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ARTIFICIAL NEST BOXES FOR HORNBILL CONSERVATION: A CASE STUDY IN KINABATANGAN, MALAYSIA

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ABSTRACT

Five artificial nest boxes for hornbills were erected along the river in the Lower Kinabatangan Wildlife Reserve, Malaysia in 2013. The nest boxes were built by a French non-government organization (i.e HUTAN/KOCP) and two zoos from United Kingdom and France (i.e. Chester Zoo and Beauval Zoo). After the artificial nest boxes were erected in the forest, a comparative study between natural cavities and nest boxes was conducted from September 2014 to February 2015, to measure internal humidity and temperature. It is assumed that these two parameters are important factors for nest box occupancy. Data loggers (RHT 10 USB EXTECH) were used to measure temperature and humidity inside and outside of the natural cavities (n = 3) and artificial nest boxes (n = 4). For nest boxes, internal temperature ranged from 21.8 to 35.0°C while internal humidity ranged from 40.1 to 99.4%. On contrary, internal temperature for natural cavity remained low (from 22.5 to 27.5°C) while its internal humidity ranged from 95.9 to 100%. Camera traps recorded several species of hornbills such as Rhinoceros (*Buceros rhinoceros*), Wrinkled (*Rhabdotorrhinus corrugatus*), Bushy-crested (*Anorrhinus galeritus*), and Oriental Pied (*Anthracoceros albirostris convexus*) hornbills that visited the nest boxes. Rhinoceros Hornbill had attempted to seal the entrance of the artificial nest boxes while Oriental Pied Hornbill was the only species that occupied one of the nest boxes. These responses indicate that nest boxes could play an important role in providing alternative nesting sites for hornbills.

Keywords: Hornbills, artificial nest boxes, data loggers, camera traps, Rhinoceros hornbill, Kinabatangan, microclimate, cavity-nesters

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Abstract
Five artificial nest boxes for hornbills were erected along the river in the Lower Kinabatangan Wildlife Reserve, Malaysia in 2013. The nest boxes were built by a French non-government organization (i.e HUTAN/KOCP) and two zoos from United Kingdom and France (i.e. Chester Zoo and Beauval Zoo). After the artificial nest boxes were erected in the forest, a comparative study between natural cavities and nest boxes was conducted from September 2014 to February 2015, to measure internal humidity and temperature. It is assumed that these two parameters are important factors for nest box occupancy. Data loggers (RHT 10 USB EXTECH) were used to measure temperature and humidity inside and outside of the natural cavities (n = 3) and artificial nest boxes (n = 4). For nest boxes, internal temperature ranged from 21.8 to 35.0°C while internal humidity ranged from 40.1 to 99.4%. On contrary, internal temperature for natural cavity remained low (from 22.5 to 27.5°C) while its internal humidity ranged from 95.9 to 100%. Camera traps recorded several species of hornbills such as Rhinoceros (*Buceros rhinoceros*), Wrinkled (*Rhabdotorrhinus corrugatus*), Bushy-crested (*Anorrhinus galeritus*), and Oriental Pied (*Anthracoceros albirostris convexus*) hornbills that visited the nest boxes. Rhinoceros Hornbill had attempted to seal the entrance of the artificial nest boxes while Oriental Pied Hornbill was the only species that occupied one of the nest boxes. These responses indicate that nest boxes could play an important role in providing alternative nesting sites for hornbills.

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INTRODUCTION

Out of ten species of hornbills recorded in Malaysia, the eight species found in Borneo occur in Kinabatangan (Myers 2009). The species include the critically endangered Helmeted Hornbill (*Rhinoplax vigil*), four near threatened species (i.e. Rhinoceros Hornbill (*Buceros rhinoceros*), Black Hornbill (*Anthracoceros malayanus*), White-crowned Hornbill (*Aceros comatus*), Wrinkled Hornbill (*Rhabdotorrhinus corrugatus*)) and three least concern species (i.e. Oriental Pied Hornbill (*Anthracoceros albirostris convexus*), Bushy-crested Hornbill (*Anorrhinus galeritus*) and Wreathed Hornbill (*Aceros undulatus*)). Hornbills nest in natural cavities of living trees (Balaraman & Balasubramanian 2003). Natural cavities offer protection from the external climate and predators (Lill & Fell 2007), safeguarding eggs from the ever-fluctuating ambient temperature (Rhodes *et al.* 2009).

Being secondary hole-nesters, hornbills do not create tree cavities (Chuailua *et al.* 1998; Datta & Rawat 2004; Poonswad *et al.* 2013a; Pasuwan *et al.* 2015). They are dependent on primary cavity-nesting birds such as woodpeckers or naturally occurring cavities for their breeding needs (Mudappa & Kannan 1997). Naturally formed cavities occur when branches break and decay due to fungal infection (Datta & Rawat 2004). These processes occur in large old growth trees (Chong 1998; Kinnaird & O'Brien 2007) and over great lengths of time. Hence, changes in forest structure greatly affects secondary cavity-nesting birds (Robles *et al.* 2011) and the hornbill population is limited by the availability of suitable tree cavities (Poonswad 1993; Kemp 1995; Datta & Rawat 2004; Poonswad *et al.* 2013b) and food plants (Poonswad *et al.* 2013a) such as *Ficus* sp.

In the 1950s, the demand for timber especially for dipterocarp tree species had increased (Sodhi *et al.* 2004) causing serious depletion of forested habitat in areas such as the Kinabatangan. To avoid further loss of forest, 27,960 hectares of Kinabatangan's remaining forests were gazetted as The Lower Kinabatangan Wildlife Sanctuary in 2005 (Abram *et al.* 2014). Logging activities (including selective logging) are known to diminish available nesting cavities as most hornbill's nests are provided by Dipterocarpaceae trees (Jinamoy *et al.* 2014). Thus, if lost nest cavities are not replaced, the hornbill populations may continue to decline. To address limitation of suitable nest cavities, deteriorated natural nest cavities can be modified accordingly (Poonswad *et al.* 2005) and artificial

nest boxes can be introduced (Cremades *et al.* 2011; James *et al.* 2011; Pasuwan *et al.* 2011).

Wildlife biologists face several problems when they attempt to provide hornbills with artificial nest boxes. A large nest entrance may attract other non-targeted animals, as occurred in India (James *et al.* 2011). In Singapore, the lack of a drainage system caused several hornbill chicks to drown during a rainstorm (Cremades *et al.* 2011); and in Thailand, only one species (i.e. Great Hornbill (*Buceros bicornis*) has been nesting successfully in the provided artificial nest boxes (Pasuwan *et al.* 2011). Pasuwan *et al.* (2015) also found that their boxes were not offering stable temperature and humidity readings when compared to the conditions of a natural cavity.

In 2012, the Thailand Hornbill Project team highlighted the scarcity of natural nests, after a rapid assessment was conducted in the Kinabatangan area. Therefore, after considering the findings of the report and acknowledging the lack of dipterocarp trees, an attempt was made to address the scarcity of natural cavities in Kinabatangan through the installation of artificial nest boxes. The designs and completion of the boxes were a collaborative effort between HUTAN/KOCP, Chester Zoo and Beauval Zoo.

In addition, hornbills possess the ability to consume and regurgitate large seeds (50−200 mm in diameter) undamaged, making hornbills ideal seed dispersers (Kemp 1995; Leighton *et al.* 1983). Plants with larger seeds may be more susceptible to extinction if their natural seed dispersers are absent (Kitamura *et al.* 2004a; Kitamura *et al.* 2004b). Due to their important ecological role, it is sensible to take the appropriate action and conserve Asian Hornbills, not only for the sake of their preservation but also for the regeneration of rainforests and the well-being of the ecosystem for future generations.

METHODOLOGY

In September 2013, five artificial nest boxes were erected along the Kinabatangan River (Fig. 1).

The artificial nests were then named according to their location; i.e. Danau, Resang, Respang, Lumun and Teniggang. Four of the artificial nests were cylindrical while the other was rectangular, as the team was interested to explore different designs. The rectangular artificial nest (Teniggang) was