

สถานภาพของชะนีแก้มดำ ในป่าสงวนแห่งชาติน้ำก่าน
สาธารณรัฐประชาธิปไตยประชาชนลาว



นายคำ หยวนจือเสียน

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

สาขาวิชาชีววิทยาสิ่งแวดล้อม

มหาวิทยาลัยเทคโนโลยีสุรนารี

ปีการศึกษา 2557

**THE STATUS OF LAOTIAN BLACK CRESTED GIBBON
NOMASCUS CONCOLOR LU IN NAM KAN NATIONAL
PROTECTED AREA, LAO PDR**



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**A Thesis Submitted in Partial Fulfillment of the Requirements for the
Degree of Master of Science in Environmental Biology**

Suranaree University of Technology

Academic Year 2014

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***NOMASCUS CONCOLOR LU* IN NAM KAN NATIONAL**
PROTECTED AREA, LAO PDR

Suranaree University of Technology has approved this thesis submitted in partial fulfillment of the requirements for a Master's Degree.

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คำ หยวนจื่อเสียน: สถานภาพของชะนีแก้มดำในป่าสงวนแห่งชาติน้ำก่าน สาธารณรัฐ
ประชาธิปไตยประชาชนลาว (THE STATUS OF LAOTIAN BLACK CRESTED
GIBBON *NOMASCUS CONCOLOR LU* IN NAM KAN NATIONAL PROTECTED
AREA, LAO PDR).อาจารย์ที่ปรึกษา: ผู้ช่วยศาสตราจารย์
ดร.พงศ์เทพ สุวรรณวารีย์ 88หน้า.

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พื้นที่ป่าของประชาชน

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เหมาะสมของชะนีแก้มดำขนาด 402 ตารางกิโลเมตร ในแต่ละพื้นที่ศึกษาได้กำหนดจุดฟังเสียงจำนวน
3 จุด ซึ่งอยู่ห่างกันประมาณ 500 เมตร โดยทำการฟัง 3 จุด พร้อมๆกัน ตั้งแต่เวลา 05.30 -10.00 นาฬิกา
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2 กลุ่ม ซึ่งคำนวณค่าความหนาแน่นของชะนีแก้มดำได้เพียง 0.09กลุ่มต่อตารางกิโลเมตรเท่านั้น
นอกจากนี้ยังได้วางแผนวงกลมขนาดรัศมี 5.65 เมตร จำนวน 150 แปลง เพื่อศึกษาลักษณะที่อยู่อาศัย
ของชะนีแก้มดำ ในทั้ง 3 พื้นที่ พบว่า ความสูงของต้นไม้เฉลี่ยเท่ากับ 32.05 เมตร ความหนาแน่นของ
ต้นไม้เฉลี่ยเท่ากับ 451.33 ต้นต่อเฮกตาร์ เส้นผ่านศูนย์กลางของต้นไม้ที่ระดับความสูง 1.30 เมตร เฉลี่ย
เท่ากับ 33.70 เซนติเมตร ขนาดพื้นที่หน้าตัดเฉลี่ยเท่ากับ 27.64 ตารางเมตร และขนาดพื้นที่หน้าตัด
เฉลี่ยเท่ากับ 55.29 ตารางเมตรต่อเฮกตาร์ ซึ่งข้อมูลพืชที่พบทั้ง 3 พื้นที่มีความแตกต่างกันอย่างมี
นัยสำคัญทางสถิติที่ความเชื่อมั่น 0.05

ในส่วนการศึกษาภัยคุกคาม ได้ทำการเดินสำรวจเส้นทางเป็นระยะทางประมาณ 2 กิโลเมตร จำนวน 23 เส้นทาง โดยเริ่มสำรวจตั้งแต่เวลา 10.00-12.00 นาฬิกา หลังจากทำการฟังเสียงร้องของชะนีแก้มดำแล้ว เพื่อบันทึกร่องรอยของประชาชนที่เข้ามาทำกิจกรรมต่างๆ ในพื้นที่ดังกล่าว ผลการศึกษาพบร่องรอยที่เป็นภัยคุกคามทั้งหมด 105 ร่องรอย มากที่สุดคือจากที่พักของคนล่าสัตว์คิดเป็นร้อยละ 46.70 รองลงมาคือ การทำเกษตรกรรม ได้ยินเสียงปืน ที่อยู่อาศัยชั่วคราว และน้กล้า คิดเป็นร้อยละ 20.95 20.95 7.62 และ 3.81 ตามลำดับ โดยเฉลี่ย 2.2 ร่องรอยต่อกิโลเมตร

การศึกษานี้พบประชากรของชะนีแก้มดำลดลงจากในอดีต ซึ่งมีสาเหตุมาจากการล่าและการบุกรุกพื้นที่ป่าของประชาชน และพบว่าพื้นที่ที่ทำการศึกษหลายพื้นที่ ไม่ปรากฏว่ามีชะนีอาศัยอยู่อีกแล้ว สำหรับ Gibbon Experience นั้นเป็นหนึ่งในไม่กี่พื้นที่ ที่ยังคงพบประชากรชะนีแก้มดำอาศัยอยู่ สืบเนื่องมาจาก ชาวเผ่าม้งมีประเพณีเกี่ยวกับการอนุรักษ์ชะนีแก้มดำ รวมถึงรายได้จากการดำเนินกิจกรรมการท่องเที่ยวเชิงอนุรักษ์อีกด้วย



สาขาวิชาชีววิทยา ลายมือชื่อนักศึกษา _____

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KHAM YOUANECHUEXIAN: THE STATUS OF LAOTIAN BLACK
CRESTED GIBBON *NOMASCUS CONCOLOR LU* IN NAM KAN
NATIONAL PROTECTED AREA, LAO PDR. THESIS
ADVISOR: ASST. PROF. PONGTHEP SUWANWAREE, Ph.D. 88 PP.

GIBBON/NAM KAN/POPULATION/LISTENING POST/GIBBON EXPERIENCE

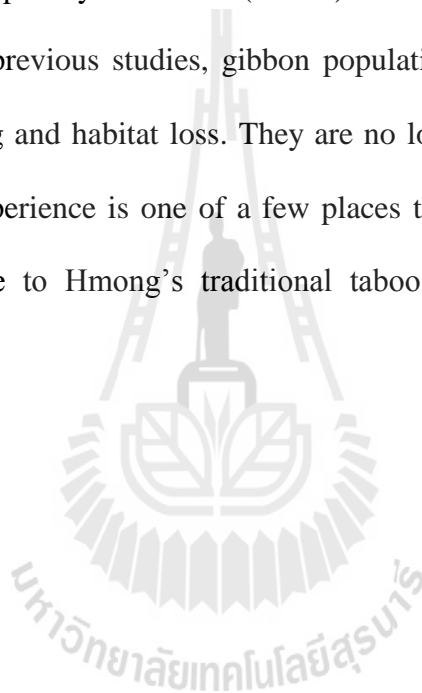
The Laotian black crested gibbon (*Nomascus concolor lu*) is a critically endangered species found only in Nam Ha and Nam Kan National Protected Area (NPA), Lao PDR. The distribution, population density and threats of this gibbon in Nam Kan NPA, were investigated for 5 months from September 2013 to January 2014. Fifty villagers from 10 villages, both inside and adjacent of Nam Kan NPA, were interviewed. They reported 14 historical distribution locations with 27 gibbon groups and 78 individuals estimated. However, gibbon populations started to disappear by 1995 mainly from hunting for food and habitat loss.

Twenty-three sites, with 3 listening posts each, were surveyed across 402 km² of dry evergreen forest, a suitable habitat for gibbons. Each listening post was approximately 500 m apart and it was visited on 3 consecutive mornings from 05:30 am to 10:00 am. Ten gibbon groups were heard from only 3 sites: 4 groups at the Gibbon Experience ecotourism, 4 groups at Nam Toun and 2 groups at Nam Nga. A total of 39 individuals were seen that gives gibbon density estimated of only 0.09 groups/km². In addition, plant study plots were conducted in these 3 gibbon sites. From 150 circular plots (5.65 m in radius), the results showed the total averages were canopy height was 32.05 m, tree density was 451.33 trees/ha, average diameter at

breast height was 33.70 cm, basal area was 27.64 m² and tree basal area was 55.29 m²/ha. The forest characteristics were significantly different ($p < 0.05$) among 3 sites.

Twenty three of 2-km non-systematic transects were also surveyed from 10:00 to 12:00 am after gibbon listening to record human activities around the areas. A total of 105 threat individuals were identified at an average of 2.2 threats/km. The most frequent threat was hunting camp (46.70%), followed by agriculture (20.95%), gunshot (20.95%), temporally settlement (7.62%) and hunter (3.81%).

Compared to previous studies, gibbon populations in Nam Kan NPA are in decline due to hunting and habitat loss. They are no longer in some previous record locations. Gibbon Experience is one of a few places that still supports good gibbon populations. It is due to Hmong's traditional taboo and partly the benefit from ecotourism.



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ACKNOWLEDGEMENTS

I am sincerely grateful to my thesis advisor, Asst. Prof. Dr. Pongthep Suwanwaree and my co-advisor Dr. Phaivanh Phiapalath for their invaluable helps, encouragement and financial support throughout the course of this research. I will be forever grateful.

I wish to thank Suranaree University of Technology for supporting a scholarship and many thanks to Mr. Jean-francois Reumaux, the head of the Gibbon Experience, ecotourism forest conservation project in Nam Kan National Protected Area in Bokeo Province, Lao PDR, for supporting scholarship and payment cost of my study and accommodation, food and staffs for their assistance in this research field worked.

I would like to express my gratitude for the permission to undertake the field survey in Nam Kan National Protected Area from the Ministry of Natural Resource and Environmental in Bokeo Province, Laos PDR (permission No. 89).

Thanks to Assoc. Prof.Dr. Tommaso Savini, Dr. Ramesh Boonratana, for their advices as academic mentors in the preparation of this dissertation. I would like to thank Dr. Camille Coudrat, Mr. Warin Boonriam, Ms. Jirapa Suwanrat, Mr. Khampasert Kong Ay and Mr. Duangphachan Souvansai for their assistances in the field and warm friendships during the course of my studies.

Finally, I wish to thank my family for their unfaltering faith in my ability and encouragement throughout the period of this research.

Kham Youanechuexian

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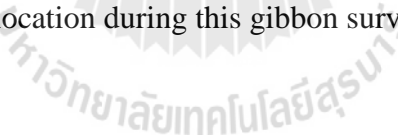


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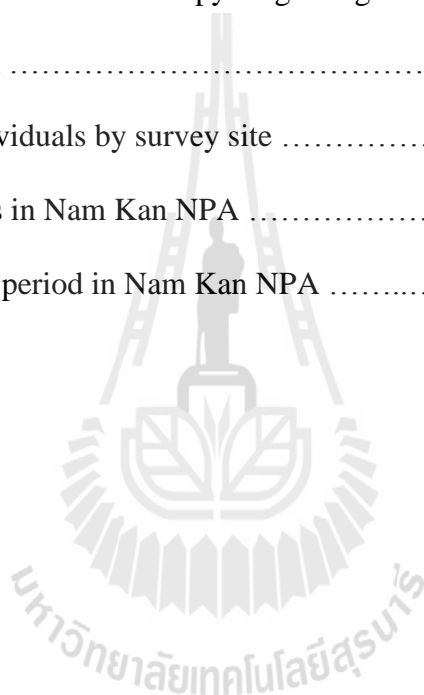


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LIST OF ABBREVIATIONS

a.s.l	Above sea level
CITES	Convention on International Trade in Endangered Species
D	Density
DBH	Diameter at Breast Height
E	Effective
etc	Et cetera
GPS	Global Positioning System
GIS	Geographic Information System
Grp	Group
<i>H.</i>	<i>Hylobates</i>
Ind	Individual
IUCN	International Union for Conservation of Nature
km	kilometer
Lao PDR	Lao People's Democratic Republic
LP	Listening post
m	Meter
n	Number
<i>N.</i>	<i>Nomascus</i>
<i>N. c</i>	<i>Nomascus concolor</i>
NNR	National Nature Reserve

LIST OF ABBREVIATIONS(Continued)

NP	National Park
NPA	National Protected Area
R	Radius
S.	<i>Symphalangus</i>
S.D.	Standard Deviation
UTM	Universal Transverse Mercator



CHAPTER I

INTRODUCTION

1.1 Backgrounds and Problem

The Laotian black crested gibbon (*Nomascus concolor lu*) is listed as critically endangered (Bleisch *et al.*, 2008) and there are only a few population in northern Laos that remain entirely unstudied in the wild. In 1939, it was discovered at Ban Nam-Khueng in Bokeo province, northwestern Lao PDR. Sample specimens of a dozen individuals were collected, which were subsequently described as a new subspecies (Delacour, 1951). The Laotian black crested gibbon only occurs in Nam Kan National Protected Area (NPA), Bokeo province and a small population in Nam Ha NPA, Luang Namtha Province, Lao PDR (Johnson *et al.*, 2005; Geissmann, 2007).

In 1999, 13 gibbon groups were recorded in Nam Kan NPA especially in Ban Toup and Ban Lor Xor in the southern half of Nam Kan NPA (Geissmann, 2007). Later Robichaud *et al.* (2010) surveyed and interviewed villagers in and around Nam Kan NPA. He made an estimate from 9 to 14 groups of Laotian black crested gibbon mainly in the southern part. Also, another later survey reported about 10 to 14 groups as especially found at Ban Chomsy area and the north-central of the NPA mostly in the catchments of the upper Nam Touey and Nam Hmongnoy, and flow to the lower Nam Touey (Timmins and Duckworth, 2013). In addition, five gibbon groups were recorded in Nam Ha NPA in 2003 (Johnson *et al.*, 2005) which is only adjacent national protected area located on the north next to the study site. However, for the

gibbon groups in Nam Ha as only one group was found three years later at the same location (Brown, 2009). This group still remains in that area from recent confirmation by Luanglueyay and Suwanwaree (2012). Therefore, Nam Kan NPA is very important for conservation of this gibbon species as only the site supports the viable population in the world.

The population of Laotian black crested gibbon has declined due to habitat loss and hunting, habitat degradation and deforestation. These activities are also impact on sustainable economic development, particularly for rural communities who are often entirely dependent upon local natural resources. The hunting appears to be the most critical issue directly affecting the recovery of gibbons that has been carried out by both local villagers and pressures from outside. Nam Kan NPA is under high pressure and the Bokeo Province is easily accessible to transportation as R3 Road runs through the eastern protected area (Robichaud *et al.*, 2010).

Anticipated results included; to obtain more understanding of the distribution and population density of this gibbon by auditory listening posts located in entirely suitable gibbon habitats of Nam Kan NPA, northern Lao PDR from September 2013 to January 2014. This research is necessary to feed for planning of further gibbon conservation and to ensure gibbons are protected from extinction.

1.2 Research Objectives

The objectives of the study are:

- 1) To determine the population density of Laotian black-crested gibbons at Nam Kan NPA, northern Lao PDR.
- 2) To examine the current and potential threats to the Laotian blackcrested

gibbon at Nam Kan NPA.

- 3) To assess factors of affecting the gibbon population in Nam Kan NPA.

1.3 Scope and Limitations of the Study

The study sites were in Nam Kan NPA. Fifty villagers from 10 villages both inside and adjacent of Nam Kan NPA were interviewed. The villagers interviewed for determined on historical distribution and population of gibbons in the area were conducted from 3 to 23 September 2013 and followed with some additional interviews in January 2014. There were 23 survey sites, 69 listening posts were selected in whole dry evergreen forest of Nam Kan NPA. Suitable habitats of Laotian black crested gibbon were confirmed during the survey from September 2013 to January 2014. In this study, the gibbon population density was investigated and the data were collected at the same time as the listening post survey was being conducted. The study has to compare the gibbon density of 23 survey sites and habitat that gibbon present or absent, then analysis of gibbon habitat suitability in Nam kan NPA was made. The threat surveys were conducted simultaneously as first local communities and gibbon field survey. A 2 km-transect walk per survey site but it was as non-systematic transect was selected depending on the terrain, made in total of 23 transect walks. The threat evidences such as sound of gun, agriculture, hunter, hunting camp, temporally settlement were identified during the field survey.

CHAPTER II

LITERATURE REVIEW

2.1 Gibbon

Gibbon constitutes the smaller ape among the order Primates of the class Mammalia. There are 17 gibbon species (Table 2.1) in four genera (*Hylobates*, *Hoolock*, *Nomascus* and *Symphalangus*) living in tropical and subtropical rainforests of south Asia, China and southeast Asia (Figure 2.1); from northeast India to Indonesia and southern China, including the islands of Sumatra, Borneo, and Java (Van Ngoc Thinh *et al.*, 2010).

The gibbon population and distribution are two crucial parameters for determining conservation status. However, many reported on population and distribution of each gibbon species (Table 2.2).

Lao PDR has a high diversity of gibbons, as second to only Indonesia in the world. Based upon taxonomic, seven species occur in Lao PDR of which the Black crested gibbon (*Nomascus concolor*) and the Northern white-cheeked gibbon (*Nomascus leucogenys*) are globally listed as critically endangered and all the others such as Northern buffed-cheeked gibbon (*Nomascus annamensis*), Red-cheeked gibbon (*Nomascus gabriellae*), Lar gibbon (*Hylobates lar*), Pileated gibbon (*Hylobates pileatus*) and Southern white-cheeked gibbon (*Nomascus siki*) are endangered. Of which *N. gabriellae* is not officially confirmed in Laos. Anyway, gibbons are distributed throughout Lao PDR (Bleisch *et al.*, 2008).

Table 2.1 Gibbon species and distribution (Bleisch *et al.*, 2008).

No	Scientific name	Common name	IUCN Red List Status	Distribution
1	<i>Hylobates agilis</i>	Agile gibbon	Endangered	Indonesia, Malaysia and Thailand
2	<i>Hylobates albibarbis</i>	Bornean white-bearded gibbon	Endangered	Indonesia
3	<i>Hylobates klossii</i>	Kloss's gibbon	Endangered	Indonesia
4	<i>Hylobates lar</i>	Lar gibbon	Endangered	Indonesia, Lao PDR, Malaysia, Myanmar and Thailand
5	<i>Hylobates moloch</i>	Silvery Javan gibbon	Endangered	Indonesia
6	<i>Hylobates muelleri</i>	Müller's Bornean gibbon	Endangered	Indonesia and Malaysia
7	<i>Hylobates pileatus</i>	Pileated gibbon	Endangered	Thailand, Lao PDR and Cambodia
8	<i>Hoolock hoolock</i>	Western hoolock gibbon	Endangered	India, Myanmar and Bangladesh
9	<i>Hoolock leuconedys</i>	Eastern hoolock gibbon	Vulnerable	China and Myanmar
10	<i>Nomascus annamensis</i>	Northern buffed-cheeked gibbon	Not assess	Vietnam, Cambodia and Lao PDR
11	<i>Nomascus concolor</i>	Black crested gibbon	Critically endangered	China, Lao PDR and Viet Nam
12	<i>Nomascus gabriellae</i>	Red-cheeked gibbon	Endangered	Cambodia, Viet Nam and Lao PDR
13	<i>Nomascus hainanus</i>	Hainan gibbon	Critically endangered	Hainan Island, China
14	<i>Nomascus leucogenys</i>	Northern white-cheeked gibbon	Critically endangered	Viet Nam, Lao PDR and Yunnan, China
15	<i>Nomascus nasutus</i>	Cao-vit crested gibbon	Critically endangered	Viet Nam and China
16	<i>Nomascus siki</i>	Southern white-cheeked gibbon	Endangered	Lao PDR and Viet Nam
17	<i>Symphalangus syndactylus</i>	Siamang	Endangered	Indonesia, Malaysia and Thailand

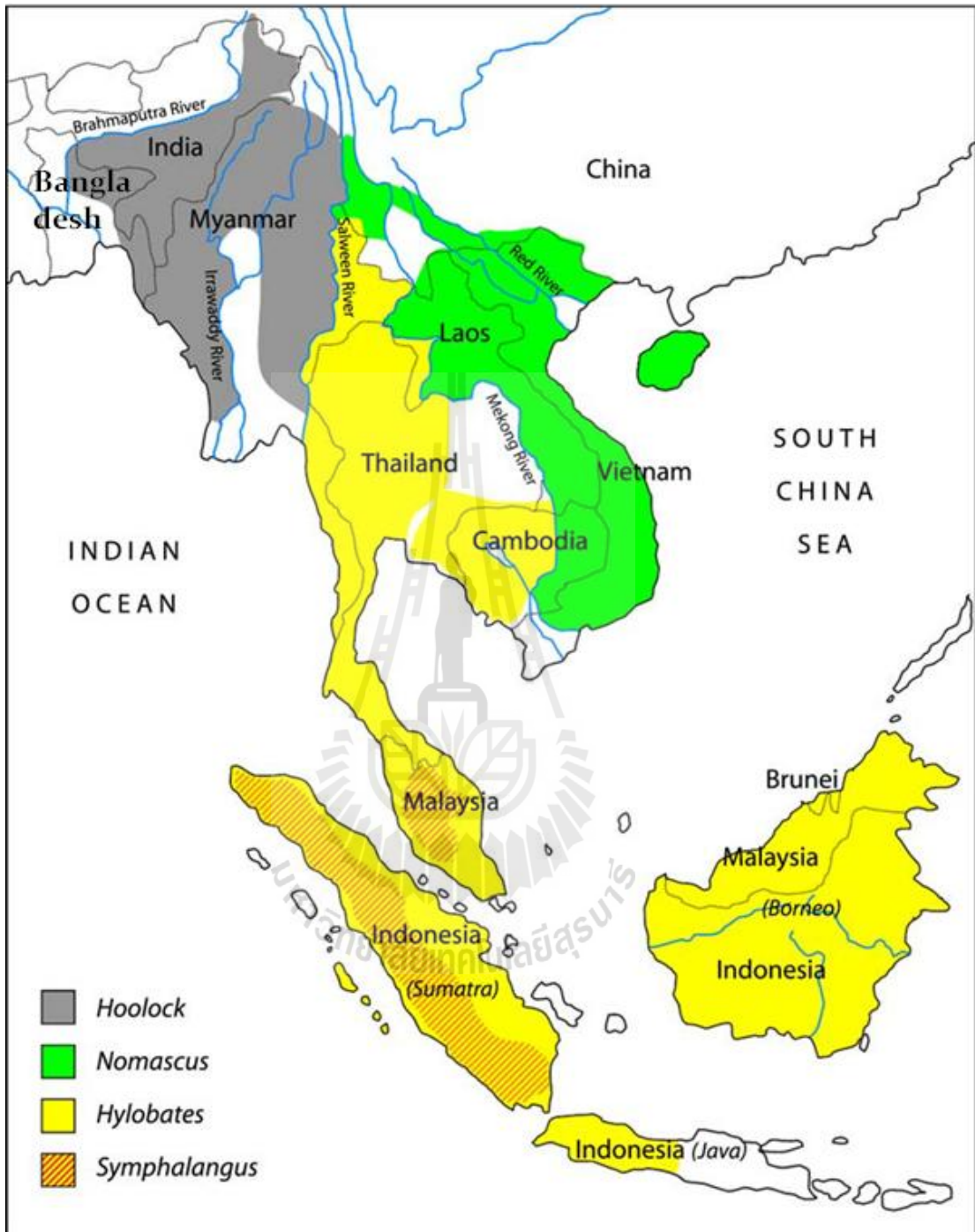


Figure 2.1 Geographical distribution of the four gibbon genera (Rawson *et al.*, 2011).

Table 2.2 Gibbon densities and population summary.

Scientific name	Population (Ind)	Density/km ²		Location	Country	References
		(Ind)	(Grp)			
<i>H.agilis</i>	4,479		0.68	Bukit Barisan Selatan NP	Indonesia	O'Brien <i>et al.</i> (2004)
<i>H.albibarbis</i>		3.5-13.9	1.39-3.92	Sabangau catchment, Central Kalimantan	Indonesia	Hamardet <i>al.</i> (2010)
<i>H.klossii</i>	20,000-25,000	11-13	1.17-2.08	Mentawai Islands, Sumatra	Indonesia	Whittaker (2005)
<i>H.lar</i>	318			Khao Yai NP	Thailand	Brockelman(2004)
<i>H.moloch</i>	4,000-4,500	1.5-9	1-2.6	Central Java	Indonesia	Nijman (2004)
<i>H.muelleri</i>	74	6.9-9.9	2.1-2.9	Kayan Mentarang NP and Sungai Wain Protection Forest, Kalimantan	Indonesia	Nijman and Menken (2005)
<i>H.pileatus</i>			1.02	Khao Ang Rue Nai Wildlife Sanctuary	Thailand	Phoonjampaet <i>al.</i> (2011)
<i>H.hooslock</i>	282			Northeast and Southeast, Bangladesh	Bangladesh	Islam <i>et al.</i> (2008)
<i>H.leuconedys</i>	168			Lohit District	India	Daset <i>al.</i> (2006)
<i>N.annamensis</i>	148		0.12	Kon Ka Kinh NP, Gia Lai Province	Vietnam	Long <i>et al.</i> (2011)
<i>N.gabriellae</i>			0.118	Ta Dung NA	Vietnam	Ducet <i>al.</i> (2010)
<i>N.hainanus</i>	17-20			Bawangling NNR, Hainan Island	China	Fellowes <i>et al.</i> (2008)
<i>N.leucogenys</i>	455		0.05-0.27	Pu Mat NP, Nghe An Province	Vietnam	Bach <i>et al.</i> (2011)
<i>N.nasutus</i>	18		0.5	Bangliang Limestone Forest, Jingxi County	China	Lok <i>et al.</i> (2008)
<i>N.siki</i>			0.7	Phong Nha–Ke Bang NP	Vietnam	Ruppell (2007)
<i>S.syndactylus</i>	22,390		2.23	Bukit Barisan Selatan NP, Sumatra	Indonesia	O' Brien <i>et al.</i> (2004)

Remark: *H*=*Hylobates*, *N*=*Nomascus*, *S*=*Symphalangus*, NP=National Park, NNR=National Nature Reserve, NA=National Area

2.2 Black Crested Gibbon (*Nomascus concolor*) [Harlan, 1826]

2.2.1 Taxonomy

Domain Eukarya

Kingdom Animalia

Phylum Chordata

Class Mammalia

Order Primates

Family Hylobatidae

Genus *Nomascus*

Species *concolor*

The Black crested gibbon has four subspecies such as Tonkin black crested gibbon (*N. c. concolor*), West Yunnan black crested gibbon (*N. c. furvogaster*), Central Yunnan black crested gibbon (*N. c. jingdongensis*) and Laotian black crested gibbon (*N. c. lu*) due to different habitats but have the same feature. Each subspecies has only minimal molecular differences among *N. c. concolor*, *N. c. furvogaster* and *N. c. jingdongensis* (Mootnick and Fan, 2011).

2.2.2 Description

Adult males are completely black. A few single white hairs may occur in the corner of the mouth. Adult females are pale yellow, yellow, orange or beige brown. Adult females have a black cap and a large, often rhomboid area with black hairs on the ventral area. The amount of ventral black varies (Figure 2.2). In some females, the whole ventral fur may be black, strongly contrasting with the light black, at the other end of the range, the ventral fur may be merely interspersed with some

black hairs (Geissmann *et al.*, 2000). This sexual dichromatism develops with age, as the female changes from black to buff or tawny coloration in early adulthood (Mootnick and Fan, 2011). Black crested gibbons generally weigh from 6.9 to 10 kg (average 8 kg) and measure of body from 43 to 54 cm (average 50 cm).

Darker fur colouration, which was originally considered to be distinctive for females of Laotian black crested gibbon, turned out to be based on inclusion of subadult females which have not completely finished their colour change from juvenile black to adult yellow. Fully adult females do not exhibit these characteristics. Males of Laotian black crested gibbon have also been reported to exhibit a silvery-black line between eye and ear (Geissmann *et al.*, 2000).



Male Female

Figure 2.2 Male and female of Laotian black crested gibbon.

Black crested gibbons communicate through vocalizations, including calls and songs, by most between 06:00 am and 08:30 am in the morning but possibly start from 05:00 am to 10:00 am as well as physical interactions and facial expressions. The songs of black crested gibbons may be used for a variety of purposes, including defense of resources and establishment of territories, as well as attracting mates and strengthening pair bonds (Geissmann, 2007). Black crested gibbons sing both alone and in pairs (Table 2.3). Duets are usually initiated by males from high locations, such as tall trees on hills. Duets may play a part in mate attraction or pair-bonding between mates, defense of resources or mates, or group cohesion (Fan *et al.*, 2009).

Table 2.3 Occurrence of Black crested gibbon song types.

Song types	Description	References
Great call	A duet bout usually consists of male loud calls repeated phrases increasing in loudness and complexity and somewhat more modulated and complex, stereotyped phrases of females called “great calls”.	Fan <i>et al.</i> (2009)
Duet song	The vocalisations of gibbon male and female together. Duet song bouts, like female song bouts, usually have duration of less than 30 minutes.	Geissmann (2002)
Male solo song	The vocalisations of gibbon male only, the mated males of most gibbon species may engage in uninterrupted solo song bouts of considerable length, sometimes lasting more than 2 h.	Geissmann (2002)
Female solo song	Female solo song bouts are of shorter duration than male solo song bouts (usually less than 30 minutes). Most gibbon species do not normally produce solo song bouts.	Geissmann (2002)

2.2.3 Population and Distribution

The Black crested gibbon global population is estimated at 1,300-2,000 individuals and occurs discontinuously in southwestern China, northwestern Lao PDR and northern Viet Nam (Bleisch *et al.*, 2008) (Figure 2.3).

N. c. concolor of 40 to 300 individuals lived in southwestern Yunnan, China (Jiang *et al.*, 2006) and 59 individuals were found at Lao Cai, Yen Bai, Son La, and Lai Chau provinces in northern Viet Nam (Dat and Phong, 2010) (Table 2.4). It is found between the Song Da (Black) and Song Hong (Red) rivers, north to 23°45' N and south to about 20°N.

N. c. furovogaster estimated 50 to 100 individuals, occurs in southwestern Yunnan, southern China (Jiang *et al.*, 2006) (Table 2.4). It is found only in a small region near the Myanmar border, west of the Mekong river from 23°15' to 23°40' N and 99°05' to 99°29' E.

N. c. jingdongensis, estimated 195 to 450 individuals, occurs in west-central Yunnan, southern China (Jiang *et al.*, 2006) (Table 2.4). It is found only in a small region around Wuliang mountain, between the Mekong and Chuanhe river about 24 to 25°N (Groves, 2001).

N. c. lu, estimated up to 200 individuals, occurs in northwestern Lao PDR (Table 2.4). An isolated population, it is known for certain only in a tiny area on the east bank of the Mekong river at about 20°17' to 20°25' N. It is confirmed in Nam Ha NPA, Luang Namtha province, and Nam Kan NPA, Bokeo province (Johnson *et al.*, 2005; Brown, 2009; Geissmann, 2007).

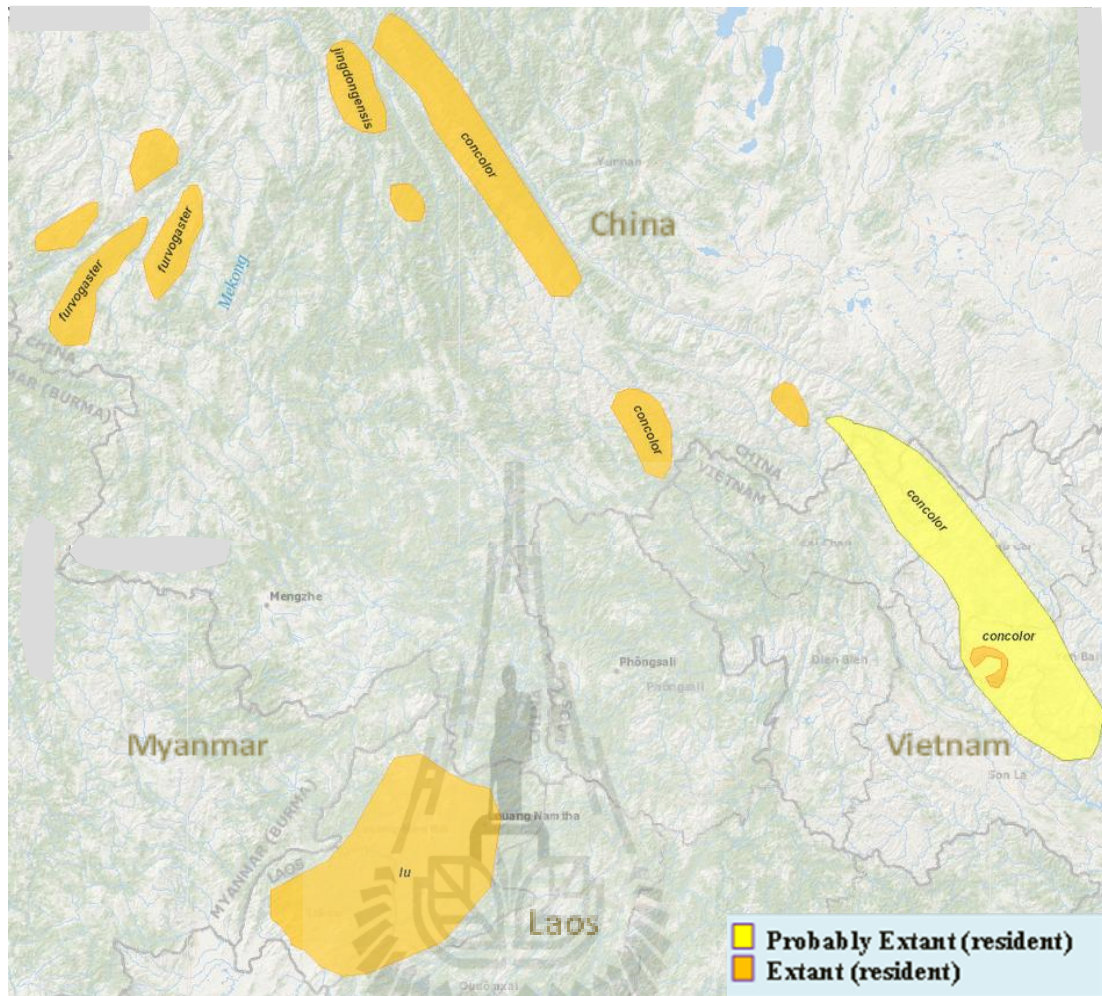


Figure 2.3 Distribution of *Nomascus concolor* (Bleisch *et al.*, 2008).

Table 2.4 Population and distribution of Black crested gibbon, *Nomascus concolor* in Lao PDR, Vietnam and China.

Scientific name	Population		Location	Country	Altitude (m)	References
	Ind	Grp				
<i>N. c. concolor</i>	59	20	Hoang Lien Mountains	China	< 2,500	Dat and Phong (2010)
		105	Ailao Mountain	China	2,200 - 2,870	Li <i>et al.</i> (2011)
<i>N. c. furvogaster</i>		26 - 42	Wuliang Mountain	China	1,800 - 2,790	Wang <i>et al.</i> (2000)
<i>N. c. jingdongensis</i>		100 - 116	Wuliang Mountain	China	1,800 - 2,790	Wang <i>et al.</i> (2000)
<i>N. c. lu</i>	195 - 450	98	Wuliang Mountain	China	1,800 - 2,790	Jiang <i>et al.</i> (2006)
	200	13	Southern half of Nam Kan NPA	Lao PDR	450 - 900	Geissmann (2007)
		9 - 14	Southern half of Nam Kan NPA	Lao PDR		Robichaud <i>et al.</i> (2010)
		10 - 14	North-central of Nam Kan NPA	Lao PDR		Timmins and Duckworth (2013)
		5	Nam Ha NPA	Lao PDR	679 - 1,535	Johnson <i>et al.</i> (2005)
		1	Nam Ha NPA	Lao PDR		Brown (2009)
		1	Nam Ha NPA	Lao PDR		Luangluexay and Suwanwaree (2012)

2.2.4 Habitats

The Black crested gibbon occurs in subtropical and montane evergreen, semi-evergreen and deciduous forest (Bleisch *et al.*, 2008). In China, it is likely restricted to broadleaved evergreen forests. In Yunnan province, it occurs at altitude ranging from 1,800 to 2,790 m above sea level (a.s.l) (Table 2.4) (Jiang *et al.*, 2006). In northern Viet Nam, the species was reported at elevation up to 2,500 m a.s.l of limestone forest (Thanh *et al.*, 2010). While, in Nam Kan NPA Lao PDR, it was found at 450 to 900 m a.s.l, but mainly above 550 m a.s.l (Table 2.4). The main forest type that the species found in Nam Kan NPA is evergreen (Timmins and Duckworth, 2013). However, specific habitat types and factors that are effluent species distribution and density are poorly studied. Some gibbon species density is not necessary due to habitat quality but also local culture. White-handed gibbon population in Mae Hong Sone forest shows higher density in the forest habitat around Akha villages as one important factor of local taboo on free hunting and consuming gibbons from this ethnic group (Yimkhao, 2005). On site level, group and population density of gibbon species due to many factors including elevation, forest type, level of threat, distance from community, distance from a stream/river.

2.2.5 Threats

The main threats to Black crested gibbon throughout its range include habitat disturbance, some destruction and hunting. History of deforestation was back to some 40 years ago that associated with steel industry and military activity, and later due to farming activity which made greatly reduce portion of suitable gibbon habitat and that threatened to populations of biodiversity, the gibbon species, in particular. Across northern Laos, there seems to be little direct hunting for gibbon, as distinct

from opportunistic off-take which, given the precarious remaining populations, is evidently very high. However despite the presence of local taboos on hunting gibbons, these animals are captured and killed by other people who have no local taboos for subsistence as well as the pet and medicine trades (Geissmann, 2007). In Viet Nam, depending on the locality, gibbons are threatened by mostly human impact on habitat (Van Ban, Lao Cai province) or mostly hunting pressure in Mu Cang Chai, Yen Bai province and Son La province, but it is ultimately always a combination of the two (Geissmann *et al.*, 2000). In addition, human disturbance including collecting forest products in gibbon habitats is considered indirect impact on gibbon species which may lead to make lower ability of gibbon reproduction in long-term.

The major threats to Laotian black crested gibbon in Nam Kan NPA are hunting and some disturbances of Houyxy district intruders (Geissmann, 2007 and Robichaud *et al.*, 2010). Habitat clearance for cultivation were reported in the past; while recent problems are non-timber forest products extraction, select certain economic value trees for timber chopping, and gibbon hunting by local villagers. These threats may lead to severe reduction of the gibbon population in Nam Kan NPA in the future (Geissmann, 2007).

2.2.6 Conservation

The Black crested gibbon is listed on CITES Appendix I so it is not traded. In China, only three-quarters of the Wuliang Mountain population's range is protected, much of it within the Wuliang Mountain Nature Reserve and Ailao Mountain Nature Reserve. The species occurs as well in Huanglianshan Nature Reserve, Fenshuilin Nature Reserve, Daxueshan Nature Reserve, Nanguanhe Nature Reserve and Lancangjiang Nature Reserve (Geissmann *et al.*, 2000).

In Lao PDR, this species is categorized as a prohibited species in Lao PDR which hunting, trade and using for food are illegal. National gibbon conservation action plan highlights the conservation need of the Laotian black crested gibbon (DoF, 2011). The Laotian black crested gibbon occurs in two protected areas, Nam Kan NPA and Nam Ha NPA. The provincial governor of Luang Namtha province set very steep fines for wildlife trade and also initiated measures for gun control in 2004; both actions, if enforced, should protect the Laotian gibbon populations from opportunistic hunting (Johnson *et al.*, 2005). As well as Bokeo province especially with contribution from Animo Company to province for the management of Nam Kan NPA where rangers are hired to work on patrolling and law enforcement routinely not only around the Gibbon Experience site but also other parts of the protected area. In addition, local taboos of Hmong in Ban Toup and Muser of Ban Chomsy on this gibbon conservation are strong. However, detailed study of the species apart from reconnaissance survey including a single listening post has not been undertaken. Also, pressures from outside will make challenge to the species conservation.

CHAPTER III

MATERIALS AND METHODS

3.1 Study Area

Nam Kan NPA was established as a provincial protected area in 1996, managed by Bokeo Provincial Forestry Division and became the 21st national protected area of Lao PDR in 2008. It is situated at latitude 20°21' to 20°23' N and longitude 100°51' to 100°59' E in west northern, Lao PDR, about 60 km from Bokeo province to the east southern or 30 km from Viang Phoukha district, the east northern while Long district, at the west northern while the district of Meung district and west southern to Houay Xay and the southern is Pha Oudom district (Figure 3.1). It covers an area of 136,000 ha, of which about 66,000 ha is in Bokeo province and 70,000 ha is in Luang Namtha province (Robichaud *et al.*, 2010).

3.1.1 Topography

Nam Kan NPA has altitude ranging from 440 to 1,468 m a.s.l. The Nam Kan NPA is mainly dominated with steep slope mountains and evergreen forest, tropical rain forest with outstanding scenic values. There are six main rivers such as Nam Pha Noy and Nam Touy are lying at the northern part and Nam Pea, Nam Kan, Nam Nga and Nam Ngao they lying at the central and southern parts of Nam Kan NPA (Robichaud *et al.*, 2010) (Figure 3.2).

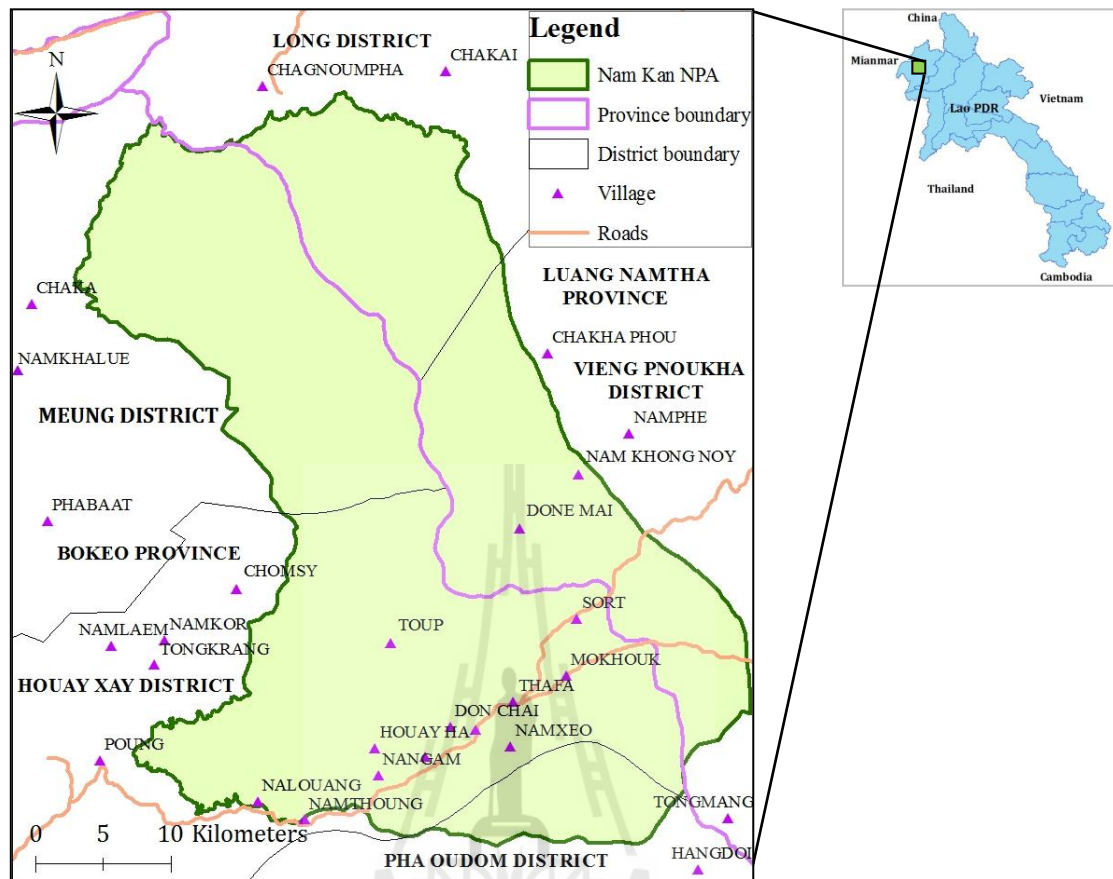


Figure 3.1 Nam Kan NPA.

3.1.2 Climate

Laos is a monsoon country, with a rainy season from May to September and a dry one from October to April. In 2013, the maximum temperature average was 33.5 °C and the minimum temperature average was 12.4 °C (Figure 3.3), while the rainfall average was 8.73 mm (Figure 3.4). The climatic data were collected from Meteorology Department Bokeo province (2013).

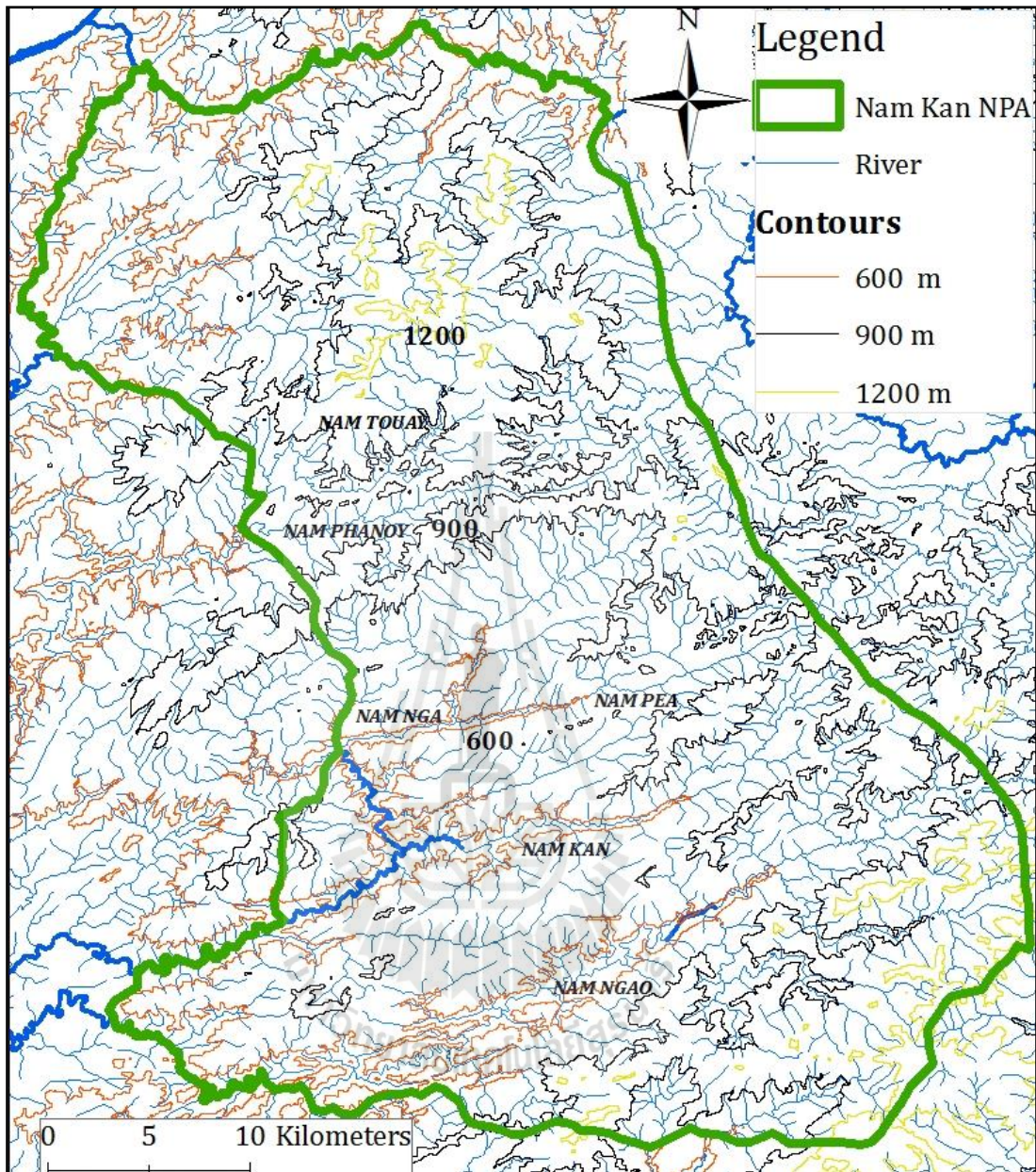


Figure 3.2 Topography of Nam Kan NPA.

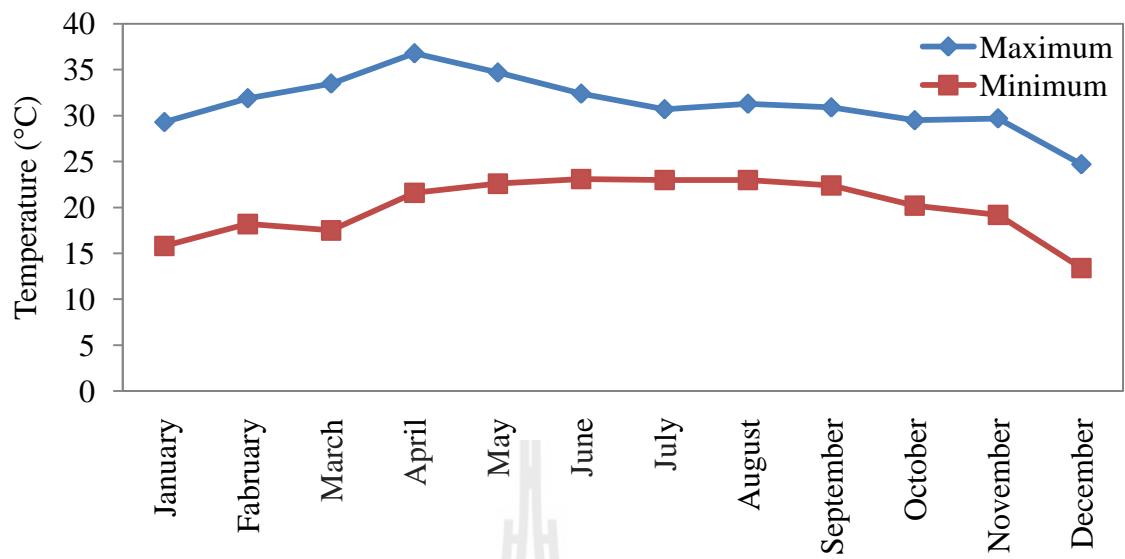


Figure 3.3 Temperature monthly averages of Bokeo province in 2013.

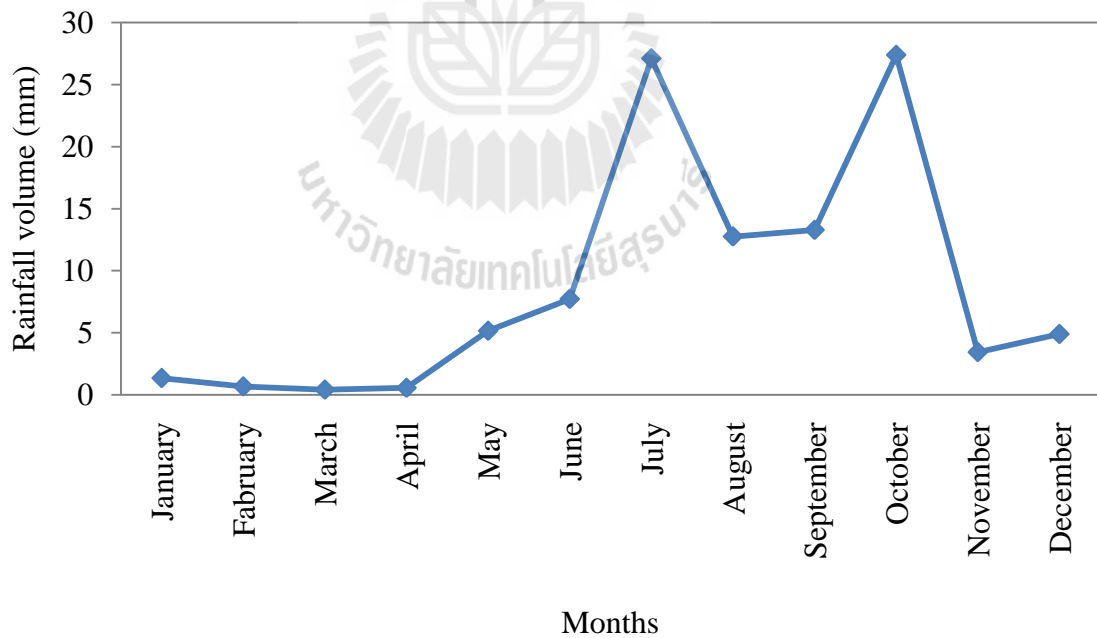


Figure 3.4 Rainfall monthly average of Bokeo province in 2013.

3.1.3 Land Cover

The Nam Kan NPA has different forest types such as at the northern part of the protected area covering of mixed deciduous forest is 65,500 ha (48.2%), the dry evergreen forest is 40,200 ha (29.6%) covering at the central part of area, secondary forest is 22,000 ha (16.2%), agriculture land is 8,000 ha (5.9%) are distributed around of area and some grassland is 300 ha (0.2%) (Department of Forestry, 2005) (Figure 3.5).

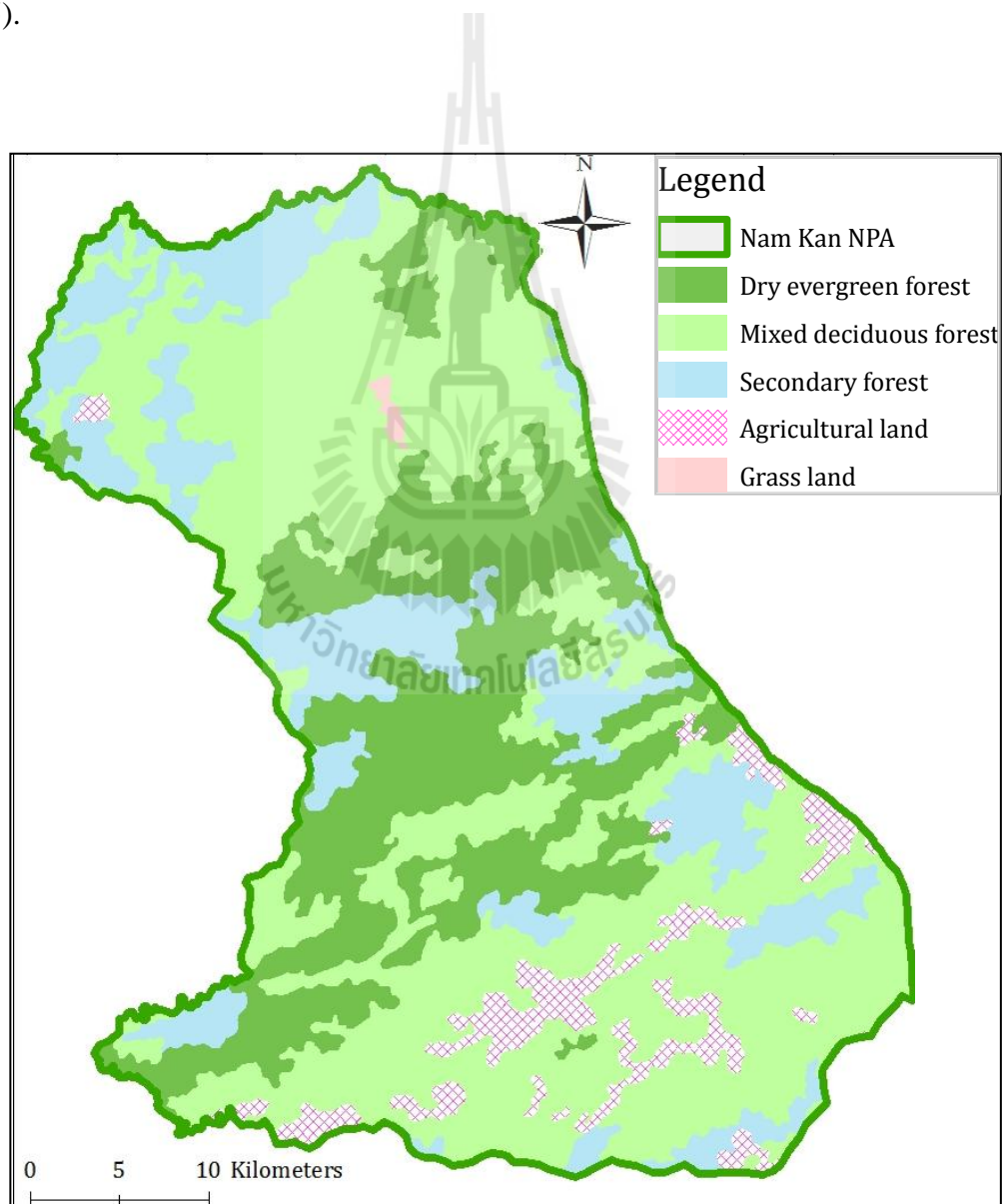


Figure 3.5 Land cover of Nam Kan NPA.

3.1.4 Flora and Fauna

Little is known about flora in Nam Kan NPA, but common species are recorded in the area including *Azelia xylocarpa*, *Pterocarpus*, *Azadirachta*, *Phyllanthus emblica*, *Spondias pinnata*, *Dipterocarpus intricatus*, *Baccaurea ramiflora*, *Ficus neriifolia*, *Amomum villosum*, rattan, broom grass and bamboo.

Nam Kan NPA is also important for wildlife conservation in Laos with high diversity of wildlife. There is a number of current wildlife identified especially for bird species (Timmins and Duckworth, 2013). The bird species recorded includes Great slaty woodpecker *Mulleripicus pulverulentus*, Woodpeckers (Picidae), Oriental pied hornbill *Anthracoceros albirostris*, Brown hornbill *Anorrhinus tickelli*, Blyth's kingfisher *Alcedo Hercules*, Stork-billed kingfisher *Halcyoncapensis*, Crested kingfisher *Megaceryle lugubris*, Barred cuckoo dove *Macropygia unchall*, Little cuckoo dove *Macropygia ruficeps*, Green pigeons *Treron*, Green imperial pigeon *Ducula aenea*, Blue-naped/Blue-rumped *Pitta nivalensis* / *P. soror* and Large-billed Crow *Corvus macrorhynchos* (Timmins and Duckworth, 2013). The mammal, include Black crested gibbon *Nomascus concolor lu*, Pig-tailed macaque *Macaca nemestrina*, Assamese macaque *Macaca assamensis*, Bear macaque *Macaca arctoides*, Phayre's leaf monkey *Semnopithecus phayrei*, Dhole *Cuon alpinus*, Otters (Lutrinae), Chevrotain *Tragulus*, Sambar *Cervus unicolor*, Muntjacs *Muntiacus* and Black giant squirrel *Ratufa bicolor* (Timmins and Duckworth, 2013).

3.1.5 Local Community

The Nam Kan NPA covers four districts of two provinces. Bokeo province has three districts (Houayxay, Pha Oudom and Meung) but only Vieng Phoukhan district belongs to Luang Namtha province. Ten villages of Houyxy district are

located inside Nam Kan NPA such as Ban Toup, Ban Thafa, Ban Namxeo, Donekham, Ban Mokhouk, Ban Nanngam, Ban Donechai, Ban Namthoung, Ban Naluang and Ban Sod. Two villages, Ban Domemai and Ban Namkhongnoy, are of Vieng Phoukha district, Luang Namtha province. Other 14 adjacent villages of the protected area include 3 villages of Meung district, 2 villages of Pha Oudom district and 5 villages of Houay Xay district (Robichaudet *et al.*, 2010) (Figure 3.1). There are six different ethnic groups living inside Nam Kan NPA such as Hmong, Black Lahu (Muser), Khmu, Lamet, Lue and Lao. Only Ban Toub (Hmong) and Ban Chomsy (Muser) have traditional belief in gibbon conservation.

3.2 Distribution and Population Study

3.2.1 Villager Interview

Prior to the field survey, the village interviews were conducted to investigate population, distribution and threat of Laotian black crested gibbon. Five villagers from 10 villages both inside and adjacent of Nam Kan NPA were interviewed. Three villages that are inside villages were chosen including Ban Toup, Ban Sod and Ban Donemai and other 7 adjacent villages such as Ban Chomsy, Ban Namkha-lue, Ban Namko, Ban Namlam, Ban Nalouang, Ban Namthoung and Ban Xaypathana (Figure 3.6). Interviewees were local hunters, elders, forest product collectors and park rangers. An opened questionnaire method was used. Fifty villagers were totally interviewed in Nam Kan NPA and detailed discussions to understand locations of gibbon groups reported were held, group structure. The threats to the gibbons were distinguished, rated for habitat loss and hunting. Additionally, enquiries

about habitat such as forest condition and disturbance to the habitat of the species were also carried out accordingly.

Prior to the fieldwork, archival study was conducted, with all reports and relating studies on Laotian black crested gibbon in Nam Kan NPA. The village interviews were conducted from 3 to 23 September 2013 and followed with some additional interviews in January 2014 (Table 3.1).

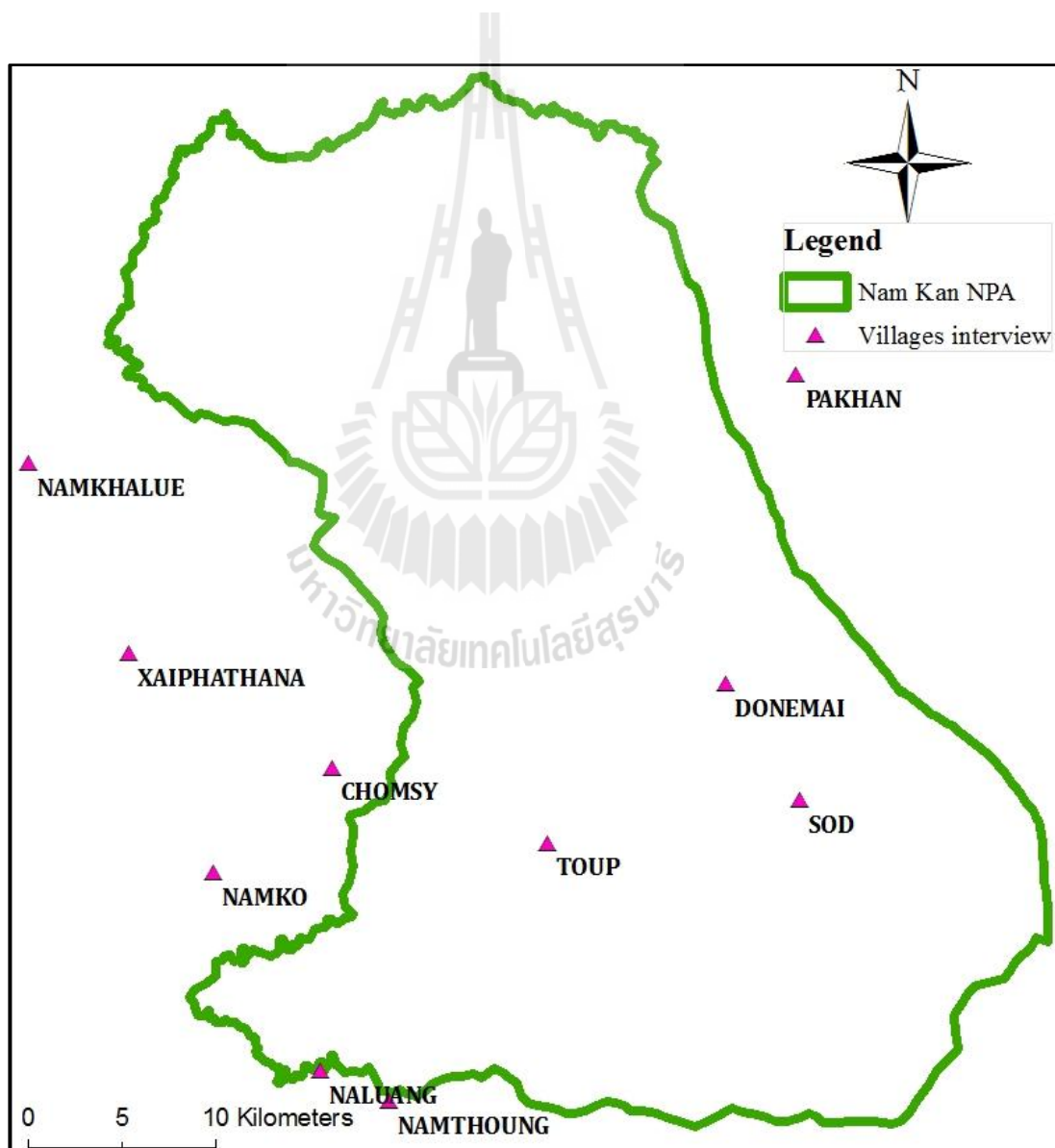


Figure 3.6 The villages suitable for gibbon interviewed this survey in Nam Kan NPA.

Table 3.1 The village interview period and locations.

Date	Village	District	Province	Village points	
				X	Y
03/9/2013	Toup*	HouayXay	Bokeo	687809	2264841
05/9/2013	Sod*	HouayXay	Bokeo	701244	2267132
08/9/2013	Donemai*	ViengPhukha	LuangNamtha	697313	2273321
09/9/2013	Namko	HouayXay	Bokeo	670090	2263278
10/9/2013	Chomsy	HouayXay	Bokeo	676382	2268843
13/9/2013	Namkhalue	Meung	Bokeo	660233	2285051
14/9/2013	Xaypathana	Meung	Bokeo	665543	2274938
19/9/2013	Naluang	HouayXay	Bokeo	675747	2252714
23/9/2013	Namthoung	HouayXay	Bokeo	679384	2251142
12/01/2014	Pakhan	ViengPhukha	LuangNamtha	701040	2289721

Remark: *The villages were inside in Nam Kan NPA

3.2.2 Listening Post

A triangular listening post is a common technique which is usually used for gibbon population estimate. Recent study of Yellow-cheeked crested gibbon *Nomascus gabriellae* in Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia (Chana and Gray, 2009) and Pileated gibbons, *Hylobates pileatus* in Khao Ang Rue Nai Wildlife Sanctuary in southeastern Thailand (Phoonjampa *et al.*, 2011). The method utilizes a point count approach (Brockelman and Ali, 1987) and took advantage of loud calls of gibbon groups to determine group location and numbers. As gibbons are a territorial animal, calls came from similar locations across morning days were assessed as to identify whether they were from the same or different groups and made cumulative counts. Three survey teams consisted of 2-3 people who were

trained and worked together in one triangular listening post unit as to ensure they are familiar with gibbon songs, bearing, distance estimation. The data was collected from October 2013 to January 2014 (Table 3.2).

The listening posts were selected on potential gibbon locations based on forest cover and topography maps and confirmed with village reports. The total 23 survey sites (listening post location/unit) were selected in entire dry evergreen forest (the suitable habitats of Laotian black crested gibbon) in Nam Kan NPA, (Figure 3.7). Three listening posts per survey site were 69 listening posts totalestablished at high altitude varying from 665 m to 1,299 m a.s.l and distance about 500 m apart. The listening post locations were identified before the listening day. Each listening post was surveyed for three consecutive morning days between 05:00 am and 10:00 am.

All sub-teams set the same time for wrist watch, GPS as well as of the sound recorders. It was aware of some bias by locating the listening location at high level and the distance between the sub-teams (ca. 500 m) was checked using GPS reading. The proposed location was marked on the topographic map to help the sub-teams lead to the locationcorrectly. Each sub-team was away from any noise such as waterfalls and did not locate a compass close to knife or mental. After listening, the sub-teams met and checked the data togetherin the afternoon.

Table 3.2 Survey activities and factor information of each survey sites.

Sites	Survey date	Sites name	Weather	Temperature (°C)	Rainfall (mm)	Distance to village (km)	Distance to river (m)	Elevation (m)	GPS	
									X	Y
1	27-29/10/2013	Nam Sakhan	Clear	19.02	2.07	6	200	915	679000	2258000
2	4-6/10/2013	Treehouse	Clear	24.77	0.00	3.5	300	685	684000	2263000
3	7-9/10/2013	Nam Nim	Clear	20.79	0.00	2	300	795	691000	2267000
4	11-13/10/2013	Nam Pong	Clear	23.42	0.00	9	200	665	682000	2268000
5	21-23/11/2013	Nam Nga	Clear	21.73	0.00	12	200	774	684000	2270000
6	18-20/11/2013	Nam Nga	Fogging	21.28	29.90	8	150	684	686000	2272000
7	24-26/11/2013	Nam Pea	Fogging	21.48	0.07	8.5	150	770	689000	2272000
8	28-30/11/2013	Nam Pea	Fogging	18.91	3.60	1.5	400	1016	698000	2272000
9	24-26/10/2013	Nam Toun	Clear	22.81	5.37	13	200	750	684000	2275700
10	15-17/11/2013	Nam Pou	Raining	21.58	0.10	9	100	778	688000	2274000
11	12-14/11/2013	Nam Dernbin	Raining	23.30	0.70	10	250	831	686000	2276000
12	9-11/11/2013	Nam Nga	Raining	22.96	0.00	8	100	749	690000	2276000
13	6-8/11/2013	Nam Kaisolo	Fogging	21.18	0.00	8	200	767	691000	2279500
14	25-27/1/2014	Nam Touy	Clear	16.24	0.00	16	100	890	680000	2282000
15	22-24/1/2014	Nam Touy	Clear	12.47	0.00	14	200	917	683000	2282400
16	17-18/1/2014	Nam Kaipa	Clear	14.33	0.00	10	250	978	688000	2284990
17	10-12/1/2014	Nam Kaipa	Clear	17.38	0.00	8	300	951	692000	2284000
18	13-15/12/2014	Nam Bopea	Fogging	18.27	41.97	5	300	935	696000	2284000
19	19-21/1/2014	Nam Touy	Fogging	12.97	0.00	15	200	982	686000	2286000
20	13-15/1/2014	Nam Kaipa	Fogging	15.49	0.00	13	300	933	690000	2286000
21	28-30/1/2014	Nam Khan	Fogging	17.90	0.00	8	50	936	694000	2286000
22	17-19/12/2014	Nam Khan	Fogging	11.49	0.00	6	100	724	696000	2287000
23	21-23/12/2014	Phu Nyakha	Clear	9.67	0.00	15	200	1299	687000	2298000

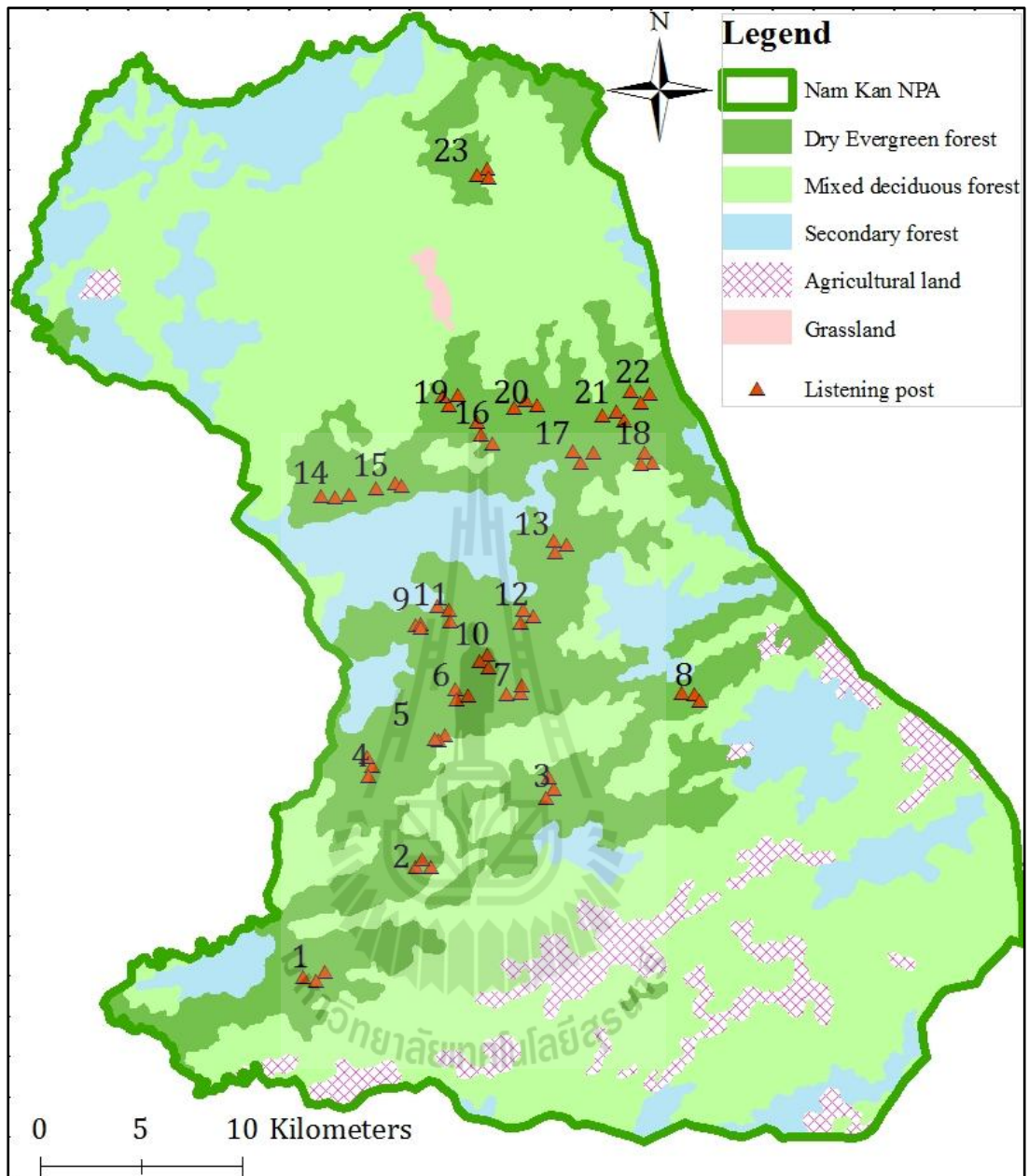


Figure 3.7 Survey location sites and sub-team listening posts.

At each listening post, I recorded the time arriving and leaving the listening posts and all gibbon calls heard as started and ended times of gibbon called for each song types such as male and female solo songs, duet song, male great call and then recorded bearing of each gibbon group heard, estimated distance from the listening post to gibbon group heard, weather and GPS point marked each listening post. The distance from listening post location to rivers and villages were recorded using topographic map to guide while planning. Day 3 was the last day of particular survey site (listening post unit) which one of the team stalked quietly to the group while they were singing as to identify a group size and age classes at those survey site where gibbons were recorded.

3.2.3 Habitat Study

Two parallel 500 m transect lines 500 m apart were established on each site. On each transect, circular plots of 5.65 m in radius (0.01 ha each) were established every 20 m resulting in 50 plots and 0.5 ha per survey site adapted from Phoonjampa *et al.* (2011). This work was conducted in afternoon of day 3 from 01:00 pm to 04:00 pm. The elements of the work were to measuring of tree canopy height and tree diameter at breast height (DBH) for the tree basal area calculates.

3.3 Threat Study

Threat surveys were conducted simultaneously with both community interviews and fieldwork. One non-systematic transect walk was created that finding the threats individual around or inside of each survey sites and goes in one direction for approximately 2 km in length. The non-systematic transect were selected depending on the terrain. In total, 23 non-systematic transect walks survey during 10:00 to 12:00

am. The team attempted to obtain information regarding human activities. The threat all recorded of illegal activities, such as heard gun, agriculture, hunter, hunter camps, temporally settlement were photographed and GPS coordinates taken.

3.4 Data Analysis

3.4.1 Density and Population

Density estimates of gibbons were obtained using the following formula (Brockelman and Srikosamatara, 1993):

$$D = n/E$$

where D is density, n is total number of groups heard based on mapping of calls and E is effective listening area. E is defined as the area in which groups could be heard singing up to 1 km away from two or more listening posts. (Brockelman and Ali, 1987). Therefore, following 1.5 km radius for calculated by Chanaand Gray (2009), here is calculated by drawing a circle of 1km radius around each of the sixty-nine listening posts, resulting in an all effective listening areas of 261 km². Therefore, the density is based only on the groups located within this listening area.

3.4.2 Habitat Comparison

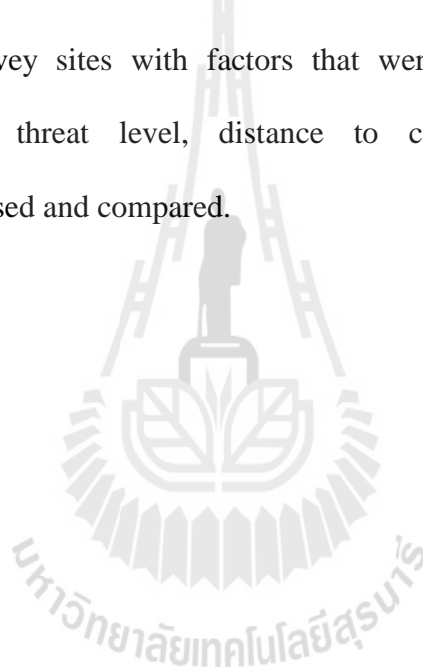
To characterize the forest of each three survey sites where gibbons were recorded as following parameters were used: (i) canopy height comparison in the three survey sites that recorded gibbon, averaged across all 150 plots; (ii) total basal area of all trees; (iii) percent cover of canopy height(iv) tree density and (v) tree DBH, by used SPSS (One way ANOVA–test).

3.4.3 Threat

All threat evidences were recorded such as sound of gun, agriculture, hunter, hunting camp and temporally settlement were shown in number of individual threats per 2 km walked by gibbon density study. The threats of each site where gibbons were recorded or not were also taken into consideration as an indicator of whether or not the number of threats are effects.

3.4.4 Gibbon Population and Environmental Factors

All 23 survey sites with factors that were influent to gibbon density including elevation, threat level, distance to community and distance to streams/streams, were used and compared.



CHAPTER IV

RESULTS AND DISCUSSION

4.1 Villagers Interview Result

4.1.1 Gibbon Population and Group Locations

About 95% of villagers living inside and around Nam Kan NPA of Laotian black crested gibbon were known. The total 50 interviewees, in 10 villages inside and around Nam Kan NPA, recognized a gibbon which was locally called “thanee” in Lao language and “rayool or khayool” in Lao Theung, “mona” in Muser and “juor” in Hmong language. All of interviewees are man and most of them used to hear gibbon songs in their areas, but they suggested fewer gibbon populations nowadays compared to those of some 20 years ago (Table 4.1 and Figure 4.1). The villagers also reported that they usually hear gibbon songs in the morning of sunny day mainly between January and April. The gibbon groups in Nam Kan NPA inhabit in dry evergreen forest.

According to the village interviews on historical distribution and population of gibbons in the area, there were 27 gibbon groups and 78 individuals estimated in 14 locations of Nam Kan NPA by 1995 (Table 4.1 and Figure 4.2). Unfortunately, the villagers reported that gibbon groups were recently heard and seen in only some locations. Certainly, only 10 groups were found to occur in Nam Kan NPA. Seven groups were last heard since 2012, 3 groups in Nam Nim (2010), 2 groups in Nam Derbin (2012), 1 group in Nam Sakham and 1 group in Nam Eap

(2012). The current gibbons recorded were mainly around treehouse areas of the Gibbon Experience, Nam Toun and Nam Nga. According to the village report, the gibbon distribution area is dramatically smaller compared to that of 1995 (Figure 4.2).

Table 4.1 Gibbon population and group location in Nam Kan NPA from village interviews in 2013.

No	Location	Distance from village (km)	Grp	Ind	Last seen	UTM	
						X	Y
1	Nam Pongnoy	12	1	4	1995	690746	2287217
2	Phu Nyai	7	2	5	1998	698269	2283724
3	Nam Kaipa	12	1	3	2000	694021	2283505
4	Nam Tuoy	11	1	2	1999	679501	2283069
5	Nam Pong	12	2	5	2004	682667	2267458
6	Nam Kan	3	1	2	2005	696859	2267676
7	Nam Kok	7	2	5	2007	686270	2260580
8	NamNim	4	3	8	2010	673977	2256805
9	Nam Sakhan	7	1	3	2007	680136	2258060
10	Nam Dernbin	16	2	5	2006	690287	2277336
11	Nam Eap	6	1	2	2012	688919	2267641
12	NamToun	12	4	11	current	683101	2274642
13	Treehouse	3	5	21	current	685070	2263394
14	Nam Nga	11	1	2	current	686503	2270036
Total			27	78			

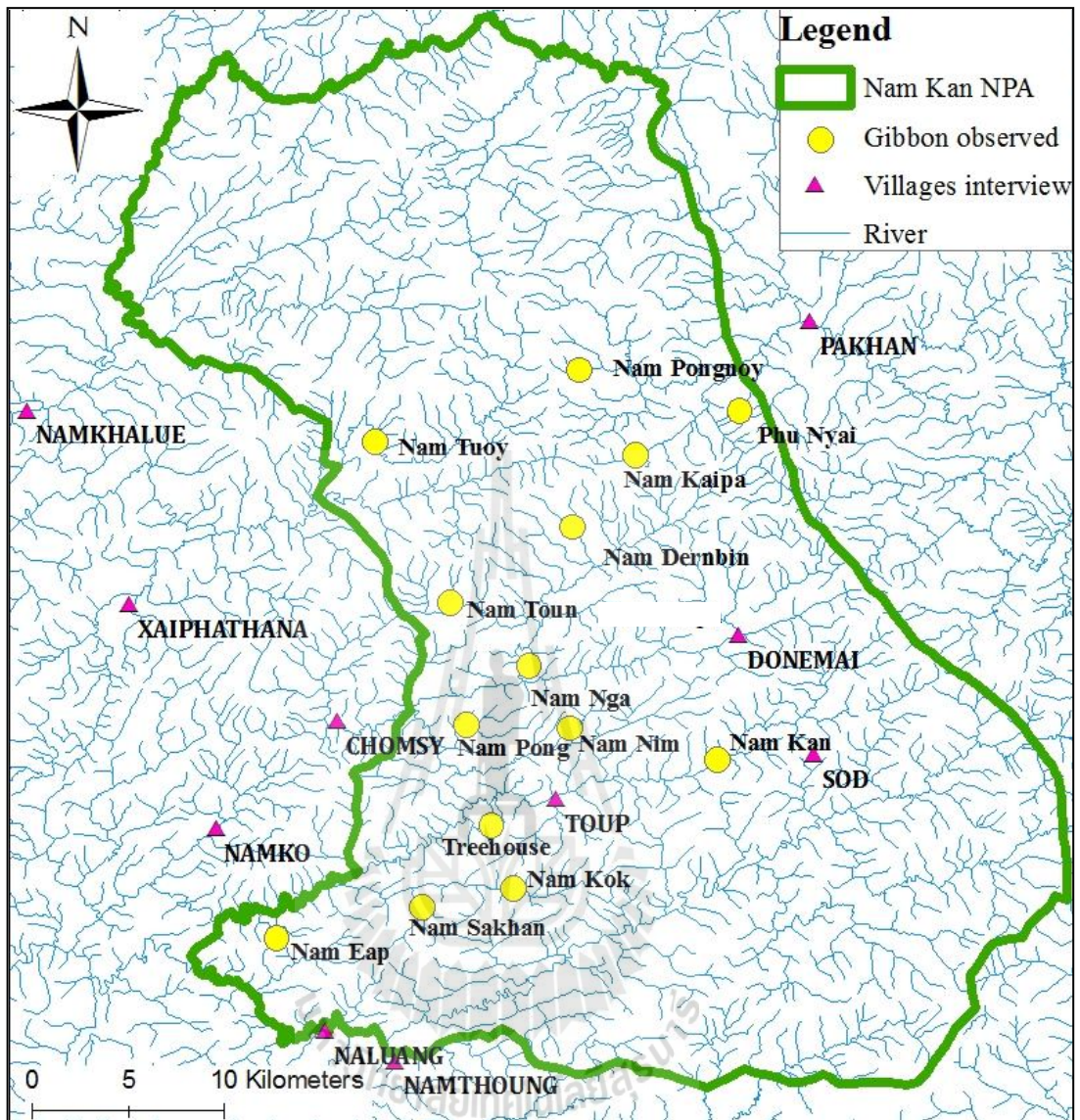


Figure 4.1 Gibbon location from villagers interviewed in Nam Kan NPA.

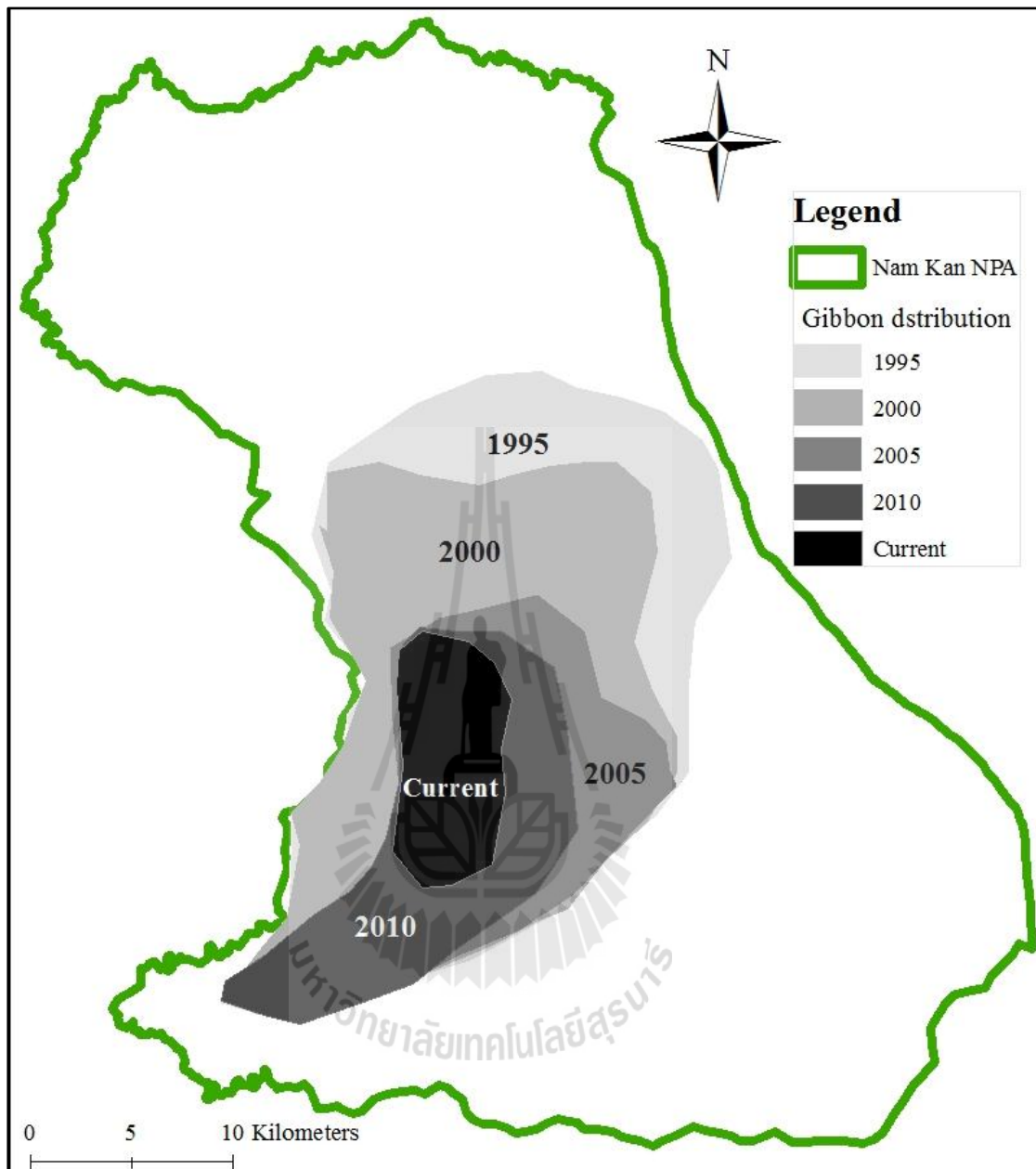


Figure 4.2 History and current distribution of Laotian black crested gibbon from villagers interviewed.

Higher village populations and non-forest cover were significantly associated with longer times since gibbons were last reported, and 80% of households in and around the Protected Area engage in shifting cultivation for hill rice production. Dependence on shifting cultivation coupled with growing human population is contributing to an expansion of agricultural activities into the forest, thus leading to habitat loss as well as an increased likelihood of opportunistic hunters encountering gibbon populations.

4.1.2 Gibbon Status and Threats

Gibbon population in Nam Kan NPA is under very high threat today due to hunting. About 67% of the respondents considered that gibbons status was rare and 4% suggested it was extinct in their village areas (Table 4.2). Only 20% reported gibbon was present. The decrease in the gibbon population was mainly due to 70% of hunting especially for food as counted and 30% of habitat loss. The hunting purpose was mainly for food (84%), pet (6%) and medicine (4%). Sixty percent of the respondents reported. The trend of hunters was decreased whereas other 40% of the respondents insisted it is increased.

Table 4.2 Summary of gibbon status and threats from villager interviews ($n=50$).

Village name	Population status			Threat		Hunting purpose			Trend of hunters	
	Present	Rare	Extinct	Hunting	Habitat loss	Medicine	Food	Pet	Increase	Decrease
Chomsy	3	2		4	1		4	1		5
Done mai	2	3		3	2		4	1	3	2
Na luang		5		4	1	1	3	1	2	3
Nam khalue		4	1	2	3		5		4	1
Nam ko	1	4		4	1		5		2	3
Nam thoung	1	4		3	2		4	1	1	4
Sod		5		4	1		5		3	2
Toup	3	2		3	2	1	4		1	4
Xayphathana		5		4	1		4	1	1	4
Pakhan		4	1	4	1		4	1	3	2
Total	10	38	2	35	15	2	42	6	20	30

4.2 Field Survey Results

4.2.1 Gibbon Population and Group Locations

Only 3 locations in 23 survey sites in Nam Kan NPA were confirmed on occurrence of gibbon groups in this study (Figure 4.3). The gibbons sang early morning after dawn between 06:00 am and 08:30 am (Table 4.3). Distance and bearing from listening posts to the singing direction were recorded and data shown in Table 9 were used to find gibbon group locations for each site (Figure 4.4). A total of 10 gibbon groups were found, 4 groups at the Gibbon Experience's treehouses adjacent to Ban Toup in the southern part of Nam Kan NPA. Four groups were also recorded at site 9, Nam Toun adjacent to Nam Nga, and the last 2 gibbon groups were found at survey site 5, Nam Nga. Both Nam Toun and Nam Nga are closed to Ban Chomsy (Table 4.3 and Figure 4.4).

4.2.2 Gibbon Group Composition

A total of 10 groups and 39 individuals were found (9 males, 12 females, 15 juveniles and 3 infants) and the group size average was 3.9 individuals (Table 4.4 and Table 4.5). Two groups have two adult females (Group 1 and 2) whereas, one group has no adult male as but 1 adult female and 2 juveniles (Group 3). The average distance from observing team to gibbon groups were from 80 to 250 m. A group size in Nam Kan NPA is large for only the group 1 and 2 as these groups inhabiting around the Gibbon Experience site as the groups size of 8 and 7 individuals, respectively. However, it was smaller than other groups and age distribution was distorted.

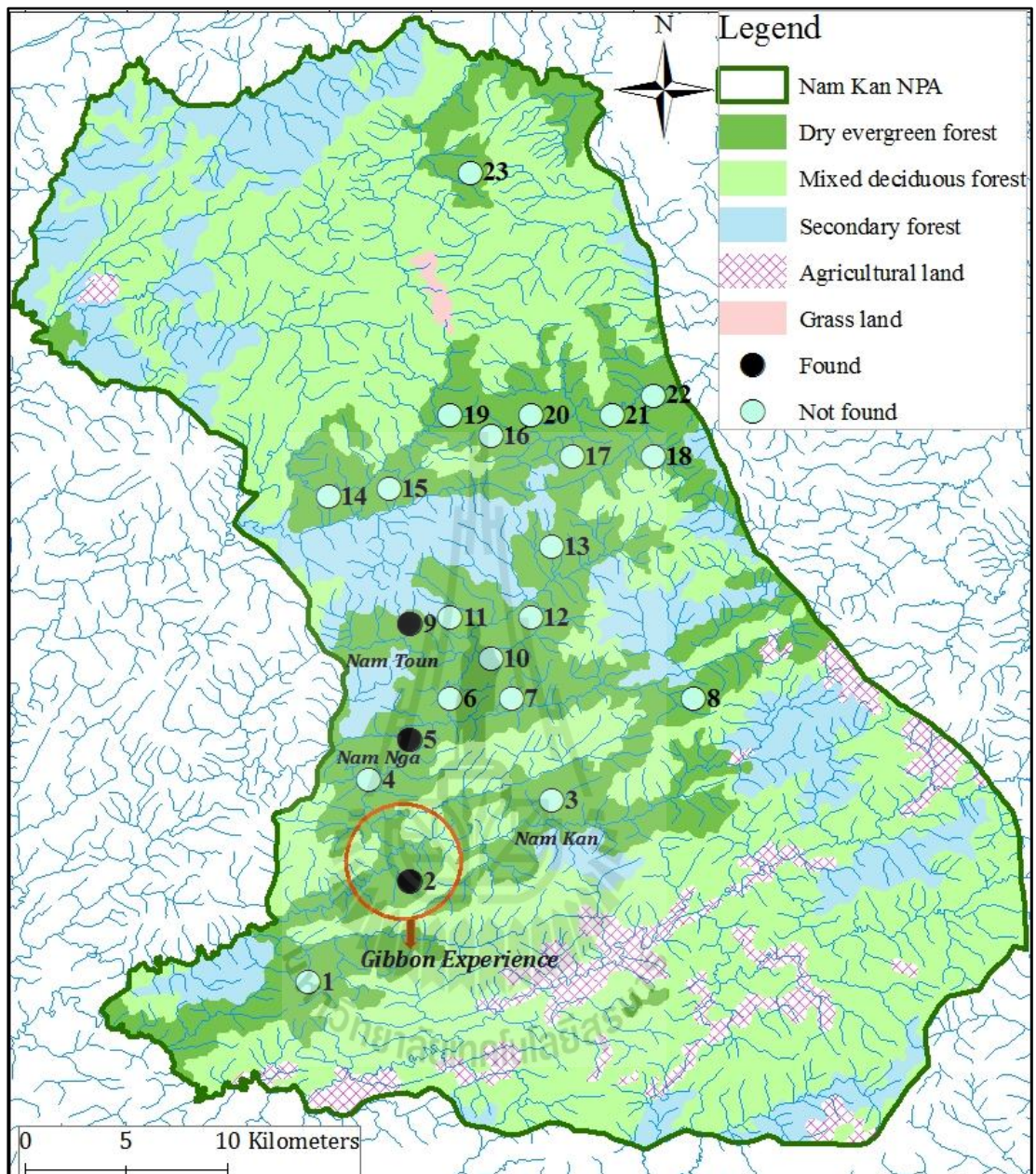
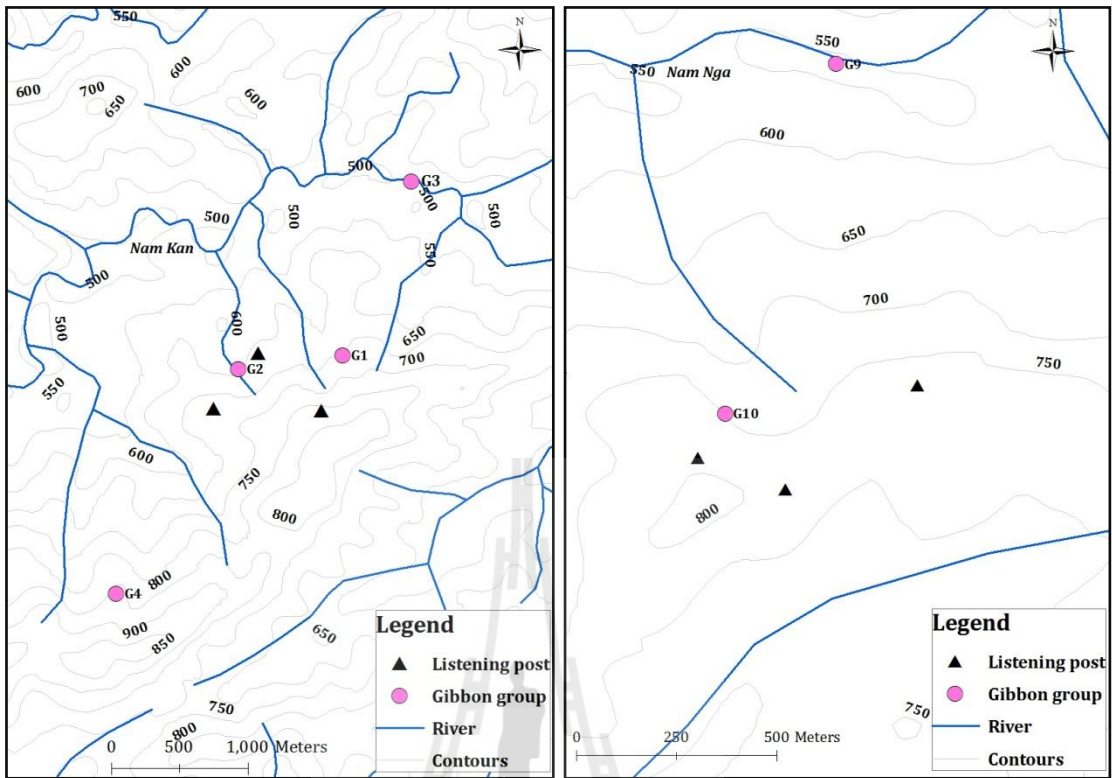


Figure 4.3 Laotian black crested gibbons were found at only 3 survey sites in Nam Kan NPA.

Table 4.3 Survey data of Laotian black crested gibbon groups from listening posts in Nam Kan NPA.

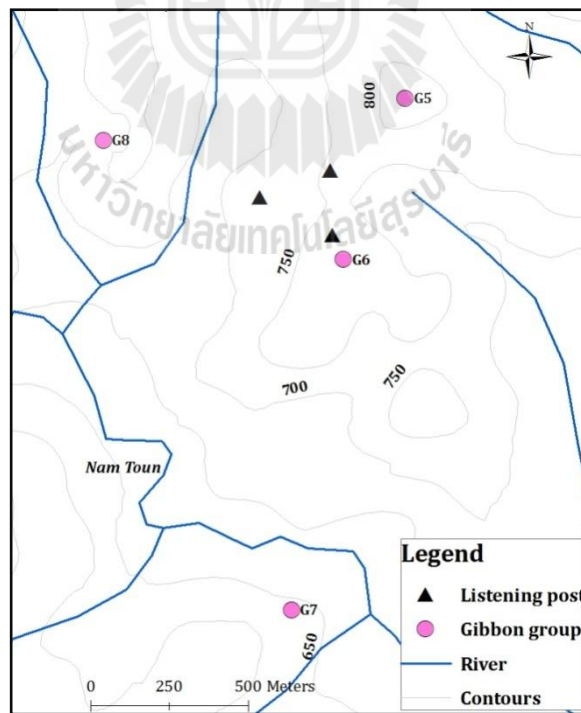
Group number	Day	Distance to LP (m)			Bearing from LP (°)			Time of call	
		LP1	LP2	LP3	LP1	LP2	LP3	Start	End
1	1	500	200	150	295	30	235	06:28	06:47
	2	1100	600	700	290	315	280	06:20	06:36
	3	500	250	650	245	150	190	06:30	06:42
2	1	200	700	500	15	65	90	06:30	06:49
	2	700	1700	1400	40	60	70	06:20	06:44
	3	650	1200	1000	100	95	100	06:35	06:48
3	2	1700	1800	1700	25	37	40	06:39	06:50
	3	1650	1700	1450	5	25	20	06:35	07:10
4	1	1300	1200	1350	230	205	210	06:40	06:41
	2	1250	1500	1700	210	180	190	06:32	06:48
5	2	550	300	400	52	40	25	06:00	06:20
	3	850	600	700	72	75	60	06:10	06:28
6	2	300	250	100	125	165	150	06:12	06:40
	3	750	700	550	130	145	135	06:05	06:30
7	2	1300	1500	1200	175	185	190	06:50	07:30
	3	1100	1300	1100	205	210	218	06:40	07:00
8	2	500	650	750	287	275	290	06:35	07:15
	3	650	700	800	335	320	325	06:20	06:45
9	1	450	300	200	260	320	25	08:04	08:20
	2	850	450	300	255	270	260	07:40	08:02
10	1	1300	1400	1000	345	5	10	08:10	08:30
	2	1200	1300	1500	320	335	340	08:00	08:20

LP=listening post



Site 2, at the Gibbon Experience (treehouse)

Site 5, at the Nam Nga



Site 9, at the Nam Toun

Figure 4.4 The gibbon group locations of 3 sites in Nam Kan NPA.

Table 4.4 Gibbon group composition observation events in this survey.

Grp	Date	Duration (am)	Distance between observers and gibbons (m)	Group composition (number in each age-sex class)
1	5/10/2013	6:30-7:35	80	AM(1), AF(2), JN(4), IF(1)
2		6:53-8:05	150	AM(1), AF(2), JN(3), IF(1)
3	6/10/2013	7:00-8:35	150	AF(1), JN(2)
4		6:55-8:10	50	AM(1), AF(1)
5	22/11/2013	6:20-7:00	100	AM(1), AF(1)
6		6:25-7:45	150	AM(1), AF(1), JN(2)
7	23/11/2013	6:35-8:00	200	AM(1), AF(1), JN(2)
8		6:40-7:45	150	AM(1), AF(1), JN(1)
9	22/10/2013	8:25-9:05	250	AM(1), AF(1), JN(1), IF(1)
10		8:20-9:38	200	AM(1), AF(1)

Remark: AM = Adult male, AF = Adult female, JN = Juvenile, IF = Infant

Table 4.5 Group composition and altitude of gibbon group records in Nam Kan NPA.

Grp	Adult male	Adult female	Juvenile	Infant	Total	Survey site	Altitude (m)
1	1	2	4	1	8	2	676
2	1	2	3	1	7	2	571
3		1	2		3	2	603
4	1	1			2	2	814
5	1	1			2	9	787
6	1	1	2		4	9	803
7	1	1	2		4	9	683
8	1	1	1		3	9	721
9	1	1	1	1	4	5	750
10	1	1			2	5	645
Total	9	12	15	3	39		
Average	1	1.2	2.1	1	3.9		

4.2.3 Gibbon Group Density and Population Estimate

Gibbon group and population density in Nam Kan NPA are very low today. The gibbon density was depending on effective areas within 1 radius for calculated of each listening posts. The density was 0.09 groups/km² and 3.9 individuals/group (Table 4.6, Figure 4.5). The estimate gibbon group and population for the effective listening area of 117.60 km² the gibbon found total 10 groups and 39 individuals.

Table 4.6 Gibbon densities and population.

Effective listening area (km ²)	Grp	Ind	Density		Habitat suitability area (402 km ²)	
			Grp/km ²	Ind/km ²	Grp	Ind
117.6	10	39	0.09	0.33	34.2	133.3

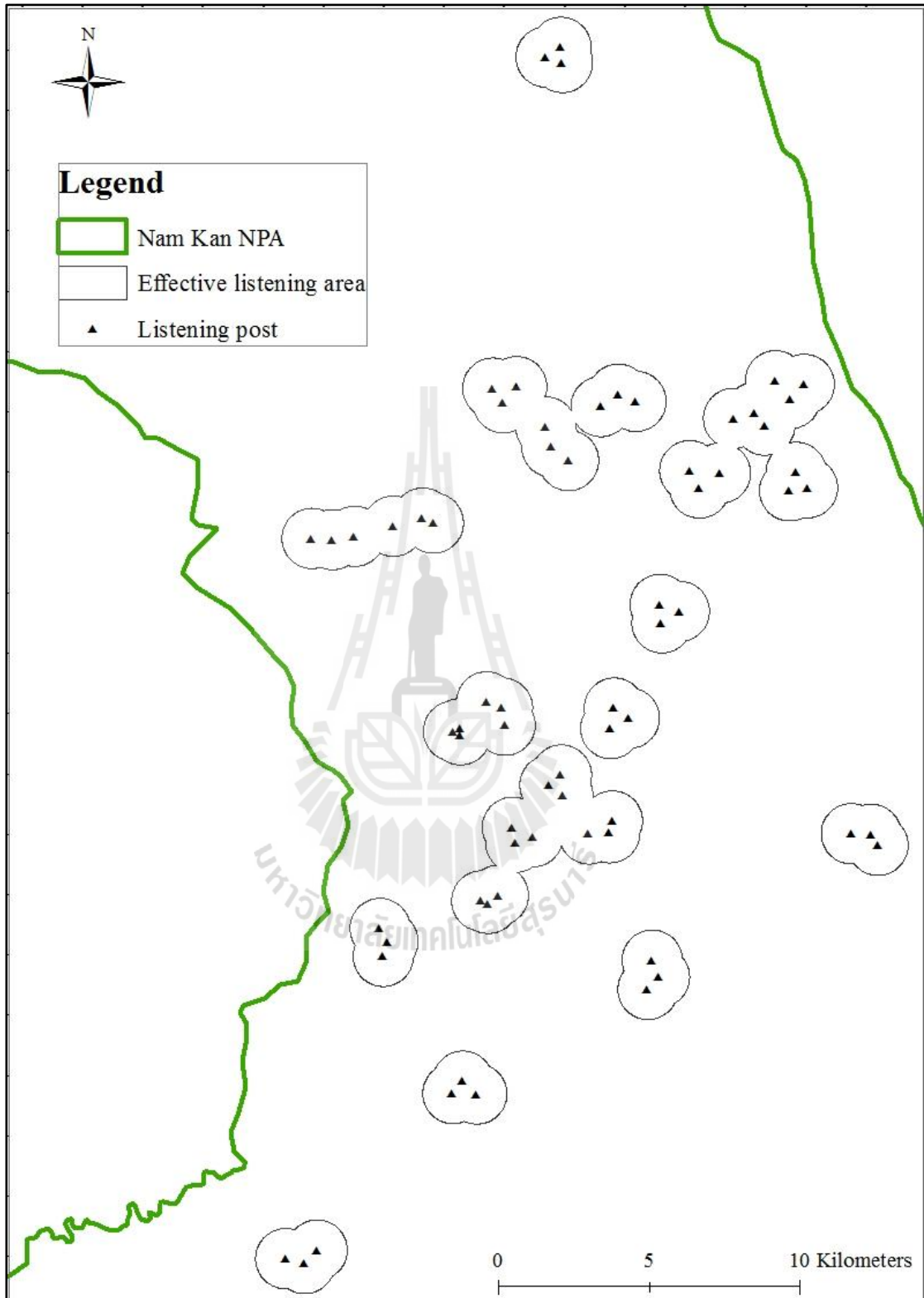


Figure 4.5 The effective listening area of 1km radius.

On the other hand, the estimate gibbon density using the effective area of only listening area that heard gibbon song for calculation revealed the higher number but gibbon groups clumped in only 3 survey sites adjacent to the treehouses of the Gibbon Experience. Those, the effective area only survey site heard was 13.5 km² the gibbon density was 0.74 groups/km² and 2.89 individuals/km². The highest gibbon density was 1.03 groups/km² and 3.33 individuals/km² at the survey location site 9 and at the survey location site 2 was 0.77 groups/km² and 3.85 individuals/km², but lowest density at the survey location site 5 was 0.45 groups/km² and 1.36 individuals/km² (Table 4.7).

Table 4.7 Gibbon densities at 3 survey sites.

Sites	Effective listening area (km ²)	Grp	Ind	Density	
				Grp/km ²	Ind/km ²
2	5.2	4	20	0.77	3.84
5	4.4	2	6	0.45	1.36
9	3.9	4	13	1.03	3.33
Total	13.5	10	39	0.74	2.89

4.2.4 Forest Characteristics of Gibbon Habitat

A total of 6 transect walks was conducted in the survey area. The survey plots identified in three survey sites that gibbon songs were recorded (Figure 4.6). There were 150 plots in total covering 1.5 ha and recorded 677 trees. The canopy height was 32.05 m average and the density was 451.33 trees/ha (Table 4.8), 4.51 trees/plot. The tree basal area average was 27.64 m² in 18.43 m²/ha and the DBH average total was 33.70 cm. The dominant canopy height class was 25 to 29 m and there were 38 trees with diameter at breast height (DBH) >80 cm. The basal area

average of tree with DBH >20 cm was 18.84 m². The dominant canopy highest class at the survey site location number 9 was from 35 to 39 m and the tree basal area was 31.60 m² (Table 4.9). The tree canopy heights and DBH were significantly different ($p < 0.05$) on 3 gibbon recorded sites.

The frequency distribution of canopy highest at the survey site number 9 was 16 tree plots and that they had 40 to 44 m canopy height, the frequency distribution of canopy highest from 25 to 29 m of 13 plots at the location site number 5 and the frequency distribution of canopy highest from 30 to 34 m of 11 plots at the location site number 2 (Figure 4.7). The frequency of tree distribution for the crown canopy at the location site that found gibbons in Nam Kan NPA was 9.67 tree plots that there are canopy height class of 25 to 29 m, 35 to 39 m and 40 to 44 m they are same frequency distribution of canopy highest (Figure 4.7).

The percent cover of tree canopy height at gibbon found location sites in Nam Kan NPA was 100% of canopy height from 10 to 45 m. Of which the percent cover was low at the canopy height from 40 to 45 m as 7.33% only (Figure 4.8). The percent cover of canopy height was highest at the survey location site number 9 as 16% of canopy height of 40 to 45 m of all canopy height (Figure 4.8).

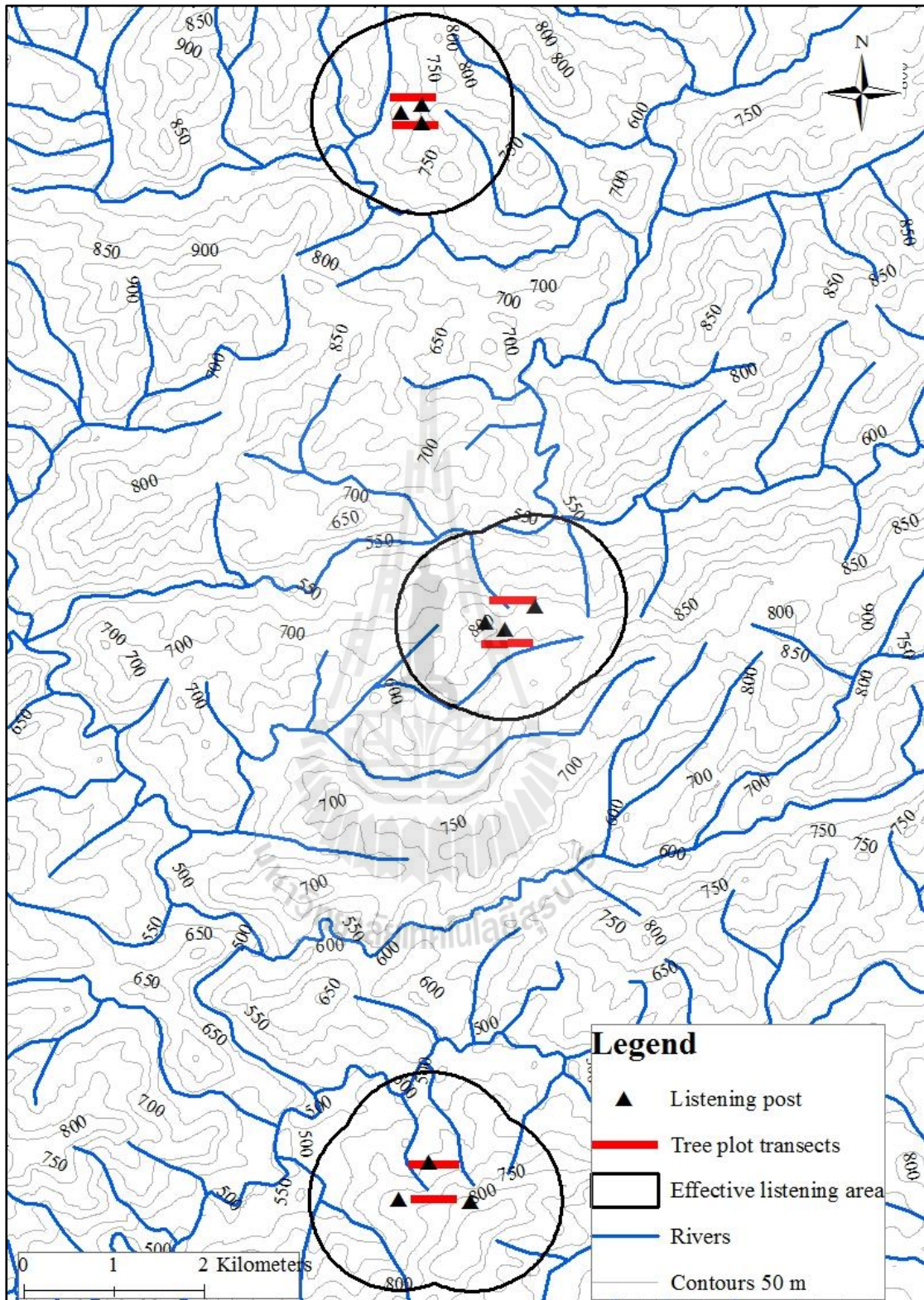


Figure 4.6 The tree plot transects in listening area.

Table 4.8 The canopy height at the gibbon recoded sites.

Sites	Canopy height			Total number of tree	Tree density (trees/ha)	Number of trees depend on DBH (cm)		
	Dominant class	Mean	S.D.			>20	>40	>80
2	30-34	31.30 ^b	8.42	232	464 ^c	149	67	11
5	25-29	29.38 ^b	7.75	226	452 ^b	163	69	7
9	40-44	35.48 ^a	7.99	219	238 ^a	177	54	20
Average		32.05	8.40	256	451.33	163	63.33	12.66

The mean difference is significant at the 0.05 level.

Table 4.9 The tree DBH and basal area at the gibbon recoded sites.

Sites	DBH average (cm)	Basal area (m ²)	Basal area (m ²)	
			DBH>10 cm	DBH>20 cm
2	32.40 ^{ab}	27.23 ^c	27.23	15.19
5	32.09 ^b	24.11 ^b	24.11	15.24
9	36.73 ^a	31.60 ^a	31.60	26.10
Average		33.70	27.64	18.84

^aThe mean difference is significant at the 0.05 level, ^{ab}The mean difference is not significant at the 0.05 level.

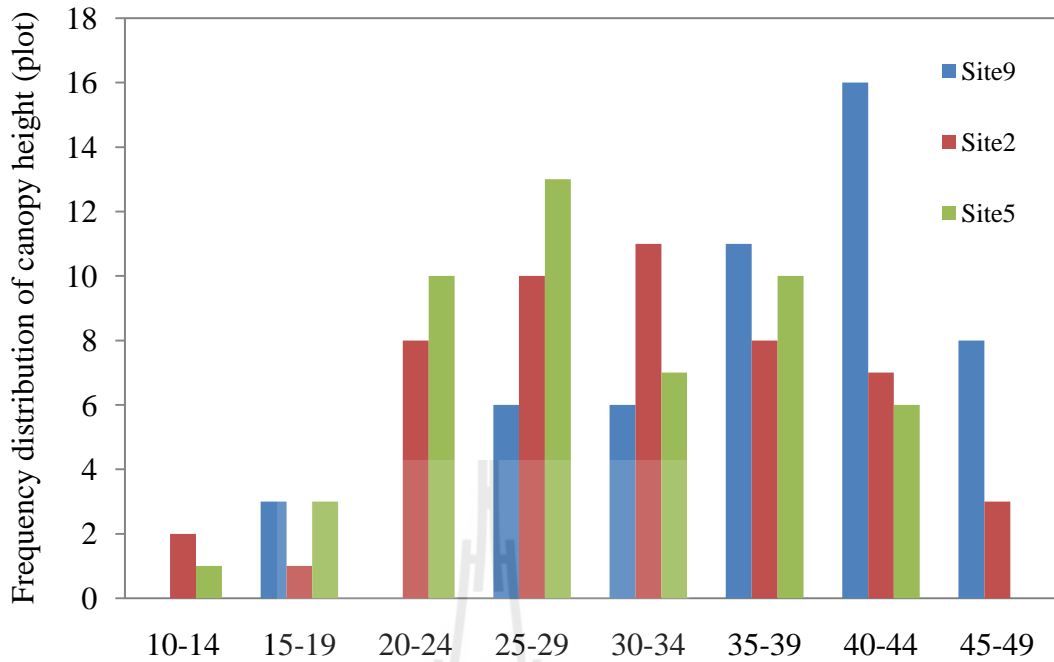


Figure 4.7 The frequency distribution of canopy height at the three location sites detection of gibbon in Nam Kan NPA.

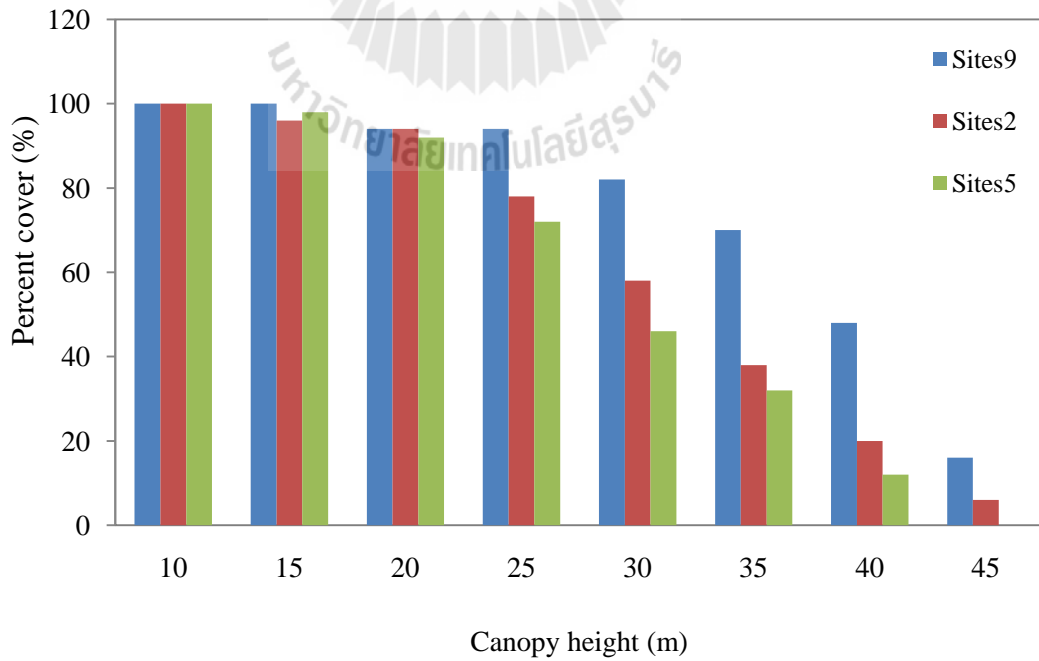


Figure 4.8 The percent cover of tree canopy height at gibbon record sites in Nam Kan NPA.

4.2.5 Threats to Gibbons

A total of 105 threat individuals was identified during the field survey from non-systematic transect walk in inside the each listening survey area (Figure 4.9 and Table 4.10). The total of 46 km non-systematic transect walked in 44 hours. The threats were categorized into five different types with each proportion of total threat records including hunting camp (46.70%), agriculture (20.95%), gunshot (20.95%), temporarily settlement (7.62%) and hunter (3.81%). On average of the threat density per km was 2.23. The threat was highest at survey site 1 and 7 mainly hunting camps were recorded (Figure 4.10). Slash and burn activity (agriculture) was found highest at survey site 2, 7, 8 and 23. Gunshot was heard highest at the survey site 1, 4, 7, 10, 17, 19 and 20. The numbers of people/hunters was encountered highest at survey site 3, 11, 15 and 18 while numbers of temporarily settlement the highest was found highest at survey site 7 and 12.

Of which, there were four survey sites that have lower threats as survey site 2 had only 3 small plantations plots, survey site 5 had one evidence of hunting camp and survey site 9 had 2 hunting camps these sites that found gibbon, and the survey site 21 had only 3 hunting camps but the habitat of this survey area was degraded.

Table 4.10 Number of threat by type and survey site.

Sites	Hunter	Gunshot		HC	TS	Agriculture		Total	Time walk (am)
		Shot number	Time (am)			Rice field	Farm rice		
1		2	11:05 11:25	5				7	10:30-11:50
2*						3		3	10:10-11:30
3	1	1	10:40	4				6	10:00-12:00
4		2	10:13 10:55	3				5	10:10-11:50
5*				1				1	10:03-12:00
6		1	11:00	2	1	1	1	6	10:00-11:55
7		2	11:28 11:50		2	1	2	7	10:10-11:08
8		1	10:30	1		2	1	5	10:20-11:52
9*				2				2	10:03-11:30
10		2	10:15 11:06	2			1	5	10:20-11:42
11	1			2				3	10:15-11:55
12		1	10:54	2	2			5	10:06-11:20
13		1	10:35	2			2	5	10:12-11:30
14				3	1		2	6	10:00-11:55
15	1	1	11:16	3				5	10:21-12:00
16		1	11:50	2				3	10:10-12:00
17		2	11:03 11:52	2				4	10:25-11:54
18	1			3	1		1	6	10:14-11:50
19		2	10:28 11:35	3				5	10:00-11:30
20		2	10:45 11:37	2				4	10:20-11:58
21				3				3	10:25-11:30
22				1	1		2	4	10:00-11:52
23		1	11:15	1			3	5	10:22-11:30
Total	4	22		49	8	7	15	105	

Remark: * survey site with gibbon records, HC = Hunting camp, TS = Temporally settlement

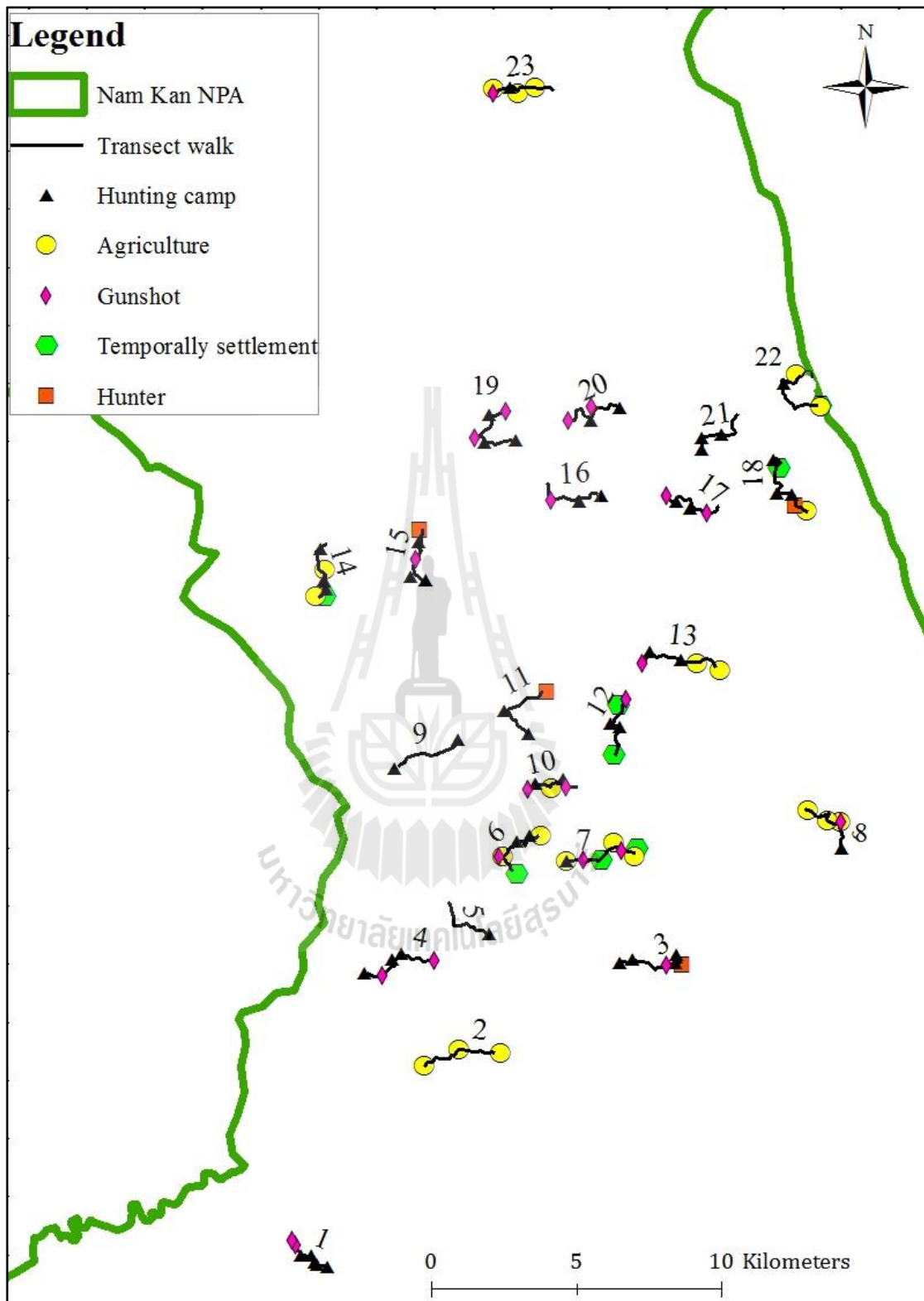


Figure 4.9 The threat individuals by survey site.



Hunting camp at the survey site 7



Hunters at the survey site 18



Hill rice at the survey site 8



Temporarily settlement at the survey site 7

Figure 4.10 The key threats in Nam Kan NPA.

4.3 Discussions

4.3.1 Gibbon Group Composition

The current gibbon group size in Nam Kan NPA is 3.9 individuals ranging between 2 and 8 individuals. As 10 groups and 39 individuals are located in 3 main locations in and around the Gibbon Experience site in Ban Toub and Ban Chomsy. Normally, one adult male and one adult female were found, but two adult females were also found in two groups (group 1 and 2), which have 8 and 7 individuals respectively. These groups inhabit just inside the treehouse of the Gibbon Experience. It is also found the same in subspecies (*N. jindongensys*) in China (Jiang *et al.*, 2006), also other subspecies in Vietnam (Geissmann *et al.*, 2002). One adult female in other groups but we also found one group without an adult male. Seven groups had 1 to 4 juveniles and 3 groups had 1 infant each.

4.3.2 Gibbon Population Density

A comparison of the Laotian black crested gibbon survey results in 1999 (Geissmann, 2007) and this survey shows a decline in gibbon observations at the southern part of Nam Kan NPA. Thirteen gibbon groups with 4 gibbon groups were recorded from current survey, that means the gibbon groups decreasing from 1999 to current of 9 gibbon groups. The number of gibbon groups in the southern and northern parts of Nam Kan NPA is lower to extirpate in present time and 6 gibbon groups recorded in the current survey is lower than the surveyed in March 2012. They estimated 9 to 14 gibbon groups would exist in Nam Kan NPA especially from the survey site 9 (Nam Toun) at the middle part up to northern part in Nam Kan NPA (Timmins and Duckworth, 2013) (Table 4.11 and Figure 4.11) and these values lower of recording for *N. c. concolor* at the Hoang Lien Mountains, Vietnam were 20 groups

and 59 individuals (Dat and Phong, 2010) and other gibbon species recorded in Vietnam, China, Bangladesh, Cambodia, Indonesia, Thailand and India (Table 4.12).

However, 10 gibbon groups found in Nam Kan NPA today is high comparing with only one gibbon group were found in Nam Ha NPA in 2012 (Luanglueyay and Suwanwaree, 2012). No any other population of this species is found in Laos, which is highly alarming for conservation action of this species to be seriously taken place in Nam Kan NPA. A group size in China is much larger than that of Laos as only 2 groups and about 17 to 20 individuals at Bawangling NNR, Hainan Island, China (Fellowes *et al.*, 2008). Also, *N. nasutus* at the Bangliang Limestone Forest in China has 3 groups, 13 individuals (Lok *et al.*, 2008).

Either case, gibbon density from the current survey in Nam Kan NPA is 0.06 groups/km² that is much lower than the previous estimates and any other gibbon survey as Geissmann (2007) estimated 2.2 groups/km². Other surveys conducted in China and Vietnam show that the density of *N. c. jingdongensis* at Wuliang Mountain, China is 0.67 groups/km² (Jiang *et al.*, 2006) and *N. concolor* at Che Tao, northern Vietnam is 1.6 groups/km² (Tallents *et al.*, 2000). For example of other gibbon species, *Hylobates agilis albibarbis* density is 2.14 groups/km² in Central Kalimantan, Indonesia (Buckley *et al.*, 2006) and *Nomascus gabriellae* density is >0.16 groups/km² in Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia (Channa and Gray, 2009). Therefore, a density value of the Laotian black crested gibbon in Nam Kan is highly lower than other gibbon species including in China, Vietnam, Cambodia, Thailand and Indonesia (Table 4.12). There are only same estimates for *N. leucogenys* at 0.05-0.27 groups/km² in Pu Mat National Park, Vietnam (Bach *et al.*, 2011).

Table 4.11 Gibbon population comparison of each period studied.

Species	Ind	Grp	Location	Country	Reference
<i>N. c. lu</i>	39	10	Nam Kan NPA	Lao PDR	This survey
		10 - 14	North-central of Nam Kan NPA	Lao PDR	Timmins and Duckworth (2013)
		13	Southern half of Nam Kan NPA	Lao PDR	Geissmann (2007)
		9 -14	Nam Kan NPA	Lao PDR	Robichaud <i>et al.</i> (2010)
		5	Nam Ha NPA	Lao PDR	Johnson <i>et al.</i> (2005)
		1	Nam Ha NPA	Lao PDR	Brown (2009)
		1	Nam Ha NPA	Lao PDR	Luangluexay and Suwanwaree (2012)
<i>N. c. concolor</i>	59	20	Hoang Lien Mountains	Vietnam	Dat and Phong (2010)
<i>N. c. jingdongensis</i>		98	Wuliang Mountain	China	Jiang <i>et al.</i> (2006)
<i>N. annamensis</i>	148	42	Kon Ka Kinh NP	Vietnam	Long <i>et al.</i> (2011)
<i>N. annamensis</i>		27	in Kon Cha Rang Nature Reserve	Vietnam	Vinh (2010)
<i>N. gabriellae</i>	34	15	Dong Nai Nature Reserve	Vietnam	Ha (2010)
<i>N. gabriellae</i>		11.94	Ta Dung Nature Reserve	Vietnam	Duc (2010)
<i>N. gabriellae</i>	600	149	Phnom Prich Wildlife Sanctuary	Cambodia	Chana and Gray (2009)
<i>N. hainanus</i>	17-20	2	Bawangling NNR, Hainan Island	China	Fellowes <i>et al.</i> (2008)
<i>N. leucogenys</i>		13	Muong Nhe Nature Reserve	Vietnam	Ha (2010)
<i>N. nasutus</i>	18	3	Bangliang Limestone Forest	China	Lok <i>et al.</i> (2008)
<i>H. agilis</i>	4,479		Bukit Barisan Selatan NP	Indonesia	O'Brien <i>et al.</i> (2004)
<i>H. lar</i>	318	64	KhaoYai NP	Thailand	Brockelman (2004)
<i>H. muelleri</i>	74		Kalimantan	Indonesia	Nijman and Menken (2005)
<i>H. hoolock</i>	282	96	Northeast and Southeast	Bangladesh	Islam <i>et al.</i> (2008)
<i>H. leuconedys</i>	168		Lohit District	India	Das <i>et al.</i> (2006)

Remark: NP=National Park, NNR=National Nature Reserve, NPA=National Protected Area, *N*=*Nomascus*, *H*=*Hylobates*.

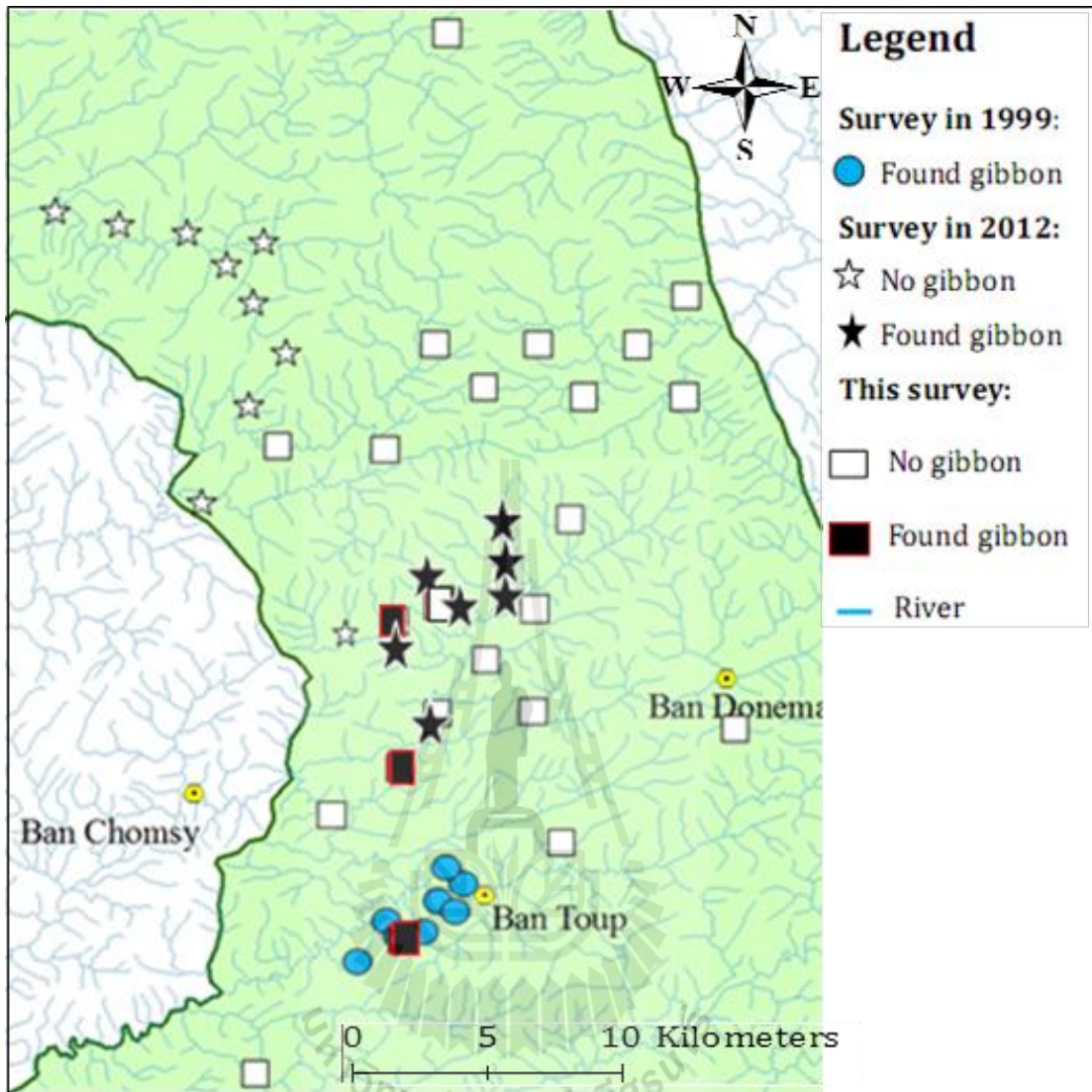


Figure 4.11 Gibbon survey period in Nam Kan NPA.

Table 4.12 Gibbon group density comparison.

Species	Grp/km ²	Location	Country	Reference
<i>N. c. lu</i>	0.06	Nam Kan NPA	Lao PDR	This survey
<i>N. c. lu</i>	2.2	Southern of Nam Kan NPA	Lao PDR	Geissmann (2007)
<i>N. c. jingdongensis</i>	0.67	Wuliang Mountain	China	Jiang <i>et al.</i> (2006)
<i>N. annamensis</i>	0.66	Kon Cha Rang Nature Reserve	Vietnam	Luu Quang Vinh (2010)
<i>N. annamensis</i>	0.12	Kon Ka Kinh National Park	Vietnam	Ha Thang Long (2011)
<i>N. gabriellae</i>	0.16	Phnom Prich Wildlife Sanctuary	Cambodia	Channa and Gray (2009)
<i>N. leucogenys</i>	0.05-0.27	Pu Mat National Park	Vietnam	Luu Tuong Bach <i>et al.</i> (2011)
<i>N. nasutus</i>	0.5	Bangliang Limestone Forest	China	Lok <i>et al.</i> (2008)
<i>H. albibarbis</i>	2.59	Sabangau Catchmen	Indonesia	Cheyne <i>et al.</i> (2008)
<i>H. agilis</i>	0.68	Bukit Barisan Selatan National Park	Indonesia	O'Brien <i>et al.</i> (2004)
<i>H. klossii</i>	5	Siberut Island	Indonesia	Höing <i>et al.</i> (2013)

Remark: NPA=National Protected Area, *N*=*Nomascus*, *H*=*Hylobates*.

The gibbon groups depleted in the northern zone of Nam Kan NPA or northern Ban Chomsy where received higher hunting pressure from Ban Donemai (Vieng Phoukha district of Luang Namtha province). The rationale of gibbon population reduction is because of hunting and habitat loss. Population immigrants into the area is also the other problem in Nam Kan NPA as Nam Kan area is considered in a region of human immigration (Duckworth *et al.*, 1995), and as new settlers are unlikely to share the beliefs. It is unclear how effective local hunting taboos will continue to be in protecting this species. Even though Gibbon Experience ecotourism has contributed to conserve the species which patrol teams are formed from local villagers to do regular patrols in their areas. However, it is not much affect since many evidences of hunting existing in the NPA.

The habitat of Laotian black crested gibbon in the survey area mainly occurred from 571 m to 814 m a.s.l. So the lower parts of the valley forest were mostly degraded forest, young fallows and hill rice. Widespread of secondary forest and some evidence of selective logging were found. Some previous gibbon locations have no longer today as 20 listening posts confirmed no gibbon due to hunting pressure and habitat loss.

Gibbons were clearly absent from the northern part of the NPA and the number was in decline from previous studies (Geissmann, 2007; Robichaud *et al.*, 2010; Timmins and Duckworth, 2013). The only remains were found near Gibbon Experience, the ecotourism site, and Ban Chomsy. They also have no clear patrol area to each other lead to some gaps and serious threat around the area. The population of Laotian black crested gibbon has declined due to hunting, habitat loss - both degradation and deforestation (Timmins and Duckworth, 2013). These activities also

impact on sustainable economic development, particularly for rural communities who are often entirely dependent upon local natural resources. The hunting appears to be the most important issue directly affecting the recovery of gibbon by both local villagers and pressures from outside. Although, Hmong people do not hunt this gibbon, they still convert forest for agriculture, easily allowing poachers from other villages to go into the area. Nam Kan NPA is under high pressure and the Bokeo province is easily accessible to transportation as R3 Road runs through the protected area (Robichaud *et al.*, 2010).

Yet another observation of this comparison is that the last two surveys took place in March 1999 (Giessmann, 2007) and March 2012 (Timmins and Duckworth, 2013), but this survey took place from September 2013 to January 2014. The current survey was conducted in different months from the previous two surveys.

Meanwhile, it is some concern where present gibbon records are not confirmed by the current survey might be due to other conditions, especially weather issue or hunting pressure to make them shy to call. It is also possible that gibbons sing less often in response to increased hunting pressure or as a result of no call at all and lead to reduced gibbon population density from this survey. This could also explain why fewer gibbon groups were heard during this survey as compared to the 1999 (Giessmann, 2007) and 2012 (Timmins and Duckworth, 2013) surveys, possibly the weather were very cold and different seasons. Usually, the Laotian black crested gibbon are not active when the weather was very cold. A time range of the current survey is cold season in Laos, which would attribute to some data bias.

4.3.3 Threats

Five categories of threats to Laotian black crested gibbon from non-systematic transect walk. The highest number of threats was identified in survey site 1 and 7 as on average of 3.5 individual threats per km. It is because these two survey sites are located adjacent to settlement that has no taboo on gibbon conservation. The survey site 1 was located close to Ban Naluang and the survey site 7 was located close to the Ban Donemai. Similarly the survey site number 3, 6, 14 and 18 (3 individual threats per km) had the second highest numbers. These survey sites are also close to Ban Donemai. In the past, it was reported on high density of other wildlife species in these survey sites such as wild pigs and deer, which attracted many illegal poachers into this area. Some other survey site 7, 8 are nearest to Ban Donemai but there were many plots of plantations around the villages. Local villagers recognize different types of camps as varies by different groups of people. Some hunting camps where cans of energy drink left around would not from local people. In some camps we found like a pig stray “fenced with wood to keep live animals”. Most people found in this camp were villagers living inside and around the Nam Kan NPA. However, at the survey site 2, 3 and 5 are nearest to Ban Toup (less than 3 km at the survey sites 2, 3,4 and 13 km from Ban Donemai at the survey site 5) but almost of the villagers respect their taboo on gibbon protection. Patrol teams are formed from local villagers and paid by the Gibbon Experience to do regular patrol and that partly additionally protect gibbons from hunting within Nam Kan NPA. Therefore, threat is lowest at the survey site number 2 and 9 since it is remotest and located between Ban Chomsy and Ban Donemai.

The survey site number from 10 to 17 and 20 to 23 are far from villages (>13 km distance each), difficult to access but forest habitats in these area are degraded and some deforested for some 40 years ago. These are also important rationale of no gibbon and low density of wildlife although threats are low.

Clearing forest for settlement and subsistence agriculture, indeed a semi-permanent settlement within the boundaries of Nam Kan NPA. Migration into the NPA may also increase the demand of woods for house construction materials, subsistence and incomes. Survey teams also recorded evidences of illegal logging and associated infrastructure within the Nam Kan NPA. Most loggers were mainly outsiders and cooperated with some inside villagers. They selected high economic timber tree especially “Rosewood” (*Pterocarpus macrocarpus*). This timber is sold in the price of 1,500US\$/m³ and also other second economic timber trees such as Resin tree (*Vatica harmandiana*) or “Mai See” in Lao language, “Mai Kuang” (*Desoxylum binectariferum*) and etc. These tree species were cut and sawn in forest with chain saw by local people but supported by businessmen from Houysay and Luang Namtha. The main purchasers are Chinese but through another Lao merchandises or brokers.

Similar approaches for wildlife hunting as both inside and outside villagers, whatever they find, they just hunt and sell to Lao brokers who live along Road No. 3 and then for Chinese purchasers. The species that they wanted to hunt most for medicine purpose are bear, pangolin and for food are deer and wild pigs. They also hunt gibbons. For example, one gibbon group living adjacent to paddy field of Mr. Lao Xao and Mr. Jalee, where are close to the survey site 2 (Gibbon Experience) have now only one adult female and two juveniles because the adult male was killed two years ago by hunter from Ban Toub (Mr. Cham Pa *pers. comm.* 2014). This means

that some taboo of Hmong would be lost when no result to death due to that gibbon hunting and that gibbon in Nam Kan NPA would be gone at last.

Animal price is quite lucrative as gall bile of bear is sold about 250 US\$/100g, 75 US\$ for a set of paws' bear and 137US\$/kg for pangolin.

4.3.4 Gibbon Population and Environmental Factors

There are at least five parameters that this survey assessed on density of gibbons in Nam Kan NPA by the survey sites. There are altitude, habitat, threat, distance to stream and distance to settlement. The survey sites that gibbons were found highest in the survey site 2, 5 and 9. In these survey sites, the altitude is between 571 m to 814 m a.s.l, which would be the best range of altitude of gibbon population in Nam Kan NPA. Threat level is lowest. Distance to settlement is far for the survey sites 5 and 9 but closer for the survey site 2. Although, the survey site 2 is closer to the settlement (Ban Tou), this village has taboo for gibbon conservation. Therefore, it is concluded that the factors that maintaining good gibbon population is good habitat and low hunting pressure (due to basically local taboo to protect gibbons). The habitat with high canopy and along river valleys is best as perhaps provide a variety of foods, also important sleeping site (Umponjan, 2006).

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

A total of 39 individuals in 10 gibbon groups was heard from 3 locations. From listening area of 117.6 km², gibbon density estimate is 0.09 groups/km² and 3.9 individuals per group on average. Higher gibbon density if using effective area only survey site heard was 13.5 km², and the gibbon density were 0.74 groups/km² and 2.89 individuals/km². Some groups have no adult male or female and only 3 groups have infants. Habitat destruction and hunting are issues that seriously impact on the gibbon population in the Nam Kan NPA. They are no longer in some places, especially in the northern part of the NPA and also partly in the southern part. Where gibbons are found higher density are where with low hunting but high forest canopy, far from communities or at least associated with local taboo for protecting gibbons. This survey shows some changes in gibbon distribution due to hunting pressures and habitat loss. Surprisingly and new knowledge gained that gibbon groups in Nam Kan NPA clump together in only three small locations where are safe for them from hunting and better habitat quality as well as food source. Highest density (0.74 groups/ km² according to an effective area of sites heard only) but on average of the total listening post area (117.6 km²), it is still 0.09 groups/km² as very low and probably lower than any gibbon populations.

A total of 105 threat individuals was identified in 23 survey sites. The survey site

where have the highest level of threat identified show no gibbons and lower wildlife population. Habitat loss is another issue for gibbons as probably not only in Nam Kan NPA but also any other places. Some villages that are located in remote area but forest habitats surrounding their villagers were lost for some 40 years ago may treat gibbons away so no gibbon was recorded from the current survey.

Gibbon Experience is one of three places in Nam Kan NPA that still supports good gibbon populations since the gibbon groups are not disturbed by hunting activity due to Hmong's traditional taboo to protect them, partly the benefit from the ecotourism business as well as habitats of those areas are well maintained. The Gibbon Experience has tried hard to protect the gibbon groups by hiring local staff to deploy on site and do regular patrol but not yet effectiveness was met since gibbon population keeps declining compared to even several years ago.

5.2 Recommendations

Current gibbon density is very low and at alarming for urgent protection from extinction in Laos as to retain and enhance the population from banning on hunting over the NPA and zoning for no-entry zone, especially where gibbons are present. Ban Toub and Chomsy will be most critical communities to work with and much to deal with Ban Donemai to stop entering these two gibbon territory villages. By the way, it calls for provincial government and Gibbon Experience to do more serious action in this regard before it is too late. Outreach for provincial and district authorities, officials and village authorities in and around Nam Kan NPA is necessary. Prior to that, attitude survey of the key stakeholders may be needed as to plan for outreach program correctly. Effective patrol which objective of biodiversity

conservation should be met as better while lower threat. It is not only to do patrol for earning daily per diems but also some indicators for success or to achieve gibbon conservation to be measured. Therefore, building team work from their interest is necessary. Also, not only assigned or hired local teams to do protect gibbons but also all concern village authorities but benefits from gibbon tourism should be well shared with them. Conservation agreements to be made with the core gibbon villages.

Monitoring of the gibbon population should be conducted in conjunction with protection in every 2-3 years following the same methodology and repeat in the same survey sites of this survey. The same, threat survey should be also conducted to see further studies related to this research study should be followed:

- 1) To conduct long term survey year (March to September) that did not cover from this survey to make a baseline for long-term survey.
- 2) To test the variations of environmental data that relevant to gibbon behavior ecology.



REFERENCES

REFERENCES

- Bach, L. T. and Rawson, B. M. (2011). **Population assessment of the northern white-cheeked crested gibbon (*Nomascus leucogenys*) in Pu Mat National Park, Nghe An province.** Conservation International/Fauna and Flora International, Hanoi, Vietnam.
- Bleisch, B., Geissmann, T., Timmins, R. J. and Xuelong, J. (2008). *Nomascus concolor*. In: **IUCN Red List of Threatened Species**. Version 2013.1. Downloaded on 10 Junly 2013.
- Brockelman, W. Y. (2004). Inheritance and selective effects of color phase in white-handed gibbons (*Hylobateslar*) in central Thailand. **Mammalian Biology**. 69(2): 73-80.
- Brockelman, W. Y. and Ali, R. (1987). Methods of surveying and sampling forest primate populations. In: Marsh, C. W. and Mittermeier, R. A. (eds). **Primate conservation in tropical rainforests**. Alan R. Liss. pp: New York. 23-63.
- Brockelman, W. Y. and. Srikosamatara, S. (1993). Estimation of density of gibbon groups by use of loud songs. **American Journal of Primatology**. 29(2): 93-108.
- Brown, J. (2009). Status of the Western black crested gibbon (*Nomascus concolor*) in the Nam Ha National Protected Area, Lao PDR. **Gibbon Journal**. 5: 28-35.

- Buckley, C., Nekaris, K. A. I. and Husson, S. J. (2006). Survey of *Hylobates agilisalbibarbis* in a logged peat-swamp forest: Sabangau catchment, Central Kalimantan. **Primates**. 47(4): 327-335.
- Chana, P. and Gray, T. (2009). **The status and habitat of Yellow-cheeked crested gibbon *Nomascus gabriellae* in Phnom Prich Wildlife Sanctuary, Mondulkiri.** WWF Greater Mekong-Cambodia Country Programme.
- Cheyne, S. M., Thompson, C. J. H., Phillips, A. C., Hill, R. M. C. and Limin, S. H. (2008). Density and population estimate of gibbons (*Hylobates albibarbis*) in the Sabangau catchment, Central Kalimantan, Indonesia. **Primates**. 49: 50-56.
- Das, J., Biswas, J., Bhattacharjee, P. C. and Mohnot, S. M. (2006). First distribution records of the eastern hoolock gibbon (*Hoolock hoolockleuconedys*) from India. **Zoo's Print Journal**. 21(7): 2316-2320.
- Dat, L. T. and Pong, L. M. (2010). **Census of western black crested gibbon *Nomascus concolor* in Mu Cang Chai species/habitat conservation area (Yen Bai Province) and adjacent forest in Muong La District (Son La Province).** Fauna and Flora International/Conservation International, Hanoi, Vietnam.
- Delacour, J. (1951). La systematique des gibbons Indochinois. **Mammalia**. 15: 118-123.
- DoF, Department of Forestry. (2011). **National gibbon conservation action plan(2011-2020).** Division of Forest Resources and Conservation, Ministry of Agriculture and Forestry.
- Duckworth, J. W., Timmins, R., Anderson, G. Q. A., Thewlis, R. M., Nemeth, E., Evans, T. D., Dvorak, M. and Cozza, K. E. A. (1995). Notes on the status and

- conservation of the gibbon *Hylobates (Nomascus) gabriellae* in Laos. **Tropical Biodiversity**. 3: 15-27.
- Duc, H. M., Bang, T. V. and Long, V. (2010). **Population status of the yellow-cheeked crested gibbon (*Nomascus gabriellae*) in Ta Dung Nature Reserve, DakNong Province, Vietnam**. Fauna and Flora International/conservation International, Hanoi, Vietnam.
- Fan, P. F., Xiao, W., Huo, S. and Jiang, X. L. (2009). Singing behavior and singing functions of Black-crested gibbons (*Nomascus concolor jingdongensis*) at Mt. Wuliang, central Yunnan, China. **American Journal of Primatology**. 71(7): 539-547.
- Fellowes, J. R., Chan, B. P. L., Zhou, J., Chen, S. H., Yang, S. and Ng, S. C. (2008). Current status of the Hainan gibbon (*Nomascus hainanus*): Progress of population monitoring and other priority actions. **Asian Primates Journal**. 1(1): 2-11.
- Geissmann, T. (2002). Duet-splitting and the evolution of gibbon songs. **Biological Reviews of the Cambridge Philosophical Society**. 77(1): 57-76.
- Geissmann, T. (2007). First field data on the Laotian black crested gibbon (*Nomascus concolor lu*) of the Nam Kan area of Laos. **Gibbon Journal**. 3: 56-65.
- Geissmann, T., Nguyen, D. X., Lormee, N. and Momberg, F. (2000). **Vietnam primate conservation status review 2000 - Part 1: Gibbons status report**. Fauna and Flora International, Indochina Programme, Hanoi, Vietnam.
- Hamard, M., Cheyne, S. M. and Nijman, V. (2010). Vegetation correlates of gibbon density in the peat-swamp forest of the Sabangau catchment, Central Kalimantan, Indonesia. **American Journal of Primatology**. 72(7): 607-616.
- Höing, A., Quinten, M. C., Indrawati, Y. M., Cheyne, S. M. and Waltert, M. (2013).

Line transect and triangulation surveys provide reliable estimates of the density of Kloss' Gibbons (*Hylobates klossii*) on Siberut island, Indonesia.

International Journal of Primatology.34(1): 148-156.

Islam, M. A., Feeroz, M. M., Muzaffar, S. B., Kabir, M., Begum, S. Hasan, K., and

Chakma, S. (2008). Population status and conservation of Hoolock gibbons

Hylobateshoolock Halan 1834 in Bangladesh. **Journal of the Bombay Natural**

History Society. 105(1): 19-23.

Jiang, X., Luo, Z., Zhao, S., Li, R. and Liu, C. (2006). Status and distribution pattern

of black crested gibbon (*Nomascus concolor jingdongensis*) in Wuliang

Mountains, Yunnan, China: Implication for conservation. **Primates**. 47(3):

264-271.

Johnson, A., Singh, S., Duangdala, M. and Hedemark, M. (2005). The western black

crested gibbon *Nomascus concolor* in Laos: New records and conservation

status. **Oryx**. 39(3): 311-317.

Long, H. T., Tam, N. I., Minh, H. T., Tinh, N. T. and Tuan, B. V. (2011). **Survey of**

the northern buff-cheeked crested gibbon (*Nomascus annamensis*) in Kon

Ka Kinh National Park, Gia Lai Province, Vietnam. Fauna and Flora

International/Conservation International, Hanoi, Vietnam.

Li, G. S., Yang, X. M., Zhang, H. Y. and Li, W. (2011). Population and distribution of

Western black crested gibbon (*Nomascus concolor*) at Ailao Mountain,

Xinping, Yunnan. **Zoological Research**. 32(6): 675-683.

Lok, C. B. P., Xue-feng, T. and Wu-jing, T. (2008). Rediscovery of the critically

endangered eastern black crested gibbon *Nomascus nasutus* (*Hylobatidae*) in

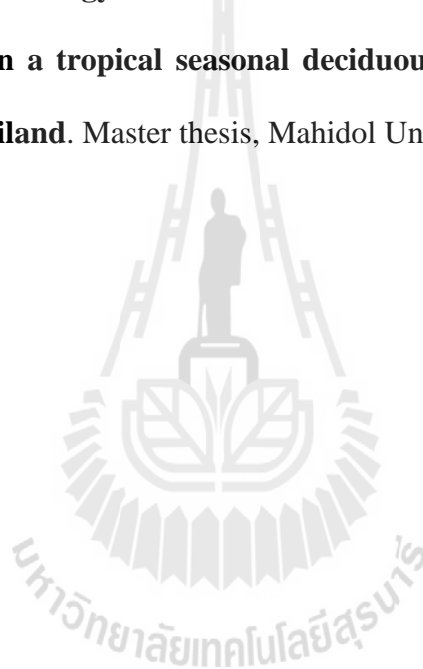
China, with preliminary notes on population size, ecology and conservation

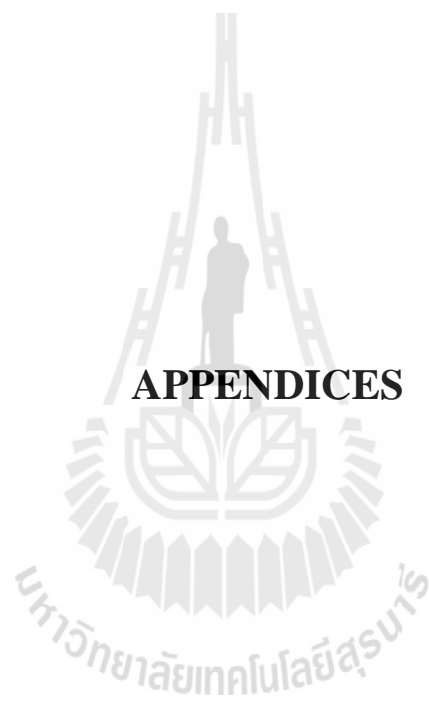
status. **Asian Primates Journal**. 1(1): 17-25.

- Luangleuxay, S. and Suwanwaree, P. (2012). **The status of western black crested gibbon (*Nomascus concolor lu*) in Nam Ha National Protected Area, Lao PDR.** The 33rd Thailand Wildlife Seminar. December 14-15, Kasetsart University, Bangkok, Thailand.
- Vinh, L. Q., Thinh, V. T., Hai, D. T., Huy, D. Q., Manh, N. D. and Trinh, B. H. (2010). **Survey of Northern Buff-cheeked Crested Gibbon (*Nomascus annamensis*) in Kon Cha Rang Nature Reserve.** Fauna and Flora International/Conservation International, Hanoi, Vietnam.
- Mootnick, A. R. and Fan, P. (2011). A comparative study of crested gibbons (*Nomascus*). **American Journal of Primatology.** 73(2): 135-154.
- Nijman, V. (2004). Conservation of the Javan gibbon *Hylobates moloch*: Population estimates, local extinctions, and conservation priorities. **Raffles Bulletin of Zoology.** 52(1): 271-280.
- Nijman, V. and Menken, S. B. (2005). Assessment of census techniques for estimating density and biomass of gibbons (Primates: *Hylogbatidae*). **The Raffles Bulletin of Zoology.** 53(1): 201-211.
- Ha, N. M., Tuoc, D., Tang, N. Q., Cuong, N. M., Dung, L. V. and Bach, L. T. (2010). **Survey of white-cheeked crested gibbon (*Nomascus leucogenys*) in Muong Nhe Nature Reserve, Dien Bien province.** Fauna and Flora International/Conservation International, Hanoi.
- Ha, N. M., Hao, N. H., Dung, T. D., Diep, N. M. and Nong, P. V. (2010). **Report of yellow-cheeked crested gibbon (*Nomascus gabriellae*) survey in Dong Nai Nature Reserve, Dong Nai province, Vietnam.** Fauna and Flora International/Conservation International, Hanoi, Vietnam.

- O'Brien, T. G., Kinnaird, M. F., Nurcahyo, A., Iqbal, M. and Rusmanto, M. (2004). Abundance and distribution of sympatric gibbons in a threatened Sumatran rain forest. **International Journal of Primatology**. 25(2): 267-284.
- Phoonjampa, R., Koenig, A., Brockelman, W. Y., Borries, C., Gale, G. A., Carroll, J. P. and Savini, T. (2011). Pileated gibbon density in relation to habitat characteristics and post-logging forest recovery. **Biotropica**. 43(5): 619-627.
- Rawson, B. M., Insua-Cao, P., Nguyen Manh Ha, Van Ngoc Thinh, Hoang Minh Duc, Mahood, S., Geissmann, T. and Roos, C. (2011). **The conservation status of gibbons in Vietnam**. Fauna and Flora International/Conservation International, Hanoi, Vietnam.
- Robichaud, W., Insua-Cao, P., Sisomphane, C. and Chounnavanh, S. (2010). **A scoping mission to Nam Kan National Protected Area, Lao PDR**. Fauna and Flora International.
- Ruppell, J. (2007). The gibbons of Phong Nha-Ke Bang National Park in Vietnam. **Gibbon Journal**. 3: 50-55.
- Timmins, R. J. and Duckworth, J. W. (2013). **A survey of gibbons and other wildlife in the Bokeo section of Nam Kan National Protected Area, Lao PDR**. Fauna and Flora International, Cambridge, U.K.
- Thinh, V. N., Rawson, B., Hallam, C., Kenyon, M., Nadler, T., Walter, L. and Roos, C. (2010). Phylogeny and distribution of crested gibbons (genus *Nomascus*) based on mitochondrial cytochrome b gene sequence data. **American Journal of Primatology**. 72(12): 1047-1054.
- Umponjan, M. (2006). **Ecology and application of GIS for analysis of the white-handed gibbon (*Hylobates lar*) habitat at Phu Khieo Wildlife Sanctuary**. Kasetsart University.

- Wang, Y. X., Jiang, X. L. and Feng, Q. (2000). Distribution, status and conservation of black-crested gibbon (*Hylobates concolor*) in China. **Acta Anthropologica Sinica**. 19: 138-147.
- Whittaker, D. J. (2005). Short communication new population estimates for the endemic Kloss's gibbon *Hylobatesklossii* on the Mentawai Islands, Indonesia. **Oryx**. 39(4): 458-461.
- Yimkao, P. (2005). **Ecology and conservation of the white-handed gibbon *Hylobateslar* in a tropical seasonal deciduous forest in Mae Hong Sone, Northern Thailand**. Master thesis, Mahidol University.





APPENDICES



APPENDIX A
DATA COLLECTION FORMS

Table A-1 Listening records of gibbon form.

- Surveyor:.....Date:.....Weather.....
- Time arriving Listening Post:Time leaving Listening Post:.....
- Name of the forest (forest or valley):Elevation.....
- Location of LP (GPS point):.....Distance to a village.....Distance to a stream.....

Gibbon group	Singing time		Time calling features (song type)					Bearing (°)	Distance (m)
	Start	End	Duet song	Great call	Solo song	Male	Female		

Table A-2 Villagers interview form on gibbon distribution and conservation.

• Interviewer name		Date		Number of interviewee	
• District		Province.....		Village	
Identification		<input type="checkbox"/> Black or yellow	<input type="checkbox"/> No tail	<input type="checkbox"/> Singing	<input type="checkbox"/> Small group, never see on ground
Population		<input type="checkbox"/> Common	<input type="checkbox"/> Present	<input type="checkbox"/> Rare	<input type="checkbox"/> Extinct
Population in last 5 years		<input type="checkbox"/> Increase	<input type="checkbox"/> Decrease	<input type="checkbox"/> Sustain	
Last observation:.....(year)					
Location:.....		Coordinate		Relate area.....	
Distance to village:..... m		Time of walking		No Group..... Individual.....	
		Snare trap	Hunting gun	Door trap	Habitat lost
Current threat					
Historical threat					
		Cultural	Medicinal	Trophy	Meat
		Food	Decoration	Pet	Crop protection
Traditional use					
Commercial purpose					
Hunting reason of local people					
Hunting reason of outsider					
		Increase	Decrease		
Pressure from local hunter					
Pressure from non-local hunter					

Table A-3The trees canopy height and basal area form.

- Surveyor:.....Date:.....
- Name of the forest (forest or valley):..... Listening point name.....Elevation.....Location of LP (GPS point):.....

Line	Canopy		DBH
	Point	Height	

Table A-4 Records of human impacts form.

- Surveyor:.....Date:.....
- Elevation.....Name of the forest (forest or valley):.....
- Location of LP (GPS point):.....Time: start.....End.....

No	Hunting	Handgun	No gun	Other weapon	Wildlife		Footprint		Heard gun	Lodging		Cutting tree			GPS		Remark
					Dead	Meat	New	Old		New	Old	Big tree	Plantation	Burning	X	Y	



APPENDIX B

GIBBON SURVEY DATA IN NAM KAN NPA

Table B-1 Information of interviewees.

Interviewee name	Age	Ethnic group	Occupation
1. Ban Chomsy, HouayXai district, Bokeo province			
Chakhue A	40	Muser	Farmer
Chata	21	Muser	Farmer
Chacho	31	Muser	Farmer
Chakhue B	39	Muser	Farmer
Chapha	25	Muser	Farmer
2. Ban Naluang, HouayXai district, Bokeo province			
Savat	40	Khmu	Villager guard
Bounsay	56	Khmu	Farmer
Saydee	58	Khmu	Farmer
Khamlee	58	Khmu	Farmer
Somphon	39	Khmu	Villager guard
3. Ban Namkhalue, Merng district, Bokeo province			
Maikhamand	40	Lue	Head of village
Tounsom	46	Lue	Farmer
Toun	39	Lue	Farmer
Mainoy	35	Lue	Farmer
Keo	40	Lue	Farmer
4. Ban Namko, HouayXai district, Bokeo province			
Keovilaisak	35	Khmu	Farmer
Sychan	27	Khmu	Farmer
Khamphu	40	Khmu	Farmer
Phochan	37	Khmu	Head of village
Tom	35	Khmu	Farmer
5. Ban Namthoung, HouayXai district, Bokeo province			
Ounekham	45	Khmu	Head of village
Outkham	43	Khmu	Farmer
Sengthong	27	Khmu	Farmer
khankeo	40	Khmu	Farmer
Cher	32	Khmu	Farmer
6. Ban Sod, HouayXai district, Bokeo province			
Ainyai	55	Lamet	Farmer
Sayphone	38	Lamet	Farmer

Table B-1(Continued).

Interviewee name	Age	Ethnic group	Occupation
Khamphone	30	Lamet	Head of village
Chan	25	Lamet	Farmer
Than	35	Lamet	Farmer
7. Ban Toup, HouayXai district, Bokeo province			
Yenglee	48	Hmong	Farmer
Champa	51	Hmong	Forest guard
Kualee	22	Hmong	Farmer
Vaserlee	42	Hmong	Farmer
Nengva	47	Hmong	Farmer
8. Ban Xaypathana, Merng district, Bokeo province			
Nyialiher	41	Hmong	Head of village
Xialivang	45	Hmong	Farmer
Chonglixong	48	Hmong	Farmer
Huaher	35	Hmong	Farmer
Poher	30	Hmong	Farmer
9. Ban Pakhan, Vieng Phukha district, Luang Namtha province			
Bounethong	35	Khmu	Villager guard
Phet	30	Khmu	Farmer
Tuoy	31	Khmu	Farmer
Thongsouk	35	Khmu	Farmer
Phaiboune	37	Khmu	Farmer
10. Ban Donemai, Vieng Phukha district, Luang Namtha province			
Kanvong	40	Lamet	Villager guard
Chakhue	30	Muser	Farmer
Chacho	45	Muser	Farmer
Chadee	61	Muser	Farmer
Chapue	57	Muser	Farmer

Table B-2 Villagers interview for status data in summary of Laotian black crested gibbon in Nam Kan NPA.

Villager numbers	Last observed location	Distant from village	Group	Individual	Year
1.	Ban Toup, HouayXai district, Bokeo province, interviewed on 3/9/2013				
1	Treehouse	4	6	20	2013
2	Treehouse	4	6	20	2013
3	Treehouse	3	4	18	2013
4	Treehouse	3	6	21	2013
5	Treehouse	3	5	24	2013
2.	Ban Sod, HouayXai district, Bokeo province, interviewed on 5/9/2013				
6	Nam Kan	3	1	2	2005
7	Nam Kan	3	1	3	1999
8	Nam Kan	4	1	3	2000
9	Nzm Nim	4	1	2	2010
10	Nzm Nim	4	1	3	2008
3.	Ban Donemai, Vieng Phukha district, Luang Namtha province, on 8/9/2013				
11	Nam Pea	11	1	2	2011
12	Nam Toun	15	4	13	2013
13	Nam Toun	10	4	12	2013
14	Nam Dernbin	16	2	5	2012
15	Nam Toun	14	3	9	2013
4.	Ban Namko, HouayXai district, Bokeo province, interviewed on 9/9/2013				
16	Nam Toun	18	5	12	2013
17	Nam Kok	9	1	3	2005
18	Nam Toun	18	2	5	2009
19	Nam Kok	15	1	3	2005
20	Nam Toun	18	2	6	2012
5.	Ban Chomsy, HouayXai district, Bokeo province, interviewed on 10/9/2013				
21	Nam Toun	10	4	10	2013
22	Nam Toun	10	2	6	2013
23	Nam Toun	10	4	15	2013
24	Nam Toun	10	4	10	2013
25	Nam Pong	12	2	5	2004
6.	Ban Namkhalue, Merng district, Bokeo province, interviewed on 13/9/2013				
26	Nam Tuoy	8	2	5	1999
27	Nam Pong	9	1	4	1999
28	Nam Tuoy	8	2	5	1995
29	Nam Tuoy	8	1	2	1996
30	Nam Tuoy	11	1	2	1996

Table B-2(Continued).

Villager numbers	Last observed location	Distant from village		Group	Individual	Year
7.	Ban Xaypathana, Merng district, Bokeo province, interviewed on 14/9/2013					
31	Nam Touy	10	2	4		1997
32	Nam Touy	8	1	2		1996
33	Nam Touy	10	1	3		1999
34	Nam Touy	18	2	5		1999
35	Nam Touy	8	2	4		1997
8.	Ban Naluang, HouayXai district, Bokeo province, interviewed on 19/9/2013					
36	Nam Sakhan	7	1	3		2005
37	Nam Eap	6	1	2		2006
38	Nam Sakhan	7	1	2		2007
39	Nam Sakhan	7	1	3		1999
40	Nam Sakhan	7	1	3		1998
9.	Ban Namthoung, HouayXai district, Bokeo province, on 23/9/2013					
41	Nam Sakhan	7	1	2		2000
42	Nam Sakhan	7	1	2		1998
43	Nam Kok	7	2	5		2007
44	Nam Kok	8	1	3		2006
45	Nam Sakhan	8	2	5		2005
10.	Ban Pakhan, Vieng Phukha district, Luang Namtha province, on 12/1/2014					
46	Nam Pongnoy	12	1	4		1995
47	Nam Touy	15	1	3		1995
48	Phu Nyai	7	2	5		1998
49	Nam Touy	15	1	2		1995
50	Nam Kaipa	12	1	3		2000

Table B-3 Listening post locations during this gibbon survey in Nam Kan NPA.

Survey sites	Survey date	Listening posts	UTM		Elevation
			X	Y	
1	27-29/10/2013	1	679774	2258218	919
		2	679363	2257774	925
		3	678729	2257931	900
2	4-6/10/2013	4	685070	2263394	750
		5	684276	2263408	674
		6	684607	2263817	631
3	7-9/10/2013	7	691128	2267265	810
		8	690745	2266859	715
		9	690886	2267827	860
4	11-13/10/2013	10	682122	2268446	691
		11	681966	2267953	594
		12	681861	2268876	711
5	21-23/11/2013	13	685781	2269970	752
		14	685450	2269710	776
		15	685232	2269789	795
6	18-20/11/2013	16	686250	2272229	625
		17	686352	2271737	619
		18	686922	2271917	809
7	24-26/11/2013	19	688791	2272010	760
		20	689479	2272050	725
		21	689565	2272440	825
8	28-30/11/2013	22	697492	2272018	951
		23	698149	2271995	1015
		24	698375	2271635	1081
9	24-26/10/2013	25	684298	2275416	755
		26	684524	2275502	763
		27	684530	2275297	731
10	15-17/11/2013	28	687876	2273965	771
		29	687493	2273629	713
		30	687923	2273285	851
11	12-14/11/2013	31	685398	2276388	832
		32	685922	2276185	821
		33	686008	2275614	841
12	9-11/11/2013	34	690125	2275847	810
		35	689632	2276184	630
		36	689510	2275506	808
13	6-8/11/2013	37	691152	2279617	810
		38	691208	2279012	730

Table B-3(Continued).

Survey sites	Survey date	Listening posts	UTM		Elevation
			X	Y	
		39	691785	2279387	761
14	25-27/1/2014	40	679605	2281806	869
		41	680293	2281767	902
		42	681020	2281876	900
15	22-24/1/2014	43	683278	2282480	920
		44	682300	2282210	929
		45	683628	2282315	901
16	17-18/1/2014	46	687360	2285496	976
		47	687556	2284839	1004
		48	688111	2284386	955
17	10-12/1/2014	49	693145	2283972	903
		50	692457	2283479	1000
		51	692129	2284050	951
18	13-15/12/2014	52	695662	2283995	931
		53	696035	2283487	956
		54	695444	2283385	918
19	19-21/1/2014	55	686391	2286833	1120
		56	685945	2286301	905
		57	685601	2286786	921
20	13-15/1/2014	58	689189	2286176	953
		59	689760	2286583	927
		60	690346	2286348	919
21	28-30/1/2014	61	693583	2285785	908
		62	694279	2285973	948
		63	694623	2285559	953
22	17-19/12/2014	64	695928	2286911	729
		65	695467	2286442	730
		66	694975	2287028	714
23	21-23/12/2014	67	687860	2298083	1349
		68	687368	2297762	1221
		69	687907	2297582	1328

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Luangleuxay, S., Youanechuexian, K. and P. Suwanwaree. (2015). Laotian black crested gibbon food and their feeding trees preliminary study in Ban Toup, Nam Kan National Protected Area, Lao PDR. **The 3rd EnvironmentAsia International Conference**. June 17-19, Bangkok, Thailand.

Youanechuexian, K., Phiapalath, P. and Suwanwaree, P. (2014). The status of Laotian black crested gibbon *Nomascus concolorlu* in Nam Kan National Protected Area, Lao PDR. **Advances in Environmental Biology**. 8(14): 7-13.

Youanechuexian, K., Phiapalath, P. and P. Suwanwaree. (2015). Historical distribution and threat survey of Laotian black crested gibbon in Nam Kan National Protected Area, Lao PDR. **The 3rd EnvironmentAsia International Conference**. June 17-19, Bangkok, Thailand.