UNIVERSITI PUTRA MALAYSIA

BEHAVIOURS OF ANTHRACOCEROS ALBIROSTRIS CONVEXUS (TEMMINCK, 1831) IN HUMAN SETTLEMENT AREA, SUNGAI PANJANG, SELANGOR, MALAYSIA

NURULHUDA MOHD JAMIL

FS 2013 50

BEHAVIOURS OF *Anthracoceros albirostris convexus* (Temminck, 1831) IN HUMAN SETTLEMENT AREA, SUNGAI PANJANG, SELANGOR, MALAYSIA

By

NURULHUDHA BINTI MOHD JAMIL

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

April 2013

DEDICATION

Dedicated to my Ecotoxicology & Wildlife Group Studies

&

Also to my beloved families for the courage, love and understanding
~my husband; Feezly B. Taib & family~
~my late mother; Sofiah Bt, Ahmad~
~my dad; Mohd Jamil B. Wahab~
~my brothers; Mohd Amirul , Syahir, Nadmi Syafree~
~Muhamad Naufal & Muhamad Arib~

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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NURULHUDHA BT. MOHD JAMIL

April 2013

Chairman : Profosser Ahmad B. Ismail, PhD
Faculty : Science

The research was conducted in Kampung Parit 13 (N 03^0 43.512', E 101^0 04.751'), Sungai Panjang situated on the north of Selangor in the District of Sabak Bernam located near the Sungai Karang Forest Reserve. There are four species of sympatric hornbill recorded in the forest namely Rhinoceros Hornbill (*Buceros rhinoceros*), Bushy-crested Hornbill (*Anorrhinus galeritus*), Black Hornbill (*Anthococeros malayanus*) and Oriental Pied Hornbill (*Anthracoceros albirostris*). This includes one sub species of Oriental pied Hornbill that is the Southern pied Hornbill (*Anthracoceros albirostris convexus*). Hornbills can be a good indicator of the forest condition and human disturbance. That is because they need large territory for feeding and breeding activities. Therefore, the presence of Southern pied Hornbill (*Anthracoceros albirostris convexus*) in the nearest village suggest that there is a need to study on their status and behaviour as they attempt to live with the human near the human settlement area.

There were three objectives in this study being the first one is to assess this Hornbills' population size at the study site. Secondly, it is to study the behaviours of Southern pied Hornbill during non-breeding season and finally the behaviours of this bird during their breeding season. Observations were done from February 2009 until April 2011. The study was carried out in 501 hectare of residential area.

Six line transects had been set up on certain areas to appraise the population size of this hornbill. Transects were chosen randomly within the study area and are based on available roads or trails. There were 18-visiting times in total for the six transect during non breeding season to estimate the population of this birds in the study area. There is also a rapid observation to identify the increasing number of birds in the area after the breeding season in which, 3-visiting times for Transect 1 and 2 respectively after the breeding season. Both transects were chosen due to the high number of birds in the area compared to the other four transects. During the transect

observations, the highest number of birds in group recorded were 24.67±4.16 individuals before breeding season and 28.67±3.06 individuals after the breeding season. It shows that there are new individuals of birds joining the group. From paired sampled test, the number of hornbill in Transect 2 is significantly different (p<0.05) between before breeding season and after breeding season. The population sizes of Southern pied Hornbill estimated in the study area is 24.5 individuals in 501 hectares.

The second objective is to study the behaviours of Southern pied Hornbill during the non-breeding season. Meanwhile the third objective is to study the behaviours of Southern pied Hornbill during the breeding season. Both objectives used the same methodology but conducted in different seasons. Their diurnal behaviours during both seasons were observed by intensive focal observations based on sampling blocks. The sampling block is the partition of time made for observation activities. The sampling blocks were used as dependent variable for each of the behavioural recorded and also to differentiate the intensity of each activity during the day. Four selected couples of Southern pied hornbill were chosen to be observed for their daily routines as they attempted to breed in four different locations in clay jars (artificial nest) in the village. Their daily behaviours were accessed by one-way ANOVA (SPSS 18) and were converted into ethogram. The result shows that sampling blocks had significant effect on each of their diurnal behaviour including feeding (F= 121.27, p< 0.001), maintenance (F= 464.31, p<0.001), interaction (F= 17.04, p< 0.001), nest visit (F= 19.35, p< 0.001) and roosting (F= 189.31, p< 0.001) during non-breeding season.

Based on ethogram analysis, the birds spend most of their time daily to forage during non-breeding (38.60%) and breeding season (49.23%). Meanwhile diurnal activities recorded for non-breeding season which are interaction of the birds (9.46%), nest visit (12.79%), maintenance activities (15.72%) and roosting (5.81%) are different from breeding season. During the breeding season, the female allocates 42.58% of her time securing and cleaning the nest, while 49.23% of male's time were used to provide food to feed the inmates and the rest is for his roosting activity (8.18%).

This study recorded the nesting periods for this species is 79±10.5 day with estimation of 27±5.5 day of incubation period. Meanwhile, there were about 1.8±0.4 of fledglings success recorded during the study.

In general, this study ascertained that Kampung Parit 13 ecosystem is worth to make it as conservation area with ample food supply and an ideal habitat for these hornbills. Moreover, the villager's acceptability toward this hornbill's occurrence might somehow aid in promoting public awareness level on their conservation effort.

Last but not least, continuous environmental monitoring program should be implemented in Sungai Karang Forest Reserve to reveal the current status of the hornbill present there. It is important to conserve this forest since it is one of the

main habitats for these hornbills in Malaysia. Losing of this hornbill will give a negative perception towards our country. At the moment, the results of the study will provide important baseline data as reference for future studies on hornbill's status and behaviour in human settlement area.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KELAKUAN *Anthracoceros albirostris convexus* (Temminck, 1831) DI KAWASAN PENEMPATAN, SUNGAI PANJANG, SELANGOR, MALAYSIA

Oleh

NURULHUDHA BT. MOHD JAMIL

April 2013

Pengerusi : Profoser Ahmad B. Ismail, PhD
Fakulti : Sains

Penyelidikan ini telah dijalankan di Kampung Parit 13 (N 03^0 43.512', E 101^0 04.751'), Sungai Panjang yang terletak di bahagian utara negeri Selangor, daerah Sabak Bernam. Ia berdekatan dengan Hutan Simpan Sungai Karang. Terdapat empat spesis burung enggang yang hidup di dalam hutan tersebut. Iaitu Enggang Badak (*Buceros rhinoceros*), Enggang Belukar (*Anorrhinus galeritus*), Enggang Gatal Birah (*Anthococeros malayanus*) dan Enggang Belulang (*Anthracoceros albirostris*). Manakala Enggang Kelingking (*Anthracoceros albirostris convexus*) adalah sub spesis bagi Enggang Belulang. Enggang boleh menjadi petanda yang baik untuk menentukan keadaan hutan dan gangguan dari manusia. Hal ini adalah kerana burung ini memerlukan kawasan yang besar untuk menampung aktiviti pencarian makanan dan waktu bertelur. Oleh itu, kehadiran Enggang Kelingking (*Anthracoceros albirostris convexus*) di kawasan kampung yang terdekat telah menyarankan bahawa perlunya kajian mengenai status dan kelakuan burung ini yang tinggal di kawasan kediaman manusia.

Terdapat tiga objektif di dalam kajian ini, yang pertama adalah kajian mengenai saiz populasi burung ini di dalam kawasan kajian. Yang kedua adalah untuk mengkaji kelakuan Enggang Kelingking ini ketika musim bukan bertelur dan yang terakhir mengkaji kelakuannya ketika musim bertelur. Pemerhatian di jalankan dari bulan Februari 2009 sehingga April 2011. Kajian ini di lakukan dia dalam kawasan kediaman yang merangkumi 501 hektar.

Enam transet garis telah di lakukan pada kawasan tertentu untuk menentukan populasi dan ketumpatan burung enggang. Transet tersebut telah di pilih secara rawak di dalam kawasan kajian berdasarkan jalan yang sedia ada. Terdapat 18 kali waktu lawatan ke atas enam transet tersebut ketika musim bukan bertelur untuk menjangkakan populasi enggang di dalam kawasan kajian. Pemerhatian secara

‘rapid’ juga di lakukan untuk mengenal pasti pertambahan jumlah burung di dalam kawasan selepas musim bertelur. Di mana terdapat 3 kali waktu lawatan di Transet 1 dan 2 secara berasingan telah di lakukan selepas musim bertelur. Kedua-dua transet dipilih adalah kerana mempunyai rekod jumlah burung yang tertinggi berbanding empat transet yang lain. Daripada pemerhatian berdasarkan transet, di dapati jumlah tertinggi burung yang di rekodkan di dalam kumpulan adalah sebanyak 24.67±4.16 individu ketika musim bukan bertelur dan 28.67±3.06 individu selepas musim bertelur. Ia menunjukkan ada individu baru yang menyertai kumpulan burung tersebut. Daripada ‘paired sampled test’, jumlah burung di Transet 2 signifikan (p<0.05) di antara musim bukan bertelur dan selepas musim bertelur. Populasi jangkaan bagi burung ini di dalam kawasan kajian adalah 24.5 ekor burung di dalam kawasan seluas 501 hektar.

Objektif kedua adalah untuk mengkaji kelakuan Enggang Kelingking ketika musim bukan bertelur. Manakala objektif ketiga adalah untuk mengkaji kelakuan burung ini ketika musim bertelur. Kedua-dua objektif ini di jalankan menggunakan kaedah kajian yang sama tetapi di jalankan pada musim yang berbeza. Kelakuan burung ini pada waktu siang untuk kedua-dua musim ini adalah melalui pemerhatian secara ‘focal observations’ berdasarkan ‘sampling blocks’. ‘Sampling block’ ini adalah pembahagian waktu yang dilakukan ketika aktiviti pemerhatian. ‘Sampling block’ ini digunakan sebagai pemboleh ubah kekal untuk setiap jenis kelakuan burung yang di rekodkan. Ia juga digunakan untuk menentukan perbezaan intensiti bagi aktiviti di siang hari. Empat pasangan burung Enggang Kelingking yang cuba untuk bertelur di dalam tempayan ini di pilih untuk di perhatikan tingkah lakunya. Aktiviti harian ini di uji dengan ‘one-way ANOVA’ (SPSS 18) dan di tukarkan ke dalam bentuk ethogram. Di mana kelakuan harian burung ini adalah signifikan di pengaruhi oleh ‘sampling blocks’ termasuklah aktiviti pemakanan (F= 121.27, p< 0.001), penjagaan (F= 464.31, p<0.001), perhubungan (F= 17.04, p< 0.001), lawatan ke sarang (F= 19.35, p< 0.001) dan waktu tidur (F= 189.31, p< 0.001) ketika musim bukan bertelur.

Berdasarkan analisis ethogram, kebanyakan masa harian burung ini dilakukan untuk makan ketika musim bukan bertelur (38.60%) dan musim bertelur (49.23%). Tambahan pula, ethogram menunjukkan, aktiviti harian burung ini ketika bukan musim bertelur termasuklah aktiviti perhubungan (9.46%), melawat ke sarang (12.79%), penjagaan harian (15.72%) dan waktu tidur (5.81%) adalah berbeza berbanding ketika musim bertelur iaitu sanitasi dan pelbagai aktiviti oleh burung betina (42.58%) manakala 49.23% daripada waktu harian burung jantan adalah untuk memberi makan kepada burung betina dan anak-anaknya, selebihnya adalah waktu tidur bagi burung jantan (8.18%).

Kajian ini telah berjaya merekodkan jangka waktu bagi waktu bertelur iaitu 79±10.5 hari dan jangkaan 27±5.5 hari bagi waktu mengeram. Manakala jangkaan jumlah anak burung yang berjaya adalah dalam lingkungan 1.8±0.4 ekor.

Keseluruhannya, kajian ini membuktikan bahawa ekosistem Kampung Parit 13 adalah berbaloi untuk di jadikan kawasan konservasi yang kaya dengan sumber makanan dan habitat yang ideal bagi burung enggang ini. Tambahan pula, penerimaan penduduk boleh memberikan kesan positif kepada peningkatan tahap kesedaran awam terhadap kepentingan usaha konservasi ini.

Kesimpulannya, program pemantauan secara berterusan haruslah dilaksanakan di Hutan Simpan Sungai Karang bagi mendedahkan status terkini enggang-enggang yang terdapat di dalam hutan tersebut. Adalah penting untuk memulihara hutan ini kerana ia adalah salah satu tempat tinggal utama bagi burung enggang di Malaysia. Kepupusan burung enggang ini akan memberikan tanggapan yang negatif terhadap negara kita. Pada ketika ini, hasil daripada kajian ini dapat menyumbangkan data penting yang berharga sebagai rujukan masa hadapan terhadap status dan kelakuan burung enggang ini di kawasan penempatan.

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Lastly, I offer my regards and blessings to all whose names are not mentioned here for being so kind in term of supporting me in any respect during the completion of the project.

THANK YOU!

I certify that a Thesis Examination Committee has met on 2 April 2013 to conduct the final examination of Nurulhudha binti Mohd Jamil on her thesis entitled "Behaviours of *Anthracoceros albirostris convexus* (Temminck, 1831) in Human Settlement Area, Sungai Panjang, Selangor, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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Declaration by Members of Supervisory Committee

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- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

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Name of Chairman of Supervisory Committee: Professor Dr. Ahmad B. Ismail

Signature: _____
Name of Member of Supervisory Committee: Dr. Syaizwan Zahmir Zulkifli

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LIST OF ABBREVIATIONS

%	Percentage
ºC	Degrees
A	Area
Anon.	Anonymous
ANOVA	Analysis of variance
ARCBC	Asean Regional Centre for Biodiversity Conservation
CEPA	The Convention on Biological Diversity's Communication, Education and Public Awareness
CITES	the Convention on International Trade in Endangered Species of Wild Fauna and Flora
CJ	Clay jar
Cp	Couple
CR	Critically Endangered
D	Density
DOF	Department of Forestry, Malaysia
DOM	Department of Meteorology, Malaysia
DWNP	Department of Wildlife and Nature Parks, Malaysia
E	Extinct
e.g.	As an example
EN	Endangered
EW	Extinct in Wild
g	Gram (s)
ha	Hectare (s)
IBA	Important Bird Area
IUCN	The International Union for Conservation of Nature
km	Kilometer (s)
LC	Least Concern
lx	Lux (SI unit measuring luminous flux per unit area)
m	Meter
M^2	Meter square
M^3	Meter cube

MOSTE	Ministry of Science, Technology and Environment
NRE	Ministry of Natural Resources and Environment, Malaysia
N	number of individuals in the area
NT	Near threatened
OBC	Oriental Bird Club
Sg.	Sungai (River)
SPSS	Statistical Package for Social Science
USAID	United States Agency for International Development
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
VU	Vulnerable
WJJ	Wildlife Junior Network

LIST OF APPENDICES

CHAPTER 1

GENERAL INTRODUCTION

1.1 Biodiversity in Malaysia

Biodiversity is our natural living heritage. The term 'Biodiversity' is a contraction of biological diversity; the definitions is varies but it is still referring to the variety of living organism. Biodiversity comprised of three basic levels that is the variety of species, the diverse of genetic within it and finally the ecosystem that they formed. However, to some ecologists, biodiversity is a product of dynamic interactions among different levels of integration within the living world (Leveque and Mounolou, 2003). The dynamic interactions create a functional interaction between biological entities of all levels of organization. Therefore, biodiversity can be used to measure the health of a biological system (NRE, 2010).

Malaysia is well known as a tropical paradise blessed with lush rainforest, magnificent rivers, mysterious limestone caves, elongated coastal line and beautiful coral reefs (Madoc, 1956; Phang, 1998; Burke *et al.*, 2001; NRE, 2010). The physical landscape supports more than half of the world's biodiversity (Delacour, 1947; Ibrahim, 2006). It has been reported that Malaysia is one of the 17 mega diverse countries in this world, which harbour over 70% of the earth's species (NRE, 2010), making the country as one of the richest inheritor, keepers and home to natural gene resources of the world. As stated by the World Bank (2010), Malaysia is a runner up of the richest countries in the world in terms of biodiversity per unit area after Indonesia among South East Asia countries (Anon., 2006), even though it has only 0.2% of the world's land mass. Since, Malaysia provides shelter to various species as listed in Table 1.1 and many more to be discovered, thus, this unique ecosystem must be conserved for the survival and sustainability of its flora and fauna.

Table 1.1: Malaysia's Biodiversity Richness.

Group	Number of Species
Mammals	306
Birds	742
Reptiles	567
Amphibians	242
Marine Fishes	4,000
Freshwater Fishes	449
Invertebrates	150,000
Flowering Plants	15,000
Orchids	3,000
Palms	536
Ferns	2,012
Fungi	700
Mosses	832
Microorganisms	NA*

*complete data is not available (Adapted from: NRE, 2010)

Malaysia itself, owns endemic species (Medway and Wells, 1976; MOSTE, 1997; Ibrahim, 2006). Certain endemic species such as the hornbills are sensitive to changes in the ecosystem (Kemp, 1995). Managing this ecosystem with reference to such species ecology and their biology are important for conservation purposes (Kemp, 1995; Amita Bachan *et al.*, 2011). In fact, each species play an important role in the ecosystem, providing variety of environmental services (UNEP, 2002). Whereby, they are important as a buffer ecosystem as contrast to human activities (UNEP, 1995). The loss of any species weakens the ecosystem and consequently may affect its ability to perform the ecosystem services. Thus, a lot of ecological and biological based studies are needed to monitor the current status of our ecosystem and to implement a protection system.

Malaysia's evergreen tropical forests (Delacour, 1947) and its wide range of beautiful coastal environment (Phang, 1998; Burke *et al.*, 2001) make it as one of the strategic destinations for travelling, learning, leisure and much more activities. As Davidson and Chew (2007) stated that, slope, altitude and drainage are some of the main factors influencing the natural habitat and support variety component species of wildlife. Besides supporting the ecosystem, the biodiversity also provides such an attractive tourism sites that allows the foreign currency to pour in the country. Thus, the biodiversity in Malaysia has an economic value that must be protected and maintained (World Bank, 2010).

According by UNEP (2002), birds are important element and mostly referred to determine the Living Planet Index system; that is a global biodiversity indicator for forest ecosystem. There is nearly one quarter of the world's mammals, one third of amphibians and more than 1 in 8 of all bird species are at risk of extinction (Vié *et al.*, 2009). It is a result from the continuing of deforestation activities in tropical country (UNEP, 2002). Thus it is an urgent to get a better view on bird's diversity and status nowadays, particularly in Malaysia to produce concise and reliable current

data on birds as in Table 1.2. As the number of species might increase or decrease as years passed by, for example the ascending numbers of birds recorded in Malaysia between 2010 (Table 1.1) and 2011 (Table 1.2).

Table 1.2: Recent record on birds in Malaysia (Adapted from: Avibase, 2011)

Detail	Number of birds recorded
Total Number of Species	792
Number of Endemic Species	10
Number of Globally Threatened	45
Number of Introduced Species	4
Total Number of Hornbills	11
Number of Threatened Hornbills	6
Number of Vulnerable Hornbill	1

1.2 Statement of the Problem

Due to anthropogenic activities, the biodiversity in Malaysia has confronted an unprecedented loss and changes (Pimm *et al.*, 1995; Winarni and Jones, 2009). That brings direct impact on human well-being and sustainable ecosystem, since they did provide genetic resources for our food and agriculture demand (UNEP, 2002). Many species are on a large scale extinction. As been reported concisely in 'Biodiversity in Malaysia' by Anonymous (2006), the basic units of life have been vanishing at 100 to 1,000 times the natural rates of extinction.

Our terrestrial ecosystem range from coastal vegetation to montane forest, meanwhile lakes, reservoirs and the ocean complete our aquatic ecosystem. Our forest only account about 18.4 million ha (56%) from our total land area (DOF, 2010). There are about 20,456,00o ha (62.3%) forest in Malaysia with 18.7% is classified as primary forest while 1,807,000 ha are planted forest (Anon., 2012) However from 1990 to 2010 Malaysia lost 8.6% of its forest with average of 0.43% (96,000 ha) per year (Anon., 2012). Our forests are most liable to destruction by our rapid global development, in which as predicted by the Food and Agriculture Organization (FAO). The lost of forest were depleted range from mangrove, freshwater, peat swamp to montane forest. Therefore, an understanding of the habitat preferences is fundamental to many approaches for species conservation, habitat management and predictive population modelling (Sutherland *et al.*, 2004).

Lacking of skills in forest management might lead to more problems on habitat loss (Kizungu, 2011). This is due to deforestation, logging, poaching and demanding urge in certain sector such as land for agriculture, aquaculture and development. The threatened habitat has affected the nearby community, such as hornbills whereby six species of them are near threaten and one species is vulnerable in Malaysia (Table 1.2). Since the unique ecosystem supports variety structures of food web, thus the disturbed ecosystem may have less number of mature and tall trees due to logging activities. Then it might reduce the quality of food production by lowering the number of fruiting trees availability. Whereby, some of the food sources such as invertebrates, small vertebrates and other plantations in the food chain already

contaminated by several source of rapid development like high concentration of pesticide, carbon monoxide and so on mostly contributed by the anthropogenic activities.

As stated by Franco *et al.,* (2007), the traditional farming practices has also become one of the main causes for the dramatic decline of wildlife population, particularly when the farming areas are abandoned. Bring a negative effect towards the quality of foraging habitat for most animal species. The interrelationships between community dynamics, stability, ecosystem functioning and how these are influenced by the environmental changes can be measured by food webs analysis (DeAngelis, 1992). According to Peter *et al.,* 2005, the food webs contain the thought to influence the dynamics and continuity of many populations in fundamental ways through the availability of energy and nutrient as resources also mortality due to predation. The loss of key species might disrupt the balance of other species in the food chain. Disturbed ecosystem might influence the imbalance status of quality food webs, hence, for some species to survive they need to switch or make some adaptation to a new environment to fulfil their daily's food supply, worst in human concentrated area (Bloem and Henrot, 2009) which then the wildlife and human conflict arise.

Thus in this study, one species of bird, Southern-pied Hornbill, was chosen based on its availability in human surrounding area. It is done to have a look at the current status of biodiversity in Malaysia, as this species shows adaptability to survive in human settlement area. Study focus on the behaviour of these birds during their non-breeding and breeding season in human settlement to maintain their continuity of life. This species is an example of animals that switch their life requirement to ensure their continuity.

Furthermore, the hornbills usually are more attractive and have a commercial value compared to the other species of birds due to the conspicuous body size and colour as well as harsh sound they always made. It has been used as an icon to represent parks (e.g. Kuala Lumpur Bird Park), groups, programs (Philakone *et al.,* 2009; Seateun *et al.,* 2009), organizations (DWNP) or even a state (Sarawak) in Malaysia. Extinction of the hornbills will give a negative perception to the outsiders towards our country.

Nowadays, the hornbills habitat has become limited as a consequence of high human disturbance in forest area, (Bloem and Henrot, 2009; Myers, 2009; Lee and Rombang, 2011). Selective logging which old and mature trees are chosen to be cut might deteriorate the natural nest and reduce the food resources. Forest thinning and clearance is transferred into agriculture or other human activities. Thus, this phenomenon would cause a negative effect to the population of the birds. Incline the probability of suitable nest sites and feeding territory. Hence, some of these birds adapt to this situation by lowering their breeding rate and some shift to other environment to continue breeding (Seateun *et al.,* 2009) whilst in rare condition they might choose to breed in artificial nest (Cremades *et al.,* 2009; Ng *et al.,* 2009;

James *et al.*, 2011; Pasuwan *et al.*, 2009; Cremades *et al.*, 2011), such in this study case.

1.3 Significant of Research

Due to our tropical evergreen forest, that enjoys precipitation throughout the year., Malaysia owns 11 species of these hornbills, which is 20% from 54 of world species (DWNP, 2010). The species are White-crowned (*Berenicornis comatus*), Bushy-crested (*Anorrhinus galeritus*), Wrinkled (*Aceros corrugatus*), Wreathed (*Aceros undulatus*), Black (*Anthracoceros malayanus*), Oriental pied (*Anthracoceros albirostris*), Southern-pied (*Anthracoceros albirostris convexus*), Rhinoceros (*Buceros rhinoceros*), Great (*Buceros bicornis*), Plain pouch (*Aceros subruficullis*) and Helmeted hornbill (*Buceros vigil*). They also represent four genera (*Aceros, Anorrhinus, Anthracoceros* and *Buceros*) from the total of nine (*Bucorvus, Ceratogymna, Ocyceros, Penelopides* and *Tockus*). They can usually be found at wide-ranging habitat from the lowland to highland forest, including around the coastal areas (Kemp, 1995; Robson, 2000; Myers, 2009).

Hornbills are a member of the family Bucerotidae and Bucorvidae (Sibley and Ahlquist, 1991). They are generally large in size, bold pied marked plumage with yellow casque that solid as ivory, have noisy manner usually notable when cackling, sometimes proceed with maniacal laughter, making them apparent and conspicuous birds. They live in many habitats mainly in mature forests that is over 75% of the total species of 54 hornbills from all over the world are forest dwellers, while others are savannah's (Kemp, 1995). Hornbills are characterized by their unique cavity-nesting birds. They do not make holes by their selves for nesting, thus they are known as second-nesters (Poonswad, 1995). They prefer, the naturally occurring tree cavities in the wild, however, in cases with limitation of suitable trees availability, they will occupy holes which are left by other animals (Cremades *et al.*, 2009).

The hornbills are frugivorous animal. Due to the large size and rarity distribution of their food resources, they need a wide range of territorial area. The distribution of their food and their existence depend on specific pattern of fruit production (Johns, 1987; Kitamura *et al.*, 2004; Walker, 2007). For that reason, their territorial areas are shared by both nomadic and other territorial species, regardless of their body sizes as well as dietary specialization (Leighton, 1982; Poonswad, 1995). Besides providing the nutritious food, the territories are also important for roosting and breeding area. Thus, the fruits phenology of a forest has become a crucial factor in determining the hornbill's breeding cycles (Kannan, 1994). However, they do sometimes take small animals and insect in their diet to fulfil their daily body requirement mainly during breeding season (Delacour, 1947; Kemp, 1995).

Hornbills can be a keystone mutualists species to a forest (Gilbert, 1980; Lee and Rombang, 2011). They are totally protected birds in Malaysia (DWNP, 2010). Their existence has been used as an indicator for the health of a forest since they adopt large territorial areas (Gilbert, 1980; Lee and Rombang, 2011). Furthermore, the

hornbills are one of the essential pollinator for some vital and rare rainforest tree species (Whitney *et al*. 1998; Kinnaird, 1998; Kinnaird and O'Brien, 2007; Lee and Rombang, 2011).

One of the state in Malaysia, Sarawak is known as 'the land of the hornbills' and is represented by a hornbill species, *Buceros rhinoceros*, through its coat of arms. However, all the 11 species can only be found in Peninsular Malaysia (Yeap, 2004). Interestingly, all of them can be discovered in pristine forest, Belum-Temenggor Rainforest, which is over 130 million of age and encompassing 300,000 ha compared to Sarawak that bear eight species of them (Yeap, 2004). It has also been reported that five species of hornbills were seen in Sabak Bernam District that is in Sungai Karang Forest Reserved (DWNP, 2010).

Sungai Karang Reserve Forest has a unique environment compared to Belum-Temenggor Rainforest because it is adjacent to residential area, industrial area, and agriculture area. It is a peat swamp forest surrounded by oil palm plantation, paddy fields and human settlement have raised new concern on the protection and conservation of these hornbills. It is included in the list of Permanent Reserve Forest in Selangor by the Selangor Forestry Department. It is the largest (50,106.60 ha) forest among the other reserve forest in Selangor. In Sungai Karang Reserve Forest, there are five groups of hornbill live in sympatric which are Rhinoceros Hornbill, Bushy-crested Hornbill, Black Hornbill, Oriental Pied Hornbill, and Southern Pied Hornbill. All of them have been recorded by Department of Wildlife and National Parks, Malaysia. Since Sungai Karang Reserve Forest covered 50% of the total number of hornbills species that presence in Malaysia with its unique ecosystem structure, it is recommended that studies should be conducted in the forest and the nearby areas to determine the current status of its biodiversity.

Southern pied Hornbill is one of the species that can be found in Sungai Karang Reserve Forests. Besides the human activities, this species might face pressures for nesting and feeding in the area because they are the smallest species of hornbill ever lives there. As they need large area for food and tall trees for nesting, disturbances in Sungai Karang Reserve Forest with surrounding development for agriculture may force them to search for other areas. They had been studied as one of the most easily adapted species towards new environment with record of breeding successes (Cremades *et al.*, 2011).

This Southern pied Hornbill (*Anthracoceros albirostris convexus*) is a subspecies of Oriental pied Hornbill. It has a restricted distribution in Asian countries. It can also be found in southward of Thailand including Malaysia (Robson, 2000). Even though, it is classified as common in Malaysia, there was still no study yet recorded on the behavioural and ecological of this species around human environment. Moreover, very little information was available on this species for future references.

1.4 Aims of Research

Since this bird can be observed in human settlements Kg. Parit 13, Sungai Panjang, Selangor, thus this study was conducted:

1. To assess the population size of Southern-pied Hornbill in Kampung Parit 13, Sungai Panjang Selangor.

2. To study the behaviour of Southern-pied Hornbill during breeding season in Kampung Parit 13, Sungai Panjang Selangor.

3. To study the behaviour of Southern-pied Hornbill during non-breeding season in Kampung Parit 13, Sungai Panjang Selangor.

1.5 Scope and Content of the Thesis

This study inquires on the adaptability of Southern-pied Hornbill in human settlement areas. It covers on their biological and ecological aspects during non-breeding and breeding seasons, as well as documentation of their current population in the study area.

This thesis is comprised of five chapters. Chapter one provides the general introduction and rationalization of the study. Chapter two contains the literature review of previous studies conducted in the field regarding on the biological and ecological aspect of the hornbills, particularly on the Southern Pied Hornbill, hornbill's current status and conservation efforts. Chapter three comprehends on the general methodology; where the study was conducted and why it was chosen, including the materials used in the study as well as explanation on some environment factors noted around the sampling areas. Chapter four clarifies the results with their discussions in a respective order. Chapter five covers on the summary, conclusion and recommendations for future research.

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