

CAMERA TRAPPING HORNIBILLS IN THE CANOPY IN BORNEO

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Abstract- Habitat modification is altering the landscape and affecting the potential breeding sites of the large iconic species of hornbills in the tropical rainforests of Asia. Of concern is the loss of old growth trees that provide large cavities, a necessary structure for these birds to breed. In this study five nest boxes were erected 18 m above the ground 12 months prior to installing camera traps and data loggers at them. During 505 trap days, between October 2014 and February 2016, a total of 54009 images were taken of which 6861 were of wildlife. In total 18 species were identified including five of eight species of hornbill that occur along the Kinabatangan River, Sabah, Borneo; hornbills made repeat visits to the nest boxes but none of them breed in them. In the same area three species (Oriental Pied Hornbill, Rhinoceros Hornbill and Helmeted Hornbill) were observed breeding during the study period in natural cavities. The interest in the nest boxes but lack of breeding suggests that tree cavities are a limiting resource but the design of the boxes may need to be adjusted to encourage breeding.

Keywords- hornbills, nest boxes, camera traps, canopy

I. INTRODUCTION

Globally old growth trees are in decline and this has serious implications for the numerous species that they support; approximately 30% of all vertebrate species use old growth trees for nesting or shelter (Lindenmayer et al. 2012). Logging of forests often targets large trees reducing the forest structure and the interactions between species that use them threatening biodiversity (Lindenmayer et al. 2012). Further, large old trees also have large lateral branches (Lindenmayer and Laurance 2016) that are important for roosting and surveillance by birds attending mates nesting in tree cavities. Suitable tree hollows are a diminishing resource in Borneo where clearing for oil plantations is rampant (Ancrenaz et al. 2014) and this may be affecting the hornbill's ability to breed.

Hornbills Family Bucerotidae, are large iconic species found in tropical and subtropical areas of Asia, Melanesia and Africa. There are eight species of hornbills in Borneo all of whom require substantial tree hollows to nest. They are diurnal and most species pair for life and repeatedly use the same tree to breed (Tsuji 1996; Raman 1998; Kinnaird and O'Brien 2007; Mobley 2008). Hornbills are recognized as keystone species owing to their role in dispersing large and small seeds over long distances (Trail 2007; Gondalez 2013). However, they are highly sensitive to habitat modification, hunting (Kinnaird and O'Brien 2007) and international trade (Gondalez 2013). In Borneo the changing landscape has resulted in a loss of old growth trees and fig trees that constitute a substantial amount of their diet (Kinnaird and O'Brien 2007). Habitat modification includes habitat loss and a decline in old growth trees factors that may threaten the survival of all species of hornbills.

Canopy research is difficult. It involves a high level of risk that is not associated with terrestrial research and considerable effort to access and install equipment. Camera traps that can ameliorate the need to climb are very attractive. Many species spend most of their lives in the trees in the canopy, and this is true for Asian hornbills. A survey of ground versus canopy methods for surveying tropical canopy birds estimated that 25-50% of species in the canopy were missed (Anderson 2009). Camera trapping is a well-established tool used to survey terrestrial mammals but has only recently been used for canopy research (Gregory et al. 2014).

However, improved technological advances in camera traps has made it an attractive non-invasive tool especially in habitat that is difficult to access such as the flooded-forest during the monsoon. This research used camera traps to investigate if nest boxes specifically designed for hornbills in tropical lowland forest of Borneo would attract and be used by hornbills, if their was seasonal use of the boxes and to identify other species that may be potential competitors and predators to them.

II. METHOD & STUDY SITE

Study Site – this study was conducted along the lower reaches of the Kinabatangan River, near the township of Sukau in eastern Sabah, Borneo. This area has been significantly modified by commercial logging that commenced in the 1960's and more recently by palm oil estates that have reduced the area to ca. 750 km² of highly fragmented and degraded landscape (see Ancrenaz et al. 2014).

The study was conducted in the remaining forest that is protected under the Class 1 Virgin Jungle Forest Reserves and the Lower Kinabatangan Wildlife Sanctuary. It is dominated by seasonally flooded lowland dipterocarps.

Study species and IUCN 3.1 (www.iucnredlist.org) - the study species included:

White-crowned Hornbill *Aceros comatus* (Near threatened); Wrinkled Hornbill *Aceros corrugatus* (Near threatened); Wreathed Hornbill *Aceros undulatus* (Least Concern); Oriental Pied Hornbill (OPH) *Anthracoceros albirostris* (Least Concern), Bushy-crested Hornbill *Anorrhinus galeritus* (Least Concern); Black Hornbill *Anthracoceros malayanus* (Near threatened); Rhinoceros Hornbill (RH) *Buceros rhinoceros* (Near threatened) and the Helmeted Hornbill (HH) *Rhinoplax vigil* (Critically Endangered. Version 2015.4 IUCN in Bird Life International 2015). All species are readily seen or heard in this area.

Five nest boxes were erected 12 months prior to this study at 18 m above the ground on the main trunk of the host tree. All host trees had a horizontal limb adjacent to the nest box hollow to allow hornbills to perch on. A Reconyx HyperFire professional camera trap ([URL:http://www.reconyx.com/](http://www.reconyx.com/)) was secured on a wooden bracket attached to a lateral branch, 1-1.5 m from the nest box, with a clear view (no leaves or twigs intercepting) facing the entrance of each nest box. They were set to take three images per a trigger with 5 minute intervals between each set. These camera traps created colour photographs during the day and black and white photographs during the night when the infra-red beam was broken. An additional camera trap was erected at a natural hollow used by hornbills. The cameras were left in situ from October 2014 to February 2016 to capture images during both the dry season and the period when the forest is flooded. Batteries and 16 GB SD cards were replaced in February 2015 and September 2016. Concurrently, RHT10 EXTECH humidity and temperature data loggers were placed inside and outside the cavities (results of this are not included). Information on nesting hornbills at natural cavities was obtained from the local community during the study.

III. RESULTS AND DISCUSSION

Camera Traps: 505 trap days (includes day and night) were conducted during the study. A total of 54009 sets of three images were taken of which 6861 were of wildlife. In total 18 species were identified, representing 8 families and 7 orders. Small animals such as mice, geckos, arthropoda, etc. were not recorded, as they are very hard to identify to species level. All of the animals were observed during the day and some also during the night, except for a Sun Bear *Helarctos malayanus*, that was only camera-trapped at night. Interestingly, the natural hollow showed a much higher rate of non-hornbill-related visits as compared to the artificial nest boxes, which were almost exclusively visited by hornbills. Two species that were not seen at the nest boxes but camera trapped at the natural cavity, used by a pair of breeding OHP, were a Tree monitor *Varanus rudicollis* and a Sunbear (Fig.1).

Five of the eight hornbill species were camera trapped at the nest boxes (Fig. 1). They were the OPH, RH, Bushy-crested, Wrinkled and Black Hornbill. OPHs were the most frequent visitors comprising 70 % of the images at three of the nest boxes. At the fourth nest box, between Aug2015-Feb2016 the RH was the most recorded species. The same individuals were recorded returning to the same next box after a year and entering the nest boxes. However, no hornbills used the nest boxes to breed. Based on the images, there was always only one species at or in the cavity at a given time, even though the visitors did change frequently. Five active natural cavities were located by the Hutan Foundation rangers during the camera trapping period; they were used by HH, RH and three OPH respectively. The HH used the same cavity on two consecutive years but the tree collapsed due to old age in 2015.



Fig. 1. Diversity of animal species at the nest boxes and the natural cavity. From upper left corner to lower right, in order: Rhinoceros Hornbill *Buceros rhinoceros*, Oriental Pied Hornbill *Anthracoceros albirostris*, Bushy-crested Hornbill *Anorrhinus galeritus*, Black Hornbill *Anthracoceros malayanus*, Sun Bear *Helarctos malayanus*, Wrinkled Hornbill *Aceros corrugatus*, Short-tailed Macaque *Macaca nemestrina* and Monitor lizard

There was greater activity at the nest boxes between December and April of 2014-2015 and September 2015-Feb 2016 coinciding with the monsoon period with significantly more visits in the 2015-2016 season, spiking in January 2016 (Fig. 2). This suggests increasing interest at the nest boxes by the hornbills. This pattern of use is similar to that observed in Khao Yai where females of all species enter the nest cavity, entomb themselves and raise chicks to fledging stage, around January to early March (Tsuji 1996).

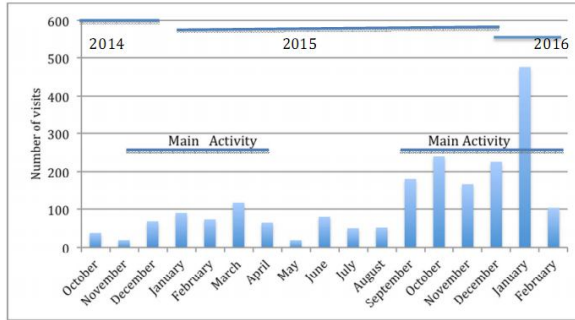


Fig. 2. Total number of camera trapped visits by hornbills to four nest-boxes and one natural cavity.

The degree of activity varied among nest boxes (Table 1); some of this was associated with problems we had with camera traps with missing images between Aug 2014-Feb 2015 for Box 1 and Box 2, and Aug 2015-Feb 2016 for Box 2 and the natural cavity. During Aug 2014-Feb 2015 at Box 3 half of the images were blurred as leaves or something fell on the camera and were obstructing the view. At the natural cavity Feb 2015 – Aug 2015 the camera trap tilted midway through the season possibly due to Long-tail macaque *Macaca fascicularis* captured in the images. The Feb2015-Aug.2015 and Aug.2015-Feb.2016 Box 3 as well as the Feb2015-Aug2015 Box 2 cameras were set on enhanced sensitivity, releasing the shutter and taking a 3-picture series for every slight movement in front of the camera, be it leaves rustling, an ant colony moving or a hundred pictures of a slow-moving gecko. The images for Feb2015-Aug2015 Box 1, show the upper top of the nest box instead of the cavity, which results in very few pictures of worth.

Behaviour at the nest boxes during most visits by hornbills was to probe inside the nest box alone or in pairs, whilst still sitting on the outer rim with most of the body on the outside, or examining the surroundings of the nest box or cavity. The only bird species to attend the cavity in greater numbers than two was the Bushy-crested Hornbill. Most of the time, the group of Bushy-crested consisted of two males and one female.

Most images of all species show the male bird, as he was more active in foraging and probing than the female. Sometimes, he carried items in his beak that

mostly appeared to be fruit or tree bark or other miscellaneous items. While the female did enter the cavity, there was no observation of any effort being made towards closing the entrance and hence commencing the typical breeding scheme of the hornbills. Also, the female did not stay in the cavity for a prolonged period of time and shortly after entering, she was seen sitting outside of the nest box again.

Table. 1: Camera trap frequency data of Hornbill visits to the four nest boxes and a natural cavity by month, over the period of 505 recording days.

Year	Month	Box 1	Box 2	Box 3	Box 4	Natural cavity	Total
2014	October			6		30	36
	November			7		11	18
	December			38		31	69
2015	January			28	4	59	91
	February		21	8	44		73
	March		86		29	5	120
	April		28	2	36		66
	May	1			15	2	18
	June	43			36	2	81
	July	33			12	3	48
	August	20		16	14		50
	September	9		7	164		180
	October	12		17	210		239
	November	8		31	127		166
	December	21		75	129		225
2016	January	164		98	215		477
	February	47		49	8		104
Total		358	135	382	1043	143	2061

No cases of hornbill disturbance by other species were captured in the images even though many different species showed interest and explored the nest boxes and natural cavity. Other visitors to the nest boxes that are potential competitors or may predate young included Long-tail macaque *Macaca fascicularis*, Stump-tail macaque *M. arctoides*, Prevost squirrel *Callosciurus prevostii*, Pallas' Squirrel *Callosciurus erythaeus*, Low's Squirrel *Sundasciurus lowii*, Tree monitor *Varanus rudicollis* and Colugo *Galeopterus variegatus*. One nest box was unable to be checked as a pair of RHs were in constant attendance; the lack of sealing of the entrance suggested they did not breed in it.

Tree hollows used by hornbills have specific-dimensions that are depth of the floor below the base of the hollow and the shape and width of the entrance. The depth is important in enabling the female and chicks to rest and reach the entrance to obtain food being feed to them from their mate. The shape and size of the entrance to the hollow is important in both enabling access and allowing the female to seal the entrance with faecal and waste material (Tsuji 1996). This was taken into consideration in designing the nest boxes but may still require modification.

Conclusion: The high level of interest by many species of hornbills and medium sized animals in the nest boxes suggests tree hollows suitable for nesting are a limited resource. Nest boxes are difficult to erect and maintain and may provide some relief but conservation needs to fight for the retention of the old growth trees within a changing forest landscape.

ACKNOWLEDGEMENTS

This research was funded by an ERGS grant to the primary author and conducted under Animal Ethics Approval from Monash University, Australia. Field support was provided by Ravinder Kaur whilst a postgraduate student at Monash University Malaysia, and Eddie Ahmad and his team of rangers from the Hutan Foundation Sabah. The latter provided exceptional support. They designed and installed the nest boxes and camera traps in the canopy. Chester Zoo and the Hutan Foundation funded the nest boxes.

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