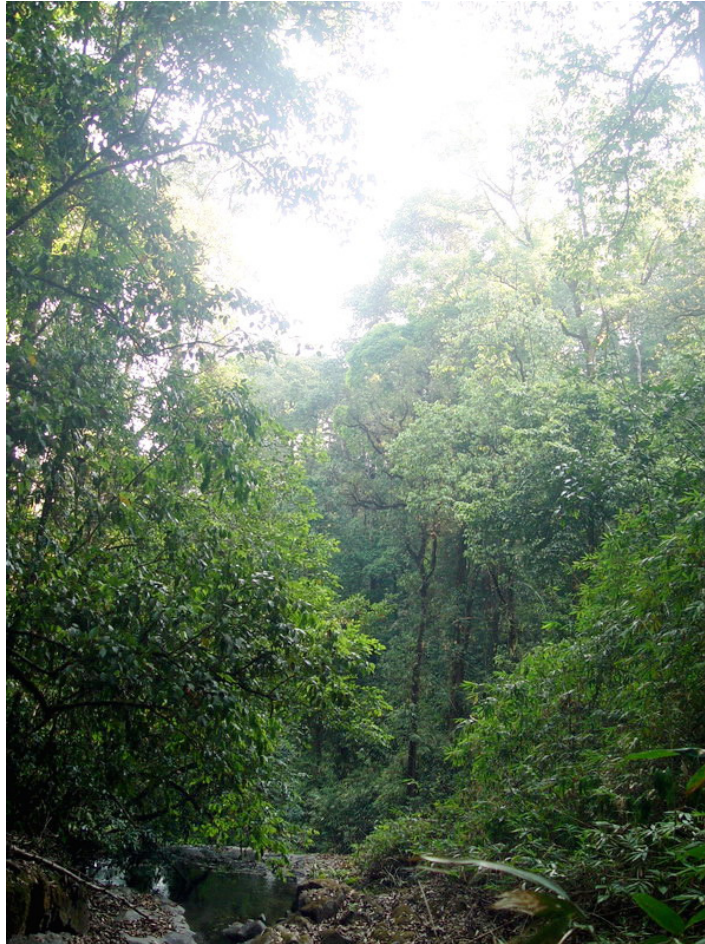


Hoolock Gibbon and Biodiversity Survey on Khe Shor Ter Mountain, Nattaung Range, Luthaw Township, Mudraw District, Karen State, Myanmar



Saw Blaw Htoo
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Myanmar Primate Conservation Program
Report No. 11

Chiang Mai, October 2010



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Cover photo: Gibbon habitat at the survey site. Credit: Saw Blaw Htoo/PRCF-KESAN

Saw Blaw Htoo & Grindley (2010)



Photo: Members of the research team in Karen state.

i. Acknowledgements

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ii. Abstract

The report details the results of a gibbon status assessment made on Khe Shor Ter Mountain, Karen State, Myanmar in April 2010 by a team of researchers from the Karen Environmental and Social Action Network (KESAN) and supported by the People Resources and Conservation Foundation (PRCF). The site had not previously been surveyed for gibbon, but experience in the area suggested good populations and habitat persisted. The area comprises fairly rugged hills and valleys on the edge of an upland plateau at about 1,500-1,600 masl. Forest is mostly wet hill evergreen, varying from slightly disturbed to undisturbed. Much of the forest is under local community management and direct threats to gibbons are very limited. The research included both primary and secondary data collection. Secondary data collection was mainly by interview with local people. Primary research used the auditory sampling technique, conducted from three field sites which were selected based on input from local communities. At each site the team established four listening posts, making a total of 12 listening posts in three survey sites. Each post was manned by a trained observer for four days, from at least 06h00 to 12h00. During this time, observers recorded details of all gibbon group calls (time, direction, distance, number in group), and any direct sightings. Call data were later analysed to determine the number of groups within a 0.6 km and 1 km 'listening radius' of each listening post. Results indicate an average estimated density across the whole area of 1.59 groups/km² or 5.25 individuals/km² (at 1 km listening radius), and 2.17 groups/km² or 8.96 individuals/km² (at 0.6 km listening radius). This estimated density is comparable to that of an earlier study for the Hoolock Gibbon in lowland evergreen forest in Mahamyaing Wildlife Sanctuary. The forest at the site therefore seems to support a significant population of Eastern Hoolock. Hunting is a relatively low threat, but the displacement of people by civil war in Karen state and subsequent shifting cultivation in the Khe Shor Ter range does threaten habitat. Additional incidental mammal, bird, reptile and amphibian records and provided, along with some recommendations for conservation of eastern Hoolock Gibbon at the site.

iii. Report conventions

All geographical references are given as decimal degrees (lat/long, hddd.ddddd°) on the WGS 84 datum, unless otherwise stated.

All altitudes are in meters above sea level.

Where non-English words or names are provided, they are indicated by the use of *italics*.

Scientific and common names for mammals come from Francis (2008). Those for birds are from Robson (2008). Those for reptiles are from Cox (1998).

Species threat status is taken from the IUCN Red List of endangered species, available at www.iucnredlist.org

At the time of the survey, one USD was roughly equivalent to 1,000 kyat.

All maps were produced by Mark E Grindley/PRCF unless otherwise stated.

iv. Acronyms and abbreviations

BANCA	Biodiversity and Nature Conservation Association
DBH	Diameter at Breast Height
FFI	Fauna and Flora International
FS	Field Site
IUCN	International Union for Conservation of Nature and Natural Resources
KESAN	Karen Environmental and Social Action Network
LP	Listening Post
PRCF	People Resources and Conservation Foundation
UNDP	United Nations Development Program
USD	United States Dollar
WCS	Wildlife Conservation Society

IUCN Threat Status (most threatened to least threatened); CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient. www.iucnredlist.org

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vi. Field site summaries

Field Site Code	Survey Dates
FS1	10/4/2010 – 13/4/2010
Site Name	Division/State
Htee Khaw Lay Ko	Mudraw District, Karen State, Burma
Camp Location	Nearest Village (inc geo-ref)
N:18° 34.399', E:096°58.306'	Htee Mu Plaw
Altitude	Prevailing Weather During Survey
1,475 m	Sunny with some cloud
Team Members	Guides/Key Respondents
Saw Blaw Htoo, Saw Day Htoo, Saw Jacob, Saw Eu Moo, Saw Day Zer, Saw Myat Doh, Saw Myat Kaw, Saw Law Bu, Saw Maung Ken Kyi, Saw Loan Moo, and Saw Christian	Saw Pah Wah and Saw Ywin Kaw
Forest Status	Habitat
The forest is protected by the community and managed by the community, who have lived close to this forest for many centuries	Pristine and undisturbed primary forest. Good forest health, with very few signs of human disturbance. Plenty of giant trees, some up to 12 meters dbh and 40 meter height. No sign of plastic waste and other chemical waste. At least four distinct layers of forest cover, from the canopy to the ground level
Biodiversity Values	Gibbon Population Density (est)
Rich megafauna, but no Asian Elephant. A few Tiger and Gaur may pass annually. Permanent populations of deer, bear, muntjac, serow, dhole, macaque, pangolin, Leopard and langur	0.93 groups and 3.07 mean gibbon individuals per km ² , at 600m listening radius

Field Site code	Survey Dates
FS2	14/4/2010 – 17/4/2010
Site name	Division/State
Htee Ler Kee	Mudraw District, Karen State, Burma
Camp location	Nearest Village (inc geo-ref)
N:18° 36.960', E:096°57.524'	Baw Lay Der village
Altitude	Prevailing weather during survey
1,599 m	Sunny, sometimes cloudy
Team members	Guides/key respondents
Saw Blaw Htoo, Saw Day Htoo, Saw Jacob, Saw Eu Moo, Saw Day Zer, Saw Myat Doh, Saw Myat Kaw, Saw Law Bu, Saw Maung Ken Kyi, Saw Loan Moo, and Saw Christian.	Saw Pah Wah, Saw Taw Lo and Saw Ywin Kaw

Forest Status	Habitat
The forest is protected and managed by the community using indigenous knowledge of forest management.	Undisturbed forest similar to at FS#1. But it contained the most abandon rattan in all three sites. It also has very small bamboo, about the width of a pencil and up to 10 meters tall. Many giant trees similar to FS#1. There is very little sign of humans visiting the area.
Biodiversity Values	Gibbon population density (est)
Rich biodiversity area which has the sign of tiger and habitat through personal observation and interview.	2.09 groups and 6.91 mean gibbon individuals per km ² , at 600m listening radius

Field Site code	Survey Dates
FS3	18/4/2010 – 21/4/2010
Site Name	Division/State
Plo Doh Kee Creek	Mudraw District, Karen State, Burma
Camp Location	Nearest Village (inc geo-ref)
N: 18° 29. 970', E: 096° 58.635'	Pay Lay Pu Village
Altitude	Prevailing Weather During Survey
1,622 m	Sunny, sometimes cloudy
Team Members	Guides/Key Respondents
Saw Blaw Htoo, Saw Day Htoo, Saw Jacob, Saw Eu Moo, Saw Day Zer, Saw Myat Doh, Saw Myat Kaw, Saw Law Bu, Saw Maung Ken Kyi, Saw Loan Moo, and Saw Christian.	Saw Pah Wah, Saw Eu Moo and Saw Ywin Kaw
Forest Status	Habitat
The forest is intact and it has less very little disturbance by humans; perhaps only once or twice per year. The forest is full of Wild pig, deer, muntjac, Gaur, bear and other large mammals.	Located in the watershed of some big streams. Evidence of wildlife is the highest of the three sites. The forest is cool all day round while the other area 20 km away will be very hot.
Biodiversity Values	Gibbon Population Density (est)
The area is rich in the biodiversity may be because there are more variety of ecosystem diversity. In the eastern part the habitat is base on the watershed in the broad leaves ever green forest types. However, in the western part this hanging rock steep valley and some part it contain rocky scrub. There are also many caves and cliff.	5.12 groups and 2.76 mean gibbon individuals per km ² , at 600m listening radius

1. Introduction

1.1 Background to the project

The survey on the Hoolock Gibbon and biodiversity was conducted by the Karen Environmental Social Action Network (KESAN), with technical support from the People Resources and Conservation Foundation (PRCF). Funding was provided to the PRCF by the Gibbon Conservation Alliance. The survey is a contribution to the project Myanmar Hoolock Gibbon Conservation Status Review project, which is jointly implemented by the PRCF, Fauna & Flora International (FFI), and the Myanmar Biodiversity and Nature Conservation Association (BANCA). Methods and approach are generally speaking those being adopted for the Status Review, to allow comparison between all survey sites throughout Myanmar.

The Status Review aims to assess the conservation status of the Hoolock Gibbon in Myanmar, while strengthening the capacity of the conservation movement in primate surveying, monitoring, and conservation. Globally, Hoolock Gibbon populations are dwindling due to forest clearance, disturbance, and hunting. Myanmar still holds significantly large and intact areas of prime habitat for Hoolock Gibbons, but there is no significant data on the conservation status of these apes.

A comprehensive review on the conservation status of the species will help identify, prioritize, and plan conservation interventions to boost options for the long-term conservation of Hoolock Gibbons. The project will help Hoolock Gibbon conservation by increasing knowledge on the distribution and relative abundance of this species in Myanmar. It will also identify major threats to gibbon populations in Myanmar and raise awareness among stakeholders regarding conservation needs for the species.

To ensure sustainability of project outcomes, international specialists in the project support national and local scientists and counterparts in gibbon survey methods so that they can conduct the surveys themselves.

1.2 Survey areas

The Status Review began in November 2008 with a survey and training conducted in the Southern Rakhine Yoma, Rakhine State (Report No. 1). Following that, the project Field Team surveyed further areas in central and southern Rakhine Yoma in December 2008 (Report No. 2); in the Sawlaw region of Kachin State, northeast Myanmar, in January 2009 (Report No. 3); in the middle and upper watershed areas of Mali Hka river in Kachin State, northern Myanmar, in February and March 2009 (Report No. 4); in north-central and north-east Rakhine Mountain Range (*Yoma*) in April and May 2009 (Report No. 5); in Nagaland around Saramiti mountain in October and November 2009 (Report No. 6); in Htamanthi Wildlife Sanctuary and the Chindwin Lowlands in December 2009 (Report No. 7); in and around Indawgyi Lake Wildlife Sanctuary in Kachin state in January 2010 (Report No. 8); in the Gangaw Taung Range of Kachin State in January and February 2010 (Report No. 9), and; in the Wusut area of north-central Mai Hka watershed, north-east Kachin state in March and April 2010 (Report No. 10).

Fig. 1 provides the overview location of field survey sites. The regions are covered by primarily evergreen lowland and mountain forests, and were selected based on published records and a workshop of national and international experts in September 2008. In Myanmar, sites west of the Chindwin river are within the range of the Western Hoolock Gibbon (*Hoolock hoolock*) and those between the Chindwin and Salween rivers fall within the range of the Eastern Hoolock Gibbon (*Hoolock leuconedys*). The current report is from the Khe Shor Ter area of northern western Karen State, in the Karen-Kahyin Hills, which is in the southern extent of the known range of the Eastern Hoolock. KESAN has been working in this area for some time and is familiar with the geography and local communities. The site was selected based on their previous experience of anecdotal records of gibbons, regular hearing of gibbon calls and direct observations.

Field studies were conducted over two weeks in April 2010. During the Khe Shor Ter survey, the team also recorded interview and incidental records of other mammals, birds and some reptiles and amphibians.

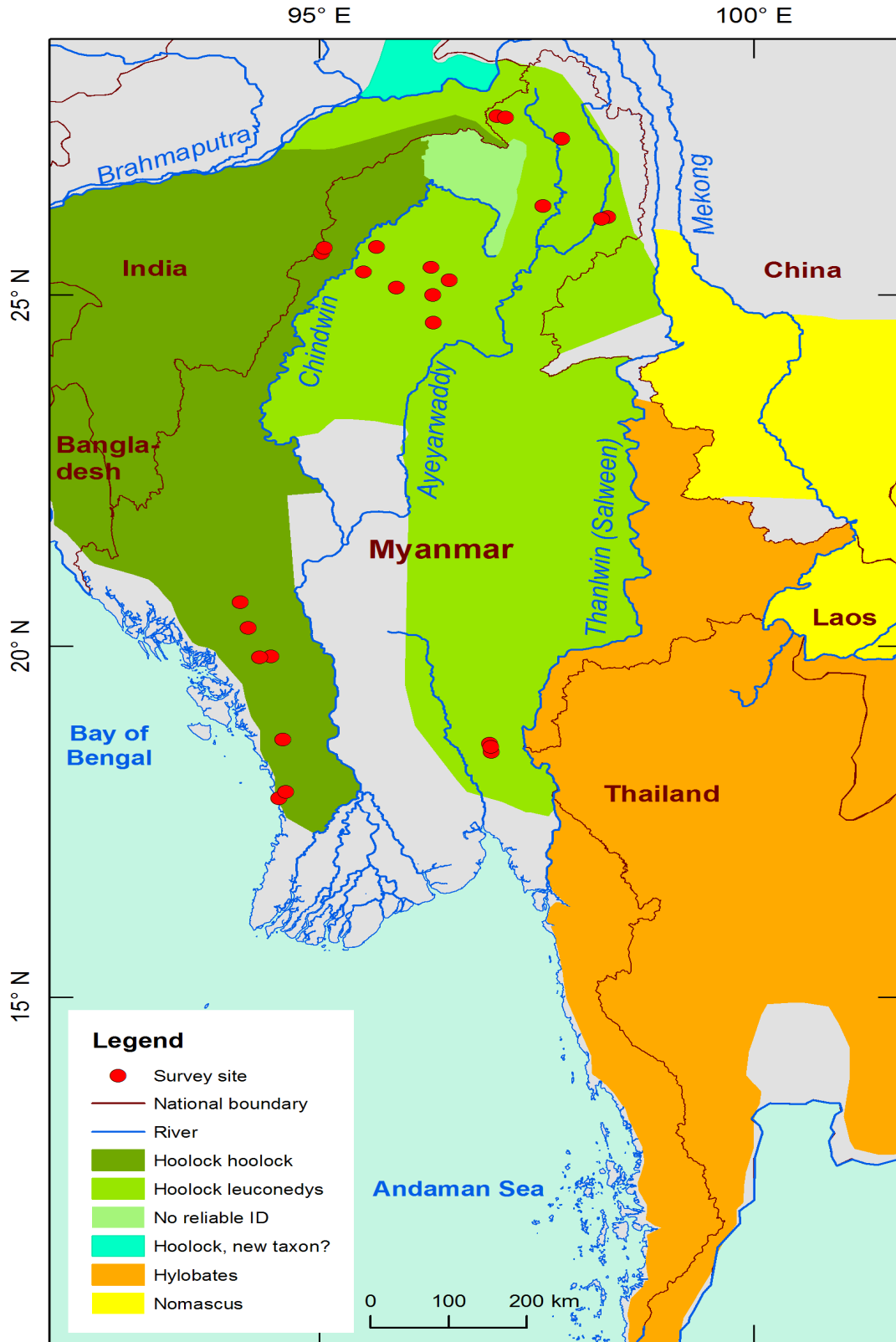


Fig 1. Field Sites included in the Myanmar Hoolock Gibbon Conservation Status Review. Source: Geissmann *et al.* (in prep)

2. Materials and methods

2.1 Gibbon surveys

Field survey techniques most suitable to estimate densities of gibbon populations are variants of the fixed point method, during which the loud morning songs of the gibbons are monitored from fixed listening points (Brockelman and Ali, 1987; Brockelman and Srikosamatara, 1993). The methods described below are based on this technique and have been standardised over all surveys under the Myanmar Hoolock Gibbon Status Review.

In order to facilitate comparison of our results to those of the earlier gibbon surveys in Mahamyaing Wildlife Sanctuary, Sagaing division, Myanmar (Brockelman, 2005; Gibbon Survey Team, 2005), we adopted the same auditory survey method as far as possible.

Listening posts were about 400-500 m apart and located on hilltops in order to enable the survey participants to hear gibbons from as many directions as possible. Surveyors had to leave the camp before dawn in order to arrive on the listening posts before 05:30 am. Listening for gibbon songs was carried out daily from at least 05:30 am to 10:30 am.

Each listening post was manned by at least two surveyors. On the listening posts, watches of the surveyors were synchronized with the GMT of the GPS. Time, compass direction, estimated distance, and type of all gibbon songs were recorded on a field form (Appendix 1). Compass bearing and distance estimates were checked by two surveyors. Song types included (1) solo song bouts, (2) duets with two singers, (3) duets with more than two singers, (4) duets with unknown number of singers. Hoolock song bouts have an average duration of 15-20 min (Feeroz and Islam, 1992; Gittins and Tilson, 1984; Lan *et al.*, 1999; Tilson, 1979). If a song interval (silence) was longer than 5 minutes, the calls after the interval were recognised as a new song bout.

In addition to gibbon song data, surveyors also recorded any evidence for hunting (hunters, gunshots, traps, snares), evidence for other primates or other rare animal species, and gibbon sighting data. Birds and other animals were surveyed ad hoc while on the listening posts and when travelling to and from the survey sites.

2.2 Mapping and density determination

On completion of the survey, the times, directions and estimated distances of gibbon songs from each day were plotted and triangulated on graph paper. Density of gibbon groups was estimated based on the triangulated results. Temporal overlap in songs or song bouts produced within short intervals from different locations helped to identify different groups, and songs that mapped more than 500 m apart were also assumed to be by different groups. Comparing song times and estimated locations of singing gibbons recorded from different listening posts was used to identify song data referring to the same groups.

Although songs of wild gibbon can often be heard over distances well exceeding 1 km, gibbons singing behind hills are often estimated to be further away than 1 km. Furthermore, different gibbon groups beyond 600 m from the listener are more difficult to be distinguished than groups singing at closer distances. Moreover, if the call comes from behind a physical feature it is possible that echo from surrounding hills will confuse the direction or the distance; groups may sound much farther away and in a different direction than reality. Also, if one group calls from close to the listener it may be difficult to locate more distant groups calling at the same time.

As a result, gibbon densities were estimated using a 0.6 km and a 1 km listening radius. Earlier gibbon surveys in Mahamyaing Wildlife Sanctuary, Sagaing division, Myanmar revealed that the 0.6 km radius consistently produced higher density estimates than the 1 km listening radius (Brockelman 2005; Gibbon Survey Team 2005).

Average group sizes for Hoolock Gibbons have been reported by Gittins and Tilson (1984) as 3.2 in Assam ($n = 24$ groups) and 3.5 in Bangladesh ($n = 7$ groups). In our analyses we will assume an average group size of 3.3 individuals, which is the approximate mean of the above two estimates. Of hoolock groups we were able to observe and of which we were able to determine the group size, we used the observed value instead of the average value to calculate density estimates.

2.3 Interview survey

Interviews with local residents and hunters were used to obtain a village profile on livelihoods and natural resource management with an emphasis on forest use, and to understand the distribution and status of gibbons, as well as to gauge direct threats. Both structured and unstructured interview were used to conduct these interviews. Interviews were conducted with four villagers in four different villages. The interviews focused mostly on the gibbon but other mammals, birds, reptiles and amphibian were also included. The interviews took at least 40 minutes per person. The questions were designed to obtain data about each species: their population;

their local status in terms of the past, present, and future; their ecological behaviour and ecological niche; their breeding season; and the types of threats, both direct, and indirect, that each species faces. Questions were also asked about the wildlife trade, human animal conflict and habitat loss. Where possible, dates were identified. Questions were also asked about methods employed to kill or capture the animals, and what trade routes were used.

3. Survey details

3.1 Itinerary

The survey lasted from 3 to 23 April, excluding travel time to and from the survey location. The itinerary is provided in Table 1.

Table 1. Survey itinerary. This itinerary does not include the survey team's travel time to and from the survey location.

Date	Activity	Days
3 April 2010	General meeting villagers from four villages and local leaders	1
4 April 2010	Prepared and collected food/rice for the field Survey	1
5 April 2010	Recruiting team members, porters and cooks	1
6 April 2010	Meeting team members and local leaders	1
7 April 2010	Training	1
8 - 9 April 2010	Walk to the field survey site	2
10 -13 April 2010	Conducting survey site FS1	4
14 -17 April, 2010	Conducting survey site FS2	4
18 - 21 April, 2010	Conducting survey site FS3	4
22 - 23 April, 2010	Walk back to the village	2
Total days		21

3.2 Site description

The climate at the site is monsoonal, comprising three seasons which are summer (March to May), rainy season (June to October) and winter (November to February). The average annual rainfall is estimated about 2,000 mm to 2,500 mm, and annual temperature from 5 to 28 degrees Celsius (°C). Humidity can be up to 80%, and is highest during the rainy season.

The forest was the same at all three Field Sites, being tropical evergreen forest type, although in the eastern part of this forest the lower elevations show some conifers. The forest comprises many giant trees in the emergent and canopy layers. The forest has at least five layers; emergent trees, canopy and sub-canopy layer, lower canopy and ground layer. The emergent trees reach up to possibly 40 meter high and approaching 4.5 m diameter. Woody vines are very abundant. The forest is rich in rattan, and the forest is generally very thick and dense. Only a small percentage of sunlight reaches the forest floor. Streams are very clean, with many kinds of fish and amphibian species visible. There are also many kind of shrubs as ginger and herbs like wild banana (musa).

This forest appears to never have been disturbed, and is very intact. There is no sign of deforestation or human activity, including no signs of logging, hunting and snaring, camps, collection of other forest products. No litter was seen. According to villagers, very few people visit the area each year, and for this reason little is known about this forest.

3.3 Survey approach

The field survey was led by a team of four KESAN staff, and nine other participants from four villages in the survey region, including forest experts and village leaders.

Three temporary camps were established at the threes survey sites (Fig. 2) and four listening points were selected from which gibbon calls were monitored during five consecutive mornings. All participants were male,

and some were formerly hunters; recruitment of hunters was intended to make use of local knowledge and also to create a conservation ethic in those most familiar with local wildlife and ecology.

3.4 Listening Post Locations

Camps were established at each Field Site, mostly close to streams and at least 300 meters away from the listening posts. The listening posts were located at higher elevations on the mountain top or the mountain ridge. Some listening posts were more windy than others. Others were placed under thick canopy where they didn't get much sunlight at the ground levels.

Table 2 . Listening Post locations and survey effort

Listening post	Listening post coordinates	Survey dates, April 2010	Total hours spent at listening post
<i>Field Site #1: Htee Khaw Lay Ko</i>			
LP1.1	N18.57282° E96.97328°	10 Apr	5h, 5h, 5h, 5h
LP1.2	N18.56867° E96.97422°	11 Apr	5h, 5h, 5h, 5h
LP1.3	N18.56932° E96.97218°	12 Apr	5h, 5h, 5h, 5h
LP1.4	N18.57707° E96.97222°	13 Apr	5h, 5h, 5h, 5h
<i>Field Site #2: Htee Ler Kee</i>			
LP2.1	N18.61715° E96.95550°	14 Apr	4h30', 4h30', 4h30', 4h30'
LP2.2	N18.61207° E96.95733°	15 Apr	5h, 5h, 5h, 5h
LP2.3	N18.61688° E96.96317°	16 Apr	5h25', 5h25', 5h25', 5h25'
LP2.4	N18.61853° E96.96283°	17 Apr	5h25', 5h25', 5h25', 5h25'
<i>Field Site #3: Plo Doh Kee Creek</i>			
LP3.1	N18.50100° E96.97583°	18 Apr	5h, 5h, 5h, 5h
LP3.2	N18.49848° E96.97267°	19 Apr	5h, 5h, 5h, 5h
LP3.3	N18.49587° E96.97817°	20 Apr	4h30', 4h30', 4h30', 4h30'
LP3.4	N18.49988° E96.98017°	21 Apr	5h, 5h, 5h, 5h
Total			213.5 h

3.5 Weather

During the survey time the average maximum temperature during the day was approximately 25 C° with an overnight average minimum of 15 C°. Most of the survey days were sunny and only a few hours were cloudy. Some survey days were very windy in some of the listening posts but the majority of the weather experienced at the listening posts was sunny with clear sky. The humidity rate in this forest was low and most of the time the weather was good throughout the day.

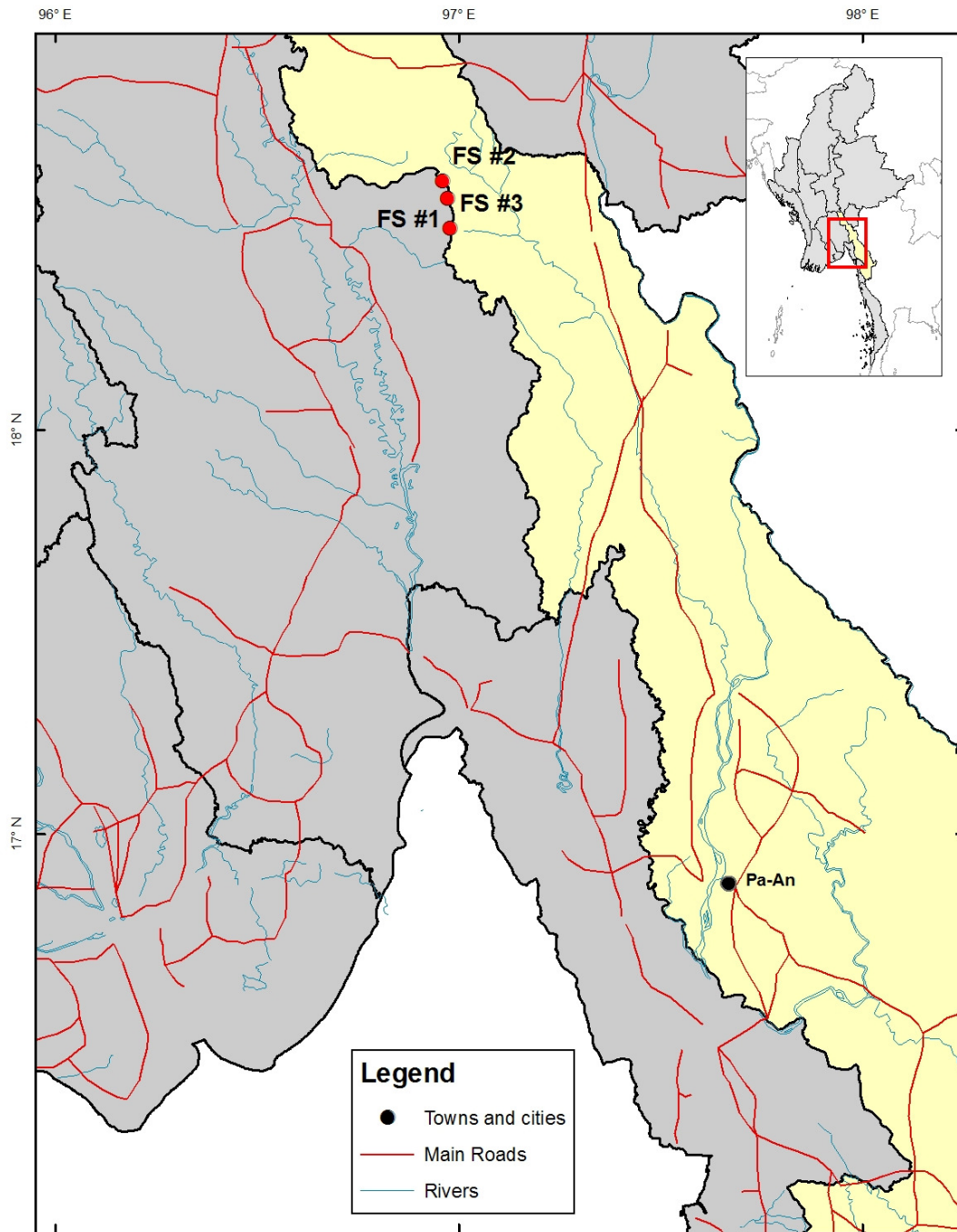


Fig 2. Map showing location of the field sites in Myanmar. Note: Karen State is indicated in light yellow.

4. Results: Gibbons

4.1 Interview results

According to interviews in four villages, there about 28 gibbon groups in the survey region, comprising around 81 individuals; seven groups around Htee Mu Plaw village, six groups around Baw Lay Der, eight groups around Shen Hta, and seven groups around the Pay Lay Pu.

Many respondents said that gibbons frequently come close to the villages and farm areas as they are not harmed by the villagers.

4.2 Aural evidence

Gibbon calls were heard on Days 2 and 3 at FS1, on Day 3 only at FS2 and on Days 1 and 3 at FS3. In total, eight records were made from FS1, 15 from FS2 and 21 from FS3. The full list of gibbon records is provided in Appendix 1. Of all the records, the earliest call was at 05:52 – 06:00 (FS3, LP2, 18 April) and the latest call was at 10:15 -10:25 (FS2, LP4, 16 April).

In addition, during the travelling period from 8-9 April, the team heard three groups of gibbon calling from up to 1.5 km away at Htee Mu Klo Stream, west of Htee Mu Plaw Village. Also during the travel on 22-23 April, when coming back from the listening post to the villages, there were two groups of gibbon calls heard at the southern part of Khe Shor Ter Mountain.

Also of note is a record from a separate trip made by another KESAN team at the beginning of April 2010. Saw Wee travelled to the southern range of Khe Shor Ter Mountain and heard calls from five gibbon groups, mainly located at Khen Pa Mountain (Mudraw district) and Yoe Mu Kyo, Paw Baw Ko, Thu Plinkoh mountain and Ter Pow Lay mountains (near the border between Mudraw and Kler Lwe Htu districts). These mountain forests may be categorized as broadleaf evergreen forests. Location data is incomplete for these records, but that which is available is presented in Table 3.

Table 3. Incidental gibbon records from southern section of Khe Shor Ter mountain, 2010

Date & Time	Name of Places & GPS Waypoints	Forest Type	Number of Sightings
Kler Lwee Htoo (Nuanglinbin) District			
17 Mar 2010 3:38:16PM	Lerkhorday, Yo Mu Kyo area N18.07469° E97.07137° Elevation: 734 m	Mountain evergreen forest	
31 Mar 2010 3:46 pm	At the forest near Tweetheueklo stream near Thuplinkoh mountain N17.80899° E97.17173° Elevation: 1038 m	Mountain evergreen forest	Saw Sha Say saw three Hoolock Gibbons in the trees; "two brown and one black"
Mutraw (Papun) District			
1 May 2010 8:18:51AM	Mowlohklo stream, near Khenpa Mountain N18.13284° E97.31095° Elevation: 591 m	Mountain evergreen forest	

4.3 Direct sightings

Eighteen gibbons from five groups were seen directly, comprising eight adult males, seven adult females, and three juveniles. Most of the observed animals were initially identified by calls, then observed either resting or feeding:

1. Group of three (FS1, LP2, 12/4/2010): Two black, one brown, all adult, producing calls like playing or seeing something strange. The animals did not see the observers but moved away after a while.
2. Groups of three (FS2, LP3, 16/4/2010): Three black and one brown, all adult, calling, observed for about 10 minutes. The gibbons were on a fig tree, bouncing up and down on branches.
3. Group of three (FS3, LP2, 18/4/2010): One adult male, one adult female, and one black juvenile, observed after the animals were heard calling. The gibbons moved away after only a short time.
4. Group of four (FS3, LP2, 20/4/10): Two adult males and two adult females, observed during about 20 minutes.
5. Group of five (FS3, LP3, 20/4/10): One adult male, two adult females, and two male juveniles. The team members observed the animals for about 30 minutes, until they stopped calling. The gibbons then saw the observers and came toward them for a closer look.

Table 4. Gibbon density estimates for the Htee Khaw Lay Ko survey area (FS1).

	Listening radius							
	0.6 km				1.0 km			
	LP1	LP2	LP3	LP4	LP1	LP2	LP3	LP4
Gibbon groups	1	1	1	1	1	1	2	3
Listening area (km ²)	1.13	1.13	1.13	1.13	3.14	3.14	3.14	3.14
Unsuitable habitat (%)*	5	5	5	5	5	5	5	5
Suitable habitat (km ²)	1.07	1.07	1.07	1.07	2.98	2.98	2.98	2.98
Gibbon groups / km ²	0.93	0.93	0.93	0.93	0.34	0.34	0.67	1.01
Mean gibbon groups / km ²	0.93				0.59			
Mean gibbon individuals / km ²	3.07				1.93			

* Estimate, based on field observation and Google Earth imagery

Table 5. Gibbon density estimates for the Htee Ler Kee survey area (FS2).

	Listening radius							
	0.6 km				1.0 km			
	LP1	LP2	LP3	LP4	LP1	LP2	LP3	LP4
Gibbon groups	1	2	2	4	3	3	5	6
Listening area (km ²)	1.13	1.13	1.13	1.13	3.14	3.14	3.14	3.14
Unsuitable habitat (%)*	5	5	5	5	5	5	5	5
Suitable habitat (km ²)	1.07	1.07	1.07	1.07	2.98	2.98	2.98	2.98
Gibbon groups / km ²	0.93	1.86	1.86	3.72	1.01	1.01	1.68	2.01
Mean gibbon groups / km ²	2.09				1.42			
Mean gibbon individuals / km ²	6.91				4.70			

* Estimate, based on field observation and Google Earth imagery

Table 6. Gibbon density estimates for the Plo Doh Kee Creek survey area (FS3).

	Listening radius							
	0.6 km				1.0 km			
	LP1	LP2	LP3	LP4	LP1	LP2	LP3	LP4
Gibbon groups	6	5	5	6	8	8	9	8
Listening area (km ²)	1.13	1.13	1.13	1.13	3.14	3.14	3.14	3.14
Unsuitable habitat (%)*	5	5	5	5	5	5	5	5
Suitable habitat (km ²)	1.07	1.07	1.07	1.07	2.98	2.98	2.98	2.98
Gibbon groups / km ²	5.58	4.65	4.65	5.58	2.68	2.68	3.02	2.68
Mean gibbon groups / km ²	5.12				2.76			
Mean gibbon individuals / km ²	16.89				9.12			

* Estimate, based on field observation and Google Earth imagery

4.4 Density estimates

In the following estimates, the aural evidence and the direct sightings are combined. Results are presented in Table 4 (FS1), Table 5 (FS2) and Table 6 (FS3).

Gibbon group songs were heard from within a listening radius of 1 km and 0.6 km. Songs were heard from all Listening Posts, though not on all days (Appendix 2).

The lowest density was at FS1, which had (at least) two groups within 0.6 km of the LPs, and three groups within 1 km. The highest density was at LP3, which had (at least) eight groups within 0.6 km of the LPs, and nine groups within 1 km.

All gibbons directly sighted during the study were located within the 0.6 km radius of LPs.

The highest density of groups within the 0.6 km listening radius was at FS3, with a mean of just over 5 per km² across the four listening posts. This site was the furthest from permanent settlement, and from the easiest point of access into the forest. The lowest mean density of groups within the 0.6 km listening radius was at FS1, with a mean of less than one group per km² across the four listening posts.

At all Field Sites, estimated densities were lower within the 1 km listening radius than the 0.6 km radius, which accords with findings from other survey locations investigated during the Myanmar Hoolock Gibbon Conservation Status Review.

Combining all evidence, we estimate that a total of 18 to 21 groups were present in the survey area (up to the 1 km listening radius). Based on the estimated number of groups identified by the listening teams, individuals totalled between 55 and 69.

4.5 Local beliefs

Local people report that gibbons call the most for a period of three days before and three days after the 'dark moon', over three days of the 'half moon' (waxing and waning), and over three days of the full moon. Villagers state that gibbons rarely call in the evening, and generally only call when they already full after eating. They also make sounds when they see some big animals or some things that scare them. The gibbons reportedly sometimes call when one of their members dies, and the local people believe that the animals are conducting a 'funeral ceremony'. At this time, the gibbons all start into full song in unison, without the preliminary whoops usually observed with Hoolock song.

Interview respondents also stated that in the wild, an adult male will help the pregnant female to give birth by holding the stomach very tight. However, sometimes the older females also come to help. Sometime males help carry juveniles, although this is usually done by females.

5. Results: Other Species

5.1 Birds

Table 7 provides a list of bird species encountered during the survey through direct sightings. A total of 16 bird species were sighted and recorded, including the great hornbill which is listed as Near Threatened by the IUCN. The remaining 15 species are all Least Concern.

Several birds were mentioned in interviews, but due to the insufficiency of proper descriptions they could not be identified to species. This information therefore was not used to draw up the species list in Table 7.

5.2 Mammals

Table 8 provides a list of the mammals encountered during the survey or reported to occur in the survey area. We interviewed four villagers from four different villages.

A total of 32 species were recorded from interview and field work during this survey.

One species listed as Endangered by the IUCN – Dhole – is confirmed from a visual sighting. Two Vulnerable species – Stump-tailed Macaque and Eastern hoolock Gibbon – were also observed. The presence of three further Endangered species is suggested by tracks – Sunda Pangolin, Chinese Pangolin and Tiger – while one additional Endangered species – Phayre's Langur – was only recorded during interview. Tracks of three further Vulnerable species were also recorded; Himalayan Black Bear, Malayan Sun Bear and Clouded Leopard.

Two unidentified mammals are noted here. One was otter faeces which could not be identified to species. A second was a langur species noted from interview but not identified.

Table 7. Birds recorded in the survey. Note: In the following table, bird species are listed by family.

Family	Common name	Scientific name	Threat status
Phasianidae	Rufous-throated Partridge	<i>Arborophila rufogularis</i>	LC
	Red Junglefowl	<i>Gallus gallus</i>	LC
	Silver Pheasant	<i>Lophura nycthemera</i>	LC
	Grey Peacock-Pheasant	<i>Polyplectron bicalcaratum</i>	LC
Charadriiformes	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC
Strigidae	Brown Wood-Owl	<i>Strix leptogrammica</i>	LC
Bucerotidae	Great Hornbill	<i>Buceros bicornis</i>	NT
Ramphastidae	Great Barbet	<i>Megalaima virens</i>	LC
	Blue-throated Barbet	<i>Megalaima asiatica</i>	LC
Columbidae	Barred Cuckoo-Dove	<i>Macropygia unchall</i>	LC
	Emerald dove	<i>Chalcophaps indica</i>	LC
	Thick-billed Green-Pigeon	<i>Treron curvirostra</i>	LC
	Mountain Imperial-Pigeon	<i>Ducula badia</i>	LC
Sittidae	Chestnut-vented Nuthatch	<i>Sitta nagaensis</i>	LC
Muscicapidae	Slaty-Backed Forktail	<i>Enicurus schistaceus</i>	LC
Timaliidae	Lesser Necklaced Laughingthrush	<i>Garrulax monileger</i>	LC

5.3 Reptiles

Table 9 lists the reptiles recorded during the survey, both of which were turtles. The Empress Tortoise, listed as Vulnerable by the IUCN, was sighted during the survey. The presence of another species listed as Endangered, the Big-headed Turtle, was mentioned during interviews, and seems plausible based on what is known about its distribution and habitat. The survey team failed to identify another tortoise species mentioned by villagers due to insufficient information.

5.4 Amphibians

Table 10 lists amphibians recorded during the survey, which comprise three frog species. All are listed as Least Concern by IUCN.

Table 8. Mammals recorded in the survey. In the following table, mammal species are listed by order and family.

Order	Family	Species Common name (<i>Scientific name</i>)	Evidence					Threat status
			Visual	Aural	Fae-ces	Tracks	Inter-view	
Pholidota	Manidae	Sunda Pangolin (<i>Manis javanica</i>)				+	+	EN
		Chinese Pangolin (<i>Manis pentadactyla</i>)				+	+	EN
Primates	Cercopithecidae	Assamese Macaque (<i>Macaca assamensis</i>)	+				+	NT
		Stump-tailed Macaque (<i>M. arctoides</i>)	+				+	VU
		Phayre's Langur (<i>Trachypithecus phayrei</i>)					+	EN
	Hylobatidae	Eastern Hoolock Gibbon (<i>Hoolock leuconedys</i>)	+				+	VU
Carnivora	Canidae	Dhole (<i>Cuon alpinus</i>)	+			+	+	EN
	Ursidae	Himalayan Black Bear (<i>Ursus thibetanus</i>)				+	+	VU
		Malayan Sun Bear (<i>Helarctos malayanus</i>)				+	+	VU
	Mustelidae	Yellow-throated Marten (<i>Martes flavigula</i>)	+				+	LC
		Hog Badger (<i>Arctonyx collaris</i>)				+	+	NT
	Viverridae	Binturong (<i>Arctictis binturong</i>)					+	VU
		Common Palm Civet (<i>Paradoxurus hermaphroditus</i>)					+	LC
		Masked Palm Civet (<i>Paguma larvata</i>)				+	+	LC
	Felidae	Leopard (<i>Panthera pardus</i>)		+		+	+	NT
		Tiger (<i>Panthera tigris</i>)				+	+	EN
		Clouded Leopard (<i>Neofelis nebulosa</i>)				+	+	VU
Artiodactyla	Suidae	Eurasian Wild Pig (<i>Sus scrofa</i>)				+	+	LC
	Cervidae	Sambar (<i>Rusa unicorn</i>)					+	VU
		Red Muntjac (<i>Muntiacus muntjac</i>)				+	+	LC
		Fea's Muntjac (<i>Muntiacus feae</i>)						DD
	Bovidae	Gaur † (<i>Bos frontalis</i>)				+	+	VU
		Chinese Serow (<i>Capricornis milneedwardsii</i>)	+				+	NT
	Rodentia	Sciuridae	Black Giant Squirrel (<i>Ratufa bicolor</i>)	+	+			+
Pallas's Squirrel, (<i>Callosciurus erythraeus</i>)			+	+				LC
Northern Treeshrew (<i>Tupaia belangeri</i>)			+	+				LC
Histicidae		Malayan Porcupine (<i>Hystrix brachyura</i>)				+	+	LC
		Brush-tailed Porcupine (<i>Atherurus macrourus</i>)				+	+	LC

† Indian Bison (*Bos gaurus*) according to www.iucnredlist.org

Table 9. Testudines (Reptiles) recorded in the survey.

Family	Species		Evidence		Threat status
	Common name	Scientific name	Visual	Interview	
Testudinidae	Impressed Tortoise	<i>Manouria impressa</i>	+	+	VU
Platysternidae	Big-headed Turtle	<i>Platysternon megacephalum</i>		+	EN

Table 10. Anura (Amphibians) recorded in the survey.

Family	Species		Evidence		Threat status
	Common name	Scientific name	Visual	Interview	
Megophryidae	n/a	<i>Leptobranchium chapaense</i>	+	+	LC
Ranidae	n/a	<i>Amolops marmoratus</i>	+	+	LC
	Large-headed Frog	<i>Limnonectes kuhlii</i>	+	+	LC

6. Description of villages and agricultural systems

6.1 Background

The temporary villages found in the survey area are originally from the ethnic Karen communities displaced by the decades-long civil war between the Karen National Union and the State Peace and Development Council (SPDC) of the military dictatorship of Myanmar. Most of the inhabitants originated from the lower valley of the Yozalin River who were once highly dependent on paddy-rice farming until the British colonial period. Produce from the farms was plentiful then and people are contended with supplemental diet procured from the forest. The civil war turned farmlands into battle fields. Fearing of being caught in the cross-fire between the ethnic KNU and SPDC forces, the villagers abandoned their homes, farms and livelihoods and now seek refuge in the forest. Many, especially women and children, get sick from malaria and other chronic diseases, exacerbated by malnutrition, stress and exposure to the elements.

Without permanent rice paddy land, villagers now have to clear areas of the forest for dry-rice cultivation, on which they are highly dependent. However, harvests from these clandestine farms are frequently insufficient owing to the small areas cultivated for fear of being detected by the SPDC forces. Biodiversity of the forest has greatly been affected by the presence of internally displaced Karen villagers, although they have no other means of survival but to clear the forest. Such behaviour is unavoidable, and villagers act in the full knowledge that what they are doing is detrimental to the health of the forest. The aspire for peace so they can return to their lowland villages and continue their traditional farming practices.

Many of the villagers practice animism, while others profess the Christian faith.

6.2 Livelihoods

Agriculture: Farming and livestock breeding are the people's main source of livelihood. There are no other means of supplementing their low income from agriculture, thus resulting in food insecurity, malnutrition and increased vulnerability to diseases especially among women, children and elderly. In the event of raids, the SPDC destroy crops and burn down dwellings. This forces people deeper into the forest.

Perennials: Villagers are highly dependent on rice farming (both hill and paddy), other crops like sweet corn, potato, yam, chilli, eggplant and herbs with medicinal value are also grown along dikes and on peripheries of rice paddies.

Livestock: Only a few of the villagers have the means to acquire raise livestock like cattle, buffalo and pigs, which are sold occasionally for much needed cash.

Timber Extraction: Generally, all houses and structures are made of bamboo and broad leaves procured from the forest and peripheral areas. Cutting of trees for timber used in construction or for trading is not practiced as the villagers are well aware of the dire consequences of forest degradation.

Wildlife Poaching: Though not full-time hunters, poaching of certain species of fauna like tigers, otters, pangolins, leopards, gaur, sambar and bear has, to a certain degree, exacted its toll on the biodiversity and ecological balance of the forest. These animals are hunted occasionally only after the planting and harvest

seasons. These animals are mainly hunted for their horns and antlers, and innards, which are believed to possess healing powers.

Non-timber Forest Product Harvesting: Nuts, mushrooms, oils, vegetables, seeds and medicinal plants are also collected.

Other Income from Labour: There has been no other kind of opportunity for people to sell labour for wages. The area is now inhabited by people displaced by the ongoing civil war who make a living from subsistence farming.

Wildlife Conflicts: Wild pigs raid crops occasionally. Tigers reportedly prey on domestic cattle and buffaloes at least once or twice per year. Leopard and dhole eat domestic pigs and goats.

Development Initiatives: There have been no project or development initiatives taking place in the area. Most people are dependent on their annual crops. There has been no employment opportunity for wages or salaries apart from teachers. Due to the civil war the villagers could not go to the city to sell their produce in markets and buy basic household necessities.

Threats to Forests and Habitat: Most often, forest fires originate from along the SPDC car roads when they rid grasses and bushes during the hot and dry months. Unattended burning of garbage by the SPDC also spreads fire into the forest. Due to the presence of landmines planted by the SPDC, people don't dare to extinguish the fire as they may lose a leg or even die from the mines. There were also rare instances when forest fires were caused by poachers and travellers discarding live cigarette butts, and from embers from torches at night. People are really careful about accidental fire as the penalty/punishment can be severe if caught by the village leader. On rare occasions, fires from swidden farm preparation spread to the forest area. It is the full responsibility of the concerned farmer and nearby villagers to extinguish it before it spreads to and engulf the forest.

Threats to Wildlife: Poaching has been the main serious threat to some endangered species. Heavy artillery and landmines used by both sides in the ongoing war reportedly cause serious injuries and casualties on wildlife. Based on accounts of interviews and carcasses and horns shown by the villagers, tigers, gaurs and bears were among the casualties of the armed conflict. One interviewee said that he witnessed a tiger seriously injured die a few hours after it stepped on a landmine.

6.3 Mythical history

Called “ther yu pwa” by the Karen, the gibbon has a special and meaningful place in the forest. The gibbon's presence in the forest brings not only physical and aesthetic beauty of diversity, but also spirituality to the people whose life are closely intertwined with the forest and natural resources. Its call, antics and agility in the forest canopy brings life and joy to anyone who happens to chance upon this wonderful mammal. Its death brings anguish to the whole place and the seven ridges and seven valleys in the local area reverberate in mourning for the great loss.

This gentle mammal is protected by the Karen people since time immemorial. It takes time for this animal to successfully produce an offspring after several bouts of mating. Sometimes, the mother dies giving birth. Besides, it takes a long time for the juvenile to mature. It does not forage on the villagers' crops or steal food from the community. Aside from its agility and antics, the gibbon would sometimes play with people thus endearing them more to the villagers. The beautiful calls is always been anticipated with excitement. The gibbon is also an effective seeds disperser thus contributing to the maintenance of the balance of life in the forest ecological system.

7. Threats and opportunities for gibbon conservation

7.1 Direct threat

Non-Karen hunt the Hoolock Gibbon just for fun, or to show their hunting prowess. Some people kill them for meat. There were times that gibbons got killed accidentally. For those who are not familiar with the gregarious behaviour of the mammals, they get harassed or intimidated or annoyed, thus resorting to killing the animal.

7.2 Indirect threats

Forest fire is probably the main threat to gibbons in the study area. Under rare conditions, natural wildfire does occur in the forest. Fires caused by humans seldom happen as the forest is moist most of the time and if ever it does occur the fire dies out at the edge before starting consuming the dense forest. However, forest fires do occur from the SPDC army who burn roadsides and around posts of grasses and bushes for better visibility.

7.3 Deforestation

The civil war and instability are the major causes of involuntary displacement of villagers into the Khe Shor Ter forest area. Abandoning their homes, properties, farms and livelihoods, the internally displaced population have to farm parts of the pristine forest causing ecological degradation. Although they feel really bad of clearing the forest which their ancestors had protected for generations, they have no other choice for survival. Their ancestors had protected this forest as a biodiversity site for preservation. The displaced Karen have found no alternative means of survival so as to spare the forest from subsistence farming.

7.4 Opportunities

The forest still maintains high diversity of both floral and faunal species, as has never been explored or exploited by the outside world. Through knowledge and practices handed down from their ancestors, the Karen people utilized the forest and its resources well so as not to cause further damage on the various ecological systems that support all life. Without the permission and assistance of the community, researchers will have a hard time exploring and conducting surveys in the forest for its conservation.

8. Conclusion

This report details the findings from the first Hoolock Gibbon survey in the Northern Eastern Karen State of Burma. The area is located in the Kayah-Karen Mountain forest specifically at the Nattuang Range, in good broadleaf evergreen hill forest within the known range of the Eastern Hoolock Gibbon.

The study estimates the densities of gibbon populations in three study sites. These three study areas are located in the same region and the forests between them are contiguous and in very good condition. The lowest estimated densities were from Field Site 1 (FS1) at Htee Khaw Lay Ko, ranging from 0.59 groups per km² at 1 km listening radius to 0.93 groups/km² at 0.6 km listening radius. The highest density was at Field Site 3 (FS3), Plo Doh Kee Creek, where the respective estimates were 2.76 groups/km² and a remarkable 5.12 groups/km².

The average estimated density across the whole area is 1.59 groups/km² or 5.25 individuals/km² at 1 km listening radius, and 2.17 groups/km² or 8.96 individuals/km² at 0.6 km listening radius. This estimated density is comparable to that of an earlier study for the Hoolock Gibbon in Mahamyaing Wildlife Sanctuary, Saging Division (Brockelman, 2005; Gibbon Survey Team, 2005) that reported 2.3-1.8 groups/km².

In total, 32 species of mammal were recorded from interview and field work during this survey. One species listed as Endangered by the IUCN – Dhole – is confirmed from a visual sighting, while two Vulnerable species – Stump-tailed Macaque and Eastern hoolock Gibbon – were also observed.

A total of 16 bird species were sighted and recorded, including the great hornbill which is listed as Near Threatened by the IUCN, as well as two testudinidae species, one of which, the Impressed Tortoise was observed in the field. Three amphibian species were recorded from observations, and all are Least Concern.

The forest in the study area is still a good habitat for the Eastern Hoolock Gibbon and other wildlife, except in some places where it has been degraded due to swidden farming and other human economic activities for survival. The armed conflict has been the most threat to wildlife and biodiversity, though population would be able to recover with the cessation of the civil war.

The local people do not hunt the gibbon for food as it is prohibited in their culture. They hunt other animals occasionally for meat, but never for trade. However, outsiders hunt endangered species for their plumage, casks, horns, antlers and organs believed to possess medicinal values. Probably, they also hunt the gibbon and the great hornbill, especially the juveniles, for the pet trade. Hunting for trade and profit is a real threat to wildlife biodiversity especially on endangered and highly threatened species.

However, for gibbons the threat from hunting is very low compared to other parts of the country, and the area still harbors a healthy population of gibbons, along with other important mammal and bird species. Hunting generally has been a constant threat to maintain the healthy population of wildlife, and therefore should be strictly prohibited to outsiders and regulated by the locals. Education, information and campaign materials on conservation should be disseminated to raise the awareness of stakeholders on wildlife and biodiversity protection and conservation.

The survey area is among few remaining hill evergreen forests in Karen State which has not yet been badly degraded, and is also part of the watershed of the Sittaung and Yozalin mountain ranges. Urgent measures should be undertaken to prevent or stop human activities detrimental to the health of these biodiversity areas.

9. References

- Brockelman, W. Y. (2005). *Conservation of the hoolock gibbon (Hylobates: Hoolock leuconedys) in Mahamyaing Wildlife Sanctuary, Sagaing division, Myanmar*. Forest Department and Wildlife Conservation Society, Myanmar Program, 20 pp.
- 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 the tropical rain forest*, Alan R. Liss, Inc., New York, pp. 23-62.
- Brockelman, W. Y., and Srikosamatara, S. (1993). Estimation of density of gibbon groups by use of loud songs. *American Journal of Primatology* **29**: 93-108.
- Cox, M. J., Van Dijk, P. P., Jarujin Nabhitabhata and Kumthorn Thirakhupt (1998), *A photographic guide to: Snakes and other reptiles of Thailand and South-east Asia*. Asia Books, Bangkok, 144 pp.
- Feeroz, M. M., and Islam, M. A. (1992). *Ecology and behaviour of hoolock gibbons of Bangladesh*, MARC (Multidisciplinary Action Research Centre), Dhaka, Bangladesh, 76 pp.
- Francis, C. M. (2008). *A field guide to the mammals of Thailand and South-East Asia*. Asia Books, Bangkok, 392 pp.
- Geissmann, T., Ngwe Lwin, Saw Soe Aung, Thet Naing Aung, Grindley, M. and Momberg F. (in prep), Myanmar Hoolock Gibbon Conservation Status Review. Research report of the Myanmar Primate Conservation Program, Biodiversity and Nature Conservation Association (BANCA), Fauna & Flora International (FFI), and People Resources and Conservation Foundation (PRCF).
- Gibbon Survey Team (2005). *Final report on Mahamyaing Wildlife Sanctuary Gibbon Survey*. Forest Department and Wildlife Conservation Society, Myanmar Program, 38 pp.
- Gittins, S. P., and Tilson, R. L. (1984). Notes on the ecology and behaviour of the hoolock gibbon. In Preuschoft, H., Chivers, D. J., Brockelman, W. Y. & Creel, N. (eds.), *The lesser apes. Evolutionary and behavioural biology*, Edinburgh University Press, Edinburgh, pp. 258-266.
- Lan, D.-Y., Ma, S.-L., Li, S.-C., and Guo, G. (1999). [Timing of hoolock gibbon (*Hylobates hoolock*) songs in West Yunnan]. *Zoological Research* **20**(4): 273-277 (Chinese text, English summary).
- Robson, C. (2008). *A field guide to the birds of Thailand and Sout-east Asia*. Asia Books, Bangkok, 544 pp.
- Tilson, R. L. (1979). On the behaviour of the hoolock gibbons (*Hylobates hoolock*) during different seasons in Assam, India. *Journal of the Bombay Natural History Society* **76**: 1-16.

10. Appendices

Appendix 1: Field form (Call Record sheet, English version)

Gibbon Observation Sheet		FS # <input style="width: 30px;" type="text"/>	LP # <input style="width: 30px;" type="text"/>	
Observers		Date		
Time arrive LP		Time leave LP		
LP position / alt				
Call records				
Start Time	End Time	Bearing (°)	Distance (m)	Type*

* Type of call
A = solo song bout
B = Duet 2 singers
C = Duet more than 2 singers
D = Duet, unknown number

Weather						
Time	Sun	Cloud	Rain	Breeze	Wind	
06:00						
15						
30						
45						
07:00						
15						
30						
45						
08:00						
15						
30						
45						
09:00						
15						
30						
45						
10:00						
15						
30						
45						
11:00						
15						
30						
45						
12:00						
15						
30						
45						

Gibbon sighting data

Other mammals

Evidence of hunting

Appendix 2: All call records

#	FS_CODE	LP_CODE	DAY_NO	DATE	ST_TIME	EN_TIME	AZIMUTH	DIST_M	TYPE
1	FS1	LP1.1	Day 2	11/04/2010	08:01:43	00:08:23	354	1500	3>
2	FS1	LP1.1	Day 3	12/04/2010	09:54:30	09:51:00	130	500	Unk
3	FS1	LP1.2	Day 3	12/04/2010	09:54:00	09:58:00	100	50	3
4	FS1	LP1.3	Day 2	11/04/2010	07:30:00	08:00:00	30	1 km>	2>
5	FS1	LP1.3	Day 3	12/04/2010	09:54:00	09:55:00	105	150	2
6	FS1	LP1.4	Day 2	11/04/2010	08:01:43	08:25:00	10	1000	3>
7	FS1	LP1.4	Day 3	12/04/2010	06:25:10	06:44:05	30	1000	3>
8	FS1	LP1.4	Day 3	12/04/2010	09:50:08	09:57:40	140	400	3>

1	FS2	LP2.1	Day 3	16/04/2010	09:31:00	09:55:00	330	300	3>
2	FS2	LP2.2	Day 3	16/04/2010	07:30:00	07:36:00	100	600	3>
3	FS2	LP2.2	Day 3	16/04/2010	08:02:00	08:16:00	100	580	3>
4	FS2	LP2.2	Day 3	16/04/2010	09:10:00	09:35:00	80	550	3
5	FS2	LP2.2	Day 3	16/04/2010	09:30:00	09:54:00	335	400	3
6	FS2	LP2.3	Day 3	16/04/2010	07:32:00	08:29:00	120	550	4
7	FS2	LP2.3	Day 3	16/04/2010	08:00:00	08:19:00	135	1 km	2>
8	FS2	LP2.3	Day 3	16/04/2010	08:01:00	08:15:00	165	350	3
9	FS2	LP2.3	Day 3	16/04/2010	09:31:00	09:45:00	300	650	3>
10	FS2	LP2.4	Day 3	16/04/2010	08:00:00	08:15:00	100	500	3>
11	FS2	LP2.4	Day 3	16/04/2010	08:05:00	08:40:00	160	400	3>
12	FS2	LP2.4	Day 3	16/04/2010	09:30:00	09:56:00	290	500	3>
13	FS2	LP2.4	Day 3	16/04/2010	09:55:00	10:13:00	350	700	3>
14	FS2	LP2.4	Day 3	16/04/2010	10:12:00	10:20:00	360	1000	3>
15	FS2	LP2.4	Day 3	16/04/2010	10:15:00	10:25:00	5	800	3>

1	FS3	LP3.1	Day 1	18/04/2010	05:54:00	05:58:00	300	200	2
2	FS3	LP3.1	Day 3	20/04/2010	07:59:23	07:46:27	340	250	3
3	FS3	LP3.1	Day 3	20/04/2010	07:23:00	07:43:00	250	300	3
4	FS3	LP3.1	Day 3	20/04/2010	07:40:00	08:18:00	180	450	3
5	FS3	LP3.1	Day 3	20/04/2010	08:00:00	08:13:00	150	1000	2>
6	FS3	LP3.2	Day 1	18/04/2010	05:52:00	06:00:00	320	80	3
7	FS3	LP3.2	Day 3	20/04/2010	07:06:00	07:45:00	340	200	3
8	FS3	LP3.2	Day 3	20/04/2010	07:09:00	07:46:00	320	100	4
9	FS3	LP3.2	Day 3	20/04/2010	07:44:00	08:16:00	140	400	3
10	FS3	LP3.3	Day 1	18/04/2010	08:11:00	08:17:00	155	800	2
11	FS3	LP3.3	Day 1	18/04/2010	08:56:00	09:05:00	145	450	1
12	FS3	LP3.3	Day 3	20/04/2010	07:13:00	07:43:00	340	650	3
13	FS3	LP3.3	Day 3	20/04/2010	07:24:00	07:46:00	300	500	3
14	FS3	LP3.3	Day 3	20/04/2010	07:46:00	08:17:00	225	70	5
15	FS3	LP3.3	Day 3	20/04/2010	07:50:00	08:20:00	70	700	3
16	FS3	LP3.4	Day 1	18/04/2010	08:56:00	08:59:00	180	500	3>
17	FS3	LP3.4	Day 3	20/04/2010	07:13:00	07:45:00	320	300	3>
18	FS3	LP3.4	Day 3	20/04/2010	07:24:00	07:47:00	270	400	3>
19	FS3	LP3.4	Day 3	20/04/2010	07:46:00	08:17:00	206	500	3>
20	FS3	LP3.4	Day 3	20/04/2010	07:54:00	08:20:00	128	150	3
21	FS3	LP3.4	Day 3	20/04/2010	08:09:00	08:14:00	144	100	3