had his own Facebook page called 'Everything Hornbill' where he shared news and images of hornbills from all over."

~ Aparajita Datta, HSG Co-chair & Scientist, Nature Conservation Foundation

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The IUCN SSC Hornbill Specialist Group would like to acknowledge those who have contributed to and supported the production of two issues of the *Hornbill Natural History and Conservation* in 2020, the newsletter of the IUCN Hornbill Specialist Group. Many members of the group have helped with reviewing the manuscripts and are listed below.

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Janhavi Rajan, from Nature Conservation Foundation (janhavi@ncf-india.org) has been instrumental in designing and formatting the issues of *Hornbill Natural History and Conservation* with the highest levels of patience and creativity.

Rangkong Indonesia, (http://rangkong.org) have set up the social media accounts for the IUCN-SSC HSG and manage our social media communications.

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