THE KINABATANGAN ORANG-UTAN CONSERVATION PROJECT (KOCP):

CONSERVING HORNBILLS IN SABAH

HUTAN
Kinabatangan Orang-utan Conservation Programme

Report written by Ravinder Kaur and Dr Marc Ancrenaz – May 2016
With the assistance in the field of: Rajak bin Saharon, Haslan Bin Saidal, Daisah Bin Kapar, Hisyamuddin Bin Abd Rauf, Azman Bin Abdullah, Ahmad Sapie Bin Kapar, Ahmad Syukrien Bin Abdul Rauf, Berjaya Bin Elahan, Eddie Bin Ahmad, Hasbollah Bin Sinyor, Johari Bin Jamal, Mahathir Bin Ratag.

2 HUTAN – KOCP: Hornbill Conservation Activities

BACKGROUND INFORMATION

The Kinabatangan Orang-utan Conservation Programme (KOCP) is conducted by the French NGO HUTAN in collaboration with the Sabah Wildlife Department. KOCP initiated a holistic conservation programme in the Kinabatangan floodplain in 1998. Today, more than 50 community members are working full-time to preserve and manage wildlife and the natural resources found in this internationally renown area. One of our goals is to enhance the prospects of long-term survival of key wildlife populations found in Kinabatangan. This includes hornbills.

Eight species of hornbills occur in Borneo. They are all found in the Lower Kinabatangan. These species are:

SPECIES	SCIENTIFIC NAME	IUCN STATUS
Rhinoceros Hornbill - RH	*Buceros rhinoceros*	Near threatened
Helmeted Hornbill - HH	*Rhinoplax vigil*	Critically endangered
Black Hornbill -BH	*Anthracoceros malayanus*	Near threatened
Oriental Pied Hornbill - OPH	*Anthracoceros albirostris albirostris*	Least concern
Bushy-crested Hornbill - BH	*Anorrhinus galeritus*	Least concern
Wreathed Hornbill - WEH	*Aceros undulatus*	Least concern
White-crowned Hornbill - WIH	*Aceros comatus*	Near threatened
Wrinkled Hornbill - WRH	*Rhabdotorrhinus corrugatus*	Near threatened

The status and the recent trends of hornbill populations in Kinabatangan are largely unknown. However, field surveys and interviews with villagers living in the floodplain gave a general indication about hornbill populations in lower Kinabatangan:

- Hornbills are relatively well known by most members of local communities. The general perception by the public is rather positive, although conflicts occur someties with orchard owners.

- The most common species seen in the forest and reported by the informants were the Oriental Pied hornbill (close to the villages) and the Rhinoceros hornbill (mostly sighted along the river banks or flying above the river).

- More species are spotted in the lower parts of the floodplain in areas where forest patches (Lots 1 to 4) are in better condition compared to the upper parts (Lots 7 to 10).

- A few decades ago, before forest conversion reached peak levels in the area, hornbills were heard regularly but seen rarely from the village; they used to remain in the forest, away from people's houses. As a result of forest fragmentation and size reduction, direct hornbill sightings have increased over the past 20 to 30 years. However, most also informants reported that sightings of larger species are now becoming rare, indicating a possible decline of hornbill numbers in Kinabatangan (especially HH, WRH and WTH). Local informants attribute this decline to the destruction of large trees that were used as nesting sites, the diminution of food supplies as well as the general degradation of the environment in Kinabatangan.


Male RH in the forest

Based on this information, we initiated a simple monitoring programme of these species around Sukau area. Our results confirmed that sightings of most species (except for the OPH) were declining.

Several hypothesis were formulated to explain this decline:

- **Hunting**: hunting pressure from local community members appears to be low. However, we cannot rule out the possibilities for some birds to be shot or caught by outsiders living in nearby oil palm plantations.
- **Capture for pet trade**: the pet trade is a common threat in Asia. However, the Kinabatangan floodplain is currently largely unaffected by this.

- **Lack of food resources**: though categorized as omnivorous (Kemp, 1995), Asian hornbills are mostly frugivorous, feeding on the fruits of an array of plant species, from various families such as Annonaceae, Burseraceae, Meliaceae, Moraceae and Myristicaceae (Leighton, 1982). The most common food source of hornbills is figs (Johns, 1987, Kemp, 1995, Kitamura et al., 2004, Leighton, 1982, Plongmai et al., 2005). Although forests in Kinabatangan are highly degraded and fragmented, they support an amazing abundance and diversity of wildlife. Previous KOCP studies have shown that plant communities are still diverse and highly productive in the Sanctuary, providing regular food supplies to different guilds of frugivorous animals. A visit by Professor Pilai, a world-know expert for Asian hornbills confirmed that food resources were sufficient to support viable hornbill populations.

OPH feeding on wild fruits

- **Lack of nesting sites**: Asian hornbills usually nests in natural cavities located in living trees (Balaraman and Balasubramanian, 2003). They are unable to excavate their own nest cavity and depend on primary cavity-nesting birds such as woodpeckers or naturally occurring cavities for their breeding needs (Mudappa and Kannan, 1997). Naturally formed cavities are created when branches break and decay due to fungal infection (Datta and Rawat, 2004). Thus, changes in forest structure as a result of logging and other type of disturbance greatly affect the reproduction of hornbills (Datta and Rawat, 2004, Kemp, 1995). Logging diminishes available nest cavities, and affects the lives of hornbills (Cahill, 2003). Large hornbill species need large cavities that are only found in large, mature trees. Hornbills are known for their habits of reusing a nest cavity year after year (Kemp, 1978). Thus, without the replacement of lost nest sites, the breeding populations may face a decline. Nesting in natural cavities is a behavior that offers protection from climate fluctuations and

Male BH visiting a natural cavity

from predators (Lill and Fell, 2007). During the past 30 years, aggressive logging and forest conversion to agriculture in Kinabatangan has resulted in the destruction of all emergent trees. As a result, large trees that could provide suitable nesting sites to large hornbill species in Kinabatangan are scarce. Professor Pilai confirmed that the lack of suitable nesting sites was explaining the decline of the larger species.

This preliminary assessment of hornbill status in Kinabatangan led to the development of a conservation strategy for hornbills in the floodplain. Our conservation targets include:

- **Enhanced scientific knowledge of hornbill ecology in Kinabatangan:**
  - Monitor hornbill population trends in Kinabatangan;
  - Document the breeding ecology of hornbills in Sabah;
- **Improved chances of long-term survival of the hornbill population living in Kinabatangan:**
  - Establish artificial nest boxes and monitor their use by hornbill species;
- **Enhanced community engagement in the conservation of the hornbills and their habitat:**
  - Develop a curriculum about hornbill conservation and ecology to be included in the environmental education programmes delivered by HEAP (HUTAN Environmental Awareness Programme;
  - Enhance knowledge and awareness about hornbill conservation needs in Sabah;
- **Enhanced human resource capacity and commitment to manage and conserve hornbill populations in Sabah.**
  - Support Ravinder Kaur to do her field work to obtain a PhD;
  - Improve capacities of like-minded people to record accurate information about hornbill presence.

Molted feathers from a female OPH recovered from an artificial nest after the successful breeding by the pair (see below).

1. Enhanced scientific knowledge of Hornbill conservation status in Kinabatangan.

Regular hornbill monitoring along the Kinabatangan River.

Two stretches of 8 km of riverbank are surveyed for three consecutive days every month to detect hornbill presence around Sukau. For every group of hornbills spotted by the field researchers, we record information about species, group size, sex and age groups (when possible), behavior and location in a specific data sheet. These sightings inform us about fluctuation of presence/absence throughout the year; group size; presence of young and juvenile birds; favorite feeding sites; etc.

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
OPH	■	■	■	■	■	■	■	■	■	■	■
BCH	■	■	■	■	■	■	■		■	■	■
BH	■	■	■	■	■	■			■	■	■
HH									■		
RH	■	■	■	■	■	■	■		■	■	■
WCH			■		■	■				■	
WH		■			■						
WRH	■		■	■	■	■	■	■	■	■	■

Table 1 showing the presence (shaded box) of hornbill species in the vicinity of Sukau area in 2015.

Spesies	Number of groups detected	Number of individuals	Average group size
BCH	24	137	5.7
BH	31	51	1.6
HH	1	1	1.0
RH	28	54	1.9
WCH	5	11	2.2
WH	2	5	2.5
WRH	53	181	3.4

Table 2 showing the average group size for different hornbill species (OPH not included)

Document the breeding ecology of hornbills in Sabah.

The KOCP team members record the location of natural cavities that are successfully used by the birds in the forest. To date, our teams have found six nests.

Spesies	Tree species	DBH (m)	Tree's height (m)	Height of cavity (m)
RH	Shorea atrinervosa	3.7	33	22.9
OPH	Nauclea orientalis	2.2	15	1.7
OPH	Artocarpus odoratissimus	1.3	12	2.4
OPH	Nauclea orientalis	1.7	16	2.5
OPH	Pterospermum elongatum	2.1	29	6.0
HH	Shorea pauciflora	3.8	50	37

Table 3 showing the characteristics of trees used by hornbills for breeding.

So far our findings show that the largest species of hornbills tend to select the largest and tallest trees for breeding purposes. The OPH is more ubiquitous and can breed in smaller trees at a lower height from the ground compared to other hornbill species.

Picture 1: team monitoring the breeding pair of HH in Pangi FR

The team is closely monitoring the pair of HH that is successfully breeding in the forest of Pangi (see Table 3). In March 2014, we first realized that the female was already sealed inside the nest. We monitored the nest twice a week from sunrise to sunset. Our observations showed that the adults fed heavily on figs and stick insects during the breeding period (picture 1 shows the tarpaulin that were set up below the nest to recover feces and feeding material rejected by the nesting birds). The female left the nest in October 2014, after having spent almost seven months enclosed in the nest. The pair of adults still fed the young inside the nest for another few weeks. In December 2014, the fledging was spotted with its parents outside of the cavity. Molding of the adult male occurred at the end of the year. The following year, the pair used the same cavity again but the female left the nest after several months without any chick.

A pair of RH started to use the natural nest in April 2015. During the period the female was sealed inside the cavity, the make was feeding her mostly with fruits and insects every two hours in average (see picture 3).

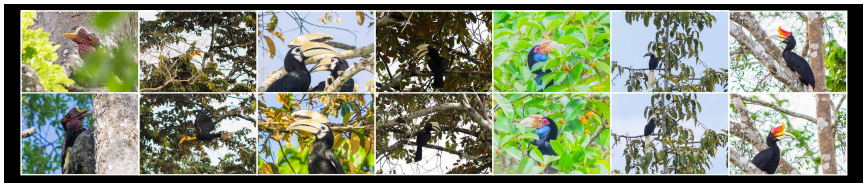
In 2015, Ravinder Kaur registered for a PhD at UPM to investigate the breeding ecology of hornbills in Kinabatangan (see below). This research will combine different techniques to better understand the breeding ecology of hornbills in the area: forest assessment plots; distribution surveys; direct sightings and monitoring of breeding pairs; camera trapping; abundance estimates; etc. The KOCP field research assistants are assisting Ravinder in the data collection.

One component of our study is to characterize the different forest types and the fluctuations of food availability for hornbills throughout the floodplain. A series of botanical plots was thus established to better document the natural resources that are available and used by these species. Earlier this month, Ravinder and the KOCP teams tested an occupancy study for hornbills in the lower Kinabatangan.

Ravinder is also testing a new capture-recapture methodology using pictures of birds: see below.

MARK RECAPTURE MODELLING
USING IDENTIFICATION PHOTOGRAPHS

BY: RAVINDER KAUR & SANJITPAAL SINGH



1 INTRODUCTION

Abundance estimation is imperative for the development of sound management and conservation practices (Davies et al., 2012). This has been challenging for the hornbill species, with methods such as 'point counts' and 'distance sampling' being prescribed. More than 1000 point counts have been recommended for hornbills while distance sampling is difficult to apply for a highly mobile species in the dense tropical rainforest.

- Photo-identification as an alternative to marking individuals.
- Mark recapture using photography - applied to several population estimate studies; tigers *Panthera tigris* (Karanth et al., 1995) and Great Argus Pheasants *Argusianus argus* (O'Brien et al., 2008).

2 METHODS

- Animals are sampled on multiple occasions and they are marked or identified from their natural markings (by photo identification).
- Photographs were taken by one volunteer photographer using a tripod bound camera to ensure high quality of images photographed in RAW format.
- Photographs of individuals that depict both its left and right sides of its head are retained to avoid misidentification of the individuals.
- The photos are captured along the riverbank in two separate surveys conducted in the morning (0700-1030 hrs) and in the evening (1600-1800 hrs).
- Length of the river surveyed is 8km.
- Photographs are then compiled in a catalogue and each individual hornbill is given an identification number
- The data is keyed in as binary data
- This study, nine hornbill species were photographed over three sampling months.

The assumptions of the Cormack-Jolly-Seber model:

- The population is open
- All members of the population are equally likely to be marked and recaptured
- All marked animals are randomly distributed in the population at the time of recapture.
- A sample of individuals is captured, marked in a manner that does not affect survival, and then released back into the population.

3 RESULTS

- Seven out of nine species of hornbills photographed, have potential of being individually recognised in an accurate manner
- Largest data set obtained was 19 individually marked Oriental Pied Hornbill.
- 16 from 618 pictures fulfilled this study's criteria.
- Results were analysed using the Cormack-Jolly-Seber model in 'R'.
- No recaptures over the three sampling periods more sampling sessions are needed before the analysis can be carried out

4 DISCUSSION

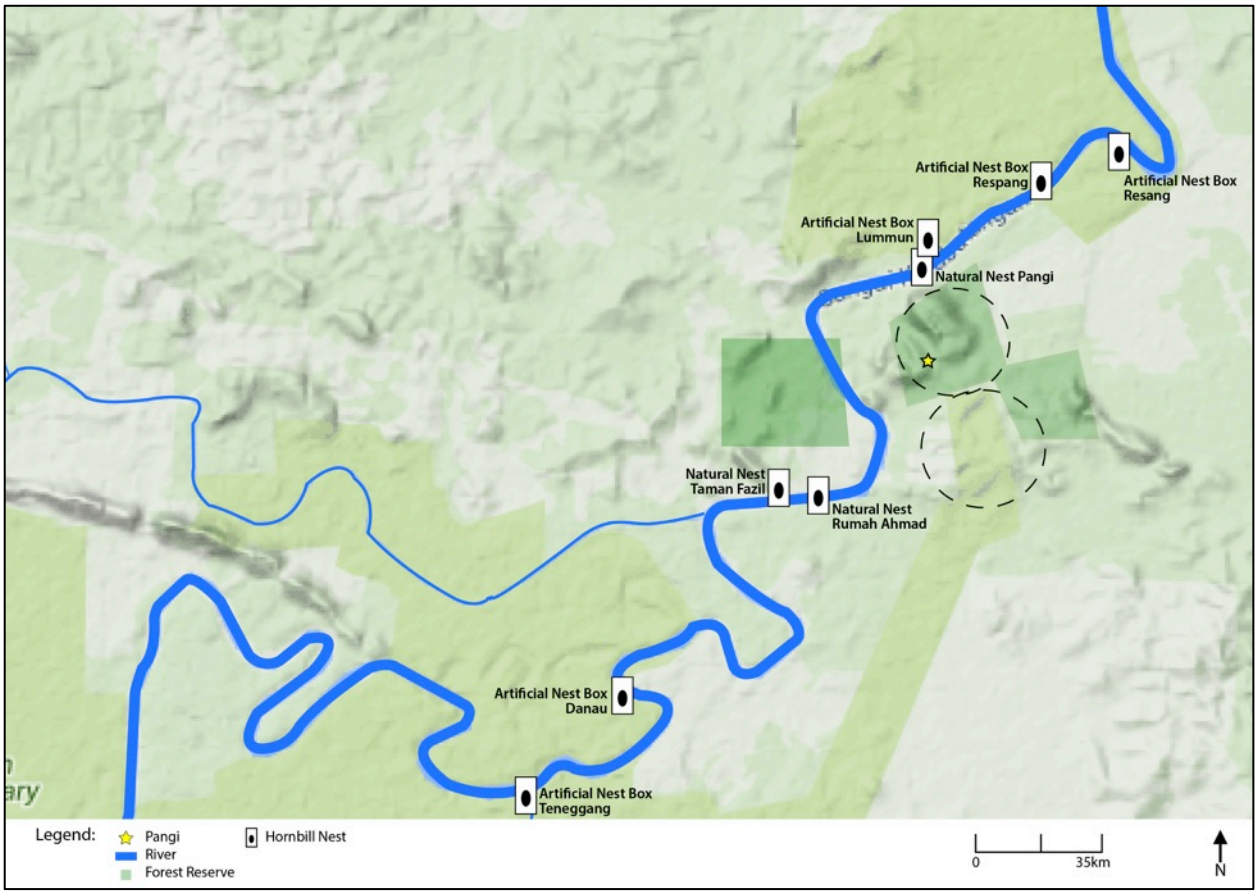
We have demonstrated here that seven species of hornbills can be identified individually from nine species of hornbills. We were limited in terms of resources and could not cover a larger area or appoint many more photographers. With the growing interest in bird photography, mark-recapture using bird photography and photographers has much potential in nature conservation. In addition, spatially explicit mark recapture (SECR) techniques has potential for future abundance estimate studies of hornbills.

REFERENCES

DAVIES, T. K., STEVENS, G, MEEKAN, M. G, STRUVE, J. ROWCLIFFE, MARCUS. 2012. Can citizen science monitor whale-shark aggregations? Investigating bias in mark-recapture modeling using identification photographs sourced from the public.
EFFORD, M. G. & FEWSTER, R. M. 2013. Estimating population size by spatially explicit capture–recapture. Oikos, 122, 918-928.
KARANTH KU (1995) Estimating tiger Panthera tigris populations from camera trap data using capture–recapture models. Biol. Conserv. 71: 333–338.
O'BRIEN T, KINNAIRD M (2008) A picture is worth a thousand words: the application of camera trapping to the study of birds. Bird Conservation International, 18, S144-S162.

2. Improved chances of long-term survival of the hornbill population living in Kinabatangan: artificial nest boxes.

In 2013, KOCP set up five artificial nests in the Kinabatangan Wildlife Sanctuary in collaboration with Beauval Zoo and Chester Zoo (Map 1).



Map 1: Location of natural nest cavities and artificial nest boxes in Kinabatangan Wildlife Sanctuary.

Four of the artificial nests were cylindrical and the fifth artificial nest was rectangular in shape (Figure 1). The rectangular artificial nest was made from recycled plastic materials. The inner part of the cylindrical artificial nest was a commercial plastic drum, commonly used for storing water. The drums were then wrapped with styrofoam, a wire mesh and then layered with a mixture of cement and sand. Two of the artificial nests were layered with a second coating of cement and sand. The artificial nests were then named according to their location; Danau, Resang, Respang, Lumun and Teniggang.

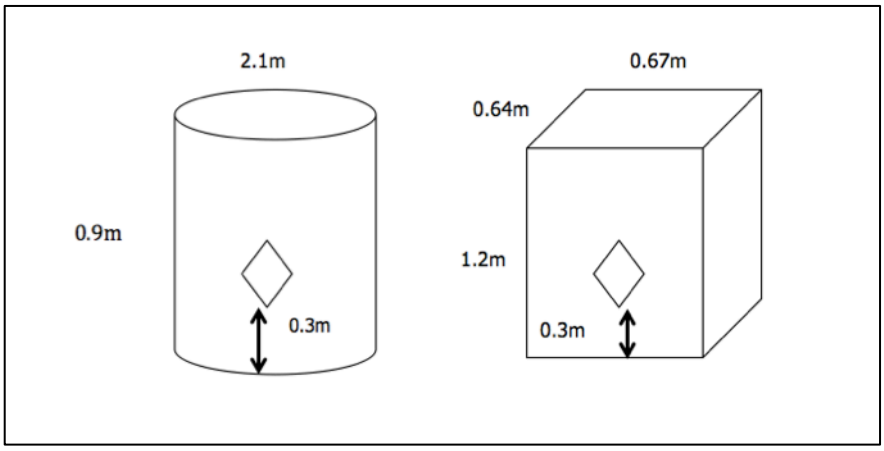
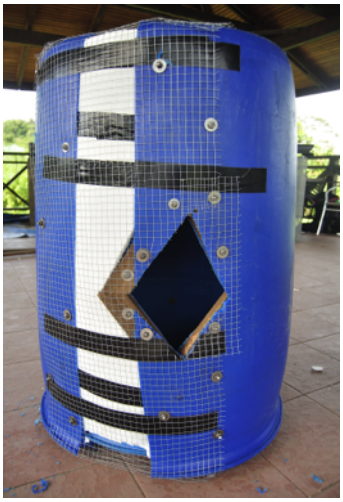
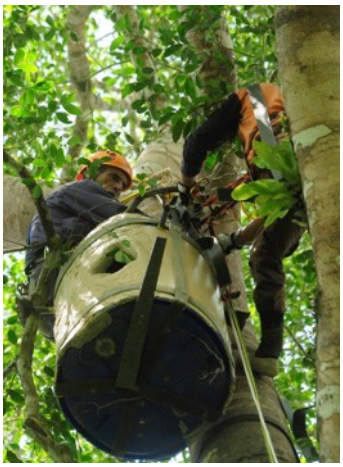


Figure 1: Two types of artificial nest cavities that were designed by Beauval Zoo (left) and Chester Zoo (right). Both diamond shaped entrances were designed to be 0.1m wide and 0.29m in length.





Micro-environmental conditions inside the nests and natural cavities.

Very little is known about the microclimate of secondary-cavity-nesting birds in natural nest cavities (Rhodes et al., 2009). There have been many studies on the breeding biology of hornbills but very little has been documented on the conditions inside the nest cavities. Hence, it is imperative to understand the microhabitat requirements of secondary-cavity nesters and apply that knowledge to develop nest boxes with appropriate microclimate conditions.

A pilot study was conducted in 2015-2016 to measure the humidity and temperature within natural cavities (that were known breeding sites) and artificial nest boxes. First, we placed four RHT 10 USB Extech data loggers measuring temperature and humidity in four natural cavities (all of these cavities were natural nests used by OPH). The data loggers were concealed inside a wire mesh for protection. The data loggers were configured to record every half an hour and remained within the cavities for five months (October 2014-February 2015), over the span of the wet monsoon season. We also placed data loggers outside of the cavity. Data loggers were also placed in a similar fashion both inside and outside four artificial nest boxes.

At the end of the experiment, we retrieved data loggers from two artificial nest boxes and one natural cavity: Teniggang, Danau and Pangi. The other devices had been destroyed or damaged by wildlife (hornbills, monkeys or else) or by weather conditions, or couldn't be retrieved because of bird's presence inside the cavity (n=1). We compared the internal and external temperatures and humidity using a box and whiskers plot, (Figure 2). The artificial nest box Teniggang experienced a wider fluctuation for both temperature and humidity whereas artificial nest box made with drums experienced a narrower fluctuation for both temperature and humidity. However fluctuations for both temperature and humidity were significantly narrower for the natural cavity: Figure 2.

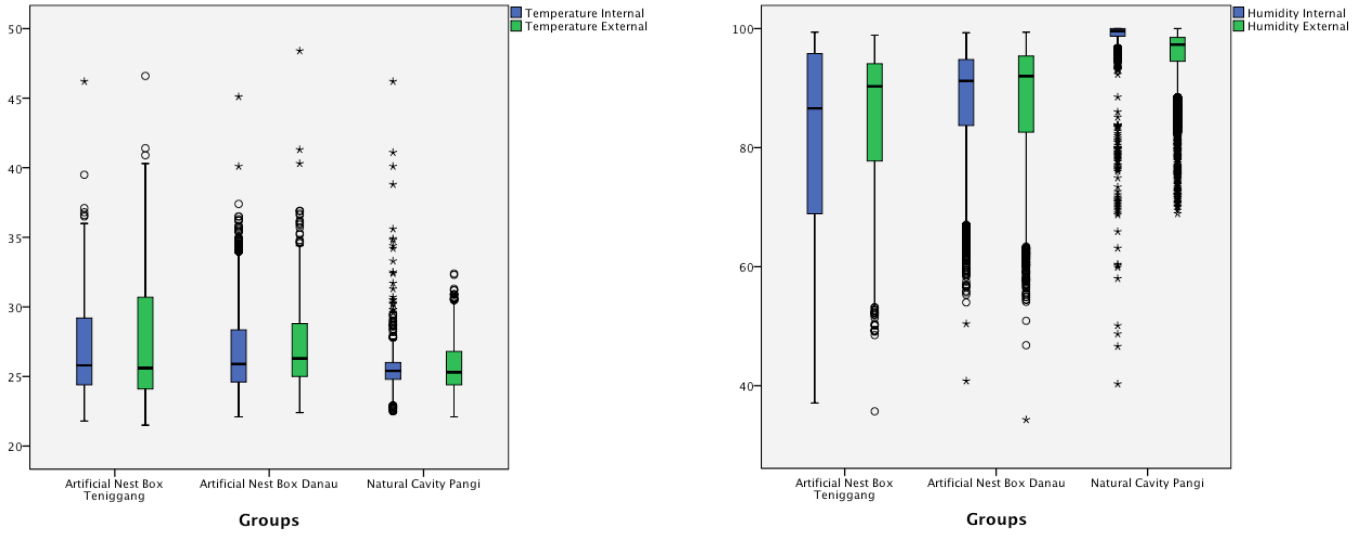
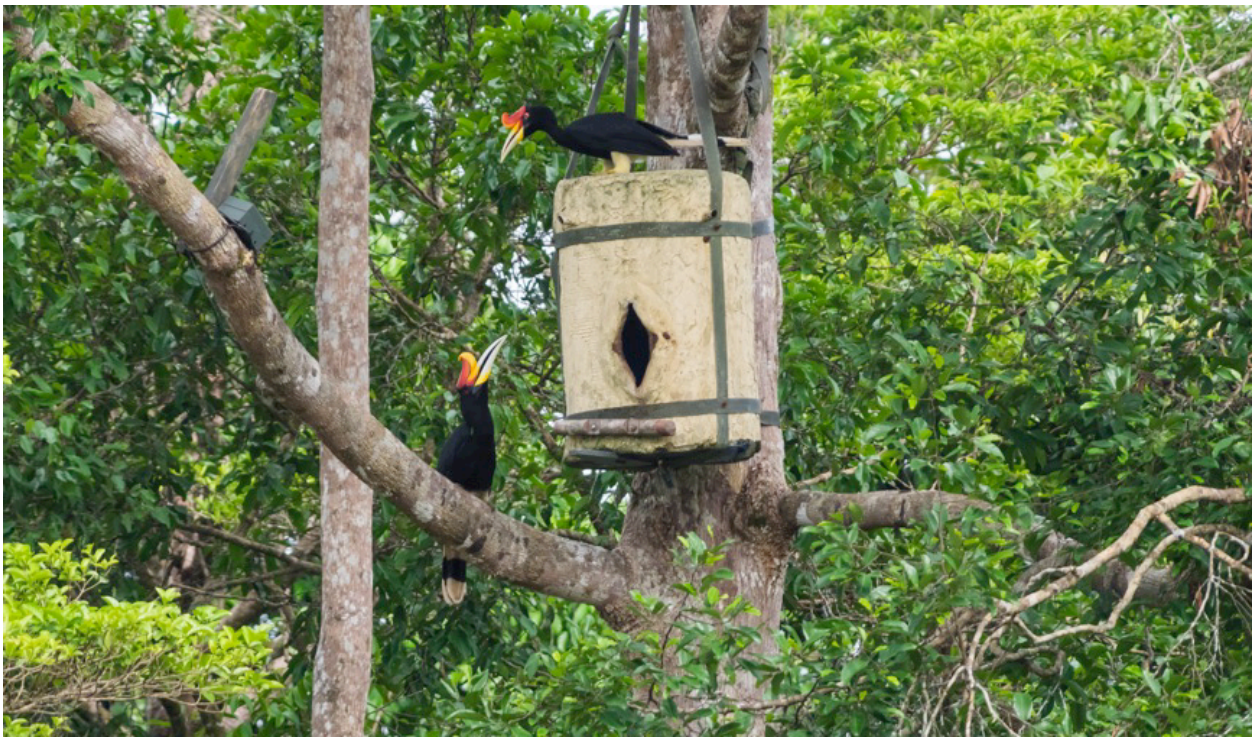


Figure 2: Internal and external temperatures and humidity for artificial nest boxes (2) and a natural cavity.

The data generated from the data loggers were also divided into groups to represent a certain time period i.e. afternoon, early morning, evening, late morning, morning and night. The average of the readings were then calculated for each time period. A line graph was generated to depict fluctuations in the daily mean temperature and humidity among all three-nest types: (Figure 3.1 - Figure 3.6).

Our findings clearly show that the micro-environmental conditions are more stable in a natural cavity. Temperature is lower in average and humidity higher compared to microclimate conditions of artificial nest boxes.



Picture 2: A pair of rhinoceros hornbills has visited and spent extended periods of time close to this artificial nest box for six consecutive months. Although the female spent some time inside and the birds started to seal the opening, the couple hasn't used this box for breeding yet.

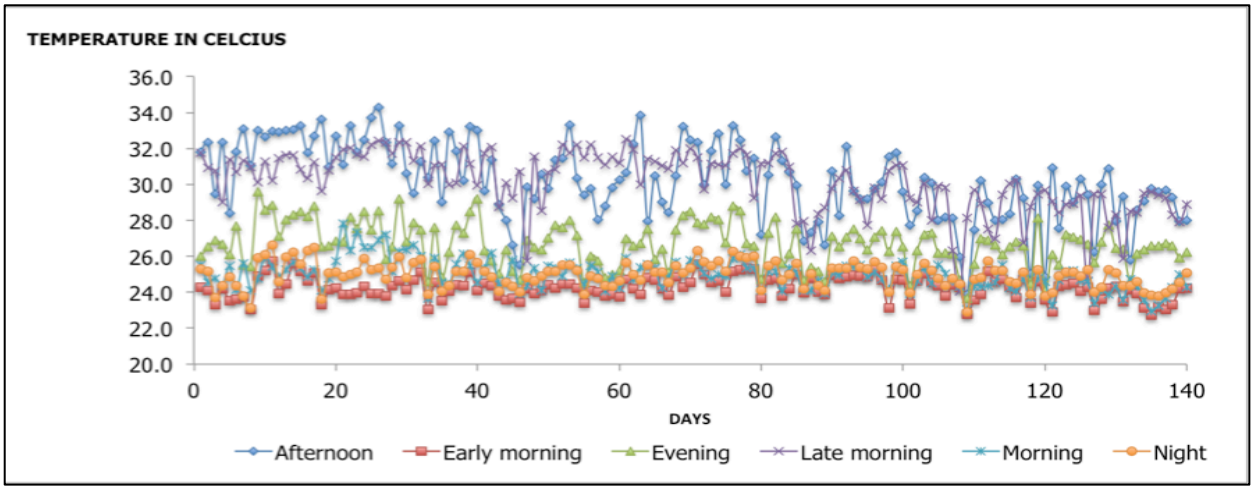


Figure 3.1: Mean internal temperature of the artificial nest box Teniggang

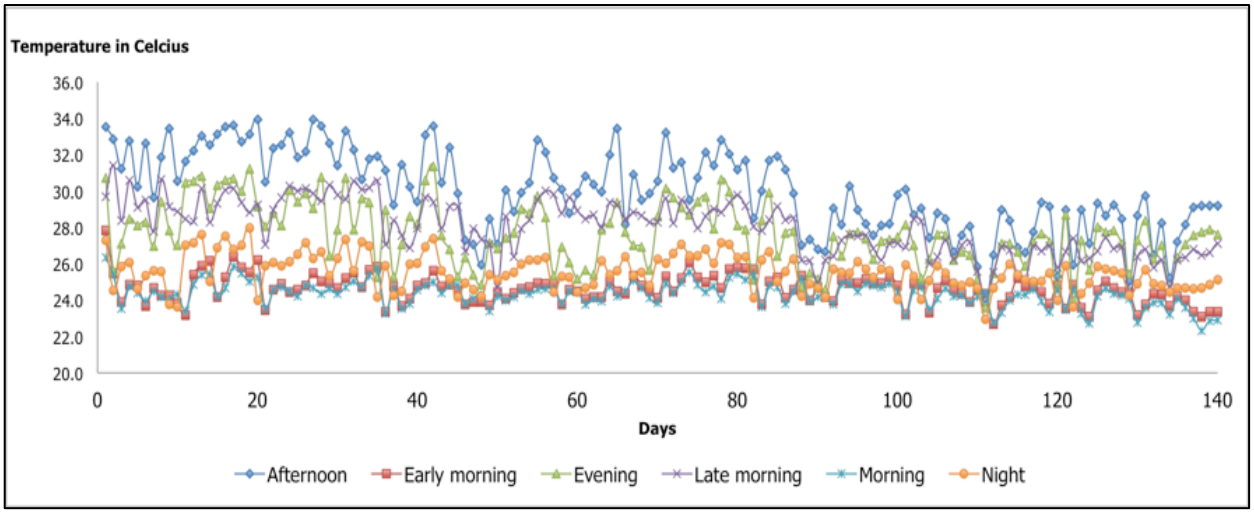


Figure 3.2: Mean internal temperature of the artificial nest box Danau

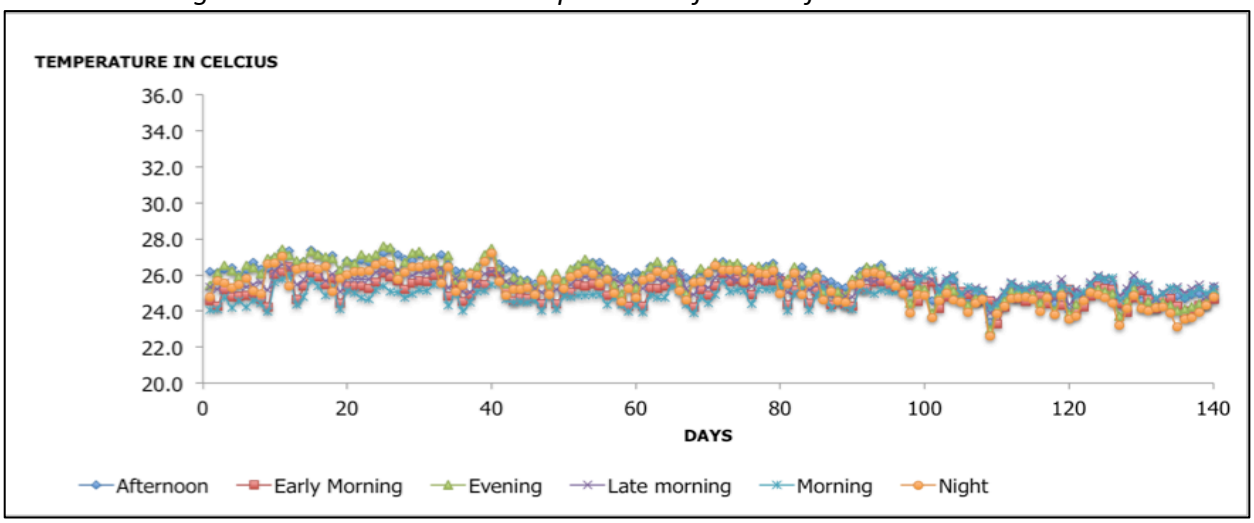


Figure 3.3: Mean internal temperature of the natural cavity Pangi

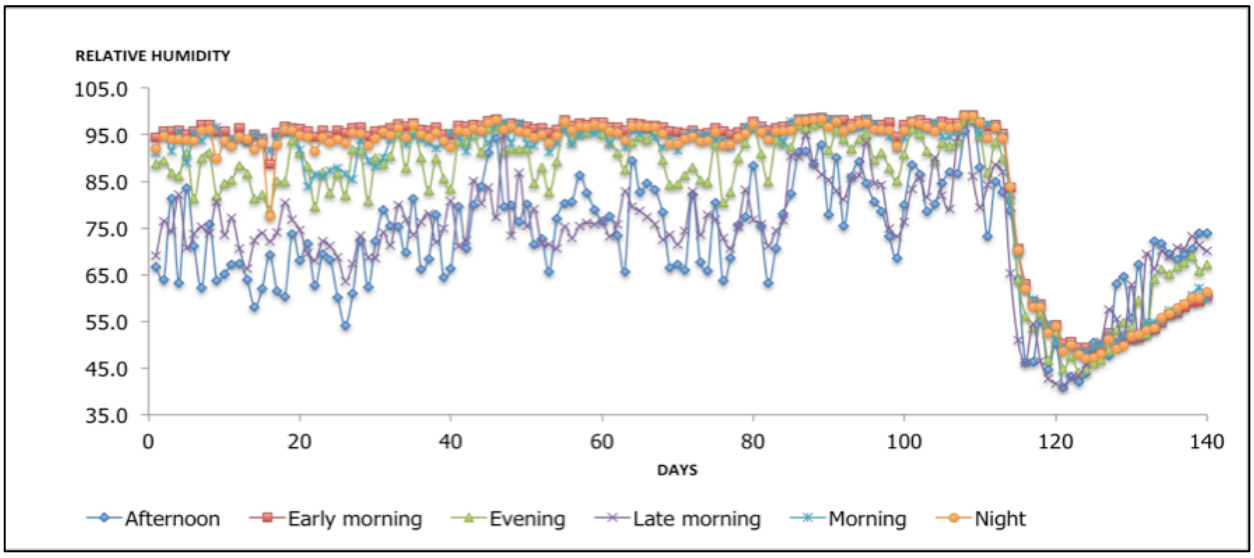


Figure 3.4: Mean internal humidity of the artificial nest box Teniggang

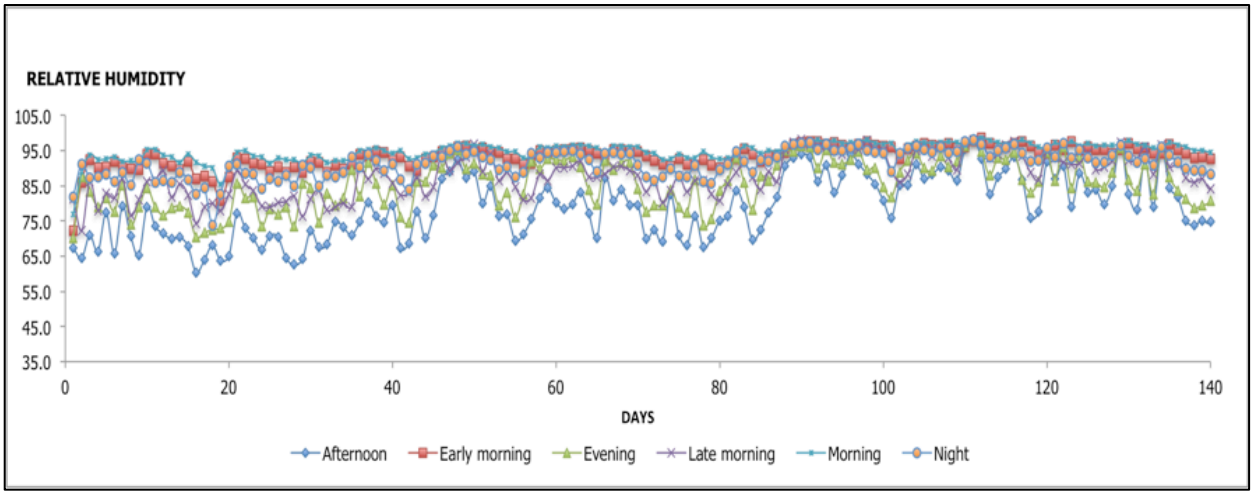


Figure 3.5: Mean internal humidity of the artificial nest box Danau

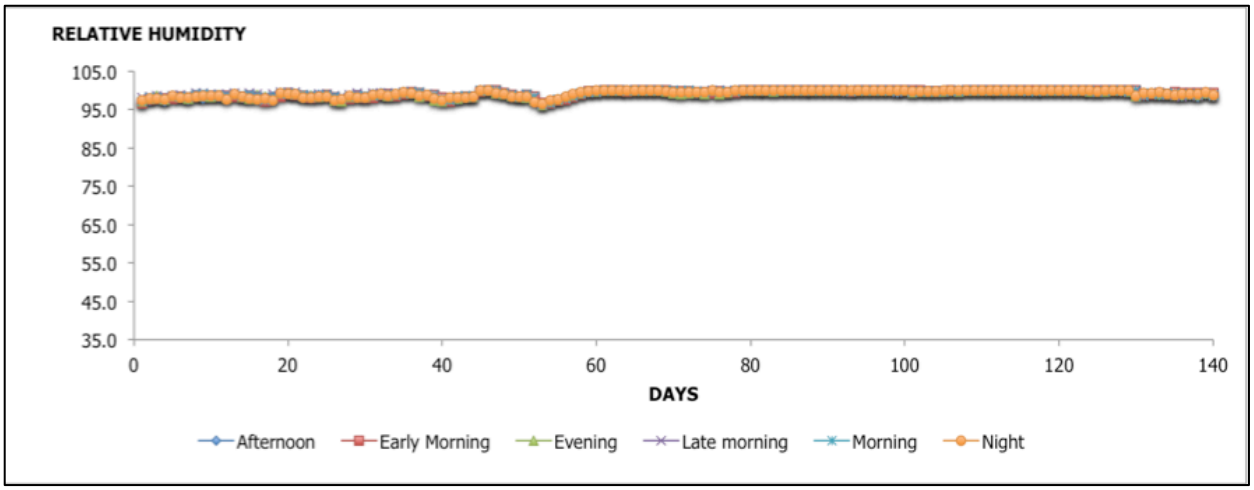


Figure 3.6: Mean internal humidity of the natural cavity Pangi

Picture 3: Male Rhinoceros hornbill feeding the female that is concealed inside a natural cavity. This couple was monitored during their breeding period in 2015.

Results of camera trapping.

We monitored the visits made by animals to the natural and artificial nest boxes by using camera traps. The camera traps (Reconyx) were placed 1 to 2 meters from the cavity facing its entrance to obtain sharp and clear images. A total of 9773 images were captured at the Teniggang artificial nest box (Figure 4); 1390 images were captured at the Danau artificial nest box (Figure 5); and 4922 images were captured at the Resang artificial nest box (Figure 6) The fourth artificial nest box could not be accessed due to the constant presence of a Rhinoceros hornbill pair (see picture 3).

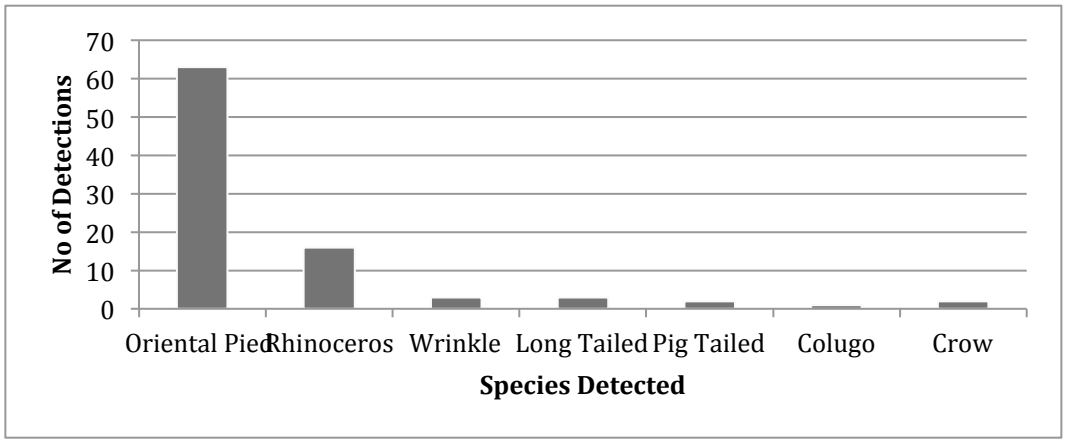


Figure 4: Teniggang Artificial Nest Box (91 images with animals from a total of 9773 images)

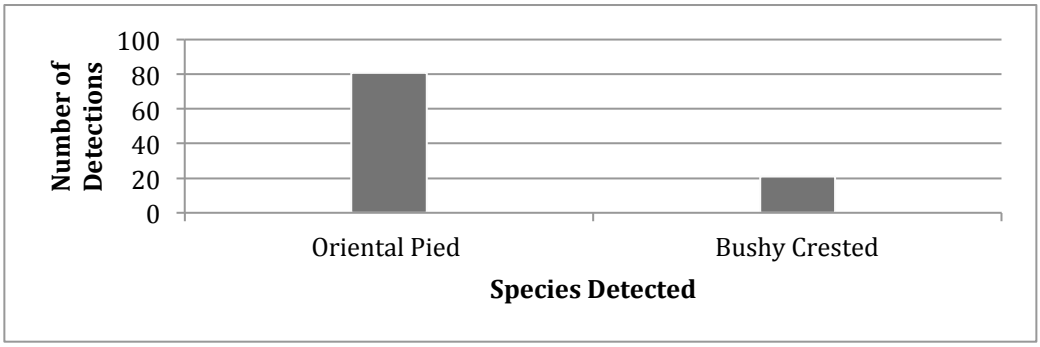


Figure 5: Danau Artificial Nest Box (102 images with animals from a total of 1390 images)

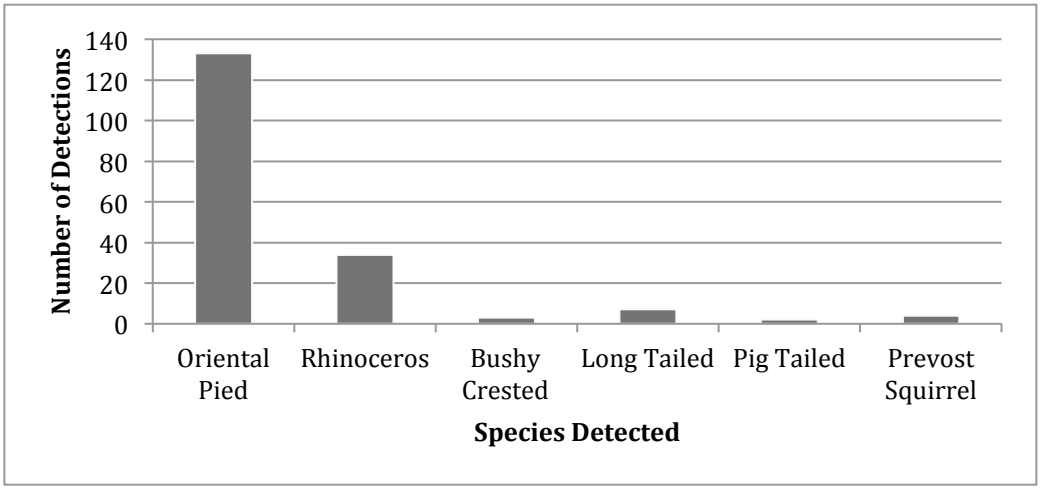


Figure 6: Resang Artificial Nest Box (183 images with animals from a total of 4922 images).

A pair of OPH investigating an artificial nest box (two of these boxes were used successfully by a pair of OPH).

A family of BCH investigating the same nest box as above.

Male and female WRH investigating the square artificial nest box.

These results show that the artificial nest boxes that were set up in 2013 attracted the attention of nearly all hornbill species in Kinabatangan. However, only the OPH has been able to use these nests for breeding purpose. Our next step will include the design of new artificial nest boxes that will (1) lower the internal temperature; (2) raise the humidity within the boxes and (3) reduce overall daily fluctuations that could be the major impediment for breeding site selection. Nests using wine barrel are currently tested at Chester zoo while other designs using water-resistant plywood are tested in Malaysia. A survey with European zoos spearheaded by the RH TAG Group will also investigate microclimate conditions experienced by breeding pairs in captivity. In Kinabatangan, we will cover the current artificial nests that are set up in the forest with epiphytic plants that may buffer the fluctuations of temperatures and humidity recorded during the day. A special attention will be given to the direction of the opening when new nests will be erected.

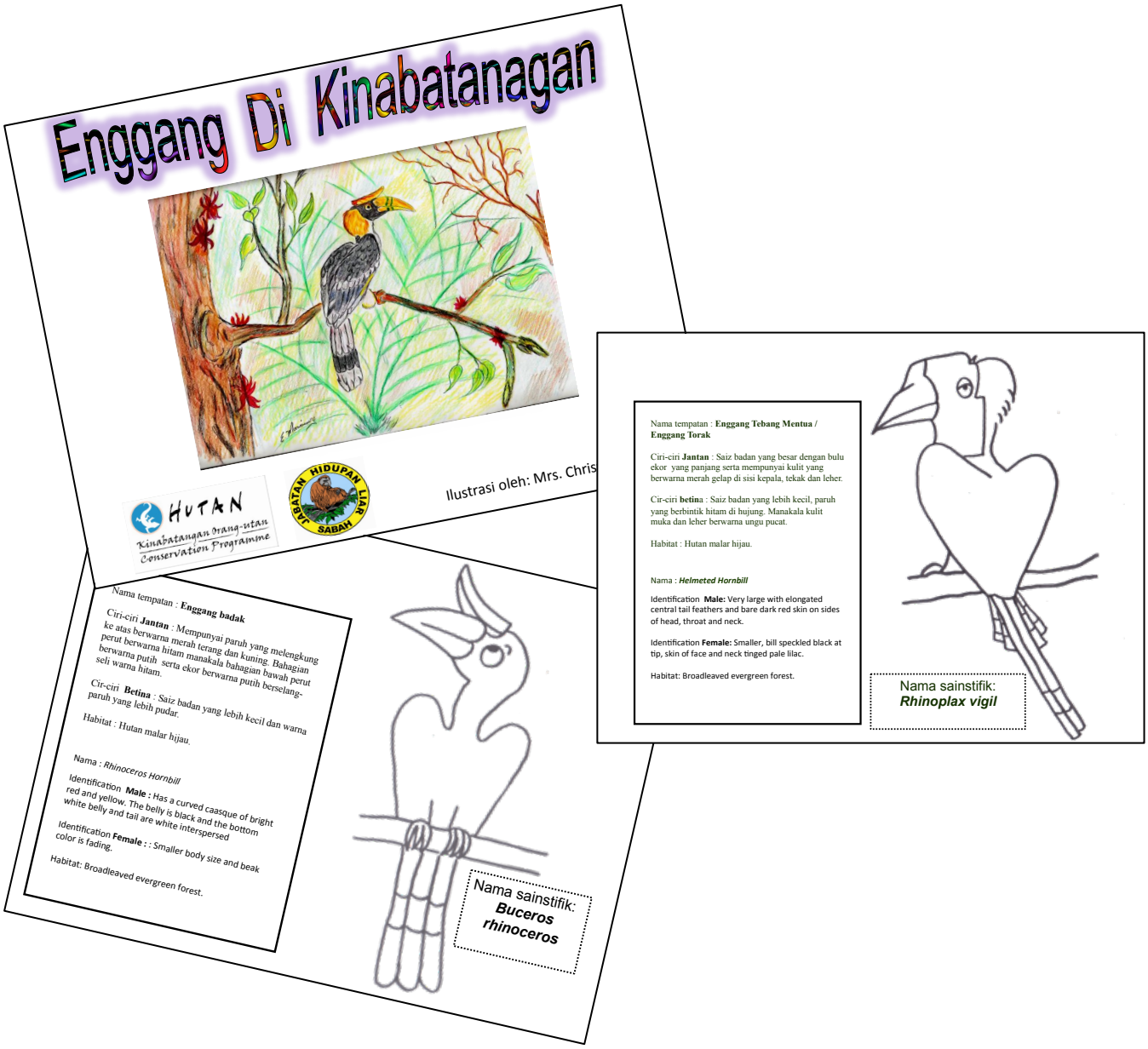
3. **Enhanced community engagement in the conservation of the hornbills and their habitat:**

Develop a curriculum about hornbill conservation and ecology to be included in the environmental education programmes delivered by HEAP (HUTAN Environmental Awareness Programme);

Raising awareness in Sabah about the need to better manage and to preserve wildlife is one of KOCP strategic goals. The "Hutan Environmental Awareness Program" or HEAP is in charge of these activities. Last year alone, HEAP organized education programmes in 24 different schools, reaching out more than 4,000 students and 300 teachers.

HEAP has developed and produced a small coloring book about the eight hornbill species found in Sabah (see pictures below). This booklet is in dual language (Bahesa Malay and English). It is part of the curriculum developed by HEAP about these birds. The curriculum includes slide shows, posters, videos and stories about hornbill explaining its ecological function and basic life history. Each student who is attending the awareness programme receives one of these booklets to bring back home.

Last year, KOCP also produced two short videos about hornbills that are used during our education events. We also welcomed a team of Malaysian professional cineastes who are producing a video about hornbill conservation efforts in Kinabatangan.



Exert (3 pages) of the booklet produced by HEAP and given to every student who is attending our awareness activities about hornbills (the front page is in color while each bird is sketched in black and white).

- **Enhanced human resource capacity and commitment to manage and conserve hornbill populations in Sabah.**

Building local capacities is one of HUTAN's priorities. This is done through the organization of training courses for selected audiences or by attending specific sessions organized by other groups and organizations.

In 2015, KOCP field research assistants attended several training courses that are directly relevant to hornbill conservation activities:

- *Borneo Eco Film Festival*: three trainings of 5-days were organized by BEFF and SUARA Community film-making during the year. A variety of skills were learnt during these courses: video editing; video programming; video recording; story telling; etc. The team produced a total of seven short documentaries: two of them were presented during the Eco Film festival organized in Kota Kinabalu last September.
- *Professional photography*: A full week session organized by professional photographers in Sandakan and followed by three team members*;*
- *Tree climbing techniques*: Ken Krank, an American professional tree climber is assisting our teams when there is a need to get access to tree canopy. Ken has been instrumental to assist the teams when they need to reach tree tops without jeopardizing personal safety!

Ravinder during her field activities in Kinabatangan.