

## Conserving the globally threatened Plain-pouched Hornbills in the Belum-Temengor Forest Complex, Peninsular Malaysia

YEAP CHIN AIK<sup>1\*</sup>, TERESA ONG<sup>1</sup>, LIM KIM CHYE<sup>1</sup>,  
RAVINDER KAUR<sup>1</sup> and DIYA RASHIDA<sup>1</sup>

**Abstract:** The globally threatened Plain-pouched Hornbill *Aceros subruficollis* is known to occur in only three countries i.e. Myanmar, Thailand and Peninsular Malaysia. In a recent assessment by BirdLife International, its global population is estimated to be between 1,500 and 7,000 mature individuals across its distribution range and is rapidly declining due to habitat loss and degradation and hunting. The occurrence of Plain-pouched Hornbills in Peninsular Malaysia was first recorded in the 1990s during scientific expeditions into the Belum-Temengor Forest Complex (BTFC), one of the Important Bird and Biodiversity Areas (IBA) in the country. Hundreds were documented moving *en masse* across the forest landscape annually between the months of August and October at dusk and dawn during their presumed non-breeding period. Between 2004 and 2007, the Malaysian Nature Society (MNS) monitored the monthly movements to/from communal roosting site(s) at a fixed location in Temengor Forest Reserve. From 2008 until 2012, a two-month daily monitoring effort was initiated under the MNS Hornbill Volunteer Programme (HVP) as a form of citizen science. The highest count in a single session was in September 2008 with over 3,200 individuals at dawn. Through the monitoring effort and cumulative data, it was shown that the number of Plain-pouched Hornbills seen fluctuates yearly, possibly corresponding with local phenological patterns in this vast forest complex. Spanning over 300,000 ha of tropical evergreen forests, BTFC is the largest forest complex in northern Peninsular Malaysia. The northern section of BTFC is also contiguous with another forest complex in southern Thailand i.e. the Bang Lang National Park and Hala-Bala Wildlife Sanctuary. Collectively, this trans-boundary forest complexes form an important stronghold for the long-term survival of the Plain-pouched Hornbill and other resident hornbill species. This paper summarizes the collated field information on Plain-pouched Hornbills to date in BTFC and discusses its conservation implications.

---

<sup>1</sup>MNS Hornbill Conservation Project, c/o Malaysian Nature Society, JKR 641 Jalan Kelantan, Bukit Persekutuan, 50480 Kuala Lumpur, Malaysia.

\*Corresponding author email: hornbills@mns.org.my / msiahornbill@gmail.com

**Keywords:** Plain-pouched Hornbill, *Aceros subruficollis*, Belum-Temengor Forest Complex, Important Bird & Biodiversity Area, MNS Hornbill Volunteer Programme, mass movement

## INTRODUCTION

Asian hornbills across their ranges are increasingly threatened due to habitat loss and degradation and hunting/poaching. As many as 11 (34%) out of 32 Asian hornbill species are now listed as threatened under different IUCN Red List categories. Another 11 are listed as Near Threatened. The Plain-pouched Hornbill *Aceros subruficollis* has been categorized as Vulnerable with an estimated global population of between 1,500 and 7,000 mature individuals in Myanmar, Thailand and Peninsular Malaysia (BirdLife International 2013). Historically, the unbroken green belt of mixed deciduous, dry and humid evergreen forests stretching from southern Myanmar to northern Peninsular Malaysia would have provided this *Aceros* hornbill with its ecological and biological needs, especially during the post-breeding period where they form large flocks and roam, possibly, in search of food. Their seasonal movements *en masse* must truly rank as one of the spectacles of nature in Asia (Davison 1995b). Continued decimation and degradation of large forest tracts, if unabated, would undoubtedly disrupt this natural process. To date, large Plain-pouched Hornbill populations are confined to remaining forest in western Thailand/Myanmar and southern Thailand/northern Peninsular Malaysia. Following the recommendations of BirdLife International, the Malaysian Nature Society (MNS) has been monitoring Plain-pouched Hornbills in the Belum-Temengor Forest Complex (BTFC) since 2004 under the MNS Hornbill Conservation Project. Results of monitoring in 2008 were published by Kaur et al. (2011). This paper collates and summarizes the field data collected from 2004 to 2012, and discusses its conservation implications.

### **Belum-Temengor Forest Complex**

Located in the northern Peninsular Malaysian State of Perak, the Belum-Temengor Forest Complex encompasses several forest blocks spanning over 320,000 ha that are administered by the Perak State Park Corporation and Perak State Forestry Department. About one-third of this forest complex has been gazetted as a protected area i.e. Royal Belum State Park (117,500 ha) while the remaining parts are classified as Forest Reserves (Banding, Temengor, Gerik and Amanjaya). Under Peninsular Malaysian's forestry laws, Forest Reserves can either be functionally categorised as production (i.e. timber) or protection forests (e.g. High Conservation Value Forest, water catchment, Virgin Jungle Reserve (VJR), education, wildlife, areas 1000 m asl and above, etc). The Forest Reserves within BTFC have both functions but logging (under

the Sustainable Forest Management system) is the primary function. A dendritic Temengor Lake forms the 'centrepiece' of BTFC as a result of the damming of the Perak River in the 1970s. A major highway *i.e.* the East-West Highway was constructed about the same time and now bisects BTFC. The northern section of BTFC is contiguous with the protected areas of Bang Lang National Park and Hala-Bala Wildlife Sanctuary in southern Thailand.

The terrain of BTFC is mostly hilly (Davison 1995a). Its lowest lying points in the south-west are at about 130 m asl and it reaches about 1,000 – 1,400 m asl along the watershed forming the Perak-Kelantan State border in the east and parts of the Titiwangsa Range. To the north along the Perak-Thailand border, the terrain reaches the high points of several peaks *i.e.* Ulu Titi Basah (1,533 m asl) and Ulu Merah (1,450 m asl). The forest complex is dominated mainly by *Shorea* spp. in hill dipterocarp forest, with sub montane forest on the upper slopes (Figure 1).

Several scientific expeditions into BTFC organized by MNS, local universities and/or government agencies have shown that the forest complex supports exceptional biodiversity (Davison et al. 1995; Latiff and Yap 2000; Latiff 2011). It is recognized internationally as one of Malaysia's Important Bird & Biodiversity Area (IBA) (Yeap et al. 2007).

### **Discovery of the Plain-pouched Hornbills in Peninsular Malaysia**

The *Aceros* hornbill movements in Peninsular Malaysia were first discovered in August 1992 when about 300 individuals were seen making dawn and dusk flights to and from Tasik (=lake) Kenering (Ho and Sutari 1993). Ho and his co-workers returned a few months later and conducted a four-day survey of the area. During the survey, they encountered the phenomenon daily and counted a maximum of 764 *Aceros* in flight. The physical markings and calls of these *Aceros* hornbills bore a resemblance to the Plain-pouched Hornbill *Aceros subruficollis*, which had not been known from Malaysia at that time.

In the following year, MNS led the first Heritage and Scientific Expedition into Belum-Temengor, with a base camp at Sungai (=river) Halong (Temengor Forest Reserve). During this period, the mass movement of *Aceros* hornbills was again documented. Observers counted 2,421 individuals on 24 November 1993 flying in a north-south direction over the base camp area in the evening. On 25 November, 2,365 individuals were recorded. Tunku Mohd. Nazim Yaacob (1994) reported an evening wave of 1,277 "Wreathed Hornbills" *Aceros undulatus* in August 1994.

MNS led a second Belum-Temengor expedition in 1998 and established base camp at Sungai Tan-Hain (then Belum Forest Reserve), when Lim and Tan (2000) encountered unidentified hornbills (most likely *Aceros* spp.) making evening flights in "considerable numbers from camp

everyday from 17 to 20 May”. However, the final count was only 233 individuals. Ho and Sutari (2000a, 2000b) consistently recorded over 1,000 Plain-pouched Hornbills in September 1998 during their five-day survey at Pos Chiong (Temengor Forest Reserve). The maximum count was 2,067 individuals.

In 1999, Ho and his co-workers officially submitted their previous findings to the MNS-Bird Conservation Council for scrutiny. Within the same year, the ‘mystery hornbill’ was identified definitely as the Plain-pouched Hornbill *Aceros subruficollis* and accepted as Malaysia’s tenth hornbill species (Records Committee, MNS-BCC 2000) (Figure 2). Earlier records of the Plain-pouched Hornbill in Malaysia were set aside due to the risks of confusion with other species prior to the clarification of taxonomy and status of Plain-pouched Hornbills by Rasmussen (2000).

### **MNS Hornbill Conservation Project**

The MNS Hornbill Conservation Project (MNS HCP) was established in 2004, a year after the conclusion of the Royal Belum State Park Scientific Expedition in 2003 (25 July-1 August), with the dual aim of (1) conserving hornbills of BTFC in its natural habitats and (2) increasing awareness on the importance of hornbills and their habitats. The MNS HCP was also a clear indication of the Society’s long-term presence and commitment towards the conservation of this forest complex. There are two components focusing on research and monitoring and Communications, Education and Public Awareness (CEPA) activities that form the operational pillars of the MNS HCP. Under the research and monitoring component, efforts are made to better understand the ecology of the Plain-pouched Hornbill, its utilization of BTFC and monitor this seasonal population.

## **MATERIALS AND METHODS**

Throughout the nine years (2004-2012), the MNS HCP has employed three methods to improve the understanding of the movements of the Plain-pouched Hornbills within BTFC and monitor their numbers. These methods are explained below:

### **Monthly monitoring**

Monitoring is conducted from a fixed location, either at Kampung (= village) Tebang/Pos Chiong or adjacent indigenous villages (05°25’58.96”N, 101°25’49.78”E) or occasionally from a nearby location at Pulau Kiroi (05°27’00.67”N, 101°24’58.53”E) in Temengor Forest Reserve. This location was chosen based on a reconnaissance trip in 2003 which seemed to indicate that a large proportion of the Plain-pouched Hornbills fly over or were in close proximity to this village

(Yeap and Noramly 2011). Thus, we postulated that Kampung Tebang is located along the hornbills' flight path between their roost site(s) and feeding area(s). From the top of a small hill in this village, the observer(s) have a 360° landscape-view of the immediate surroundings (as far as 1 km) hence it is possible to count the number of hornbills in flight. While every effort is made to count all visible hornbills during monitoring, some could avoid detection if they flew below the forest canopy, at the height of the treeline, behind hills or using alternate routes.

Typically, two counts were conducted per monitoring day *i.e.* after dawn (0700-0900 hours) and before dusk (1700-1930 hours). Population numbers and (where possible) sex, age, flight direction and behaviour were noted as well. Binoculars and telescopes were used to spot and count the hornbill flocks and individuals.

While every effort was made to monitor the hornbills consistently on a monthly basis at Kampung Tebang every year, the limitation of resources (manpower and funds) could not be avoided in some years. From 2004-2007, total monitoring days per year ranged from 13 to 44 days spread out between eight to 11 months. Effort was least in 2005 where only four months (13 days) were covered. Between 2008 and 2012, the MNS Hornbill Volunteer Programme was introduced whereby participants assisted experienced MNS counter(s) to monitor the hornbills for two months *i.e.* August-September annually. Through this citizen-science effort, intensive daily counts were possible during this period. The total number of monitoring days in these two months ranged between 60 and 79 days per year during the five-year period.

### **Simultaneous counts**

In order to identify major and minor flight paths, small groups of seasoned MNS observers, who have field experience in identifying Plain-pouched Hornbills, were placed at several locations within the Royal Belum State Park and Temengor Forest Reserve suspected to be part of the hornbills' flight path. Information gathered followed the monitoring protocol. This exercise was conducted in 2010 and 2011.

### **Roost searches**

Ground surveys were conducted during the 'Plain-pouched Hornbill months' to locate their roost site(s) believed to be situated in Temengor Forest Reserve. Once the flight direction of the hornbills to their suspected roost site(s) had been determined, survey teams would follow and search for visual/physical clues of roost(s) *e.g.* droppings, feathers etc. Surveys have been conducted twice *i.e.* in 2004 and 2010.

## RESULTS AND DISCUSSION

### **What do we know from the monitoring results?**

Over the course of nine years (2004-2012), MNS was able to maintain monitoring presence at Kampung Tebang/Pos Chiong for 71 months (65% of the total number of months). A total of 461 count days were spent monitoring the hornbills involving 712 count sessions i.e. 384 dawn counts and 328 dusk counts. The difference between the total number of dawn and dusk counts was primarily caused by the cancellation of counts due to adverse weather conditions e.g. heavy rains that were more frequent in the afternoons, and other unforeseen circumstances. The counts totalled 1588 hours.

Taking into account only the maximum monthly counts, Figure 3 shows an interesting ‘high-low’ alternate pattern over the period of nine years. The highest number of individual hornbills counted (i.e. peak count) in a single session was 3,261 in 2008 followed by 2,734 in 2012, both in September. The ‘lowest’ peak count was 85 individuals in August 2009.

The arrival and build-up of the hornbills starts as early as the end of May leading to a peak around August or September before a gradual decline in numbers (Figures 4A-E). More hornbills were counted in the dawn counts compared to the dusk counts. This led to our assumption that some of the hornbills could have used other ‘minor’ flight path(s) that were not detected by our monitoring and survey teams.

At Kampung Tebang, observers started to detect hornbills as early as 0630 hours, although it was still dark. The peak Plain-pouched Hornbill movements, however, fell within 0700-0729 hours ( $n = 311$ ), which coincided with first light from the sunrise in this landscape. Within this period, the highest number of hornbills counted in a single flyby was 3,152 individuals followed by the next hour i.e. 0730-0759 hours ( $n = 200$ ) (Table 1). At dusk, the large majority of hornbills were detected within the 1800-1859 hours period.

### **Which flight path(s) are hornbills using?**

Simultaneous surveys were attempted once in 2009, 2010 and 2011 respectively. While monitoring efforts were on-going in Kampung Tebang, smaller count teams of experienced birdwatchers were positioned at several locations or river valleys e.g. Sungai Halong, Sungai Tiang etc. suspected to be part of the hornbills flight path(s). The counts from these locations showed that some hornbills do use river valleys as navigational landmarks within their flight path to a certain extent.

### **Where are they roosting?**

The annual presence of the hornbills in BTFC, although numbers seem to fluctuate yearly, ignites a pertinent question as to the exact location(s)



of their roost. Our monitoring data suggest that the hornbills move between their feeding and roost site(s) in Temengor every day during the months of July and October. Their flight direction, generally from south/southwest to north/northeast in the morning, and the reverse in the evening, points to possible locations of roost site(s) south/southwest beyond Kampung Tebang/Pos Chiong. Although ground surveys have been attempted twice, we have not been able to confirm the exact location(s) of the hornbills' roost site(s) to date. More attempts to locate these will be made in future. Prior to 2010, it was believed that the hornbills roosted in Temengor. However, simultaneous surveys in mid-August 2010 in Kampung Tebang (Temengor) and Sungai Tiang (Royal Belum State Park) suggested that as many as 1,600 Plain-pouched Hornbills could be roosting in the Sungai Temin area at the same time, at least for that year. These findings from the simultaneous surveys indicate perhaps that the hornbills could be roosting in several areas within this forest complex and are not confined to only a single area. However, it is not known if the hornbills return to the newly suspected roost area in Sungai Temin annually, hence more simultaneous monitoring efforts need to be invested to address this question.

### **Utilization of BTFC by Plain-pouched Hornbills**

The cumulative field information strongly suggests that the Belum-Temengor Forest Complex is an important part of the hornbills population's life cycle (breeding/non-breeding) in northern Peninsular Malaysia/southern Thailand. The presence of Plain-pouched Hornbills in this forest complex could possibly be linked to its flowering/fruiting patterns although there has been no long-term monitoring of phenology. Previous expeditions have revealed interesting diversity of fruit trees found in this landscape (Latiff et al. 1995; Salma et al. 2000). Based on this information, a 'typical' yearly cycle for Plain-pouched Hornbills in BTFC could perhaps be described as follows:

From January to May, mature hornbills would initiate breeding in southern Thailand and/or BTFC (although the nest trees have yet to be found here) and would only leave the nest tree upon completion of their breeding cycle. At the same time, small numbers of immature or unpaired hornbills would linger in the BTFC in search of fruiting trees. As the breeding season comes to an end in May, the number of hornbills begins to build up in the landscape. New family units (pairs and new-fledged young) augment the existing non-breeding population in search of fruiting trees. This build-up occurs from end of May onwards and peaks in August or September, which also coincides with the second flowering season in Upper Perak (Corner 1988). The large seasonal hornbill population starts to dissipate in October towards the onset of another new breeding season.

### **The Hornbill Triangle (HoT)**

The contiguity of the BTFC and Bang Lang National Park/Hala-Bala Wildlife Sanctuary (BLNP/HBWS) provides a vast forest area for hornbills to roam, feed and breed thus supporting its life cycle and processes. Another piece of the puzzle emerged in July 2004 when hornbills were also reported from another forest complex located north-west of BTFC in the adjacent state of Kedah: the Greater Ulu Muda Forest Complex (GUMFC) (Yeap et al. 2005). The GUMFC comprises of the Ulu Muda, Pedu, Chebar Besar and Padang Terap Forest Reserves and includes the proposed Ulu Muda Tambahan, Bukit Keramat and Bukit Saiong Forest Reserves with a total area of about 160,000 ha of lowland and hill dipterocarp forests. Monitoring of hornbills in GUMFC is patchy due to lack of resources. Despite this shortcoming, data from 2004, 2008, 2010 and 2011 showed that the hornbills do utilize this forest complex as well. The highest count was about 1,200 individuals (2004) but subsequent counts were less than half of this figure. The ‘combination’ of the three large forest complexes forms a “Hornbill Triangle” (HoT) (Figure 5).

The discovery of Plain-pouched Hornbills in GUMFC provokes several questions; where do they originate from, what is attracting them to GUMFC, are they breeding there, are they part of the larger BTFC flock or separate, do they fly to BTFC from GUMFC, etc. *Aceros* hornbills are known to travel long distances for food resources. Given that much is still unknown about their life cycle and conservation needs, the HoT area most likely offers the best chance of survival for the southern population of Plain-pouched Hornbills.

## **CONCLUSIONS**

Davison (1995b) once remarked that “*the totals of more than 2000 hornbills at Temengor seem to be unprecedented anywhere in the world for any hornbill species, but there are now sufficient reports to be sure that substantial numbers are of regular occurrence there*”. The seasonal migration of Plain-pouched Hornbills must rank as one of the most spectacular natural wonders in Asia. The Hornbill Triangle offers the best hope for the future survival of the southernmost population of Plain-pouched Hornbills. Efforts need to be continually invested in improving our understanding of the ecology and biology of resident hornbills, monitoring hornbill populations including the hornbills, engaging local indigenous communities and securing better habitat conservation.



## ACKNOWLEDGEMENTS

We would like to thank the Forestry Department Peninsular Malaysia, Department of Wildlife and National Parks (Peninsular Malaysia), Perak State Parks Corporation, Zoo Negara and Hymeir Kamarudin (Earth Lodge Sdn. Bhd.) for their support and assistance in the MNS HCP. The MNS HCP is also indebted to our three Orang Asli field assistants i.e. Roslan Carang, Azam Carang and Marisan Pandak (from Kg Chuweh), the Tok Batin and villagers of Kampung Tebang, all the MNS HCP and HVP volunteers (2008-2009) and MNS Secretariat colleagues. We would also like to thank our previous donors who helped kick-start the MNS HCP and more recently Sime Darby Plantation Sdn. Bhd. and Sime Darby Foundation, which provided much needed long-term support. Schidmt Marketing (Malaysia) Sdn. Bhd. generously loaned high-quality optics.

## REFERENCES

- BirdLife International. 2013. *Aceros subruficollis*. Downloaded from <http://www.birdlife.org/datazone/species> on 30 December 2014.
- Corner, E.J.H., 1988. *Wayside Trees of Malaya* (Volume 1) (3<sup>rd</sup> ed.). Kuala Lumpur: Malaysian Nature Society.
- Davison, G.W.H. 1995a. Belum: *A Rainforest in Malaysia*. Kuala Lumpur: Malaysian Nature Society.
- Davison, G.W.H., 1995b. The Birds of Temengor Forest Reserve, Hulu Perak, Malaysia. *Malayan Nature Journal* 48: 371-386.
- Davison, G.W.H., Soepadmo, E. and Yap, S.K. 1995. The Malaysian Heritage and Scientific Expedition to Belum: Temengor Forest Reserve, 1993-1994. *Malayan Nature Journal* 48: 133-146.
- Ho, H.C. and Sutari, S. 2000a. Observations of Plain-pouched Hornbills *Aceros subruficollis* in Tasek Temengor, Peninsular Malaysia. *Forktail* 16: 65-67.
- Ho, H.C. and Sutari, S. 2000b. Plain-pouched hornbills: a new species for Malaysia (*Aceros subruficollis*). *Malaysian Naturalist* 54: 36-39.
- Ho, H.C. and Supari, S. 1993. Plain-pouched in Perak? A spectacular movement of hornbills. *Malaysian Naturalist* 46: 19-22.
- Kaur, R., Ong, T., Lim, K.C. and Yeap, C.A. 2011. A survey on mass movements of the Vulnerable plain-pouched hornbill in the Belum-Temengor Forest Complex, Peninsular Malaysia. *Raffles Bulletin of Zoology, Supplement* No. 24: 171-176.
- Latiff, A., 2011. Pengenalan. In: Abd. Rahman Abd. Rahim, Koh, H.L., Muhamad Abdullah and A. Latiff (eds.). *Taman Negeri DiRaja Belum, Perak: Pengurusan Hutan, Persekitaran Fizikal, Kepelbagaian Biologi dan Sosio-ekonomi. (Siri Kepelbagaian Biologi Hutan No. 15)*. Forestry Department of Peninsular Malaysia. Pp. 10-16.

- Latiff, A. and Yap, S.K. 2000. An Expedition to Belum Forest Reserve, Perak, Peninsular Malaysia: An Introduction. *Malayan Nature Journal* **54**: 147-149.
- Latiff, A., Zainuddin Ibrahim, A., Muzni, S., Turner, I.M. and Yong, J.W.H. 1995. Preliminary checklist of flowering plants from Temengor Forest Reserve, Hulu Perak, Malaysia. *Malayan Nature Journal* **54**: 175-188.
- Lim, K.C. and Tan, M. 2000. Bird Observations in Belum Forest Reserve, Perak, Peninsular Malaysia. *Malayan Nature Journal* **54**: 259-265.
- Rasmussen, P.C. 2000. A review of the taxonomy and status of the Plain-pouched Hornbill *Aceros subruficollis*. *Forktail* **16**: 83-91.
- Records Committee, MNS-BCC. 2000. Plain-pouched Hornbill *Aceros subruficollis* – A New Species for Malaysia. *Malayan Nature Journal* **54**: 267-269.
- Salma, I., Masrom, H. and Yahya, I. 2000. A survey of edible fruit species in Belum Forest Reserve, Perak, Peninsular Malaysia. *Malayan Nature Journal* **54**: 223-226.
- Tunku Mohd Nazim Yaacob. 1994. Wreathed Hornbills *Rhyticeros undulatus* in the Temengor Dam area. *Malaysian Naturalist* **48**: 12-14.
- Yeap, C.A. and Noramly, G. 2011. Brief observations and counts of the daily movements and population of the Plain-pouched Hornbills *Aceros subruficollis* at Pos Chiong, Temengor Forest Reserve. In: Abd. Rahman Abd. Rahim, Koh, H.L., Muhamad Abdullah and Latiff, A. (eds.). *Taman Negeri DiRaja Belum, Perak: Pengurusan Hutan, Persekitaran Fizikal, Kepelbagaian Biologi dan Sosio-ekonomi. (Siri Kepelbagaian Biologi Hutan No. 15)*. Forestry Department of Peninsular Malaysia. Pp 280-286.
- Yeap, C.A., Lim, K.C. and Noramly, G. 2005. *A Survey of Globally Threatened and Near-threatened Hornbills in the Belum-Temengor Forest Complex, Important Bird Areas in Peninsular Malaysia*. Kuala Lumpur: MNS-Bird Conservation Council. (Unpublished)
- Yeap, C.A., Sebastian, A.C. and Davison, G.W.H. (Compilers) 2007. *Directory of Important Bird Areas in Malaysia: key sites for conservation. (MNS Conservation Publication No. 8)*. Kuala Lumpur: Malaysian Nature Society.

**Table 1.** Breakdown of Plain-pouched Hornbill arrival patterns at (a) dawn and (b) dusk according to half-hour blocks at Kampung Tebang, Temengor Forest Reserve (2004-2012).

(a) Dawn

Time (hours)	0600-0629	0630-0659	0700-0729	0730-0759	0800-0829	0830-0859	>0900
Number of Individuals	0	1-1348	1-1,3152	1-1,641	1-466	1-173	2-115
No. of Occasions (n)	0	144	311	200	104	132	4

(b) Dusk

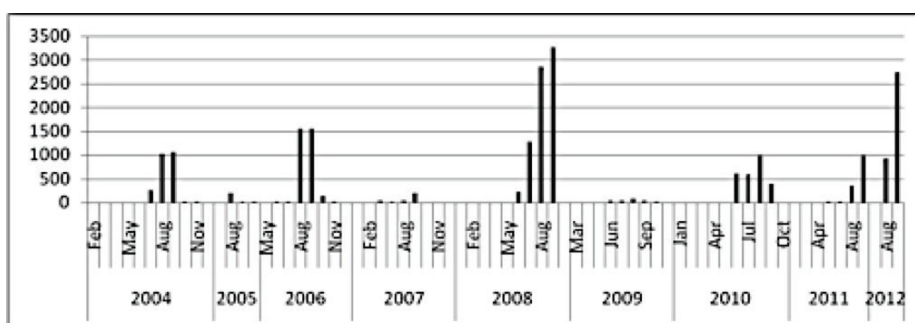
Time (hours)	1600-1629	1630-1659	1700-1729	1730-1759	1800-1829	1830-1859	1900-1929	1930-1959
Number of Individuals	2-30	1-314	2-1,130	1-839	1-1,595	1-1,728	1-968	2-70
No. of Occasions (n)	11	31	79	137	186	169	78	7



**Figure 1.** A landscape view of the Belum-Temengor Forest Complex.  
(Photo credit: KH Khoo/MNS)

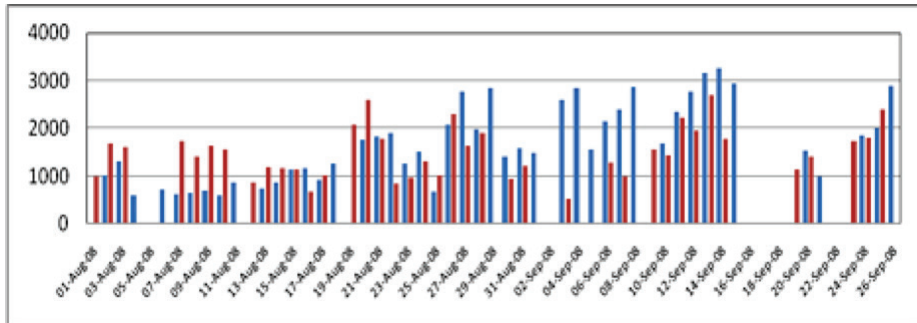


**Figure 2.** A group of at least 70 Plain-pouched Hornbills resting on an emergent in Belum-Temengor Forest Complex.  
(Photo credit: Lim Kim Chye/MNS)

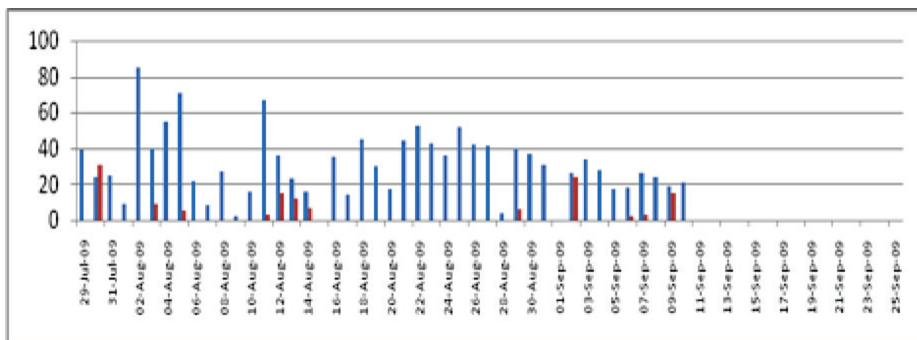


**Figure 3.** Monthly maximum counts of the Plain-pouched Hornbills at Kampung Tebang, Temengor Forest Reserve (2004-2012).

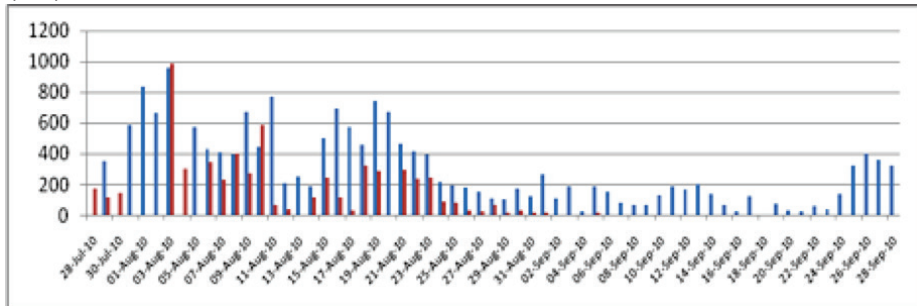
(4A)



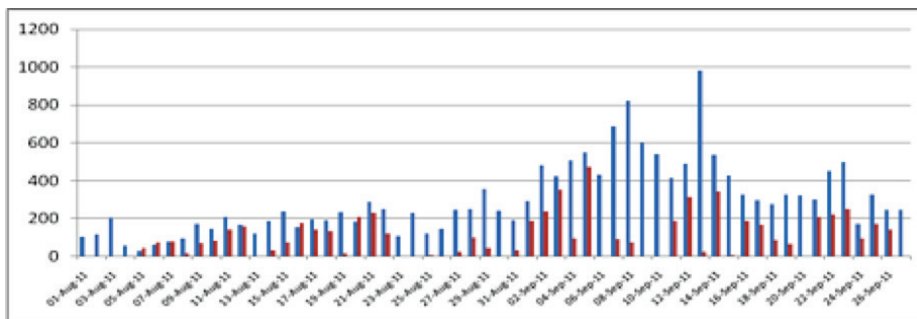
(4B)



(4C)

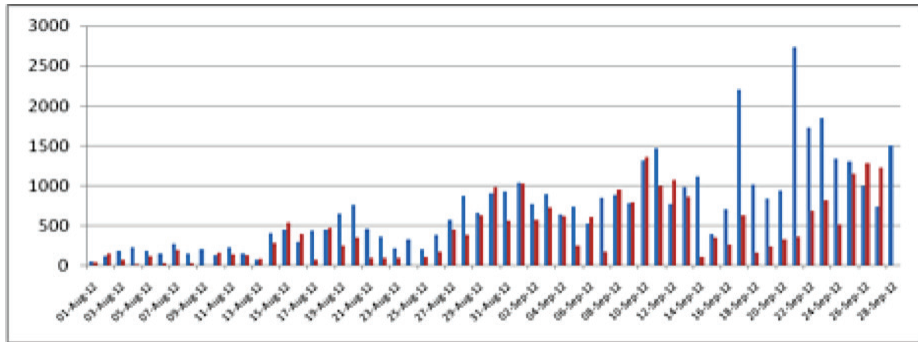


(4D)



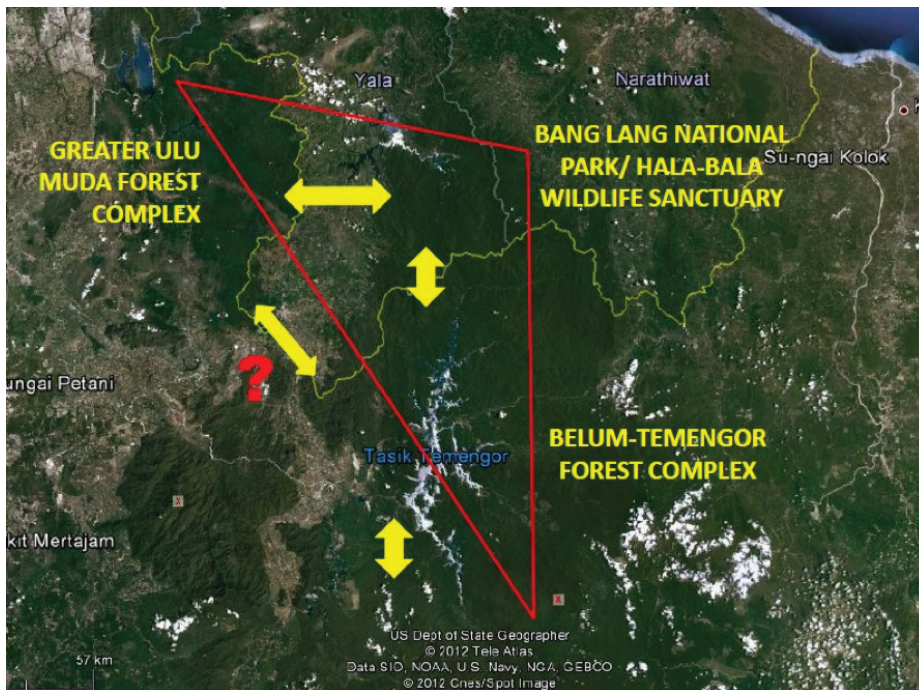


(4E)



**Figure 4.** Daily counts of the Plain-pouched Hornbills at Kampung Tebang during the MNS Hornbill Volunteer Programme in August and September (A: 2008 – E: 2012).

*[Note: BLUE = dawn count / RED = dusk count]*



**Figure 5.** The Hornbill Triangle (HoT) in northern Peninsular Malaysia and southern Thailand. *[Note: Image generated from Google Earth.]*