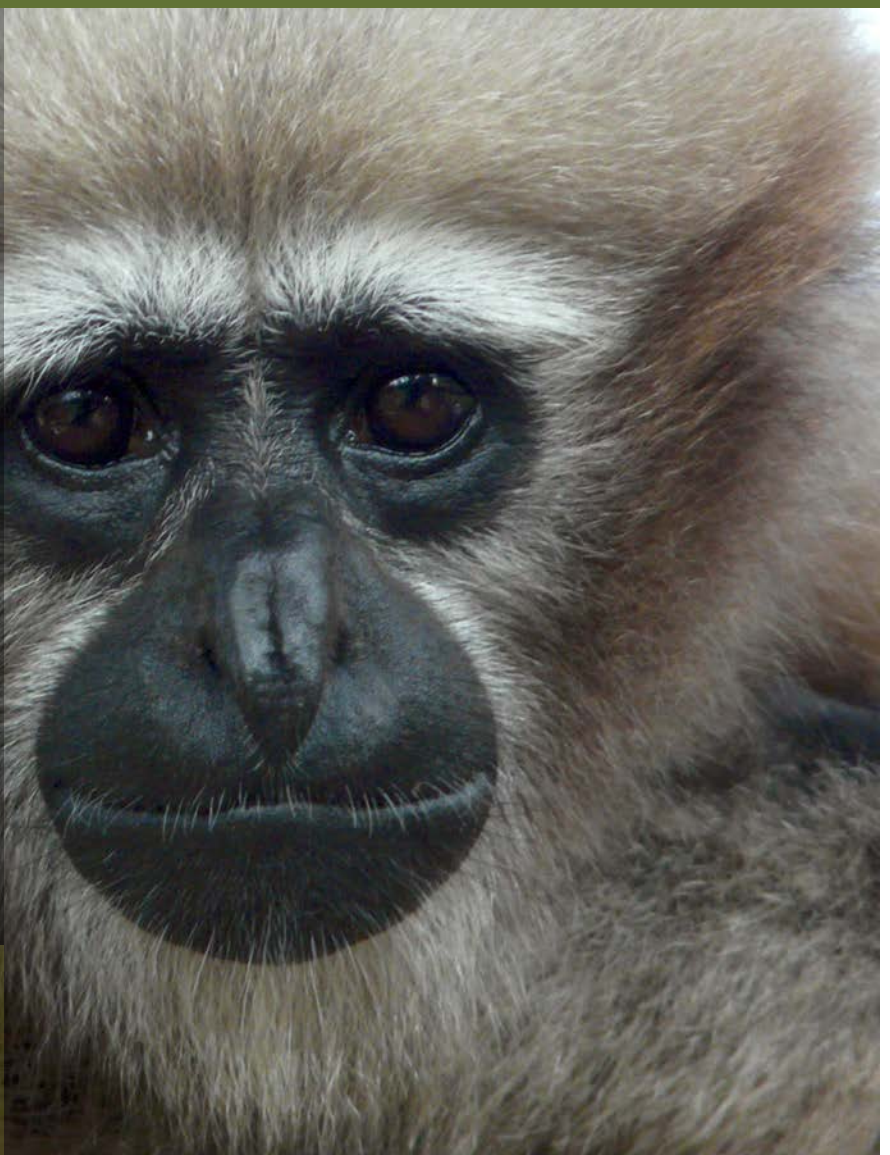


The Conservation Status of **Hoolock Gibbons** in Myanmar

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People Resources and Conservation Foundation
Fauna & Flora International
Myanmar Biodiversity and Nature Conservation Association
Gibbon Conservation Alliance
Karen Environmental and Social Action Network



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by

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2013



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i. Dedication

This status review is dedicated to the memory of three friends and colleagues who passed away during its implementation, and who present a sad loss to conservation in Myanmar.

Firstly, we honour U Uga, a committed conservationist with over 36 years service in the Myanmar Forest Department, who became the much respected founder and chairman of the Biodiversity and Nature Conservation Association (BANCA) from its birth in 2004 until his passing in 2010. U Uga's drive and commitment to the protection of biodiversity in Myanmar was exemplary, and inspired many. This research program would not have been possible without his kind support and encouragement from the very early days of planning through several years of fieldwork. Sadly he did not see its completion.

We also dedicate this work to the memory of Kyaw Thet Khine, a budding young conservationist from Rakhine state who tragically drowned while relaxing between gibbon surveys in early 2010. He joined the project as a research assistant in 2008 and quickly showed a deep passion for the preservation of his native natural heritage. He was a much loved and committed member of the project team.

Lastly, we honour Dr "Tony" Htin Hla, a long-term collaborator who was the second chairman of BANCA, from 2010. Tony dedicated the latter years of his life to surveying and enjoying the avifauna of Myanmar, conducting environmental assessments and supporting others' work through his encyclopaedic knowledge of Myanmar. He helped design and supervise this status review, and guided in site selection and logistics, sharing extensive unpublished records. He finally succumbed to a long illness during the final stages of publication of this report.

ii. Acknowledgements

This report was only possible due to the hard work, support and encouragement of a great number of individuals. We would particularly like to thank the following individuals and organizations for their particularly important contribution to the preparation of this status review.

During the establishment of the status review we received invaluable assistance from Prof. Dr. Win Maung (Zoological Department of Yangon University), who helped organise the initial planning and training workshop, Dr. Aye Mi San and Pwint Thu Aye (Zoological Department of Yangon University), who assisted with survey planning, and Dr. Thein Pe (Rakhine Coastal Association), who provided logistical assistance and advice during the first survey and training in Rakhine state.

Advice, references, data and technical input were provided by the participants of the initial training and planning workshop in 2008, and of the review workshop in 2010: U Thein Aung (Assistant Director, Forest department), U Than Myint (WCS Country Director), U Ohn (Chairman, Forest Resource Environment Development and Conservation Association, FRED), U Myint Swe (ECCDI Coordinator), Prof. Dr. Maung Maung Gyi (Department of Zoology, Yangon University), Dr. Aye Mi San (Primatologist and Associated Professor, Myeik University), U Myint Aung (Indo-Myanmar Country Director), U Thaung Htut (marine biologist, Marine Science Association, Myanmar), Daw Khin Aye Thit (Executive Director, Htoo Trading Co Ltd), Swe Swe Aung (mammologist, BANCA), Naing Naing Win (researcher, BANCA), Thida Nyein (researcher, BANCA), Thiri Htin Hla (ecotourism guide), U Thet Zaw Naing (Secretary, Myanmar Bird and Nature Society), U San Lwin Oo (Forester, Rakhine Yoma Elephant Range), and U Myint Kyaw Thuya (researcher, BANCA).

Rob Tizard and U Saw Htun, both of the WCS Myanmar Program, contributed to planning and implementation and also provided additional information on the gibbons of the Hukawng Valley.

For direction and guidance during the design and implementation of the study, we are grateful to Mark Infield (Asia Pacific Program Director, FFI), Stephen Browne (Asia Pacific Program Manager, FFI), Dr. Fan Peng-Fei (Institute of Eastern-Himalaya Biodiversity Research, Dali University, Yunnan, China), Fernando Potess (President Director, PRCF), Simi Bhagwandass (Program Development Officer, PRCF), Jonathan Eames (Director, BirdLife International in Indochina), Matthew James (British Council, Yangon), Simone Bianchi (Myanmar GIS Advisor, Oikos Institute), Karin Eberhardt (naturalist and independent consultant), and Laura Befasti (Myanmar Program Manager, Oikos Institute).

Paul Sein Twa and the administrative support team of the Karen and Social Action Network were instrumental in developing the gibbon research program in Karen state that was born from this status review, and in taking those results forward to support local communities to help protect the species and its habitat.

Much under-appreciated administrative and logistical support came from Khin Marla (Finance Officer, BANCA), Zun Khine Thin (aka “Su Su”; project bookkeeper, BANCA), Khin Min Min Thwin (Accountant, BANCA), Nguyen Quynh Nga (Finance Officer, PRCF), and Yen Anh (Finance Officer, FFI).

We are also grateful to Prof. Warren Y. Brockelman of Mahidol University, Thailand, and Ulrike Streicher, independent wildlife veterinarian, for reading and commenting on parts of this report. Prof. Brockelman also provided scientific advice and assistance with training.

Assistance in identifying the location of De Visme’s first hoolock gibbon record (De Visme 1769) was provided by Suprio Chakma.

Finally, we would like to express our sincerest thanks and deep appreciation for all the support and encouragement received from countless individuals and officials during the conduct of 11 extensive field expeditions throughout the country. The expertise, hospitality and curiosity of the people we met on the way made the sometimes arduous research a delight. We hope to work with some of them in the future, to turn this research into concrete actions for the protection of Myanmar’s hoolock gibbons.

The Arcus Foundation Great Apes Fund, the US Fish and Wildlife Service Great Ape Conservation Program, and the Gibbon Conservation Alliance generously provided funding for the status review.

iii. Abbreviations and acronyms

ASEAN	Association of Southeast Asian Nations
BANCA	Biodiversity and Nature Conservation Association
CI	Conservation International
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
ECCDI	Ecosystem Conservation and Community Development Initiative
ERI	EarthRights International
FAO	Food and Agriculture Organization of the United Nations
FFI	Fauna and Flora International
GIS	Geographic information system
IUCN	International Union for Conservation of Nature and Natural Resources
KESAN	Karen [= Kayin] Environmental and Social Action Network
NNR	National Nature Reserve
PA	Protected area
PRCF	People Resources and Conservation Foundation
TRAFFIC	Trade Records Analysis of Flora and Fauna in Commerce (an independent CITES and wildlife trade monitoring organization)
UNDP	United Nations Development Program
US	United States
WCPA	World Commission on Protected Areas (an IUCN initiative)
WCS	Wildlife Conservation Society
WS	Wildlife sanctuary

iv. Conventions

All geographic references provided in this report are given decimal degrees (lat/long) on the GCS WGS 1984 datum unless otherwise stated, for instance where quoted from other sources.

To save space, we have sometimes used abbreviations for the cardinal points of the compass: N, E, S, W, NE, SE, SW and NW.

All altitudes are in meters above sea level.

Where more than one English name exists for a locality, the more recent or official name is used, except in direct quotes. In each case, the alternative option is given at first mention, in brackets and preceded by an equals sign; for instance ‘Myanmar (= Burma)’. Choices of name indicate no political preference or view on behalf of the authors, their supporting organizations or donors. The most common place names that have an older and more recent alternative are listed here for easy reference:

Former name	Name used in this report
Arakhan	Rakhine
Pegu	Bago
Irrawaddy	Ayeyarwady
Karen	Kayin
Karenni	Kayah
Rangoon	Yangon
Tenasserim	Tanintharyi
Dawei	Tavoy

Note that until 2010 administrative ‘regions’ were called ‘divisions’. Older references to ‘divisions’ have not been amended in this report.

Common English transliterations of names of geographical features such as rivers and mountains often incorporate the feature type along with the name, particularly with non-Burmese (*i.e.*, ethnic) language names. Thus, for example, Imaw Bum (‘Imaw mountain’ or ‘Imaw peak’) is frequently called ‘Mount Imawbum’ in English, and ‘N’mai Hka’ (‘N’mai river’) is frequently called ‘N’mai Hka river’. We have generally adopted the technically incorrect transliterations where they are commonplace, or where the reader is otherwise likely to be confused. Other common examples are ‘chaung’ (= river), and ‘taung’ (= hill or hill chain).

Scientific and common names for mammals come from Francis (2008). Those for birds are from Robson (2008). Species threat status is taken from the IUCN (2011) Red List (www.iucnredlist.org). ‘Threatened species’ are those in the top three threat categories: Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

All maps were produced by the authors of this report unless otherwise stated.

During the conduct of field research, one United States dollar (USD) varied between 900 and 1,100 Myanmar kyat (MMK).

v. Summary

1. Two species of hoolock gibbon (family Hylobatidae) are recognized: the western hoolock gibbon (*Hoolock hoolock*, Harlan 1834), which is considered to be globally Endangered, and the eastern hoolock gibbon (*Hoolock leuconedys*, Groves, 1967), which is considered globally Vulnerable.
2. They are distributed in forested areas from eastern India (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura states) and Bangladesh, through Myanmar to southern China (W Yunnan province), their ranges being separated by the Chindwin river in Myanmar, which flows into the Irrawaddy (= Ayeyarwady) river.
3. The boundary between the two species is uncertain in the Chindwin headwaters in the north, and possibly includes a zone of intermediates or variable population. Rivers are frequently inter-species boundaries for gibbons, but it is currently unclear at present to what degree the main river in this region, the Tanine, acts as a boundary between the two hoolock species. Observations of adult males from the area would help to resolve the question.
4. Moreover, a population of the eastern hoolock (*H. leuconedys*) was discovered in Arunachal Pradesh, northeast India, which has traditionally been considered to be part of the distribution area of the western hoolock (*H. hoolock*). As a result, gibbon populations in southeastern Tibet are yet to be determined.
5. Myanmar was believed to hold significant populations of both hoolock species, but conservation actions were constrained by a lack of reliable and up-to-date data on their distribution, population size and threats. We addressed this need by conducting a nationwide review of the status of the species based on: (1) a full desk review of the taxonomic and ecological knowledge on both hoolock species throughout their range, (2) compilation of a full annotated list of 146 hoolock records, published and unpublished, for Myanmar, and (3) population estimates and threats assessments for both species throughout Myanmar based on three previously published field surveys and 11 original surveys conducted by the authors between 2008 and 2010.
6. Myanmar is also home to the white-handed gibbon (*Hylobates lar*), which is geographically separate from the range of the hoolock gibbons, lying east of the Salween river into Thailand. We make some incidental comments on the distribution and status of this species in Myanmar.
7. Another gibbon species, the siamang (*Symphalangus syndactylus*), is also often mentioned as part of the southern Myanmar fauna. Its distribution range includes southernmost Thailand, peninsular Malaysia, and Sumatra (Indonesia) (Geissmann, 1995; Marshall and Sugardjito, 1986). Evidence for siamangs occurring in Myanmar can be traced back for more than 170 years, though with multiple repetitions in the literature. Yet despite a number of references since 2000, no recent, confirmed records can be found. We therefore conclude that there is currently no justification for the inclusion of the siamang in the list of Myanmar fauna, but we recommend conducting surveys for siamangs in the Tanintharyi region.
8. The first legal protection for gibbons in Myanmar occurs under the Wildlife Law (1994), Article 15 of which allows for the Director General of Forestry to nominate protected wildlife. The notification that accompanies the law contains the list of species in each category, and includes both hoolock and white-handed gibbons as “completely protected animals”. These provisions provide the current legal basis for protection of both “*Hylobates hoolock*” (*sic*) and *Hylobates lar*, although the law requires updating to reflect current systematics, namely the recognition of the genus *Hoolock* and the separation of western and eastern hoolocks.
9. All three of Myanmar’s gibbons are listed as Appendix I in the Convention on International Trade in Endangered Species of Wild Fauna and Flora, to which Myanmar acceded in 1997.
10. Hoolocks are found in several types of habitats: tropical evergreen forest, the wetter tropical semi-evergreen forests, sub-tropical monsoon evergreen broadleaf forests, and sub-tropical evergreen broadleaf hill or montane forests. They appear to be less common in deciduous forest and scrub forest, and absent from mangrove forest (Choudhury, 1996; Gittins and Tilson, 1984; Lan, 1994).

11. Although hoolock gibbons occur from the floodplains to the mountains, they appear to be more common at altitudes of 80-1500 m. In Myanmar we recorded western hoolock at 2,300 m in the Naga Hills.
12. Based on the review of literature we provide an updated map of hoolock distribution in Myanmar that excludes areas of unsuitable habitat and identifies an intergrade area between the two species based around the upper Hukawng valley where the hoolock species is uncertain.
13. We also compile all hoolock gibbon records that could be located, several previously unpublished. The oldest date back to the mid-1800s, well before the distinction between western and eastern hoolock was made by Groves (1967), but which nonetheless can usually be separated by locality. Based on this literature review, we group hoolock gibbon record data from Myanmar into three time periods: Historical Records (before 1960), Modern Records (1980-2004) and Recent Records (2005-201). In total we have compiled 52 records for western hoolock, 89 records for eastern hoolock, and five records for hoolock gibbons in the inter-species zone in the Hukawng valley.
14. We use the publicly available vegetation data from the Global Land Cover 2000 project to estimate the amount of remaining habitat within the ranges of each hoolock species in Myanmar. This is adjusted to 2010 equivalence by applying a multiplier of 0.572, based on the loss of closed canopy forest between 2000 and 2010 estimated by the United Nations (UN) Food and Agriculture Organisation (42.8%).
15. Adjusted to 2010 equivalence, our calculations indicate 13,092 km² of suitable habitat remains within the range of the western hoolock gibbon, 42,571 km² within the range of the eastern hoolock gibbon, and 7,823 km² within the inter-grade area of uncertain hoolock species.
16. Based on the adjusted hoolock habitat area figures we estimate the population for each species using 28 available density estimates. Our analysis suggests that within Myanmar there are from 310,000 to 370,000 eastern hoolock gibbons, 82,000 to 110,000 western hoolock gibbons, and 65,000 to 70,000 hoolocks of uncertain species in the inter-species zone (all figures calculated to 2 significant figures). In combination, we therefore estimate a total hoolock population in Myanmar of 450,000 to 550,000 individuals.
17. Our results indicate that the vast majority of the global populations of both western and eastern hoolock gibbons remain within Myanmar. Even using our most conservative estimates for each species, Myanmar accounts for 100% of the global population of the eastern hoolock gibbon (to 3 significant figures) and at least 90% of the global population of the western hoolock gibbon.
18. Despite these seemingly impressive population figures – particularly for eastern hoolock – and a seeming lack of decline on previous estimates, threats to both species are varied and widespread, and high in many places. The Chinese and Bangladesh populations of both species are of course nationally significant in those countries, but their current contribution to global populations is very limited. Even the relatively more important hoolock population in India is highly fragmented (Molur *et al.*, 2005). Clearly, Myanmar represents by far the best chance of protecting significant numbers of each species.
19. Threats to hoolock gibbons in Myanmar are, however, multiple and highly varied across the country, and many are not well documented. Our results indicate that the main threat to western hoolock in survey sites visited by us is habitat fragmentation, *i.e.*, the reduction of larger contiguous areas of gibbon habitat into smaller “islands” through conversion of forest land to agriculture. The threats to eastern hoolock at survey sites are more varied, though the main threat is considered to be hunting, followed by habitat fragmentation. In 25% of sites, an additional threat to eastern hoolock is habitat degradation, *i.e.*, the selective removal of some trees that reduce the carrying capacity for gibbons and may increase ease of hunting.
20. We discuss the status of both eastern and western hoolock gibbons in relation to ten sub-ranges defined based on physical features (mountain ranges, rivers), Ecoregions defined by WWF, Priority Corridors identified by BirdLife International, and the personal experience of the authors. Several priority areas are identified.
21. Based on our assessment of the conservation status of the species throughout Myanmar, we find no evidence to support a change in the threat status of either hoolock species at this time.

22. Hoolock gibbon conservation in Myanmar requires three main outcomes: (1) protection of sufficiently large blocks of forest to hold large populations of the species, ideally of several thousand animals each, (2) reduction of fragmentation in small remnant patches to ensure no individual sub-population is reduced below 30 groups, and (3) reduction in hunting pressure through awareness, regulation and law enforcement.
23. We offer a number of recommendations to achieve these objectives: (1) Reduction of hunting, (2) Reduction of cross-border trade into China, (3) Reduction of internal trade, (4) Reduction of trade to Thailand, (5) Legislative reforms, (6) Reduction of demand for traded animals, (7) Improved control of logging of gibbon habitat, (8) Improved control of forest conversion, (9) Control of hydropower development, (10) Improved watershed protection, (11) Improved representation of gibbon habitat in the projected area system, (12) Increased local participation in gibbon conservation, (13) Improved protection, (14) Promotion of national awareness and pride, (15) Building national primatology capacity, (16) Increased civil society engagement, (17) Promotion of wild gibbons as a tourist attraction, (18) Further distribution and status surveys, (19) Other research into hoolock ecology and threats, and (20) Population monitoring.

Note to readers

This report collates all current published, and many previously unpublished hoolock gibbon records from Myanmar. The authors would like to ensure that the records list remains as up to date as possible and will maintain a database of all hoolock records in Myanmar. We therefore request any reader with new hoolock gibbon records to provide the authors with details, including; location, date, time, call duration, number of groups, and habitat type. Any additional information will also be included in the database. All current gibbon records and call data from field surveys conducted under this status review are available on request as a Microsoft Excel spreadsheet, provided they are for the purpose of conservation or research, and that the original authors and their organizations are acknowledged in any subsequent publications. Other conditions may also apply.

1. Introduction

This status review was conducted as a two-year project between 2008 and 2010, and aimed to assess the status of the hoolock gibbon in Myanmar. The project was a response to the fact that populations of these enigmatic small apes are dwindling throughout their known range due to forest clearance, disturbance, and hunting, with the western hoolock gibbon (*Hoolock hoolock*, Harlan 1834) considered to be globally Endangered and the eastern hoolock gibbon (*Hoolock leuconedys*, Groves, 1967) globally Vulnerable (Brockelman *et al.*, 2008, and Brockelman and Geissmann, 2008, respectively).

Myanmar was known to hold significantly large intact areas of prime habitat for hoolock gibbons, but conservation actions were constrained by a lack of reliable and up-to-date data on their distribution, population size and structure, and threats. This made it impossible to know which areas were most important for the species, the relative importance of threats, or where the greatest opportunities were for protection of either species of hoolock in Myanmar. This status review hopefully goes some way to providing the information required to better conserve both species.

The review comprises three parts; (1) a full desk review of the taxonomic and ecological knowledge on both hoolock species, (2) compilation of a full annotated list of all available hoolock records, published and unpublished, in Myanmar, and (3) population estimates and threats assessments for both species throughout Myanmar based on published information and a number of field surveys conducted by the authors between 2008 and 2010.

As an introduction to the Hoolock Gibbon Status Review project, a training workshop was held in Yangon on 21-23 Nov 2008 (Fig. 1.1). The participants included lecturers and students from Yangon University, Western Yangon University, Pyay University, Dawei University, local NGO staff from BANCA, and the Rakhine Coastal Association. Training topics included, among other things: Introductions to the project, conservation issues in Myanmar, gibbon biology, gibbon conservation issues, status review method, survey techniques for gibbons, and interview techniques. Additional training sessions in interview techniques, compass and GPS handling, plotting and triangulation of gibbon song data, and estimating gibbon group densities were provided during a first field survey to Southern Rakhine Yoma (Fig. 1.2) and after the survey in Yangon (Geissmann *et al.*, 2008, 2009a).



Fig. 1.1. Training workshop held at the beginning of the Hoolock Gibbon Status Review project in Yangon, 21 Nov 2008. Photo: Thomas Geissmann.



Fig. 1.2. A training session on interview techniques held at the first field campsite on 28 Nov 2008.
Photo: Mark Grindley.

A team from the Myanmar Biodiversity and Nature Conservation Association (BANCA), with technical support from Fauna and Flora International (FFI), the People Resources and Conservation Foundation (PRCF), and the Gibbon Conservation Alliance, undertook the original field surveys (Fig. 1.3). Surveys were undertaken based on a prioritization of large (>100,000 ha) forest ‘blocks’ suitable for hoolock gibbons throughout the country, several of which were then visited by the project research team for the conduct of gibbon density estimates and threats assessments. The overall methodology for field surveys is outlined in Appendix 1 and in Geissmann *et al.* (2009a).



a)



b)

Fig. 1.3. Intensive surveys throughout Myanmar forests provided most of the data presented on this report.

(a) Campsite at Nant Nint, near Indawgyi lake, Hkamti district, Sagaing region, Jan. 2010.

(b) Campsite at Salin mountain range, Gangaw Taung, Mohnyin district, Kachin state, Feb. 2010. Photos: Saw Soe Aung and Thet Naing Aung, respectively.

These surveys resulted in hoolock gibbon density estimates and threats assessments at 25 field sites, undertaken during 11 survey expeditions (Table 1.1). Nine of the 25 field sites were located within the distribution area of the western hoolock gibbon, and 16 were located within the distribution area of the eastern hoolock. The sites used for listening point surveys and some key findings for each site are listed in Appendix 2, and descriptions of all survey sites are presented in Appendix 3. The 11 associated reports are available on request from the contact given on the back cover.

Table 1.1. Surveys conducted for this status review.

Report	Survey dates	Location
1	26 - 30 Nov 2008	Southern Rakhine Yoma (= Arakan hills), Rakhine state
2	10 - 23 Dec 2008	Central and southern Rakhine Yoma, Rakhine state
3	13 Jan - 2 Feb 2009	Middle Mai Hka (= N'mai Hka) watershed area, northeast Kachin state
4	5 Feb - 24 Mar 2009	Middle and upper Mali Hka watershed area, northern Kachin state
5	18 Apr - 5 May 2009	Northeast and north-central Rakhine Yoma, Magway Region
6	20 Oct - 12 Nov 2009	Saramiti mountain and Naga Hills, west-central Sagaing Region
7	21 Nov - 4 Dec 2009	Chindwin lowlands and Htamanthi Wildlife Sanctuary, central Sagaing Region
8	8 - 28 Jan 2010	Indawgyi Lake Wildlife Sanctuary and adjacent forest, southern Kachin state
9	28 Jan - 15 Feb 2010	Gangaw Taung hills, south-central Kachin state
10	3 - 27 Mar 2009	Wusut area of north-central Mai Hka watershed, north-east Kachin state
11	10 - 18 Apr 2010	Khe Shor Ter mountain, Nattaung range, central Kayin state

During the conduct of field research, a workshop was held in Yangon on 25 June 2010 to present initial findings and seek feedback on progress and priorities (Fig. 1.4). The workshop included a summary of published data, a summary of the status of gibbons in China, and the results from the field sites visited by the project since 2008 (Myanmar Primate Conservation Program, 2010). This was followed by group discussions on gaps in the analysis, missing data, national threats and priorities, and suggested actions. Over 30 participants, including 21 Burmese conservationists from the government, national universities and domestic non-governmental organizations, and representatives from six international conservation organizations, attended the workshop. Results have been incorporated into the recommendations section in this report.



Fig. 1.4. A workshop held in Yangon on 25 June 2010 to present the findings of the status review, including an analysis of existing records from Myanmar, India, Bangladesh and China, plus original fieldwork conducted by the project partners throughout Myanmar between September 2008 and May 2010. Photo: Mark Grindley.

In addition, several *ad hoc* publications also resulted from the fieldwork that formed the basis for this status review, detailing the results of individual surveys (Geissmann *et al.*, 2008; 2009a, 2009b), preliminary findings of the status review research (Ngwe Lwin *et al.*, 2011), observations of non-maternal infant carrying in a western hoolock gibbon (Ngwe Lwin and Geissmann, in press), notable bird records and observations (Ngwe Lwin and Grindley, 2009; Saw Moses, 2011), and the discovery of a new species of snub-nosed monkey (Geissmann *et al.*, 2011).

2.1 Primates in Myanmar

A phylogenetic tree of primates, showing the evolutionary relationships between various families. The tree is rooted on the left and branches out to the right. The families are listed on the left, and the corresponding groups are listed on the right, connected by curly braces. The families are: Daubentoniidae, Indridae, Lepilemuridae, Lemuridae, Cheirogaleidae, Galagonidae, **Loridae**, Tarsiidae, Aotidae, Cebidae, Callitrichidae, Pitheciidae, Atelidae, **Cercopithecinae**, **Colobinae**, **Hylobatidae**, and Hominidae. The groups are: Wet-nosed Primates (Strepsirrhini), Tarsiers (Tarsiiformes), New World Monkeys (Platyrrhini), Tailed Old World Monkeys (Cercopithecoidea), and Apes and Humans (Hominoidea).

Phylogenetic tree of primates showing relationships between various families and their corresponding groups:

- Daubentoniidae
- Indridae
- Lepilemuridae
- Lemuridae
- Cheirogaleidae
- Galagonidae
- Loridae**
- Tarsiidae
- Aotidae
- Cebidae
- Callitrichidae
- Pitheciidae
- Atelidae
- Cercopithecinae**
- Colobinae**
- Hylobatidae**
- Hominidae

Corresponding groups (indicated by curly braces):

- Wet-nosed Primates (Strepsirrhini)
- Tarsiers (Tarsiiformes)
- New World Monkeys (Platyrrhini)
- Tailed Old World Monkeys (Cercopithecoidea)
- Apes and Humans (Hominoidea)

The western hoolock (*Hoolock hoolock*), as the name implies, occurs in western Myanmar and is separated from the eastern hoolock by the Chindwin river. The eastern hoolock (*H. leuconedys*) occurs

east of the Chindwin up to the Salween river. The distribution areas of the western and the eastern hoolock gibbons are discussed in more detail in Section 4.

Table 2.1. List of gibbon species known to occur in Myanmar, and the IUCN conservation status.

Common name	Latin name	IUCN conservation status (IUCN, 2011)
Western hoolock gibbon	<i>Hoolock hoolock</i>	Endangered
Eastern hoolock gibbon	<i>Hoolock leuconedys</i>	Vulnerable
White-handed gibbon	<i>Hylobates lar</i>	Endangered

The white-handed gibbon (*Hylobates lar*) is the only non-hoolock gibbon species reliably recorded from Myanmar. The fur of this polychromatic species is black, brown, buff or creamy, with contrasting white hands and feet and a white ring around the face (Fig. 2.2). The species occurs only east of the Salween river. In Myanmar, this includes mainly parts of Shan state, Kayah (= Karenni) state, Kayin (= Karen) state, Mon state, and Tanintharyi (= Tenasserim) region. An old report by Tickell (1864, p.196) also states that the white-handed gibbon occurs in Bago (= Pegu) region. Tickell's report was also cited by Anderson (1879, pp. 3 and 6). In his report, however, Anderson (1981, p. 29) changed the locality to "Lower Pegu", and he also added Arakan (= Rakhine state) to the list of localities of the white-handed gibbon (*H. lar*) in Myanmar. The occurrence of the species in Arakan state was also mentioned by Tate (1947), but this is only based on the Anderson source and not on primary information. Hill (1949, p. 42) also states that the hoolocks' range overlaps southwards with the range of the white-handed gibbon. However, the occurrence of the white-handed gibbons west of the Salween river, which would therefore make them sympatric with the hoolock gibbons, is not confirmed by field surveys or museum specimens.



Fig. 2.2. White-handed gibbons (*Hylobates lar*). (a) Dark brown adult male at Nay Pyi Daw Zoo, (b) buff subadult male pet at Yangon Zoo. Photos: Thomas Geissmann, 29 Feb 2012 and 22 Nov 2008, respectively.

Outside of Myanmar, the distribution range of the white-handed gibbon stretches eastward up to the Mekong river and includes parts of Laos, large parts of Thailand, peninsular Malaysia, and northern Sumatra (Indonesia). A relatively small population also existed in southwestern Yunnan

province of China but apparently became extinct in the late 1990s (Geissmann, 2008; Grueter *et al.*, 2009). The white-handed gibbon is easily distinguished from the hoolock gibbon by a broad ring of white hair surrounding the face, white hands and feet, and by its more melodious, wailing song. This gibbon species is not the topic of this report and will not be presented in more detail.

Another gibbon species, the siamang (*Symphalangus syndactylus*), is also often mentioned as part of the southern Myanmar fauna. The distribution range of this largest of all gibbon species includes southernmost Thailand, peninsular Malaysia, and Sumatra (Indonesia) (Geissmann, 1995; Marshall and Sugardjito, 1986). Evidence for siamangs occurring in Myanmar can be traced back for more than 170 years: Helfer (1838, p. 858) reported that the siamang occurred in southern Tenasserim (= Tanintharyi region) “to the 15th degree of north latitude”. This information is repeated by Horsfield (1851), Anderson (1879), and Sterndale (1884). Elliot (1913, p. 176) quotes Helfer’s information more carefully, stating that the species “is found in the Malay Peninsula *possibly* as far north as Tenasserim” (emphasis added). This version of the primary information is adopted by Tate (1947), who in return is quoted by Ellerman and Morrison-Scott (1951) and by Tun Yin (1993). However, Ellerman and Morrison-Scott (1951, p. 213) add a question mark to Tenasserim as a siamang locality. Wolfheim (1983, p. 677f) quotes Ellerman and Morrison-Scott (1951) in their assertion that siamangs occur in Tenasserim, but mentions that “no modern first-hand confirmations of its presence [in Tenasserim] were located.”

Yet the ambiguity remains, and a number of recent references continue to suggest siamangs exist in Tenasserim (e.g., Anonymous, 2006; Khin Maung Zaw, 2010; Saw Htun *et al.*, 2006). When reporting on a survey for Gurney’s pitta (*Pitta gurneyi*) in Tanintharyi region, Htin Hla *et al.* (2003, p. 13) commented: “We were supposed to find two species of Gibbons in Tanintharyi. But we only managed to record only one species, which is the White-handed Gibbon (or) Lar *Hylobates lar entelloides*. We did not find or hear the Siamang *Hylobates syndactylus*, which has a characteristic loud voice and could be easily heard. But locals said that they sometimes hear that call, but not as common as lar.”

However, no recent, confirmed records can be found. We therefore conclude that there is currently no justification for the inclusion of the siamang in the list of Myanmar fauna. It is unclear whether the historical records are correct, but we recommend to conduct surveys for siamangs in Tanintharyi region.

2.2 Protection status of Myanmar’s gibbons

The main national agency responsible for protection of species and habitat is the Forest Department of the Ministry of Environmental Conservation and Forestry (MoECF), established in 1856 and one of the oldest national forest administrations in Southeast Asia. Its Nature and Wildlife Conservation Division (NWCD) is responsible for overseeing species protection and protected area management, while daily forest management commitments are exercised through local Forest Officers and protected area staff.

Notwithstanding hunting restrictions in place in sanctuaries and reserve forests, gibbons did not receive special legal protection until the Wildlife Law (SLORC, 1994), Article 15 of which allows for the Director General of Forestry to nominate protected wildlife. The notification that accompanies the law (Myanmar Forest Department, 1994) contains the list of species in each category, and includes both hoolock and white-handed gibbons as “completely protected animals”, which thereby prohibits the selling, transporting, transferring or exporting of the species “or any part thereof without permission” (SLORC, 1994; Articles 36 and 37). These provisions provide the current legal basis for protection of both *Hylobates lar* and “*Hylobates hoolock*” (sic), although the law clearly requires updating to reflect current systematics, namely the recognition of the genus *Hoolock* and the separation of western and eastern hoolocks.

Although enforcement of prohibitions on hunting and trade are chiefly down to the Forest Department and its regional officers, “When a request is made by the Forest Staff for assistance in the performance of their duties, the People’s Police Force shall render necessary assistance” (SLORC, 1994, Article 44). This reflects the fact that most forest officers do not have police powers.

All three of Myanmar's gibbons are listed in Appendix I in the Convention on International Trade in Endangered Species of Wild Fauna and Flora, to which Myanmar acceded in 1997. This gives them the strongest protection in international trade. CITES is in theory enabled through the Wildlife Law (SLORC, 1994). However, CITES currently does not consider this law adequate to meet the requirements of implementing obligations (World Bank, 2005).

As a member of the Association of Southeast Asian Nations, Myanmar is a signatory to the ASEAN Regional Action Plan on Trade in Wild Fauna and Flora 2005-2010, which lead to the formation of the ASEAN Wildlife Enforcement Network (WEN) in December 2005. As part of this commitment, Myanmar established a national interagency wildlife trade taskforce in July 2007 under direction of the Forest Department, and including the Customs Department, Attorney General's Office, Directorate of Trade, Progress of Border Areas and National Races Department, Police Force, Judicial Department and the General Administrative Office. The current WEN focal point is currently U Win Naing Thaw, Director of the Nature and Wildlife Conservation Division (NWCD).

Myanmar joined the Convention on Biological Diversity in 1994, though does not currently have a national Biodiversity Action Plan. There is also no national 'Red List' indicating the national threat status of various species in Myanmar.

2.3 Protection of gibbon habitat

Protection of forest is enacted under a mixture of reserved forests, protected public forest, and protected areas, with areas recorded as "forest" by local administrations but not yet assigned a management category considered as "unclassified" (the area of which is not entered onto national inventories). All forest categories are considered state property under the constitution (SDPC, 2009).

The Permanent Forest Estate (PFE) is the land area managed by the Forest Department, which accounts for about 210'000 km², or 30% of the total land area of the country. The PFE comprises Reserved Forests (18% of the total land area), Protected Public Forests (5%) and Protected Areas (7%) (NCEA, 2009). The National Forestry Master Plan (2001 to 2030) envisages expansion of the forest estate under government control to 40% in the next ten years, including expansion of protected area coverage to 10% (NCEA, 2009).

The Wildlife and Conservation of Natural Areas Law (1994) defines seven categories of protected area: (1) Scientific Nature Reserve, (2) National Park, (3) Marine National Park, (4) Nature Reserve, (5) Wildlife Sanctuary, (6) Geo-physically Significant Reserve, and (7) "other Nature Reserve determined by the Minister" (Article 7). The management functions and objectives of each category are not detailed however, and Myanmar designations do not directly match ICUN categories (Rao *et al.*, 2002).

The currently recognized protected network comprises 43 areas (NCEA, 2009; Fig. 2.3 and Appendix 4), six of which are also ASEAN Heritage Parks. Three categories of protected area – Strict Nature Reserves, Managed Nature Reserves and Protected Landscapes – are currently absent from the protected area system.

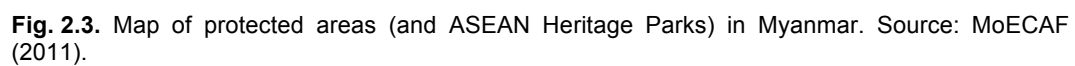
The protected area network is relatively small by regional standards, covering approximately 49,400 km², or around 7% of the total land area of the country. The declared intention of the Nature and Wildlife Conservation Division (NWCD) was to increase this coverage up to 10% by 2010 (NCEA, 2009), and although some progress has been made to increase the coverage from the 5.4% seen in 2003, this still falls short of regional norms, with the average in Asia being 8.3% and globally nearer to 11% (EarthTrends, 2003).

Myint Aung (2007) suggests the NWCD has since 1981 attempted to "design a PAs [protected areas] system that represents the full complement of the country's biogeographic regions", and notes that since then the coverage has become somewhat more representative. However, the system is still skewed towards terrestrial forest sites (91% of the total of protected areas), against marine and wetland sites. There is particularly uneven representation of the Eastern Himalayan Biounit (*sensu* MacKinnon, 1997), which is considered the lowest priority for increased protected area coverage in Myanmar since around 44% of the portion that lies within the countries of the Association of

Southeast Asian Nations is within existing protected areas, predominantly Hkakaporazi National Park (BirdLife International and IUCN-WCPA South-East Asia, 2007).

In addition, a disproportionally large area of the far north in general is under protected areas, particularly due to the establishment of the Hukawng Valley Nature Reserve and the subsequent Extension (aka Hukawng Valley Tiger Reserve). Indeed, with a combined area of around 22,000 km², the two Hukawng valley parks form by far the largest single protected area in the country.

Yet, despite the relatively high number of parks in Myanmar, more than half are under 500 km², and not all of them have been fully gazetted. U Myint Aung (2007) indicates that of the 39 areas he identified, six were yet to be given full legal status. Of the 43 parks that we identify (Appendix 4), ten are awaiting full gazettelement at this time (October 2010). Due to a lack of resources and investment, several are “unmanaged holdings, either degraded beyond recognition as PAs, or highly vulnerable to encroachment and degradation” (Myint Aung, 2007, p. 195).



2.4 Forest extent and trends

Gibbons are closely associated with closed canopy broadleaved evergreen forests, and hoolock gibbons are no exception. Most of the closed canopy broadleaved evergreen forests in Myanmar are distributed in the mountain chains that ring the west, north and east of the country, and in the lowlands of the middle and upper Chindwin basin. There were formerly significant areas of lowland broadleaved evergreen forests in the Salween and upper Irrawaddy basins, but large portions of these have been subject to conversion to agriculture and logging for some time, and coverage is now only patchy in significant portions of their former extent.

Other areas within the range of the hoolock gibbons have probably never held significant areas of suitable habitat in modern times. At high altitudes, particularly in the far north, oak and pine forests and, over 3,000 m, alpine grasslands, predominate. The central dry zone of the country is dominated by deciduous dry dipterocarp forests which are unsuitable for gibbons. These give way to mixed deciduous and teak forests at higher latitudes, within which low densities of gibbons have been observed, but mostly where these forests are in association with larger patches of predominantly evergreen forest such as along watercourses or on more suitable substrates.

There is no clear consensus on the country's overall area of forest cover, partly due to methodological differences. Data are patchy, and the only complete forest cover dataset available since 1990 is from an interpretation of Landsat 7 ETM images primarily from 2006 but including some images from 2005, 2007 and 2008 (FAO, 2010a). This dataset was apparently "field checked" during 2006 and is therefore regarded by FAO (2010a, p. 7) as the "most reliable" dataset available.

These data were used as the basis for FAO's latest Global Forest Resources Assessment (FRA) country estimate for Myanmar for 2010 (FAO, 2010a). The FRA extrapolates the older data to suggest the area of combined 'closed' and 'open' forest in Myanmar in 2010 to be 318'000 km², or 47% of the total land area. This figure compares with 68% for Laos, 57% for Cambodia, 44% for Vietnam, 37% for Thailand, 23% for India and 22% for China (FAO, 2010b). Of this, 134'000 km² is regarded as 'closed forest', which represents 42% of total forest or 20% of the total land area.

While one might expect this 'closed forest' to represent gibbon habitat, the FAO definition is of trees higher than 5 m and a canopy cover of more than 40%, and may therefore include a wide range of forest types including heavily logged forest, plantation forest or even regenerating swidden land. We would therefore expect that figures based on the FAO definition for 'closed forest' to over represent forest suitable for gibbons.

The most recent FRA figures indicate total forest cover in the country has reduced from nearly 400'000 km² in 1990 to just under 320'000 km² in 2010 (FAO, 2010a; Table 2.2). This represents a decline of 19% in ten years.

An alternative estimate of forest cover (Leimgruber *et al.*, 2005) uses Landsat imagery from 1990 and 2000 to examine deforestation rates in Myanmar. The authors found the country to have some of the most extensive remaining forest cover in Southeast Asia, at about 430,000 km² in the early 2000s, representing 65% of the total land area. This is significantly more than the roughly 52% estimated by the Forest Department itself for 2000 or 49% in 2005 (FAO, 2010a), and suggests the wide margins possible in estimates based on different data and assumptions.

Figures from Leimgruber *et al.* (2005) indicate a reduction in cover from 442,000 km² (67% of the total area) in the early 1990s, to 430,000 km² in the early 2000s – a total reduction of 2.7%, or an annualized deforestation rate of 0.2% over the period. This is in line with the global average but much lower than estimated by FAO (2010a). The authors did however find annualized rates to vary widely between states and regions (formerly divisions), ranging from 0.0% (Kayin and Kayah states) to 1.2% (Ayeyarwady region), primarily as a result of a highly heterogeneous distribution of people and economic activity. We would suppose that widely different proportions of pre-existing forest would also help explain the difference in deforestation rates, since some areas – particularly those in central and coastal Myanmar – had already been heavily deforested by the early 1990s.

Although there may be no consensus on exact figures, it is clear that Myanmar has seen a significant decline in both forest extent and quality throughout the country.

Table 2.2. Forest Resources Assessment estimates of forest area in Myanmar in 1990, 2000, 2005 and 2010, and % change (from FAO, 2010a).

a) Total forest area (km²)

Forest type	1990	2000	2005	2010
Closed	308,830	235,050	184,750	134,450
Open	83,350	113,640	148,460	183,290
Total	392,180	348,690	333,210	317,740

b) Total change in forest area (km²)

Forest type	1990-2000	2000-2005	2005-2010	1990-2010
Closed	-73,780	-50,300	-50,300	-174,380
Open	+30,290	+34,820	+34,830	+99,940
Total	-43,490	-15,480	-15,470	-74,440

c) % change in forest area

Forest type	1990-2000	2000-2005	2005-2010	1990-2010
Closed	-24%	-21%	-27%	-56%
Open	+36%	+31%	+23%	+120%
Total	-11%	-4%	-5%	-19%

2.5 Previous gibbon conservation initiatives

To date, the only conservation measures undertaken specifically for gibbons in Myanmar have been by the Forest Department in collaboration with the Wildlife Conservation Society (WCS). Efforts focused on eastern hoolock gibbons in the (notified but not gazetted) Mahamyaing Wildlife Sanctuary, and of hoolocks on the border between the western hoolock and the inter-species zone in the Hukawng Valley Tiger Reserve.

The initial work in Mahamyaing was funded by the US Fish and Wildlife Service and consisted primarily of gibbon census work conducted in 2004/2005. Fourteen trainees from the Forest Department and Yangon University received initial training from WCS and Prof. Warren Brockelman from Mahidol University, Thailand. From this group, a five-person team was selected to conduct gibbon censuses at 11 sites within the sanctuary. This project effectively set the standard for gibbon census research in Myanmar as the methods have largely been replicated in subsequent surveys by the Forestry Department, WCS and ourselves. The project team also drew up preliminary lists of bird, mammal and tree species based on field data, with supplementary activities including education and awareness, socioeconomic surveys and a threats assessment. A habitat quality assessment and extent mapping was also conducted using remote sensing data.

The survey indicated a total population of eastern hoolock of about 5,900 individuals in 800 km² of closed canopy forest suitable for gibbons (Brockelman, 2005), and provides a strong baseline for monitoring. It was also intended to support the process of formal gazettement of the sanctuary.

Sadly there appears to have been no substantive follow-up to this project. Conservation International made a field visit to the site in August 2007, and expressed interest in assisting with its gazettement, as did the smaller non-governmental organization Indo-Myanmar Conservation. However, to our knowledge there are no longer any gibbon-specific conservation activities in what was at the time considered the most important site for conservation of hoolock gibbons in Myanmar.

The Nature and Wildlife Conservation Division of the Myanmar Forest Department and WCS also collected gibbon census data from the “Hukawng Tiger Reserve” (Hukawng valley, Kachin state) between December 2005 and February 2006 (Anonymous, 2006; Brockelman *et al.*, in prep.; Saw Htun *et al.*, 2006), employing the same survey protocol as adopted previously in Mahamyaing Nature Reserve. The main goals were to establish the conservation status of the species in the Hukawng Valley and incorporate “concrete conservation strategies” for the species into the management plan that was being developed at that time (Saw Htun *et al.*, 2006, p. 1). In addition, the project aimed to increase awareness of gibbon conservation issues in the reserve. Their results indicated gibbon

densities ranging from 0.56 to 4.39 groups per km² (at 0.6 km listening radius), but note declining populations due to hunting. However, the conservation recommendations provided in the report are only generic, and no species-specific conservation actions appear to have been undertaken following the study.

3. Taxonomy

3.1 An introduction to the gibbons (Family: Hylobatidae)

The gibbons or small apes form the family Hylobatidae. They form a relatively homogeneous group of species, which are distributed throughout the tropical rain forests of South-East Asia (Chivers, 1977; Geissmann, 1995; Groves, 1972; Marshall and Sugardjito, 1986). They are unusual among primates in several respects that can be summarized under three key complexes: locomotion, social structure, and communication.

Gibbons are strictly arboreal and mainly frugivorous (Chivers, 1984a; Leighton, 1987). Their unique arm-swinging form of locomotion (brachiation), suspensory behaviour, and habitual erect walking on branches represent extreme specializations, which evolved in connection with the animals' substrate and diet (Chivers, 1984b). Gibbons live in socially monogamous, territorial family groups (Brockelman and Srikosamatara, 1984; Chivers, 1984b; Leighton, 1987). In the wild, single offspring are born at intervals of approximately 3 years. Offspring remain with their family group until attaining sexual maturity at about 8 years of age, at which time they usually leave the group in order to find a mate and a territory.

All species of gibbons are known to produce elaborate, species-specific and sex-specific patterns of vocalizations, often referred to as "calls" or "songs" (Geissmann, 1993, 1995; Haimoff, 1984a; Marshall and Marshall, 1976, 1978). Song bouts are loud and complex and are mainly uttered at well established times of day. In most species, mated pairs may characteristically combine their songs in a relatively rigid pattern to produce coordinated duet songs. Several functions have been attributed to gibbon songs, most of which emphasize a role in territorial advertisement, mate attraction and maintenance of pair and family bonds (Geissmann, 1999; Haimoff, 1984a; Leighton, 1987).

It is generally accepted that gibbons, great apes and humans together form the monophyletic group Hominoidea (Groves, 1989). Gibbons share a number of common derived (synapomorphous) characteristics with other members of the Hominoidea, including a broad thorax, dorsally placed scapulae, long clavicles, very long forelimbs, a humerus with a spool-shaped trochlea, a reduction of the lumbar region, a higher number of sacral vertebrae, a reduction of the tail, a relatively broad iliac blade (Os ilium) and a reduction of the ischial callosities (e.g. Fleagle, 1999).

It has also been widely accepted in recent years that the gibbons constitute the sister group to the combined great apes and humans (Fig. 2.1) and show some of the most primitive characteristics within the Hominoidea (Fleagle, 1999). This view is supported by results from comparative studies of a wide array of morphological (Biegert, 1973; Remane, 1921; Sawalischin, 1911; Schultz, 1933, 1973; Wislocki, 1929, 1932), physiological (Hellekant *et al.*, 1990), cytogenetic (Wienberg and Stanyon, 1987) and molecular data (Bailey *et al.*, 1991; Darga *et al.*, 1984; Dene *et al.*, 1976; Felsenstein, 1987; Goldman *et al.*, 1987; Goodman *et al.*, 1990; Sarich and Cronin, 1976; Sibley and Ahlquist, 1984, 1987).

3.2 Splitting the gibbons

Although the monophyly of the gibbons (family Hylobatidae) is widely accepted, this is not the case for the taxonomy adopted within the family. In early studies on gibbon systematics, the Hylobatidae were grouped into two distinct genera including the siamang (*Symphalangus*) on one hand, and all the remaining gibbons (*Hylobates*) on the other (e.g. Napier and Napier, 1967; Schultz, 1933; Simonetta, 1957). This dichotomic view probably originated from the limitations of the available material. Siamangs and members of the *lar*-group of gibbons (*sensu* Geissmann, 1994, 1995) have usually been the more readily available specimens to early scientists. Differences between these two groups are easily recognizable (siamangs are heavier and they have a much deeper voice, an external throat sac and webbing between toes 2 and 3). When additional species of gibbons were

studied in more detail, it became clear, that more than two groups needed to be recognized, if any were recognized at all. In the then prevailing lumping-tradition, these groups were referred to as subgenera by Groves (1972) and most authors after him, except Lekagul and McNeely (1977), who recognized three genera (*Symphalangus*, *Nomascus*, and *Hylobates*).

Research carried out during the 1980's provided increasing evidence that four distinct groups had to be recognized. Each of the four groups is, among other characteristics, identified by a distinctive karyotype, the diploid number being 50 (*Symphalangus*), 52 (*Nomascus*), 38 (*Bunopithecus*) and 44 (*Hylobates*) (Prouty *et al.*, 1983a, b; Liu *et al.*, 1987). Other distinctive characteristics include skull anatomy (Creel and Preuschoft, 1984) and vocalizations (Marshall and Sugardjito, 1986).

Building up on the work of Groves (1972), it has been proposed that the four groups should each be referred to separate subgenera (i.e. *Symphalangus*, *Nomascus*, *Bunopithecus*, and *Hylobates*, respectively) (Marshall and Sugardjito, 1986; Nowak, 1999; Prouty *et al.*, 1983a; Rowe, 1996).

There is considerably less agreement on the phylogenetic relationships among the four groups. Several authors suggested that among modern gibbons, the siamang (*Symphalangus*) was the first species to split off from the main stem (Bruce and Ayala, 1979; Creel and Preuschoft, 1976, 1984). Others disagreed, seeing the crested gibbons (*Nomascus*) in that position (Groves, 1972; Haimoff, 1983; Haimoff *et al.*, 1982, 1984), whereas preliminary molecular data suggested that *Bunopithecus* may be the most basal branch (Zehr *et al.*, 1996). According to a fourth view, the siamang and the crested gibbons shared a common ancestor not shared by other gibbons (Shafer, 1986; van Tuinen and Ledbetter, 1983, 1989). A survey of published phylogenetic trees of gibbons is presented in Geissmann (2002a). Groves (1989) commented that the “relationships of the main divisions are very even, and any dichotomy is hard to elucidate”. The phylogenetic relationships among the four groups remain not well resolved in recent DNA studies (Israfil *et al.*, 2011; Roos and Geissmann, 2001; Van Ngoc Thinh *et al.*, 2010).

Goodman *et al.* (1998, p. 596) pointed out that “relative to the great apes, the gibbons have been grossly under-split”. Indeed, several DNA studies indicated that all four gibbon groups have roughly the same age and that they rapidly diverged from each other during the late Miocene about 7-8 million years ago (Matsudaira and Ishida, 2010; Van Ngoc Thinh *et al.*, 2010). The rapid radiation of the four groups would explain why it is so difficult to resolve their phylogeny.

Analogy with other primates suggests that a late Miocene date for the radiation corresponds to a genus-level split. Consequently, the four groups of gibbons are now generally recognized as distinct genera: *Hylobates* (dwarf gibbons or *lar* group), *Hoolock* (hoolocks or hoolock gibbons), *Nomascus* (crested gibbons), and *Symphalangus* (siamangs). The generic name for hoolock gibbons was changed from *Bunopithecus* to *Hoolock* by Mootnick and Groves (2005; see below).

3.3 An introduction to the hoolock gibbons (genus *Hoolock*)

Currently, two species of hoolock gibbons are recognized, the western hoolock (*Hoolock hoolock*) and the eastern hoolock (*H. leuconedys*) (Geissmann, 2007; Groves, 2001). Their respective ranges are separated by the Chindwin river, which flows into the Irrawaddy (= Ayeyarwady) River (Groves, 1967, 1972). The boundary between the two species is uncertain in the Chindwin headwaters in the north, and possibly includes a zone of intermediates or variable population. Moreover, a population of *H. leuconedys* was discovered in eastern Arunachal Pradesh and northeastern Assam, northeast India (Chetry and Chetry, 2010; Chetry *et al.*, 2008, 2012; Das *et al.*, 2006), which has traditionally been considered to be part of the distribution area of *H. hoolock*. As a result, gibbon populations in southeastern Tibet are yet to be determined.

Of all gibbons, the range of the hoolock gibbons extends the farthest north and west, and it is the only genus of apes represented in the Indian sub-continent (see below). Hoolocks are found in several types of habitats: tropical evergreen forest, the wetter tropical semi-evergreen forests, sub-tropical monsoon evergreen broadleaf forests, and sub-tropical evergreen broadleaf hill or montane forests. They appear to be less common in deciduous forest and scrub forest, and absent from mangrove forest (Choudhury, 1996; Gittins and Tilson, 1984; Lan, 1994).

Although hoolock gibbons occur from the floodplains to the mountains, they appear to be more common at altitudes of 80-1500 m (Choudhury, 1996; Mukherjee, 1986). They have been recorded up to 2,550 m in Manipur, northeast India (Choudhury, 2001). In Myanmar, hoolocks also occur at higher altitudes. On the slopes of Mt. Victoria (Chin state, western Myanmar), they were observed at elevations of 2,100-2,300 m (King *et al.*, 1995). During the Vernay-Cutting expedition to northeastern Myanmar, hoolocks were also observed in pine-dominated forests at altitudes of up to 2,400-2,700 m (Anthony, 1941).

Previously found throughout the forests of their present range, deforestation and hunting have exterminated from much of their historical range. From an original ranging habitat of about 168,000 square kilometers, available habitat in 1987 was estimated at no more than 56,378 square kilometers, representing a 67 percent habitat loss (Anonymous, 1997, cited in Gupta *et al.*, 2005, pp. 6 and 13).

Prior to this status review, hoolock gibbons were believed to have experienced a drastic population decline. The 1971 and 1972 Zoological Survey of India census of primates estimated that the population of *H. hoolock* was between 78,000 to 80,000 individuals in northeast India (Chivers, 1977), whereas the present population there is estimated to be below 8,000 individuals (Chetry and Chetry, 2011; Das *et al.*, 2009, p. 423). Other recent population estimates for *H. hoolock* include less than 300 individuals of *H. hoolock* in Bangladesh (Islam *et al.*, 2006, 2011; Molur *et al.*, 2005), less than 200 individuals of *H. leuconedys* in China (Fan and Ai, 2011; Fan *et al.*, 2008, 2011; Fan, personal communication to TG, Sept 2010) and about 250 *H. leuconedys* in India (Chetry *et al.*, 2010, 2012; Das and Biswas, 2009; Das *et al.*, 2006; see also Section 4.2 of this report).

However, beyond the two surveys mentioned above and some presence/absence data from a few general biodiversity surveys in protected areas, no additional data on the status of hoolock gibbons in Myanmar exists. Hoolock gibbons are identified as a priority for conservation in Myanmar (Tordoff *et al.*, 2005), with the immediate priority being the conduct of a status review. A status review is deemed critical for identifying, prioritizing, and planning conservation interventions to enhance options for the long-term survival of the Myanmar population of hoolock gibbons.

3.4 Taxonomic history of the hoolock gibbons

The earliest known published description and depiction of what appear to be hoolock gibbons (Fig. 3.1) were provided by De Visme (1769), who reported:

„Perhaps the drawing, which I now send you, of a singular sort of Monkies, male and female, may not prove unacceptable. These animals are called Golok, or wild people, and are thought to be originally a mixture with the human kind, having no tails. They come out of the forests in the interior part of Bengal, from the country called Mevat. They inhabit the woods: their food is fruit, leaves, bark of trees, and milk: flesh only when caught. They are very gentle, and extremely modest. They are of the height of a man; their teeth are as white as pearls; their legs and arms are in due proportion to their body, which is very genteel. Some of them were brought to Decca; and what I now send you is a copy of the original drawing.” (De Visme, 1769, pp. 72-73, and plate III).



Fig. 3.1. The “Golok” (Table III from De Visme, 1769).

The location of “Mevat” in De Visme’s account remains unclear. Although there is a Mevat or Mewat district in southernmost Haryana state of northwestern India, it is located far outside the hoolock distribution area. It is unlikely that De Visme was referring to this locality. Alternatively, another location called Mevat or Meuat appears to have existed farther to the east in Bihar state, at the shore of the Ganges river (Suprio Chakma, personal communication to TG, March 2010). The exact location of that second Mevat is not known, but Bihar state is, again, located west of, and not adjacent to, the Brahmaputra river. This fact makes it also doubtful that De Visme was referring to this locality.

The accepted scientific description of the hoolock gibbons started with *Simia hoolock* by Harlan (1834). Traditionally, the hoolock gibbons were identified as one species of the genus *Hylobates* and named *Hylobates hoolock*. The differences between hoolocks west and east of the Chindwin river were already noted during the Vernay-Hopwood Chindwin expedition of 1935 (Morris, 1943). Groves (1967) scientifically described the second subspecies, *H. h. leuconedys*. However, because the differences between the two recognized subspecies are apparently fixed, Mootnick and Groves (2005) suggested that they are diagnosably different and are better ranked as separate species: *H. hoolock* (Harlan, 1834) west of the River Chindwin and *H. leuconedys* (Groves, 1967) east of it.

Prouty *et al.* (1983a) showed that hoolock gibbons have a different karyotype, and so should be set apart in a distinct subgenus. Prouty *et al.* (1983b) proposed that the subgenus should be *Bunopithecus*, using a name proposed 60 years earlier for a fossil gibbon (Matthew and Granger, 1923). Roos and Geissmann (2001) provided molecular evidence that the four subgenera of the gibbons (*Bunopithecus*, *Hylobates*, *Nomascus*, and *Symphalangus*) were at least as distant to each other as humans (*Homo*) and chimpanzees (*Pan*) and should, therefore, all be elevated to genus rank. Mootnick and Groves (2005) showed that the generic nomen *Bunopithecus* is not applicable to hoolock gibbons and changed the generic name for hoolocks to the new name *Hoolock*.

The genus *Hoolock* is distinguished from all other gibbons by having a diploid chromosome number of 38; by the high number of coccygeal vertebrae (averaging 4.5); by the convex nasal bones pointed at the tip; by the narrow chest girth; by brow hair length increasing at the onset of maturity in males; and by the vocalizations, which are not sexually dimorphic, and include a guttural growl. Of all

the gibbon taxa, hoolock infants display the greatest contrast in colour compared to their mothers, being almost white (Mootnick and Groves, 2005).

Like crested gibbons (genus *Nomascus*), hoolock gibbons (genus *Hoolock*) occur in a particularly wide range of elevations in comparison to other gibbon species. The two genera share a mode of colour change which is unique among the Primates: both sexes change from a pale infant coat to an overall black one, but females change again at sexual maturity to brown or fawn. The possible significance of this for sexual selection is unknown. Because the two genera do not form a monophyletic clade, the colour change was suggested to be a symplesiomorphic condition related to their distribution outside the tropics and their tolerance of high altitudes (Mootnick and Groves, 2005).

Although gibbons of the genus *Hoolock* have occasionally been termed “white-browed gibbons”, the common English name of members of this genus is hoolock gibbons, which is derived from one of the local names. Some of the various ethnic and national languages and their respective names for hoolock gibbon include:

Assamese – *holou (bandar)*, Barman – *hulau*, Bengali – *ulluk* or *ulu bandar*, Bilashpuri – *bomamnush*, Bodo – *hulu makhra*, Chakma – *lagabandar*, near Cox’s Bazaar – *futubandar*, Garo – *heru* or *huru*, Hindi – *uluk*, Jayantias – *hulu*, Kachin – *woi*, Karbi – *jambli* or *kinghorduk*, Khamti – *howtu*, Khasi – *hulu* or *hulaing*, Lisu – *chemi*, Manipuri – *yongmu*, Idu Mishmi – *amepo*, Digaru Mishmi – *hulu*, Mizo Mishmi – *hulu*, Mizo – *hahuk* or *hauhuk*, Myanmar (Burmese) – *myauk-hlwe gyaw*, Nagamese – *kala bandar*, Nepali – *ban manche*, Rakhine – *too-boung*, Rankhol – *saha*, Riyang – *hulao*, Rukni – *hoolau*, Shan – *wu-wa*, Singpho – *hagrao*, Tangsa – *lungkhang* (Chetry *et al.*, 2007; Pocock, 1939; Walker and Molur, 2007; project findings).

The pronunciation of many of these names sounds similar to the biphasic notes the hoolocks produce during their loud song bouts (see, e.g., Geissmann, 1995, 2000).

3.5 How many hoolock species?

Two species of the hoolock gibbons are currently recognized: the western hoolock (*Hoolock hoolock*) and the eastern hoolock (*H. leuconedys*). The two forms are known to differ in their fur colouration (Groves, 1967, 1972, Mootnick and Groves, 2005) and their DNA-sequences (Thin *et al.*, 2010). The two *Hoolock* species may have diverged 1.42 million years ago from each other (Van Ngoc Thin *et al.*, 2010).

The classification of the hoolock gibbons is summarized in Table 3.1.

Table 3.1. Classification of the hoolock gibbons.

Taxonomic level	Taxonomic name	English vernacular
Kingdom	Animalia	Animals
Phylum	Chordata	Chordates
Class	Mammalia	Mammals
Order	Primates	Primates
Family	Hylobatidae	Gibbons, small apes
Genus	<i>Hoolock</i>	Hoolock gibbons
Species	<i>H. hoolock</i>	Western hoolock gibbon
	<i>H. leuconedys</i>	Eastern hoolock gibbon

The Chindwin River in Myanmar forms the common boundary between the two species (Groves, 1967), but hybrids between the two taxa are believed to occur in the headwaters of the Chindwin (Groves, 1967, 1972). Preliminary data from Arunachal Pradesh, India, suggests an as yet undescribed third form may occur in Dibang Valley, Lower Dibang Valley, Lohit and Anjao districts between Lohit and Dibang rivers (Das and Biswas, 2009).

The distinguishing fur characteristics of the hoolock taxa and the evidence for the occurrence of an intergrade area in the upper Chindwin are discussed below.

4. Range and distribution

4.1 Range of the genus *Hoolock*

Introduction

The hoolock gibbons range (Fig. 4.1) from the Brahmaputra River in the west to the Salween River in the east, extending the farthest north and west of all gibbon species (Geissmann, 1995; Groves, 1967).

Geopolitically, hoolock gibbons are distributed in forested areas from eastern India (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura states) and Bangladesh, through Myanmar to southern China (W Yunnan province).



Fig. 4.1. Distribution of the four genera of gibbons in Southeast Asia. Source: Thomas Geissmann.

4.2 Western hoolock gibbon (*Hoolock hoolock*)

Distribution in China

It is possible that the populations of hoolock gibbons near the Chinese border of Arunachal Pradesh (NE India) are contiguous with populations on the Chinese side, but no western hoolock gibbons have so far been recorded in China. Most of the borderline between eastern Arunachal Pradesh and China follows the crests of Himalayan mountain ranges that are too high to be crossed by gibbons. The large valley of the Lohit river, however, cuts through these barriers. The road along the Lohit River runs right up to the border with China at Kahao at an altitude of about 1,400 m. This is not a particularly high elevation for hoolock gibbons. Therefore, gibbon distribution may reach further upstream the Lohit and the occurrence of hoolock gibbon populations on Chinese territory may be a possibility, provided that suitable habitat remains there.

Distribution in India

In India, the western hoolock gibbon (*Hoolock hoolock*) occurs only in the northeastern part of the country. The gibbons occur in all the seven states of NE India, but only in the areas south of the Brahmaputra River and south of the Lohit district in Arunachal Pradesh (Fig. 4.2). The species has been recorded from altitudes of less than 50 m in Meghalaya to above 2,600 m in Nagaland (Choudhury, 2006).

Assam state has the largest hoolock population in India. Its population size was estimated to be around 4,500–5,500 individuals (excluding solitary individuals) (Das *et al.*, 2009, p. 423). The total population in the other states in India to be around 1,700–2,200 individuals, including 350–500 gibbons in Manipur, 500–600 in Meghalaya, 500–600 in Mizoram, and 350–500 in Nagaland (Choudhury, 2006, p. 84). Therefore, the total number of individuals in India was estimated to be in the range of 6,200–7,700 individuals (Chetry and Chetry, 2011; Das *et al.*, 2009, p. 423). This was an optimistic estimate however, because, as the authors point out, the actual area of occupancy and number of individuals may be less than estimated (Das *et al.*, 2009).

The gibbons of Arunachal Pradesh were apparently not included in this estimate. Several hoolock gibbon taxa have been reported to occur in this state, but the population of the western hoolock has been estimated to be about 160 individuals (Das and Biswas, 2009). Thus, the total estimate for this species in India might be around 6,350–7,850 individuals.

A much lower estimate of about 2,500 individuals was proposed by Das *et al.* (2006) and Molur *et al.* (2005), but this estimate does not include the gibbons from Manipur and Nagaland, as it was impossible to survey these states because of security problems.

The gibbon habitat in India is strongly fragmented and up to 111 hoolock sub-populations have been identified in the country (Molur *et al.*, 2005, p. 6). More than 55% of the sub-populations are believed to number less than 15 individuals, while only ten sub-populations have more than 50 individuals.

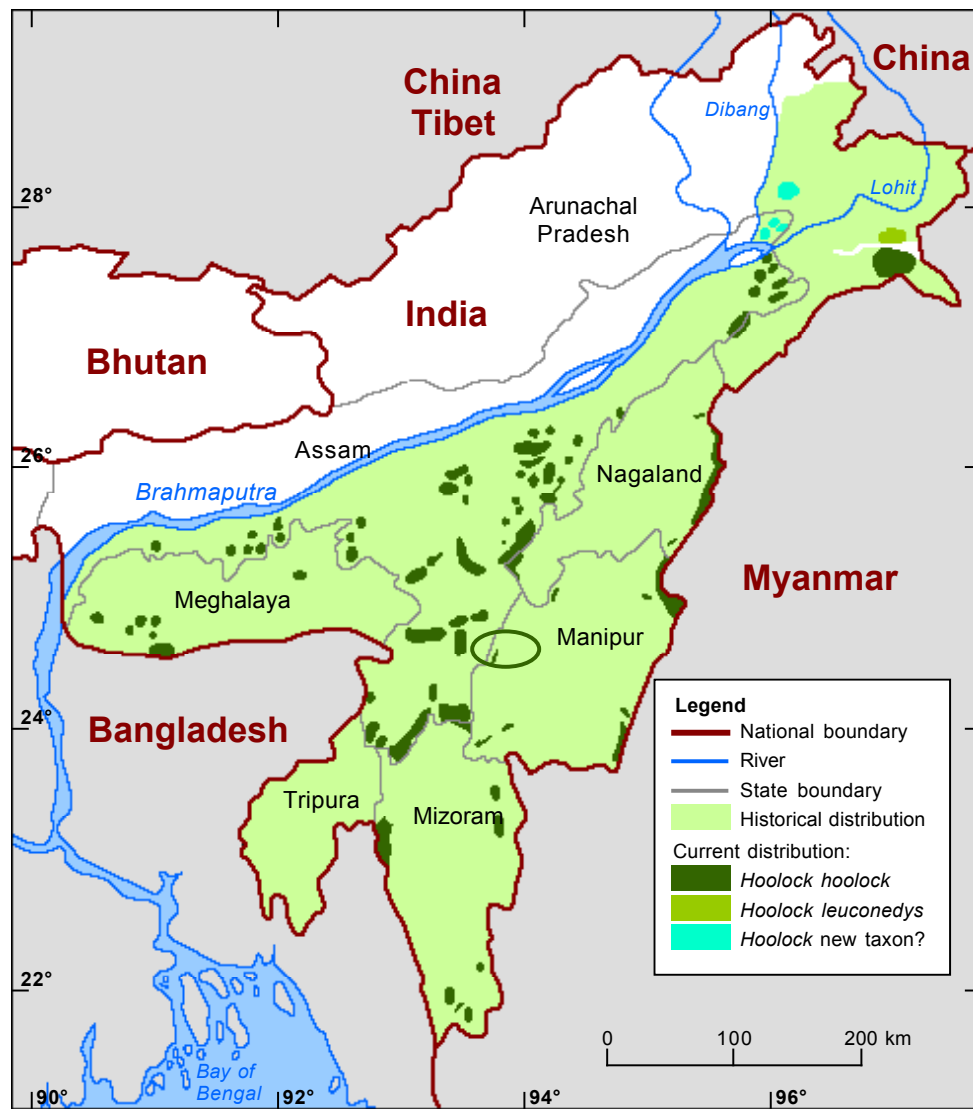


Fig. 4.2. Distribution map of hoolock gibbons in of Northeast India, based on Das *et al.* (2003), Choudhury (2006), Das *et al.* (2006), and Das and Biswas (2009).

Distribution in Bangladesh

In historical times, the western hoolock gibbon (*H. hoolock*) was distributed in Bangladesh southeast of the Brahmaputra river (Fig. 4.3).

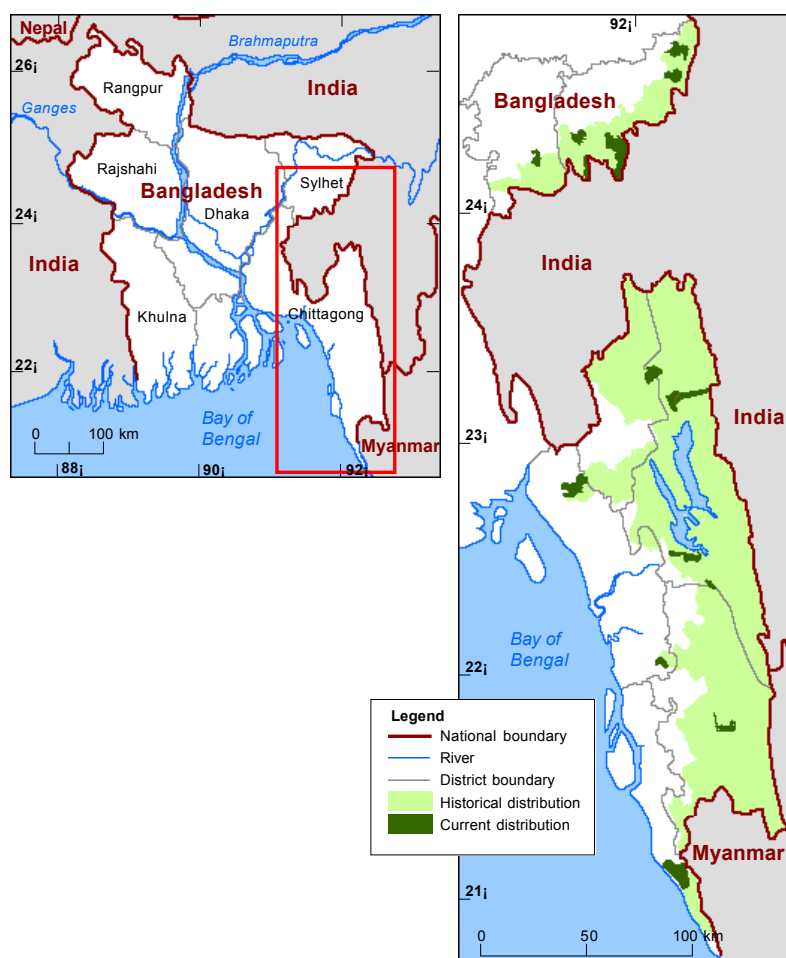


Fig. 4.3. Distribution map of the western hoolock gibbon (*H. hoolock*) in Bangladesh, based on Islam *et al.* (2006, 2011). The current hoolock population is spread across 35 isolated forest fragments that can be grouped into 13 areas as shown in the map. Most areas are situated near the eastern border of the country and all of them are located within the Chittagong and Sylhet divisions.

The current gibbon population was estimated to consist of 82 groups with a total of close to 300 individuals (Islam *et al.*, 2006, 2011).

The gibbons were distributed across 35 forest fragments. The largest of these (Lawachara and Kaptai) supported 42 and 84 individuals respectively, but 17 of the fragments had less than ten individuals. For a better overview the forest fragments are grouped into 13 areas in Fig. 4.3. All areas are located within Chittagong and Sylhet divisions, mostly near the eastern border of the country.

Over the last 20 or so years, the population dropped from over 3,000 individuals to less than 300 individuals. Between 2001 and 2005, eight sub-populations were extirpated from Bangladesh. A simulation model predicted about 95% population decline over the next two decades (Islam *et al.*, 2006, 2011).

The main threats include habitat loss and fragmentation (Islam *et al.*, 2011). Inbreeding depression was also suggested to pose a threat, but such an effect in the hoolock population has not been demonstrated by data.

4.3 Eastern hoolock gibbon (*Hoolock leuconedys*)

Distribution in China

In historical times, the eastern hoolock gibbon (*H. leuconedys*) was recorded in nine counties in the west bank of the Salween River in westernmost Yunnan province (Fig. 4.4).



Fig. 4.4. Distribution map of the eastern hoolock gibbon (*H. leuconedys*) in westernmost Yunnan province, China, based on Fan *et al.* (2008, 2011) and Fan and Ai (2011). The current hoolock populations can be grouped into four isolated main areas, which are numbered in the map. The first three areas are inside Gaoligongshan Nature Reserve (1: western slope, 2, 3: eastern slope).

Various earlier population estimates for *H. leuconedys* in China ranged from 50 to 300 individuals (Lan, 1994; Tian *et al.*, 1996; Zhang, 1998; Zhang *et al.*, 2002).

Based on more recent interview surveys conducted in Oct-Nov 2008 and field surveys conducted in Mar, Apr, and Aug 2009, the current Chinese population of hoolock gibbons was found to be restricted to three counties (Baoshan, Tengchong, and Yingjiang). The population size was estimated to be less than 200 individuals (Fan and Ai, 2011; Fan *et al.*, 2008, 2011; Fan, personal communication to TG, Sept 2010). The distribution area was restricted to four main areas (Fig. 4.4), three of which are located in the Gaoligongshan Nature Reserve, the fourth one being unprotected. The population was fragmented into 21 subpopulations, with the biggest of these comprising five groups.

The gibbons were found in forests between 1,600-2,600 m above sea level.

Group compositions of nine groups were determined during the surveys. Most groups comprised one adult pair, but two groups had one adult male with two adult females (Fan *et al.*, 2008, 2011). Group size (mean \pm standard deviation) was 3.89 ± 1.17 individuals (range 2-6 individuals).

Comparison with earlier surveys suggested a decline of the Chinese population. The main threats seem to be illegal hunting (Fig. 4.5), cardamom cultivation (which changes forest structure), isolation and small size of sub-populations, logging, and agricultural encroachment. Commercial logging (resulting in habitat destruction, degradation and fragmentation) was the main threat to gibbons living outside Gaoligongshan Nature Reserve.



Fig. 4.5. Gibbon skulls – presumed to originate from Myanmar – confiscated from wildlife traders in the Gaoligongshan mountains, China. Photo: Fan Pengfei.

Distribution in India

The hoolock gibbons in India were traditionally identified as western hoolocks (*H. hoolock*), but several surveys conducted from May 2005 onwards revealed that the eastern hoolock occurred in Lohit district and Lower Dibang Valley district of Arunachal Pradesh (Das and Biswas, 2009; Das *et al.*, 2006; Chetry *et al.*, 2008, 2010) (see Fig. 4.2). A total of 168 individuals were observed in the area south of the Lohit river (Das *et al.*, 2006). About 129 groups were estimated to occur in the Mehao Wildlife Sanctuary Lower Dibang Valley district (Chetry *et al.*, 2010), suggesting a population size of 518 individuals (based on an average hoolock group size of 3.3 individuals). Furthermore, at least ten groups of eastern hoolock gibbons were also recorded in the Sadiya subdivision in Tinsukia district of easternmost Assam (Chetry and Chetry, 2010; Chetry *et al.*, 2012; Pathak, 2010).

Based on their surveys in northeastern Arunachal Pradesh, Das and Biswas (2009) suggested that a possibly new taxon of hoolock gibbons may occur there. Reportedly, the taxon was distinguished from other hoolock gibbons by darker brown patches concentrated on the dorsal fur of adult females. According to Das and Biswas (2009), who observed a total of 58 individuals, the distribution area of the new taxon to be limited to the area between Lohit and Dibang rivers and includes parts of the Dibang Valley, Lower Dibang Valley, Lohit and Anjao districts (see Fig. 4.2). In another study conducted at Mehao Wildlife Sanctuary in the Lower Dibang Valley district, these gibbons are identified as *Hoolock leuconedys* (Chetry *et al.*, 2010).

5. Hoolock behavioural ecology

5.1 Social organization

Group size and social structure

Hoolocks live in small, socially monogamous family groups. Typical groups consist of an adult pair with 0-4 immature offspring. Table 5.1 lists published information on hoolock group size, showing that average group size ranges from 2.5 to 4.

Forest fragmentation appears to affect gibbon group size. During a study on the western hoolock in eastern Assam, gibbon groups were smallest (mean 2.5, $n = 2$ groups) in small forest fragments, whereas larger groups were found in medium-sized fragments (mean 3.29, $n = 24$ groups) and large forest-tracts (mean 3.9, $n = 28$ groups). This probably results from a loss of food sources and degradation of the habitat structure in smaller forest fragments (Kakati *et al.*, 2009).

Young gibbons leave their natal group when they reach maturity. Groups with two adult males or two adult females are very rare (e.g. Choudhury, 1990, 1991, 1996; Siddiqi, 1986). One untypical group which included two adult females (probably sisters) was unstable and ended up with one female permanently leaving the group (Ahsan, 1995). Mukherjee *et al.* (1992a, b) also reported one all-male group of seven individuals from Lohit district, Arunachal Pradesh (NE-India). This highly unusual group contained three adults, two subadults, and two juveniles. The authors did not specify whether this group was just seen just once or whether it was followed over several days in order to confirm that no female was present and that only one group was observed and not a temporary meeting of two groups.

Table 5.1. Published information on hoolock group size^(a)

Study site	Group size			Source
	Average ^(b)	Range	No. grps	
Western hoolock (<i>H. hoolock</i>)				
Bangladesh	2.65	?	34	Khan and Ahsan, 1986
Bangladesh	3.03 ±0.82	2-5	36	Das <i>et al.</i> , 2003
Chunati WS, Chittagong, SE-Bangladesh	2.71	2-4	7	Feeroz and Islam, 1992; Islam and Feeroz, 1992
Chunati WS, Chittagong, SE-Bangladesh	2.9 ±0.7	2-4	7	Ahsan, 2001
3 sites (Rajkandi RF, West Bhanugach, + Bhomariagona), NE-Bangladesh	3.5	2-5	6	Gittins, 1980, cited in Gittins and Tilson, 1984
West Bhanugach WS, Sylhet dist., NE-Bangladesh	4.0	3-5	6	Siddiqi, 1986
West Bhanugach WS, Sylhet dist., NE-Bangladesh	3.17	2-5	6	Feeroz and Islam, 1992; Islam and Feeroz, 1992
West Bhanugach WS, Sylhet dist., NE-Bangladesh	3.0 ±1.1	2-5	8	Ahsan, 2001
NE-India	3.32 ±0.35	2-4	129	Das <i>et al.</i> , 2003
Mizoram, NE-India	3.0	3-3	3	Gupta and Sharma, 2005a
Tripura, NE-India	3.2	2-4	5	Mukherjee, 1982, cited in Alfred and Sati, 1990b
Tripura, NE-India	3.0	?	9	Mukherjee, 1986, Mukherjee <i>et al.</i> , 1992a
Tripura, NE-India	3.1	2-3	8	Gupta and Dasgupta, 2005
Manipur, NE-India	2.66	?	3	Mukherjee et al., 1992a

Table 5.1. ctd.^(a)

Study site	Group size			Source
	Average ^(b)	Range	No. grps	
Western hoolock (<i>H. hoolock</i>)				
West Garo Hills dist., Meghalaya, NE-India	3.1	2-6	42	Alfred and Sati, 1990b
Meghalaya, NE-India	4.0	?	22	Gupta and Sharma, 2005b
Meghalaya and Assam, NE-India	3.2	2-6	24	Tilson, 1979
S-Assam, NE-India	2.9	2-4	10	Choudhury, 1996
Inner-line Reserved Forest, Barak valley, Cachar dist., S-Assam, NE-India	3.6	2-4	9	Islam <i>et al.</i> , 2013
Hollongapar, Assam, NE-India	3.4 ±0.9	2-5	7	Tilson, 1979
E-Assam, NE-India	3.83	2-5	6	Kakati, 2004
Gibbon Wildlife Sanctuary, Jorhat dist., Assam, NE-India	3.0	2-4	3	Sankaran, 2009
Assam, NE-India	3.1	2-4	8	Choudhury, 1990
Assam, NE-India	3.16	?-6	62	Das <i>et al.</i> , 2009
Assam and Arunachal Pradesh, NE-India	3.0	2-5	14	Choudhury, 1991
Tirap Dist., Arunachal Pradesh, NE-India	3.17	2-5	12	Mukherjee <i>et al.</i> , 1988, 1992a
Arunachal Pradesh, NE-India	3.1	?	46	Das <i>et al.</i> , 2009
Eastern hoolock (<i>H. leuconedys</i>)				
Sadiya subdivision, Tinsukia dist., E-Assam, NE-India	3.3	2-5	10	Chetry <i>et al.</i> , 2012
Lohit dist., Arunachal Pradesh, NE-India	3.40	2-7	16	Mukherjee <i>et al.</i> , 1992a, b
Mehao WS, Lower Dibang Valley dist., Arunachal Pradesh, NE-India	3.3	2-5	26	Chetry <i>et al.</i> , 2010
Mahamyaing WS, Sagaing region, Myanmar	3.0	2-4	7	Brockelman <i>et al.</i> , 2009
W. Yunnan, China	2.5	2-3	4	Lan, 1994
W. Yunnan, China	3.9	2-6	9	Fan <i>et al.</i> , 2011
<i>Hoolock</i> , uncertain species				
Hukawng Tiger Reserve, Kachin state, Myanmar ^(c)	3.5	3-4	8	Anonymous, 2006; Saw Htun <i>et al.</i> , 2006

(a) Groups consisting of a single individual were excluded from the count and the average was recalculated here, because solitary individuals are not considered as groups in the present study.

(b) Numbers indicate mean ± standard deviation (where available).

(c) Two sites were surveyed, one of which is considered within the range of eastern hoolock in this report. The figures given here are the averages from the two sites.

It should be noted that many group counts stem from surveys of non-habituated groups, not from long-term studies on habituated groups. During surveys, most groups are seen only briefly or while fleeing, which can sometimes lead to some individuals being missed (Brockelman *et al.*, 2009).

Locomotion

Gibbons typically exhibit a highly specialized form of locomotion called brachiation, swinging below branches suspended by their arms. Brachiation is an energetically advantageous mode of locomotion, and facilitates feeding in the terminal branch niche (Grand, 1972). Brachiation also allows for relatively high speeds in the canopy, and for jumps of ten meters or more (Fleagle, 1999).

Gibbons can also walk bipedally along large branches or on the ground, often using their arms for balance. Gibbons are strongly arboreal, however, and rarely come to the ground. When their habitat is fragmented and food trees are isolated, hoolocks are forced to descend from trees to cross clearings

(Chetry *et al.*, 2007; McCann, 1933; Kakati, 1997, 1999a) and may even be compelled to come down to the ground for feeding upon corn (Sarma *et al.*, 2013).

Locomotion on the ground is more common among captive animals, probably because there are few options for brachiation in many gibbon enclosures, or because the food for captive gibbons is often placed on the ground.

Home range and ranging behaviour

Like other gibbons, hoolocks are territorial. Territories are indicated by loud morning songs and defended by actively chasing intruders off of the territory.

Table 5.2. Published information on hoolock home range size. Numbers indicate mean home range size (and range of values).

Study site	Sample size		Home range (ha)	Source
	Groups observed	Study duration		
Western hoolock (<i>H. hoolock</i>)				
Chunati WS, Chittagong, SE-Bangladesh	1	24 months	25.7	Ahsan, 2001
Rajkandi, NE-Bangladesh	?, survey	5 months	23	Gittins and Tilson, 1984
West Bhanugach, Sylhet dist., NE Bangladesh	2	2 months	10.6 (3.2-18)	Gittins, 1980, cited in Gittins and Tilson, 1984
West Bhanugach WS, Sylhet dist., NE-Bangladesh	1	12 months	35 (30-35)	Feeroz and Islam, 1992; Islam and Feeroz, 1992
West Bhanugach WS, Sylhet dist., NE-Bangladesh	2	24 months	63.4 (40.7-86)	Ahsan, 2001
NE-India	?	?	(15-30)	Alfred and Sati, 1986, 1990a; Alfred, 1992
Tripura, NE-India	5 + 1 ^(a)	?	300 (300-400)	Mukherjee, 1982, cited in Alfred and Sati, 1990b
Tripura, NE-India	2	1976-1983		Mukherjee, 1986
West Garo Hills dist., Meghalaya, NE-India	42, survey	?	31 (14-55)	Alfred and Sati, 1990b
Hollongapar, Assam, NE-India	7	2 months	22 (18-30)	Tilson, 1979
Gibbon Wildlife Sanctuary, Jorhat dist., Assam, NE-India	3	3 months	41.8 (23.5-58.0)	Sankaran, 2009
E-Assam, NE-India	6	12 months	25.7 (13.0-47.8)	Kakati, 2004
Borajan RF, Tinsukia dist., E-Assam, NE-India	2	6 months	8 (5.4-10.5)	Kakati, 1997
Tirap dist., Arunachal Pradesh, NE-India	?, survey	3 months	ca. 200 ^(b)	Mukherjee <i>et al.</i> , 1988
Eastern hoolock (<i>H. leuconedys</i>)				
Lohit dist., Arunachal Pradesh, NE-India	?	?	100-200	Mukherjee <i>et al.</i> , 1992b
Nankang, Gaoligongshan National Nature Reserve (NNR), Yunnan, China	1	“preliminary observation”	ca. 100	Fan, 2008

^(a) Heard calling

^(b) Areas of high gibbon density

Table 5.2 summarizes published information on hoolock home range size and day range distance. Each family group occupies a home range of about 13-86 hectares (Ahsan, 2001, Feeroz, 1996; Feeroz and Islam, 1992; Kakati, 2004). One solitary female covered an area of about 73 ha which overlapped

nearly 15% with the home ranges of three neighbouring groups (Feeroz, 1996). Much larger home ranges of 300-400 ha were reported by Mukherjee (1982, cited in Alfred and Sati, 1990b), whereas particularly small home ranges were found by Kakati (1999a, b).

Table 5.3 summarizes published information on hoolock day range distances. Average day ranges vary widely among groups, and range from about 100 m to 3,000 m.

Table 5.3. Published information on hoolock day range distance. Numbers indicate mean day range (and range of values).

Study site	Sample size		Day range (m)	Source
	Groups observed	Study duration		
Western hoolock (<i>H. hoolock</i>)				
West Bhanugach WS, Sylhet dist., NE-Bangladesh	1	12 months	1,200 (600-1,600)	Feeroz and Islam, 1992; Islam and Feeroz, 1992
West Bhanugach WS, Sylhet dist., NE-Bangladesh	3 ^(a)	24 months	1,367 (278-3,375)	Ahsan, 2001
Tripura, NE-India	2	1976-1983	600 (300-1,000) ^(b)	Mukherjee, 1986
West Garo Hills dist., Meghalaya, NE-India	2	12 months	(300-2,000)	Alfred and Sati, 1994, + unpublished data cited in Kakati, 2004
Gibbon Wildlife Sanctuary, Jorhat dist., Assam, NE-India	3	3 months	1,136 (973-1,421)	Sankaran, 2009
E-Assam, NE-India	6	12 months	1,116 (654-1,513)	Kakati, 2004
Borajan RF, Tinsukia dist., E-Assam, NE-India	2	6 months	380.7 (130-1,000)	Kakati, 1997
Eastern hoolock (<i>H. leuconedys</i>)				
Lohit dist., Arunachal Pradesh, NE-India	?	?	100-200	Mukherjee <i>et al.</i> , 1992b

^(a) Includes one group from Chunati, Chittagong, SE-Bangladesh

^(b) Seasonal differences: summer 700-1,000 m, winter 400-800 m, rainy season 300-500 m

5.2 Habitat

Forest types

Hoolock gibbons are found in several types of habitats: tropical evergreen forest, the wetter tropical semi-evergreen forests, sub-tropical monsoon evergreen broadleaf forests, and sub-tropical evergreen broadleaf hill or mountain forests. The hoolocks appear to be less common in deciduous forest and scrub forest, and absent from mangroves (Choudhury, 1996; Gittins and Tilson, 1984; Lan, 1994). In some areas western hoolock gibbon home ranges include village woodlands or village orchards, for instance in the villages surrounding Nokrek National Park in the Garo Hills, Meghalaya, India, or in the Barikuri area in Tinsukia district of eastern Assam, India (Chetry *et al.*, 2007; Choudhury, 2001; Kakati, 1997). Similar observations were reported of eastern hoolock gibbons living in highly fragmented forest in the southeast boundary of Mehao Wildlife Sanctuary, Lower Dibang Valley district, Arunachal Pradesh, India (Sarma *et al.*, 2013).

Altitude range

Hoolock gibbons mostly occur at altitudes of 80-1,500 m (Choudhury, 1996; Mukherjee, 1986). However, western hoolocks have been recorded up to 2,550 m in Manipur (Choudhury, 2001), at elevations of 2,100-2,300 m on the slopes of Mt. Victoria, Chin state (King *et al.*, 1995), and up to about 2,600 m on Mt. Saramati in Nagaland of NE-India on the Nagaland-Myanmar border (Choudhury, 2006).

In Yunnan Province, China, eastern hoolocks were found at altitudes of 1,600–2,600 m (Fan *et al.*, 2011). During the Vernay-Cutting expedition to NE-Myanmar, eastern hoolocks were even reported in pine-dominated forests at altitudes as high as 2,400–2,700 m (Anthony, 1941), representing the highest altitude recorded for either species.

Non-human predators

Adult gibbons typically live in the canopy region of the forest where they have few natural predators except man and perhaps some birds of prey. In the lower stories of the forest, leopards, clouded leopards, and pythons are potential predators.

Densities

Table 5.4 summarizes published information on hoolock population densities. As the methods used to estimate these densities differ among authors, the comparability among these results is limited.

Table 5.4. Published information on hoolock population density (\pm standard deviation, where available) and habitat altitude (meters above sea level).

Study site	Population density		Altitude (m)	Source
	Groups/ km ²	Individuals/ km ²		
Western hoolock (<i>H. hoolock</i>)				
Bangladesh	0.3	1.6		Green, 1977
Bangladesh	0.40	1.06		Khan and Ahsan, 1986
Rajkandi RF, NE-Bangladesh	4.4	15.4		Gittins, 1980, cited in Gittins and Tilson, 1984
Lawachara NP, West-Bhanugach WS, Sylhet dist., NE-Bangladesh	1.12	4.08	22	Österberg, 2006
West-Bhanugach WS, Sylhet dist., NE-Bangladesh	0.23	0.91	10-25	Siddiqi, 1986 (Altitude: Ahsan, 2001; Feeroz and Islam, 1992; Islam and Feeroz, 1992)
Tripura, NE-India	0.55	1.45		Mukherjee, 1982, cited in Alfred and Sati, 1990b
West Garo Hills dist., Meghalaya, NE-India	3.01	9.03	165-1,170	Alfred and Sati, 1990b
Meghalaya and Assam, NE-India	2.20 ^(a)	7.04 ^(a)		Tilson, 1979
S-Assam, NE-India		0.5, 1.1 ^(b)	80-1,500	Choudhury, 1996
Karbi Anglong district, Assam, NE-India		2.43		Choudhury, 2009
Namdapha NP, Arunachal Pradesh, NE-India	0.74		200-4,500	Chetry, 2002
Eastern hoolock (<i>H. leuconedys</i>)				
Lohit dist., Arunachal Pradesh, NE-India	> 1			Mukherjee <i>et al.</i> , 1992a
Mahamyaing WS, Sagaing region, Myanmar ^(c)	1.8 ±0.3 2.3 ±0.4		258-474	Brockelman <i>et al.</i> , 2009
<i>Hoolock</i> , uncertain species				
Hukawng Tiger Reserve, Kachin state, Myanmar ^(c)	1.40, 1.46		206-1,409	Saw Htun <i>et al.</i> , 2006

^(a) This figure assumes complete occupancy of available space and thus represents a maximum value.

^(b) The lower (first) estimate is for degraded forest, the higher estimate for good forest.

^(c) Fixed listening post survey. The first density estimate is for a 0.6 km listening radius, the second estimate for a 1.0 km listening radius.

During a study on western hoolocks in eastern Assam, encounter rates for gibbon groups were lowest (0.09/km) in the small forest fragments (< 5 km²), increasing in medium-size fragments

(0.23/km in 20–30 km² forest fragments) and in large forest tracts (0.58/km in >100 km²), suggesting that forest fragmentation has a negative impact on gibbon density (Kakati *et al.*, 2009).

5.3 Feeding ecology

Like other gibbons, hoolock gibbons are arboreal and diurnal, prefer the upper canopy of the forest, and sleep and rest in emergent trees (Ahsan, 2001; Islam and Feeroz, 1992; Leighton, 1987). Most of their activities are performed on small branches on the peripheries of trees, and least on the trunks of trees (Hasan *et al.*, 2007).

Table 5.5 summarizes published information on hoolock diet composition, though it is worth noting that most of the available data on hoolock feeding ecology were collected on study groups of the western hoolock.

Table 5.5. Published information on hoolock mean dietary proportions (%).

Study site	Groups ob- served	Dietary proportions (mean and range)				Source
		Fruit [Figs alone]	Leaves	Flowers	Insects, small animals	
Western hoolock (<i>H. hoolock</i>)						
Chunati, Chittagong, SE- Bangladesh	1	71 [30]	13	14	1	Ahsan, 2001
West Bhanugach WS, Sylhet dist., NE-Bangladesh	?	89 [38]	6	5		Feeroz and Islam, 1992; Islam and Feeroz, 1992
West Bhanugach WS, Sylhet dist., NE-Bangladesh	2	78 [44]	12	4	5	Ahsan, 2001
NE-India	?	65 [36]	25 ^(a)	10 ^(b)		Alfred and Sati, 1986; Alfred, 1992
Tripura, NE-India	?	(30-40)	(50-60)	10 ^(c)		Mukherjee, 1986
Garo Hills, Meghalaya, NE- India	2	60 (37-75)	28 (7-59)	11 (0-34)	1 (0.4-3)	Alfred and Sati, 1994
Hollongapar, Assam, NE- India	?	67	32 ^(d)		1	Tilson, 1979 ^(e)
Borajan RF, Tinsukia dist., E-Assam, NE-India	2	38 (6-86)	59 ^(a) (3-93)	<3	<1	Kakati, 1997
E-Assam, NE-India	6	58 [15.7]	29	5.4	6.0	Kakati, 2004
Borajan RF, Tinsukia dist., E-Assam, NE-India	?	53	43			Das, 2002, cited in Kakati, 2004
Namdapha, Arunachal Pradesh, NE-India	?	63	30			Das, 2002, cited in Kakati, 2004
Eastern hoolock (<i>H. leuconedys</i>)						
Nankang, Gaoligongshan NNR, Yunnan, China	1	49.1 [13.5]	43.3	1.8	5.3	Fan, 2011; Fan <i>et al.</i> , 2013

^(a) Including buds.

^(b) Including insects.

^(c) Including buds and animal protein.

^(d) Including flowers.

^(e) Winter diet only. Summer diet may include higher proportion of fruit.

Hoolocks eat mostly fruits (51-89%), supplemented by leaves (6-32%); hoolocks also consume small quantities of flowers and insects (Alfred, 1992; Alfred and Sati, 1986, 1994; Feeroz and Islam, 1992; Gittins and Tilson, 1984; Islam and Feeroz, 1992; Kakati, 2004; Tilson, 1979). Only Mukherjee

(1986) found lower amounts of fruits (30-40%) and higher amounts of leaves (40-60%) in the diet of hoolocks in Tripura (NE-India), but it is unclear why his findings differ from those of the other studies. Among fruits, figs appear to be the most important food item and make up about 43-60% of the fruits consumed by hoolocks and about 36-38% of their total diet (Alfred, 1992; Alfred and Sati, 1986; Feeroz and Islam, 1992; Islam and Feeroz, 1992; Kakati, 2004).

Hoolock diet may exhibit marked seasonal changes (Alfred and Sati, 1994; Fan, 2011; Feeroz and Islam, 1992; Islam and Feeroz, 1992; Kakati, 2004; Mukherjee, 1986). Due to seasonal variation on the availability of different food items, leaves form a major portion of the hoolock gibbon's overall diet, especially when fruits are least available (Alfred and Sati, 1994). Maximum proportions of fruits are eaten in winter months, while in spring and summer increased proportions of flowers and leaves are consumed respectively. In eastern Assam, the general pattern is that gibbons eat more fruit than leaf in the wet season (53.7% and 13.7%), and more leaf than fruit in the dry season (Kakati, 2004).

In a study group of eastern hoolocks in Nangkang, Gaoligongshan National Nature Reserve (NNR), Yunnan, China, seasonal fluctuations were particularly pronounced (Fan, 2011; Fan *et al.*, 2013). This group lived in high montane forest at around 2000 m a.s.l., where fruit availability (including figs) declined to nearly zero in cold months (December to February). During a one-year study, leaves accounted for 81.9% of the group's monthly diet in January and decreased to 6.8% in October, when fruits were most abundant. Figs accounted for around 50% of the monthly diet in August and September but accounted <20% in all other months. Non-fig fruit accounted for 76.7% of monthly diet in October but only accounted 4.0% in August.

Very little is known about the behavioural ecology of high altitude hoolock populations, e.g. in NE-Arunachal Pradesh or NE-Myanmar, which may differ considerably from that of hoolocks living at lower elevations.

5.4 Life history

Life history variables in hoolock gibbons are not well studied. In the following review, where specific information on hoolock gibbons is lacking, it is supplemented with data from the well-studied white-handed gibbon (*Hylobates lar*), based on the assumption that the species share ecological traits. However as more research will be conducted on the hoolock this information may have to be revised.

Body size

Males and females in all gibbons are of a similar body size (Geissmann, 1993). Body weights of adult, wild hoolock gibbons are summarized in Table 5.6. The average weight is about 7 kg (range: 6.0-8.5 kg, N = 18) (Geissmann, 1993). Head-and-body length is about 45-63 cm (Gurung and Singh, 1996).

Table 5.6. Published information on hoolock body weights in kg (Geissmann, 1993, pp. 155-156). All weights are of adult, wild individuals.

Taxon	Males					Females				
	Mean	SD	Count	Min	Max	Mean	SD	Count	Min	Max
Western hoolock (<i>H. hoolock</i>)	7.32	0.62	3	6.69	7.94	6.35	–	1	–	–
Eastern hoolock (<i>H. leuconedys</i>)	6.96	0.96	7	5.30	8.50	7.74	0.36	2	7.48	8.00
Genus <i>Hoolock</i> ^(a)	6.87	0.83	13	5.30	8.50	6.88	0.83	5	6.01	8.00

^(a) Includes three males and two females of unknown species identity.

Reproduction

Ovarian cycles in hoolock gibbons were reported to have an average duration (\pm standard deviation) of 27.8 \pm 4.1 days (Matthews, 1946). This information is based on observations of menstrual

bleedings of one captive female, of which six cycles were monitored. Ovarian cycle durations determined for various gibbon species (including individuals of the genera *Hylobates*, *Nomascus* and *Symphalangus*) using hormonal data produced lower values of 21.7 ± 1.5 days (range of means from nine studies: 20.0-25.4 days; Geissmann and Anzenberger, 2009). The reason for this discrepancy is that monitoring of menstrual bleedings may not yield sufficiently reliable estimates of cycle length (Geissmann and Anzenberger, 2009). Therefore, the hoolock value suggested by Mathews (1946) may be an overestimate.

In wild hoolock gibbons, matings were reported to occur more often in March-May (Feeroz and Islam, 1992).

Gibbons give birth to single offspring; twins are very rare (Geissmann, 1989). Birth in wild hoolocks typically occurs from November to February (Alfred, 1992; Alfred and Sati, 1990b; Ahsan, 2001; McCann, 1933; Tilson, 1979). The gestation period in gibbons of the genera *Hylobates*, *Nomascus* and *Symphalangus* is about seven months, *i.e.* about 183-225 days (Geissmann, 1991). No reliable information on the gestation period for hoolock gibbons is available, but it is likely to be similar to that of the other gibbons.

The mean inter-birth interval in wild white-handed gibbons (*Hylobates lar*) is at least three years (Brockelman, 1999), or 41 ± 9.1 months (Reichard and Barelli, 2008). A similar duration probably applies to hoolock gibbons as well.

Maturation

Young gibbons are born with virtually hairless ventral parts and must rely on their mothers for warmth. Nursing lasts about two years. In wild white-handed gibbons (*H. lar*), weaning ages of two infants were determined as 21 and 23 months (Treesucon, 1984). An infant gibbon born to a family group of western hoolocks at Lawachara, West Bhanugach Reserve Forest, Sylhet Forest Division of Bangladesh “was performing all activities freely, but still suckling from time to time and spending the night with its mother” (Ahsan, 2004).

Young gibbons stay with their parents until they are past adolescence [suggest an age?]. In captivity, gibbons usually attain sexual maturity at an age of about 6-8 years, but this appears to be highly variable (Geissmann, 1991; Matthews, 1946) and may occur earlier in captive than in wild gibbons. At maturity, offspring probably leave the natal group or may be chased off by their parents. In wild white-handed gibbons (*H. lar*), dispersal commonly occurs between 8 and 10 years (Brockelman *et al.*, 1998), and female mean age at first reproduction is 11.06 years (Reichard and Barelli, 2008).

Life span

Most captive hoolock gibbons are held in Asia and have rarely survived long in captivity. No reliable information about their maximum life span is available. Life spans exceeding 40 years have been recorded for other gibbon species in captivity. A gibbon longevity record of 60 years was recorded for an Abbott's gibbon (*Hylobates muelleri abbotti*) in captivity (Geissmann *et al.*, 2009). This is one of the highest known life spans among non-human primates, including the great apes.

Maximum longevity may be considerably lower in wild gibbons than in captive ones, since older gibbons receive special care in captivity, whereas their wild counterparts would be much less likely to survive due to the need to travel, forage, and defend themselves against sickness and competitors.

5.5 Behaviour and communication

Behavioural characteristics

Hoolock gibbons shun open water and may drown if they fall into it (Candler, 1903), but at least one captive hoolock infant was apparently observed to swim (McCann, cited in the editor's comment to Parsons, 1940).

Hoolocks bask in the morning sun, especially during the cold winter season (Choudhury, 1996; McCann, 1933; Tilson, 1979; Kakati, 2004). High, leafless trees situated at the centre of the territory are favoured for this behaviour.

Hoolock groups appear to have favourite pathways through the canopy of their territory, which they use more frequently than other routes (Feeroz and Islam, 1992; Islam and Feeroz, 1992; Kakati, 1997).

Table 5.7 summarizes published information on the activity budget of wild hoolock gibbons. Again, most of the available data stem from western hoolocks.

Table 5.7. Published information on hoolock daily activity budget (%).

Study site	Groups observed	Feed	Travel + Forage	Rest	Call	Social activities	Source
Western hoolock (<i>H. hoolock</i>)							
Chunati, Chittagong, SE-Bangladesh	1	33.9	25.8	36.0	2.1	2.3	Ahsan, 2001
Lawachara NP, West-Bhanugach WS, Sylhet dist., NE-Bangladesh	2	26.8	16.7	36.2	≤1.9	18.4	Österberg, 2006
West Bhanugach WS, Sylhet dist., NE-Bangladesh	?	39	25	26	4	6	Feeroz and Islam, 1992; Islam and Feeroz, 1992
West Bhanugach WS, Sylhet dist., NE-Bangladesh	2	30.2	34.7	25.8	3.2	4.1	Ahsan, 2001
NE-India	?	60	15	8	2-3	15	Alfred and Sati, 1986; Alfred, 1992
Tripura, NE-India	?	40 ^(a) 50 ^(b) 65 ^(c)					Mukherjee, 1986
Garohills, Meghalaya, NE-India	?	25-45					Alfred and Sati, 1994
Inner-line Reserved Forest, Barak valley, Cachar dist., S-Assam, NE-India	1	32.3	27.9 ^(c)	23.5	3.1	13.2 ^(c)	Islam <i>et al.</i> , 2013
Borajan RF, Tinsukia dist., E-Assam, NE-India	2	11.6	5.0	81.9	0.7	0.5	Kakati, 1997
E-Assam, NE-India	6	16.8-23.7	16.1-27.7	45.1-52.0	0.6-1.5	0.4-6.4	Kakati, 2004
Borajan RF, Tinsukia dist., E-Assam, NE-India	?	43.0	6.0	46.0	0.6	0.9	Das, 2002, cited in Kakati, 2004
Namdapha, Arunachal Pradesh, NE-India	?	55.0	5.7	33.0	1.6	2.4	Das, 2002, cited in Kakati, 2004
Eastern hoolock (<i>H. leuconedys</i>)							
Nankang, Gaoligongshan NNR, Yunnan, China	1	31.6	25.1	36.7	≤0.4	6.3	Fan, 2011; Fan <i>et al.</i> , 2013

(a) Rainy season

(b) Summer

(c) Winter

(d) In this study, the activity "Travel" was not combined with "Forage", but with "Social activities".

Hoolocks spend the largest part of their activity period feeding (11.6-65%) or resting (8-81.9%). However, as with their day ranges and their dietary choices, hoolock activity budgets exhibit strong seasonal fluctuations. Because of these seasonal fluctuations, activity budget data should be sampled for at least one year in order to be representative. In the winter season, hoolocks spend more time feeding, less time travelling, less time grooming, their songs start later, they produce fewer song bouts, and they retire to their sleeping trees earlier than in summer (Feeroz and Islam, 1992; Islam and Feeroz, 1992; Mukherjee, 1986).

In a study on a group of eastern hoolocks living in high montane forest of Nangkang, Gaoligongshan National Nature Reserve (NNR), Yunnan, China, seasonal changes of the activity budget were pronounced (Fan, 2011; Fan *et al.*, 2013). During the cold months (December to February), when fruit availability declined to nearly zero, the gibbon group shifted their diet to leaves and increased feeding time, but also increased resting and decreased travel and social behaviours, possibly to conserve energy. At night, gibbons most often sleep sitting up, and (less often) in a lying position (Fan and Jiang, 2008; Reichard, 1998). A hoolock family group spends the night in one of its preferred “sleeping” trees, which are usually among the tallest within the territory, and are situated on its periphery, on slopes or near a hilltop (Ahsan, 2001; Feeroz and Islam, 1992; Islam and Feeroz, 1992). The whole group may sleep on one tree or distributed between two different trees.

Vocal communication

Gibbon groups produce loud, stereotyped song bouts in the early morning. Songs probably serve to defend resources such as territories, food trees and partners, but may also help to attract potential mates or to advertise the singer's fitness. In addition, simple duet songs may serve mate-guarding or pair-status advertisement. More complex duets, such as those of the siamangs (*Symphalangus syndactylus*) may also serve to strengthen the pair-bond and to advertise pair-bond strength (Geissmann, 1999; Geissmann and Orgeldinger, 2000).

Gibbon songs include species-specific characteristics, which are inherited and not learned (Geissmann, 1993).

Mated hoolocks typically produce duet songs, which consist of coordinated vocal interactions by both partners. Mates may use sex-specific phrases, but in contrast to other gibbon species, no sex-specific note types are used during hoolock songs (Choudhury, 1989; Geissmann, 1993, 1995, 2002; Gittins and Tilson, 1984; Haimoff, 1985; Marshall and Marshall, 1986; Marshall *et al.*, 1986).

Other family members may participate in the song bout. Solo song bouts are typically produced by unmated hoolocks only (Geissmann, 2002a).

Duet song bouts have an average duration of 14-20 min (Ahsan, 2001; Feeroz and Islam, 1992; Gittins and Tilson, 1984; Lan *et al.*, 1999; Tilson, 1979).

Hoolocks produce most song bouts from preferred calling trees. These are tall emergent trees mostly situated near the territorial border (Ahsan, 2001; Feeroz and Islam, 1992; Sankaran, 2009).

Like other gibbons, hoolocks sing more on sunny days and less on rainy or stormy days (Ahsan, 2001).

Olfactory communication

Hoolocks exhibit a sternal glandular field as well as a less well-defined glandular concentration in the inguinal area, which may play a role in olfactory communication (Geissmann, 1993; Geissmann and Hultegger, 1994). In addition, skin glands of hoolock gibbons (and crested gibbons, genus *Nomascus*) produce a reddish secretion (Geissmann, 1993; Geissmann and Hultegger, 1994; Mootnick and Groves, 2005). In females, the colour of the secretion may tinge the fur colouration. Therefore, the secretion may not only provide olfactory information but also visual information. In addition, a thermoregulatory role of the glands has also been suggested (Geissmann, 1993).

Tactile communication

Social grooming is the most commonly observed social behaviour in hoolocks (Alfred, 1992) and probably plays a role in reinforcing the bonds between group members, reducing tension, and keeping the pelage clean (Ahsan, 2001).

5.6 Discussion of hoolock behavioural ecology

The currently available data on the behavioural ecology of the hoolock are biased by several factors:

- Most observations were carried out on the western hoolock (*H. hoolock*), whereas the eastern hoolock (*H. leuconedys*) has been rarely studied.
- Most behavioural and ecological studies were carried out in Bangladesh and NE India. Comparatively little is known of the behavioural ecology of hoolocks in China. The main populations of both hoolock species, however, occur in Myanmar, and remain completely unstudied.
- All behavioural and ecological observations were carried out in the more accessible lowland or hill forests. Little is known about the hoolocks living at elevations above 1,500 m. Of particular interest are the high altitude populations reportedly living in pine-dominated forests at altitudes of up to 2,400-2,700 m (Anthony, 1941; Fan *et al.*, 2011). Given the differences in habitat and climate, their behavioural ecology (e.g. home range, day range, diet, activity budget, seasonal fluctuations on behaviour) might differ considerably from that of the hoolock gibbons studied so far.

6. Hoolock gibbon species descriptions

6.1 General features of hoolock gibbons

Adult hoolock gibbons

Adult hoolock gibbons exhibit a striking sexual dichromatism, meaning pelage colouration of males and females contrast strongly (Fig. 6.1). The pelage of adult males is black with distinct white eyebrows, and they also have a long genital tassels. Adult females have a beige or grey-buffy pelage, and the cheeks and ventral area are often darker brown. In addition to the white eyebrows, the female also exhibits a thin whitish margin around the black facial area and a white stripe below the eyes and across the ridge of the nose (Geissmann, 1995; Groves, 1967).

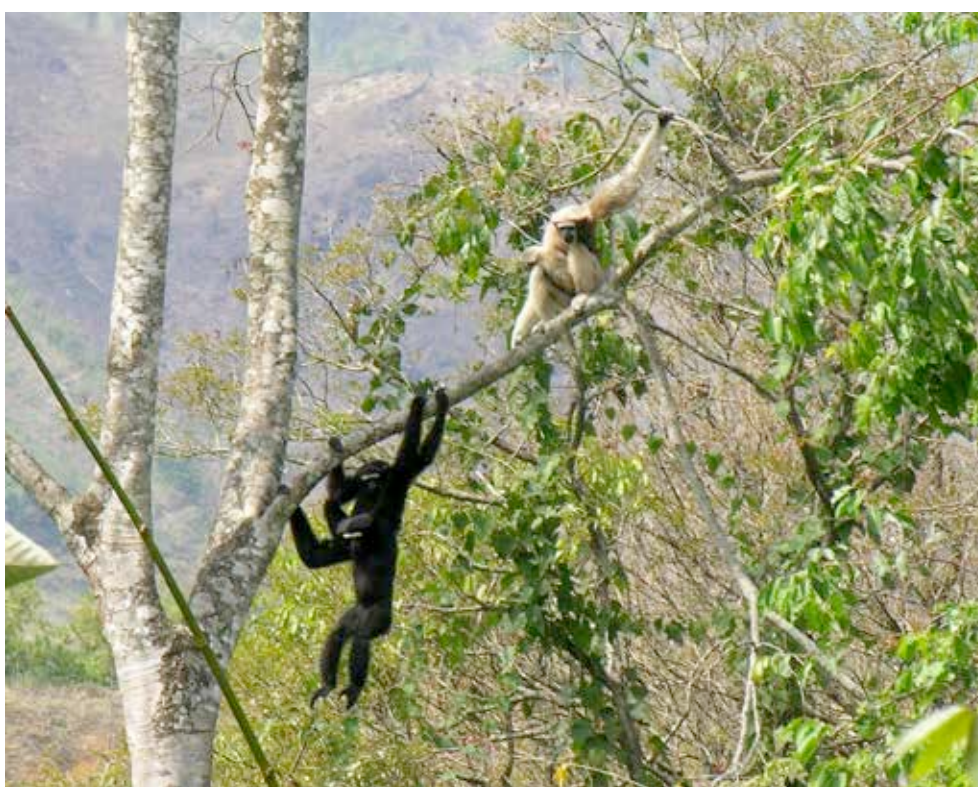


Fig. 6.1. Eastern hoolock gibbon (*H. leuconedys*), family group: The adult male and a juvenile individual are hanging from a branch on the left, the adult female carrying an infant is sitting on the same branch to the right. Mehao Wildlife Sanctuary, Lower Dibang Valley district, Arunachal Pradesh, India. Photo: Jihosuo Biswas, 6 April 2009.

Immature hoolock gibbons

Figure 6.2 shows hoolock gibbons in various stages of pre-adult fur colouration. When a hoolock is born, its coat is a milky white colour (Alfred, 1992; Alfred and Sati, 1990; Kakati, 1999a, b). During the second half of the first year, the colour changes to black within a few months; only the brow band remains white. The young gibbons then resemble adult males in their fur colouration. Females turn to their adult beige colouration about the time of sexual maturity. The timing of the colour changes is variable and takes several months to complete.



Fig. 6.2. Hoolock gibbons showing various stages of pre-adult fur colouration: (a) infant western hoolock (*H. hoolock*) with cream-coloured neonatal coat. Lawachara National Park, Bangladesh, 2006. (b) Infant males of the eastern hoolock (*H. leuconedys*) after the change to the dark fur colouration which they will keep for several years. Pets, Myitkyina, Kachin state, 1 Feb 2010. (c) juvenile/subadult female eastern hoolock (*H. leuconedys*), pet, one year before changing to pale fur colouration of adult females. Pet, Myitkyina, Kachin state, 2 Feb 2010. (d) subadult female eastern hoolock (*H. leuconedys*), in mid-change between dark juvenile and light adult fur colouration. Yangon Zoo, 4 Dec 2008. Photos: (a) Sirajul Hossain, (b)-(d) Thomas Geissmann.

6.2 Species identification

Species-specific characteristics

The species-specific fur characteristics of the western and the eastern hoolock gibbon are summarized in Table 6.1, and were described by Groves (1967, 1972, 2001) as follows:

- Western hoolock gibbon (*Hoolock hoolock*): Adult male: “preputial tuft black, or with only a faint grizzling; brow streaks close together, with white hairs between; little white on chin or under eyes.” Adult female: “hands rarely lighter than body.” (Groves, 1972, p. 66).
- Eastern hoolock gibbon (*H. leuconedys*): Adult male: “all males have a white preputial tuft; brow streaks are well-separated with no white hairs between; chin often with white hairs; often white hairs under eyes.” Adult female “Females: ... usually have at least a trace of lightening on the hands and feet.” (Groves, 1972, p. 67).

Examples of adult males and females of both species are shown in Figs. 6.3 and 6.4.

Table 6.1. Fur colouration characteristics of western and eastern hoolock gibbons.

Character	Western hoolock (<i>H. hoolock</i>)	Eastern hoolock (<i>H. leuconedys</i>)
Male white brows	Close together	Separate
Male chin	No or little white	Grizzled with some buff or whitish hairs
Male genital tassel	Black or dark brown	Grizzled with buff or whitish hairs or all buff
Female hands and feet	Like arms and legs	Often lighter than arms and legs

The characteristics listed in Table 6.1 were established based on wild-shot museum specimens of known origin. They are often difficult to observe in unhabituated wild hoolocks. Furthermore, more variation appears to be involved than documented in previous publications. These characteristics should be regarded as guidelines for species identification rather than truly diagnostic characteristics, because they do not apply to every adult individual due to a number of restrictions that are listed below and that are discussed in more detail in the following sections:

1. Atypical individuals of one species may exhibit features of the other species, or individuals may exhibit a mixture of characteristics of both species.
2. An intergrade area between the two species may occur around the headwaters of the Chindwin.
3. The genus *Hoolock* may comprise additional taxa.



Fig. 6.3. Western hoolock gibbon (*Hoolock hoolock*) from Borajan Wildlife Sanctuary, Tinsukia district, Assam, India: (a) adult male, (b) adult female carrying infant. Photos: Dhritiman Mukherjee, 14 June 2008.



Fig. 6.4. Eastern hoolock gibbon (*H. leuconedys*), adult pair (left: female, right: male) at Nay Pyi Daw Zoo, Myanmar. Photo: Thomas Geissmann, 29 Feb 2012.

Atypical individuals

Atypical individuals within the distribution of one species may exhibit features of the other species. Two examples are shown in Fig. 6.5.



Fig. 6.5. Hoolock gibbon males with untypical fur characteristics. (a) Western hoolock (*Hoolock hoolock*) from Lawachara National Park, Bangladesh, showing clearly separated eyebrows that are usually typical of the eastern hoolock. (b) Eastern hoolock (*H. leuconedys*) from Mehao Wildlife Sanctuary, Lower Dibang Valley district, Arunachal Pradesh, India, showing joined eye-brows resembling those normally found in western hoolocks and hardly any grizzling on the chin. Photos: Sirajul Hossain, 2006, and Jihosuo Biswas, 6 April 2009, respectively.

Wild-born hoolock gibbons exhibiting a mixture of species-specific characteristics have repeatedly been found in captivity. It is usually unknown where they come from, particularly whether they might originate from an intergrade area (see below). An example is shown in Fig. 6.6. This adult male exhibits a broad white brow-band that is fused in the middle, suggesting an identification as *H. hoolock*. On the other hand, the white beard and the white genital tassel suggest an identification as *H. leuconedys*.

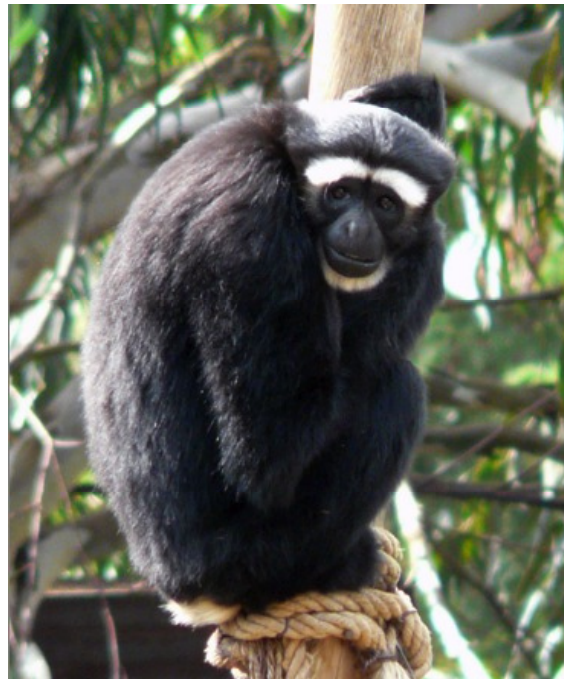


Fig. 6.6. Adult male hoolock gibbon at Kunming Safari Park, Yunnan province, China, exhibiting characteristics of both the western and the eastern species. Photo: 7 June 2010, Thomas Geissmann.

Additional taxa?

Das and Biswas (2009) suggested, that an additional taxon may occur in Arunachal Pradesh state, NE India, in the area confined by the Dibang river to the west and by the Lohit river to the south. The distinguishing characteristics of this species reportedly include the presence of darker brown patches concentrated on the back of females only. Gibbons from this area were identified as eastern hoolock (*H. leuconedys*) by Chetry *et al.* (2010). Until formal description of the new taxon, we follow Chetry *et al.* (2010).

Intergrade area?

Groves (1967) documented the differences in fur colourations between western and eastern hoolock populations separated by the Chindwin river. Based on his study of museum skins, Groves (1967) suggested that interbreeding between the two forms may take place around the headwaters of the Chindwin, more specifically at Dalu (26.26°N, 96.08°E) (Groves, 1972, p. 67). In contrast, Marshall and Sugardjito (1986, p. 180) listed specimens from Dalu stored at the American Museum of Natural History, New York (AMNH 112684, 112686, 112963) as eastern hoolocks (*H. leuconedys*).

The Chindwin river is named Tanine (or Tanai) in its headwaters, which are located within the Hukawng valley and which includes the Hukawng Valley Wildlife Sanctuary and the Hukawng Valley Tiger Reserve (extension). From Dec 2005 to Jun 2006, hoolock gibbon surveys were conducted by WCS teams at various sites in Hukawng valley east of Tanine town (Anonymous, 2006; Saw Htun *et al.*, 2006). According to the earlier of the WCS reports (Anonymous, 2006, p. 7), fur colouration of gibbons west of the Tanine river corresponded to that of *H. hoolock* (“with eye brows separated” and “genital tufts have no white colour”), whereas gibbons east of the Tanine looked like *H. leuconedys* (“with eye brows separated” and “genital tufts are of white colour”). This suggests that the Tanine river west of Tanine town is still an efficient species boundary, contradicting Groves (1972) who suggested that interbreeding may occur at Dalu, which is located downstream and west of Tanine town.

According to field leader of the WCS team, Saw Htun, the evidence for the species distribution collected during these surveys consisted of three pets kept by local people (Saw Htun, pers. comm. to TG, 2011). Photographs of these animals are shown in Fig. 6.7. They suggest that the main Tanine

river is the dividing line between two hoolock species (Saw Htun, pers. comm. to TG, 2011). Therefore, if a transitional area between the two species exists, it should be located in the headwaters of the Tanine river further upstream of Tanine town.



Fig. 6.7. Pet hoolock gibbons from the Hukawng valley area west of the Tanine river (a), and east of the Tanine river (b) and (c). Photos used with permission by Saw Htun / WCS Myanmar Program.

These three animals, however, do not represent a conclusive sample size for documenting the absence of interbreeding in the WCS study area (Saw Htun, pers. comm. to TG, 2011). Furthermore, two of the pets are infants (Figs. 6.7a and c), and it is currently unclear to what degree the fur characteristics of immature hoolock gibbons are species-specific. Thus, the value of these individuals as evidence for the absence of interbreeding in the study area is uncertain. If their eyebrows were an indicator, the eyebrow separation of the infant shown in Fig. 6.7c would appear to be intermediate between the conditions shown in Figs. 6.7a and 7b.

However, it appears that infant hoolock gibbons tend to have broader brow bands that are often fused between the eyes, regardless of whether they are western or eastern hoolocks. At some stages, young infants may even exhibit whitish face rings. This is illustrated in Fig. 6.8, showing two infant pet gibbons from the Indawgyi Lake area (both were reported to originate from there). Although the Indawgyi Lake area is located within the distribution area of the eastern hoolock (*H. leuconedys*), the white brow bands of both infants are fused above the nasal ridge, suggesting that this characteristic is of limited value for species identification in infant hoolocks.



Fig. 6.8. Two infant eastern hoolock gibbons (*H. leuconedys*) from the Indawgyi Lake area, Kachin state, Myanmar. In both pet gibbons, the brow bands are fused to some degree. Infant b also exhibits a light face ring. Photos: 14 and 29 Jan 2010, Thomas Geissmann.

In conclusion, it is unclear at present to what degree the Tanine river acts as a boundary between the two hoolock species. Observations of adult males from the area would help to resolve the question.

7. Hoolock gibbon records in Myanmar

7.1 Introduction

For this status review, we have compiled all hoolock gibbon records that could be located, a number of which were previously unpublished. The oldest date back to the mid-1800s, well before the distinction between western and eastern hoolock was made by Groves (1967), but which nonetheless can usually be separated by locality.

Based on this literature review, hoolock gibbon record data from Myanmar can be roughly grouped into three time periods:

Historical Records (before 1960)

Modern Records (1980-2004)

Recent Records (2005-2010)

In this section, hoolock records are ordered by species (western hoolock, then eastern hoolock), then by state or region (roughly, from north to south), then by record type (historical, modern, then recent), then from north to south. Records are numbered sequentially by species, for ease of reference. For each record we note alternate spellings for place names found either in the literature or otherwise known to us, as well as whether the site is categorized as reserved or protected forest under Myanmar law. In the case of protected areas, we do not distinguish here between areas that are fully gazetted or only notified.

Firstly, however, we provide here a brief discussion of the history of hoolock research in Myanmar, and the origin of the records that follow.

7.2 Origin of Myanmar hoolock gibbon records

Some early accounts on the hoolock gibbons of Myanmar were provided by John Anderson, who accompanied three expeditions to Myanmar as a naturalist in 1867, 1875-6, and 1881-2 (Alcock, 1901). The first two expeditions, to northeastern Myanmar, met particularly numerous obstacles and dangers. “The difficulties experienced by both missions from the time they crossed the frontier between Myanmar and China, and the opposition of the inhabitants of the country, seriously interfered with zoological observations, and the collection of specimens was generally impossible” (Alcock, 1901; Anderson, 1879).

Many of the historical hoolock gibbon records for Myanmar were collected by the Bombay Natural History Society’s Mammal ‘Survey of India, Burma and Ceylon’ between 1913 and 1915 (Fry, 1929; Riley and Shortridge, 1913; Whroughton, 1916a, b), the Vernay-Hopwood Chindwin expedition of 1935 (Carter, 1943; Morris, 1936), and the Vernay-Cutting expedition of 1938-1939 (Anthony, 1941). Although field observations were occasionally collected during some of these early expeditions, their main goal was to collect wildlife specimens for zoological collections. Nonetheless, they provided new insights in the diversity and distribution of species in the areas they surveyed, and various new species descriptions resulted. They also yielded much additional information on hoolock gibbons.

There is a considerable gap in the records between the 1940s and 1980s. Indeed, the only hoolock record between 1939 and 1983 comes from 1959 (Chi Ko Ko, 1983), which we have included with Historical (i.e. pre-1960) Records rather than Modern (post-1960) Records.

World War II (1939-1945), and particularly the Japanese invasion of the then British-administered Burma in 1942, effectively closed the country to scientific research. The aftermath of war must likewise have limited possibilities for research due to the difficulties of raising the funding

necessary for big and costly collection expeditions, not to mention constraints posed by the country's transition to independence in 1948. Chi Ko Ko's 1959 survey to the Saramati (= Saramiti) area might be an indicator that the conditions for field research in Myanmar were improving by this time, but before that project could bear further fruits the political system changed radically and field research in the country became impossible again.

The first Modern Records on hoolock gibbons in Myanmar were collected in 1983, when the UNDP- sponsored 'Nature Conservation and National Parks Project, Burma', was looking for sites in Myanmar suitable for protected areas (Blower *et al.*, 1983; Salter, 1983; Sayer, 1983; Sayer *et al.*, 1983). The resurgence of surveys in the 1980s indicated a new opening of the country for research. Bird watching tours in Myanmar started to become popular during the 1990s, and occasionally collected hoolock records (e.g. Eames *et al.*, 2002; King *et al.*, 1995). The most recent Modern Records of hoolock gibbons were collected during tiger surveys in various parts of Myanmar conducted by the Myanmar Ministry of Forestry and the Wildlife Conservation Society (WCS) (Lynam, 2003).

For this purpose of this report, Recent Records are defined as those from 2006 until this compilation of our own original surveys. Recent Records mainly originate from three sources:

- (1) Occasional hoolock records (mostly present/absent records) collected during bird watching tours (e.g. Htin Hla, 2005, 2006, 2007).
- (2) Hoolock gibbon surveys conducted by WCS teams in Mahamyaing Wildlife Sanctuary and the Hukawng valley (Anonymous, 2006; Brockelman, 2005; Gibbon Survey Team, 2005; Saw Htun *et al.*, 2006, Brockelman *et al.*, in prep.).
- (3) Hoolock records collected by the authors during the Myanmar Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program (see Appendix 3).

7.3 Western hoolock gibbon (*Hoolock hoolock*)

Sagaing region

WH-01: Northern Naga Hills, Hukawng valley, Sagaing region

Site location: 26.70146°N 95.99272°E, Nanyun township, Hkamti district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

This location was surveyed by the Forest Department and the Wildlife Conservation Society in 2005/6 on a hoolock survey that also included Wantoke Hill, which we have designated as within the area of 'Hoolock gibbon, uncertain species'. For details, see Section 7.5, record UH-01.

WH-02: Linhpar, west bank, Hkamti district, Sagaing region

Alternate spellings: Linhpar = Limpa = Linhpa

Site location: Linhpar village (coordinates 25.80326°N, 95.52638°E, elevation 128 m), Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

Carter (1943, p. 106) reports that two gibbons were collected at Limpa on the west bank during the Vernay-Hopwood Chindwin expedition of 1935.

Linhpa West is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the western hoolock gibbon (*H. hoolock*) from "Linhpa west bank" that is stored at the American Museum of Natural History, New York (AMNH 112709).

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day survey was conducted around Linhpar village on the east bank of the Chindwin river on 28 Nov 2009. Two gibbon groups were heard calling on the west bank of the river in the morning.

WH-03: Gaba Gaso camp, near Saramati mountain in Naga Land, Hkamti district, Sagaing region

Site location: Gaba Gaso camp (coordinates 25.68039°N, 95.05390°E, elevation 1,420 m), near Latte village (coordinates 25.64536°N, 95.01761°E), Lashi township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Gaba Gaso camp from 1 to 5 Nov 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 3.32 groups/km² using the 0.6 km listening radius, and 1.67 groups/km² using the 1 km listening radius. On 8 Nov 2009, a gibbon group consisting of an adult pair, a young gibbon with black fur and an infant with yellowish fur colour and carried by its mother were seen resting and later singing on trees near one of the listening posts. On 9 Nov 2009, two gibbon groups were observed near another listening post.

WH-04: Yawparmi village area, near Saramati mountain in Naga Land, Hkamti district, Sagaing region

Site location: Yawparmi village area (coordinates 25.59854°N, 95.01308°E, elevation 984 m), near Yawparmi village (coordinates 25.59846°N, 95.01490°E), Lashi township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Yawparmi village from 1 to 5 Nov 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 2.87 groups/km² using the 0.6 km listening radius, and 1.27 groups/km² using the 1 km listening radius. Two groups were encountered near one of the listening posts on 1 Nov 2009 and 2 Nov 2009. Two additional gibbon groups were observed near two other listening posts on 3 and 4 Nov 2009, respectively.

WH-05: Between Jakaw and Tikon villages, Naga Land, Hkamti district, Sagaing region

Site location: Between Jakaw and Tikon villages (coordinates 25.53169°N, 95.02696°E, elevation 863 m), Lashi township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted between Jakaw and Tikon villages on 16 Nov 2009. Three gibbon song bouts were recorded in the morning.

WH-06: Hahti, Sagaing region

Alternate spellings: Hahti = Harti

Site location: 26.13333°N, 95.58333°E, Lashi township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

Hahti is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66).

Chit Ko Ko (1983, p. 49) reports hearing gibbon calls in the morning of 17 Nov 1959 on the way from Hahti to Laungnaw village (less than 6 km west of Hahti).

WH-07: Mt. Saramati, Naga Hills, Sagaing region

Alternate spellings: Saramati = Saramiti

Site location: 25.63995°N, 95.03457°E, Lashi township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

On a reconnaissance trip to Mt. Saramati done by WATT (Wildbird Adventure Travels and Tours) in December 1997, hoolocks were heard calling every morning when the surveyors approached the base of Mt. Saramati (Tony Htin Hla, personal communication to TG, May 2010).

WH-08: Saramati area, Naga Hills, Sagaing region

Alternate spellings: Saramati = Saramiti.

Site location: 25.57812°N, 95.13896°E, Lashi township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 11 gibbon records were collected in Saramati (Lynam, 2003, p. 57). The area lies between 25°20'-25°43'N and 94°50'-95°40'E. Elevation 124-3,826 m. Survey area: 650 km² (Lynam, 2003).

WH-09: Thaungdut, Homalin township, Sagaing region

Alternate spellings: Thaungdut = Thaung Dut

Site location: 24.38879°N, 94.60690°E, Homalin township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, ten gibbon records were collected in Thaungdut (Lynam, 2003, p. 57). The area lies between 24°17'-24°30'N and 94°30'-94°43'E in the Homalin Township, Sagaing region and includes with Kabaw Valley. Elevation 130-695 m. Survey area: Covers an area of 210 km² 16 km from Thaungdut village (Lynam, 2003).

WH-10: Way from Jangtang to Dagung Hka, Sagaing region

Alternate spellings: Tagum Hka = Dagung Hka

Site location: 26.23304°N, 96.00484°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Carter (1943, p. 106) reports that two gibbons were collected on the way Jangtang–Dagung Hka during the Vernay-Hopwood Chindwin expedition of 1935. Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the western hoolock gibbon (*H. hoolock*) from that locality that is stored at the American Museum of Natural History, New York (AMNH 112688).

WH-11: Tagum Hka, Sagaing region

Alternate spellings: Tagum Hka = Dagung Hka

Site location: 26.20000°N, 95.98333°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 657) reports that gibbons were collected at Tagum Hka during the Vernay-Hopwood Chindwin expedition of 1935: “Here ... a female gibbon and her young were secured” and “February 21st saw us add two gibbons ... to the collection.” He also reports the altitude as 750 ft (230 m). The expedition was stationed in Tagum Hka on 20-23 Feb 1935. Carter (1943, p. 106) specifies that two gibbons were collected there, but this does not correspond to the four gibbons mentioned by Morris (1936).

Dagung Hka is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the western hoolock gibbon (*H. hoolock*) from the west bank of that locality that is stored at the American Museum of Natural History, New York (AMNH 112954).

WH-12: Way from Tagum Hka to Changa Hka, Sagaing region

Alternate spellings: Tagum Hka = Dagung Hka; Changa Hka = Chenga Hka

Site location: 26.18505°N, 95.95988°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 658) reports that gibbons were collected on the way from Tagum Hka to Changa Hka during the Vernay-Hopwood Chindwin expedition of 1935: “...while marching [we] came on a troop of gibbons of which Raven took movies, and subsequently a male and a female were secured.” The expedition travelled from Tagum Hka to Changa Hka on 23 Feb 1935. Carter (1943, p. 106) specifies that two gibbons were collected on the way, both of which were “preserved entire”.

WH-13: Changa Hka, Sagaing region

Alternate spellings: Changa Hka = Chenga Hka

Site location: 26.17105°N, 95.94334°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 658) reports that gibbons were collected at Changa Hka during the Vernay-Hopwood Chindwin expedition of 1935: “Two gibbons ... were added to the collection. On February 24th sixteen mammals were collected, including four gibbons...”. He also reports the altitude as 1,700 ft (520 m). The expedition was stationed in Changa Hka on 23-25 Feb 1935. Carter (1943, p. 106) specifies that five gibbons were collected there, but this does not correspond to the six gibbons mentioned by Morris (1936).

Changa Hka is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) of the western hoolock gibbon (*H. hoolock*) from the west bank of that locality that are stored at the American Museum of Natural History, New York (AMNH 112690, 112692).

WH-14: Way from Changa Hka to Hai Bum, Sagaing region

Alternate spellings: Changa Hka to Hai Bum = Cheng-ga Hka to Hai Bum

Site location: 26.13287°N, 95.90963°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 659) reports that gibbons were collected on the way from Changa Hka to Hai Bum during the Vernay-Hopwood Chindwin expedition of 1935: “On the way ... five gibbons ... were collected.” The expedition travelled from Changa Hka to Hai Bum on 24 Feb 1935. Carter (1943, p. 106) specifies that four gibbons were collected on the way, but this does not correspond to the five gibbons mentioned by Morris (1936).

Marshall and Sugardjito (1986, p. 180) list three adult specimens (skins and skulls) of the western hoolock gibbon (*H. hoolock*) from the west bank of the way from Cheng-ga Hka to Hai Bum that are stored at the American Museum of Natural History, New York (AMNH 112692, 112955, 112964).

WH-15: Hai Bum, Sagaing region

Alternate spellings: Hai Bum = Haibum

Site location: 26.08113°N, 95.85711°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 659) reports that gibbons were collected at Hai Bum during the Vernay-Hopwood Chindwin expedition of 1935: "On February 26th, ... and a gibbon were collected." He continues (Morris, 1936, p. 660): "On February 28th, ... The total collected for the day amounted to three gibbons ... On March 1st, ... three gibbons ... were collected. ... The next day ten more mammals were added to the collection including ... two gibbons ...". He also reports that the animals at Hai Bum were collected at altitudes ranging from 700 ft (210 m, near the Chindwin river) to 1,700 ft (520 m). The expedition was stationed in Hai Bum from 25 Feb to 3 Mar 1935. Carter (1943, p. 106) specifies that nine gibbons were collected at Hai Bum (one of which was "preserved entire").

Haibum is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list five adult specimens (skins and skulls) of the western hoolock gibbon (*H. hoolock*) from Hai Bum that are stored at the American Museum of Natural History, New York (AMNH 112696-112698, 112701, 112702).

WH-16: Way from Hahti to Singkaling Hkamti, Sagaing region

Site location: 26.07740°N, 95.69462°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 664) reports that one gibbon was collected on the way from Hahti to Singkaling Hkamti (i.e. southeast of Hahti) during the Vernay-Hopwood Chindwin expedition of 1935.

Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) of the western hoolock gibbon (*H. hoolock*) from "Four miles southeast of Hahti" that are stored at the American Museum of Natural History, New York (AMNH 112705, 112706). This locality may be similar or identical to "Way from Hahti to Singkaling Hkamti" of Morris (1936), although the latter author reports only one gibbon (not two) was collected on that way.

WH-17: Hkamti, west bank, Sagaing region

Alternate spellings: Hkamti = H'kamti = Singkaling Hkamti = Zingkaling Hkamti

Site location: 26.03948°N, 95.71275°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Based on information from G. C. Shortridge and the late S. A. Macmillan, who collected along the Chindwin river for the Bombay Natural History Society's Mammal Survey during June-August 1914, Wroughton (1916a, p. 296) reports that gibbons occur on both sides of the Chindwin river at Hkamti. He cites G. C. Shortridge as follows: "Plentiful in the Upper Chindwin. Occurring on the West bank of the river from below Kindat Northwards. In Zingkaling Hkamti state, it was equally plentiful on both sides of the river. It had evidently crossed over by way of the Hukawng Valley, above the source of the Chindwin, but the comparatively flat country south of the state, on the East bank, has not proved favorable for its extension further South."

Jenkins (1990, pp. 28-29) lists three western hoolock gibbons (*H. hoolock*) (ZD.1915.5.5.1, ZD.1937.3.24.1, ZD.1937.3.24.3) from the west bank of Hkamti that are stored at the British Museum

(Natural History). She references these specimens to Wroughton's (1916a, p. 296) report. According to the museum records, they were collected on 26 Jul 1914 and 6 Aug 1914 at elevations of 500-550 ft (150-170 m).

In the time period from June 1914 to April 1915, Hkamti was also one of the gibbon collecting localities of J. M. D. Mackenzie, also for the Bombay Natural History Society's Mammal Survey. Mackenzie is cited in Wroughton (1916b): "[The gibbon] chiefly inhabits the heavier jungle on the hills where it can always be heard on the west of the river. I have seen it up to 5,000 feet [1,520 m] and it is said to go up to 7,000 [2130 m]."

Presumably based on specimens from the Bombay Natural History Society's Mammal Survey, Hkamti is also mentioned as a site for hoolock gibbons by Pocock (1939), although he does not specify on which side of the Chindwin river the gibbons were seen or collected.

Morris (1936, p. 664-665) reports that gibbons were collected at Singkaling Hkamti during the Vernay-Hopwood Chindwin expedition of 1935: "McCann had not been idle in our absence having collected ... two gibbons...". The expedition was stationed in Singkaling Hkamti on 4-10 Mar 1935. Carter (1943, p. 106) confirms that two gibbons were collected there. Morris (1936) and Carter (1943) do not specify on which side of the river the gibbons were collected. However, Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the western hoolock gibbon (*H. hoolock*) from Singkaling Hkamti that is stored at the American Museum of Natural History, New York (AMNH 112704).

Hkamti is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66).

WH-18: Kawai, west bank, Sagaing region

Site location: 26.06667°N, 95.63333°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 662) reports that gibbons were collected at Kawai during the Vernay-Hopwood Chindwin expedition on 8 March 1935: "The writer secured a couple of gibbons...".

Kawai is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the western hoolock gibbon (*H. hoolock*) from Kawai that is stored at the American Museum of Natural History, New York (AMNH 112707).

WH-19: Kabaw Valley (west of Chindwin), Sagaing region

Alternate spellings: Kabaw Valley, 20 miles N.W. of Kindat

Site location: 23.92212°N, 94.31536°E, Tamu township, Tamu district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

In the time period from June 1914 to April 1915, Kabaw Valley (west of Chindwin) was one of the gibbon collecting localities of J. M. D. Mackenzie for the Bombay Natural History Society's Mammal Survey. Mackenzie is cited in Wroughton (1916b, p. 762): "[The hoolock gibbon] chiefly inhabits the heavier jungle on the hills where it can always be heard on the west of the river ... I have twice seen parties of 3 in the Kabaw Valley, on the level, both times in the hot weather. It is generally found in parties of 3 or 4, but I have seen single ones, and once a party of six. Burmans and Chins eat the flesh, I have tried it myself but found the flavour very strong."

Jenkins (1990, pp. 28-29) lists one juvenile male western hoolock gibbon (*H. hoolock*) (ZD.1937.3.24.5) from "Kabaw Valley, 20 m[iles] N.W. of Kindat" that is stored at the British Museum (Natural History). She references this specimen to Wroughton's (1916b, p. 762) report. According to the museum records, it was collected on 24 Jan 1915 at an elevation of 600 ft (180 m).

Presumably based on gibbons collected for the Bombay Natural History Society's Mammal Survey, Kabaw valley is also mentioned as a site for hoolock gibbons by Pocock (1939).

Kabaw valley is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66).

WH-20: South of Kindat (west of Chindwin), Sagaing region

Site location: 23.60704°N, 94.36242°E, Mawlaik township, Mawlaik district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Based on information from G. C. Shortridge and the late S. A. Macmillan, who collected along the Chindwin river for the Bombay Natural History Society's Mammal Survey during June-August 1914, Wroughton (1916a, p. 296) reports that gibbons occur west of the Chindwin river south of Kindat. He cites G. C. Shortridge as follows: "Occurring on the West bank of the river from below Kindat Northwards."

WH-21: Chin Hills, 50 miles, W., Sagaing region or Chin state [not mapped]

Site location: Unknown

Forest classification: Unknown

Gibbon status: Historical record (before 1960)

In the time period from June 1914 to April 1915, "Chin Hills, 50 m., W." was one of the gibbon collecting localities of J. M. D. Mackenzie for the Bombay Natural History Society's Mammal Survey, as reported by Wroughton (1916b, p. 762). We have not been able to locate this site accurately and, therefore, have not mapped it.

WH-22: Nasung Chaung, Sagaing region [not mapped]

Site location: Unknown

Forest classification: Unknown

Gibbon status: Historical record (before 1960)

Based on information from G. C. Shortridge and the late S. A. Macmillan, who collected for the Bombay Natural History Society's Mammal Survey along the Chindwin river in June-August 1914, Wroughton (1916a, p. 296) reports that gibbons occur at Nasung Chaung. We have not been able to locate this locality; and it is not described further in Wroughton (1916a). The author reports, however, that a capped langur (*Trachypithecus pileatus*) was also hunted by the same team at that locality and that the capped langur only occurs on the west bank of the upper Chindwin river. Therefore, we assume that Nasung Chaung is a locality for western hoolock gibbons (*H. hoolock*), but the information is not sufficient for mapping it.

Chin state

WH-23: Kyaukpantaung, Chin state

Alternate spellings: Kyaukpantaung = Kyauk Pan Taung = Kyauk-pan-taung = Kyaukpandaung

Site location: 21.35000°N, 93.05000°E, Paletwa township, Mindat district, Chin state

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

A survey of the area of the proposed Kyaukpantaung National Park was carried out between 27 Jan and 12 Feb 1983 (Blower *et al.*, 1983). "The heavily forested upper valley of the Palet Chaung, well protected by surrounding cliffs, is a natural wildlife sanctuary. Here we heard gibbon (*Hylobates hoolock*) calling each morning..." (Blower *et al.*, 1983, p. 9).

Gibbons were recorded on 26 Oct 2003, on the way from Minchaung bawa to the summit of Kyaukpantaung (3,197 ft [970 m]) (Htin Hla, 2003a).

Expeditions to Kyaukpantaung Wildlife Sanctuary in December 2006 also recorded hoolocks in that area (Tony Htin Hla, personal communication to TG, May 2010).

WH-24: Mt. Victoria, Chin state

Alternate spellings: Mt. Victoria = Natmataung = Natma Taung

Site location: 21.22247°N, 93.96467°E, Kanpatlet township, Mindat district, Chin state

Forest classification: National Park

Gibbon status: Recent record (2005-2010), confirmed

Mt. Victoria is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the western hoolock gibbon (*H. hoolock*) from Mt. Victoria that is stored at the American Museum of Natural History, New York (AMNH 163630).

Sayer (1983) spend the time between 22 and 30 Mar 1983 surveying Mount Victoria, but reported not hearing any hoolock gibbons.

Hoolock gibbons were observed during a bird-watching expedition to Mt. Victory at elevations of 2,100-2,300 m (King *et al.*, 1995): A single group was heard on the northern forested slopes of Mt. Victoria at about 2,300 m, on a steep slope about 1 km to the northeast of the campsite (21°13.348'N, 93°57.880'E). The group was heard on 2 and 3 April, 1995 (King *et al.*, 1995).

Various birding tours to Chin state done between 1997 to 1999 recorded (heard) hoolock gibbons on Mt. Victoria (Tony Htin Hla, personal communication to TG, May 2010).

Gibbons were also heard on 22 Mar 2007 between 10 miles and 13 miles from Kanpetlet town on the way to Mt. Victoria peak (Thiri Htin Hla, 2007).

WH-25: Mindat-to-Matupi road, nr. Mt. Victoria (Natmataung), Chin state

Site location: 21.39818°N, 93.81818°E, Mindat township, Mindat district, Chin state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

Two gibbon groups were heard on steep slopes about 1 km south (2,200 m) of, and 3 km west northwest (2,300 m) of 21°23.891'N, 93°49.091'E on 6 April 1995. The coordinates are at mile 16 on the Mindat-to-Matupi road. This site is about 22 km (direct) NW of the Mt. Victoria site on a parallel east/west ridge on which Mindat lies (King *et al.*, 1995).

In early 1998, gibbons were heard distantly on Mt. Victoria and at "Mindat mile 16" (Robson, 1998).

Magway region

WH-26: Pyat Chaung near Bu village, north-east Rakhine mountain range, Magway region

Alternate spellings: Pyat Chaung = Paik Chaung

Site location: Pyat Chaung (coordinates 20.63292°N, 94.09126°E, elevation 387 m), near Bu village (coordinates 20.65095°N, 94.15836°E), Sadoktaya township, Minbu district, Magway region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Pyat Chaung from 1 to 5 May 2009. Five listening posts were established in the survey area. Estimated gibbon population densities were 3.71 groups/km² using the 0.6 km listening radius, and 2.10 groups/km² using the 1 km listening radius. A female gibbon was sighted traveling near one of the listening posts on 3 May 2009. Two gibbon groups consisting of two animals and three animals, respectively, were sighted near the same listening

post on 5 May 2009. A gibbon group consisting of an adult pair and one young gibbon was observed near another listening post on 4 May 2009.

WH-27: Kyaukpyar ridge, north-east Rakhine mountain range, Magway region

Alternate spellings: Kyaukpyar = Kyatpyar

Site location: Kyaukpyar ridge (coordinates 20.26650°N, 94.18403°E, elevation 642 m), near Sinchebo village (coordinates 20.24027°N, 94.21348°E), Ngape township, Minbu district, Magway region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Kyaukpyar ridge from 10 to 14 May 2009. Five listening posts were established in the survey area. Estimated gibbon population densities were 3.76 groups/km² using the 0.6 km listening radius, and 3.02 groups/km² using the 1 km listening radius. A gibbon group consisting of an adult pair and an independently moving young with black fur was sighted moving through the trees near one of the listening posts on 11 May 2009. Another gibbon group consisting of an adult pair, two young gibbons with black fur and an infant that was carried by its mother was observed near two other listening posts on 12 and 14 May 2009, respectively.

WH-28: Between Paaing and Sinchebo villages, Magway region

Site location: Between Paaing and Sinchebo villages (coordinates 20.23653°N, 94.30024°E, elevation 513m), near Ngape town, Minbu district, Magway region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted between Paaing and Sinchebo villages on 8 May 2009. A first gibbon song bout was recorded at 09:30 am, and seconded song bout started at 10:00 am. These calls came from two different directions, and it can be assumed that they were produced by two different groups.

WH-29: Laukpale village, central Rakhine mountain range, Magway region

Site location: Laukpale village (coordinates 20.03086°N, 94.33677°E, elevation 883 m), Ngape township, Minbu district, Magway region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted around Laukpale village on 20 Feb 2009. Calls of three gibbon groups were heard and one of these groups was sighted near Laukpale village.

WH-30: Natyekan mountain range, north-central Rakhine mountain range, Magway region

Alternate spellings: Natyekan = Nat-yay-kan = Nat Ye Gan = Net Ye Gan

Site location: Natyekan mountain range (coordinates 19.84726°N, 94.31078°E, elevation 1,253 m), near Linte village (coordinates 19.84921°N, 94.37969°E), Ngape township, Minbu district, Magway region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted in the Natyekan mountain range from 13 to 17 Apr 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 1.55 groups/km² using the 0.6 km listening radius, and 1.67 groups/km² using the 1 km listening radius. A gibbon group consisting of an adult pair and three young with black fur colouration and moving independently was encountered when listening posts were established on 12 Apr 2009, one day prior to the actual survey work. Compare with the Modern Record for Mt. Natyekan, also in Magway region.

WH-31: Goatsiyoe ridge, north-central Rakhine mountain range, Magway region

Site location: Goatsiyoe ridge (coordinates 19.85500°N, 94.36212°E, elevation 1,136 m), near Goatsiyoe village (coordinates 19.84779°N, 94.31081°E), Ngape, Minbu district, Magway region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Goatsiyoe ridge from 20 to 24 Apr 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 3.54 groups/km² using the 0.6 km listening radius, and 2.63 groups/km² using the 1 km listening radius. An adult gibbon pair was observed singing on a tree near one of the listening posts on 20 Apr 2009. A gibbon group consisting of two adults and two young gibbons with black fur colouration and moving independently was observed singing on a tree near another listening post on 24 Apr 2009.

WH-32: Shwetaunggyi village, eastern Rakhine mountain range, Magway region

Site location: Shwetaunggyi village (coordinates 19.21048°N, 94.62840°E, elevation 821 m), Mindon township, Magway region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted around Shwetaunggyi village on 8 Mar 2009. Calls of four gibbon groups were heard and one of these groups was sighted about 6.4 km away from the village.

WH-33: Mt. Natyekan, Magway region

Alternate spellings: Natyekan = Nat-yay-kan = Nat Ye Gan = Net Ye Gan

Site location: 19.86323°N, 94.39250°E, Mindon township, Thayet district, Magway region

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

An orchid study group visiting Natyekan in October 2000 recorded hoolock gibbons at an elevation of about 3,000 ft [900 m] (Tony Htin Hla, personal communication to TG, May 2010).

During a bird survey to Mt. Natyekan during the last week of August 2003, hoolock gibbons were recorded repeatedly (Saw Moses, 2003). The team heard “the close up sound of more than two of them in the area C on 29-8-03 morning, ...[and] the voice of a group of them in the ravine in area A, but unable to see them. The distant sound of them can be heard through out all the areas where observations was carried out.” Areas surveyed included: Area A (Guest House area), 19°50.94N 94°22.83E, elevation 3742 feet [1,141 m], near Nat Ye Gan road. Area B (Road Junction area), 19°51.523N 94°21.528E, elevation 3769 feet [1,149 m], vicinity of mile post 55 where the old and new road meet. Area C (Upper Nat Ye Gan area), 19°51.881N 94°22.115E, elevation 4771 ft [1,454 m], about 3 miles east of area B. Area D (Upper junction area), 19°51.831N 94°22.133E, elevation 4251 ft [1,296 m]. Area G (Top of Nat Ye Gan), 19°51.794N 94°23.550E, elevation 5177 ft [1,578 m].”

A bird watching group led by WATT (Wild-Bird Adventure Travels and Tours) also recorded hoolock gibbons in the same area in October 2003 (Tony Htin Hla, personal communication to TG, May 2010).

WH-34: Natyekan area, border between Rakine state and Magway region

Alternate spellings: Natyekan = Nat-yay-kan = Nat Ye Gan = Net Ye Gan

Site location: 19.83797°N, 94.29327°E, Mindon township, Thayet district, Magway region

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During a bird survey to Mt. Natyekan during the last week of August 2003, hoolock gibbons were recorded repeatedly (Saw Moses, 2003). The calls were also heard in the border areas between Rakine state and Magway region, including Area E (Border of Arakan state area), 19°50.278N 94°17.596E, elevation 3841 ft [1,171 m], on 30 Aug 2003, and Area F (3 miles east of border line), 19°50.609N 94°18.596E elevation 3865 ft [1,178 m], on 20 Aug 2003.

WH-35: Sapardan village, Mindon township, Magway region

Site location: 19.03800°N, 94.59000°E, Mindon township, Thayet district, Magway region

Forest classification: Reserve Forest

Gibbon status: Modern record (1980-2004), confirmed

During timber extraction work in the reserve forest near Sapardan village in Mindon township, a pair of hoolock gibbons was observed moving through the tree crowns (Maung Maung Pyone, personal communication to Ngwe Lwin, September 2010).

Rakhine state

WH-36: Bandula village, Maungtaw district, Rakhine state

Site location: Bandula village (coordinates 21.40789°N, 92.28082°E, elevation 32 m), near border to Bangladesh, Maungtaw township, Maungtaw district, Rakhine state

Forest classification: None

Gibbon status: Recent record (2005-2010), provisional

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Bandula village on 29 Jan 2009. According to the interviewees, gibbon calls are usually heard at the village coming from two different directions (i.e. northeast and west of the village).

WH-37: Tinkanatai village, Kyaukpyu district, Rakhine state

Site location: Tinkanatai village (coordinates 20.04092°N, 93.84646°E, elevation 6 m), Ann township, Kyaukpyu district, Rakhine state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Tinkanatai village on 10 Apr 2009. According to the interviewees, two gibbon groups occur west of the village about 5 km away.

WH-38: Between Tazukaing and Linte villages, Kyaukpyu district, Rakhine state

Site location: Between Tazukaing and Linte villages (coordinates 19.88626°N, 93.84618°E, elevation 25 m), northern Rakhine mountain range, near Ann town, Kyaukpyu district, Rakhine state

Forest classification: Reserved

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted between Tazukaing and Linte villages on 11 Apr 2009. A gibbon song bout was heard at 08:35 am.

WH-39: Sa Lu village, Taung Up district, Rakhine state

Site location: Sa Lu village (coordinates 18.74257°N, 94.50092°E, elevation 628 m), central Rakhine mountain range, Taung Up township, Taung Up district, Rakhine state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted around Sa Lu village on 15 Dec 2008. One duet song bout was reliably heard at the village coming from 1 km away and southwest of the village. A gibbon pair was sighted about 500 m away from Sa Lu village (coordinates of sighting: 18.74594°N, 94.50467°E, elevation 643 m).

According to interview data, a gibbon pair is normally seen in the morning north Sa Lu village, about 1.6 km away. Another gibbon pair is often encountered in the morning east of the village, also about 1.6 km away, and yet another pair was seen two days prior to the survey south of the village. Gibbon calls are often heard in the mornings from southeast of the village. It is assumed that there are at least four gibbon groups around the village.

WH-40: Ye Paw Gyi village, Taung Up district, Rakhine state

Alternate spellings: Ye Paw Gyi = Yepawgyi

Site location: near Ye Paw Gyi village (coordinates 18.67438°N, 94.5799°E, elevation 695 m), central Rakhine mountain range, Taung Up township, Taung Up district, Rakhine state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted at Ye Paw Gyi from 10 to 14 Dec 2008. Four listening posts were established in the survey area. Estimated gibbon population densities were 0.66 groups/km² using a 0.6 km listening radius, and 0.88 groups/km² using a 1 km listening radius.

WH-41: Kwe Lay camp, Taung Up district, Rakhine state

Site location: Kwe Lay Camp (coordinates 18.66883°N, 94.74577°E, elevation 971 m), central Rakhine mountain range, Taung Up township, Taung Up district, Rakhine state

Forest classification: Reserve forest

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted on 26 Dec 2008 around Kwe Lay camp. During this survey, one duet song bout was heard from a distance of about 300 m at one locality (coordinates 18.67048°N, 94.74134°E), and two additional duet song bouts were heard from two directions about 1 km away from the same place. A fourth duet song bout was heard at a timber extraction camp (coordinates 18.61915°N, 94.73773°E, 382 m) from a distance of about 1 km. The timber camp was located about 4.8 km away from Kwe Lay camp. In addition, a pair of gibbons was sighted near Kwe Lay camp (coordinates 18.67965°N, 94.74525°E, 985 m). According to interview data, people from the Kye Lay camp often hear gibbon calls from up to four directions in the morning. This suggests that there may be about four gibbon groups around the camp. People from the timber extraction camp reported having hunted three gibbons around their camp during last the 6 months. Interviews suggest that two or three gibbon groups may live around the timber camp.

WH-42: Chaung Tha village, Thandwe district, Rakhine state

Site location: Chaung Tha camp (coordinates 17.84126°N, 94.53486°E, elevation 409 m), near Chaung Tha village (coordinates 17.84296°N, 94.50069°E), southern Rakhine mountain range, Gwa township, Thandwe district, Rakhine state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted in Kyeintali from 26 to 30 Nov 2008. Three listening posts were established in the survey area. During the survey, one gibbon group consisting of an adult pair with an infant carried by its mother, was sighted near one of the listening posts. Estimated gibbon population densities were 0.37 groups/km² using a 0.6 km listening radius, and 0.13 groups/km² using a 1 km listening radius. The main reason for the low gibbon density is believed to be low habitat quality (Geissmann *et al.*, 2008, 2009).

WH-43: Do Kwe Chaung, Thandwe district, Rakhine state

Alternate spellings: Do Kwe Chaung = Dukwe Chaung = Do Kwe river

Site location: near Kha Yin Chaung village (coordinates 17.92560°N, 94.58801°E, elevation 150 m), southern Rakhine mountain range, Ba Win village tract, Kyaing Ta Li township, Thandwe district, Rakhine state.

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Kha Yin Chaung village from 19 to 23 Dec 2008. Five listening post were established in the survey area. An adult pair was encountered near one listening post on 20 Dec, and an adult pair with an infant of whitish fur colouration and carried by its mother was sighted near another listening post on 23 Dec of the survey. Estimated gibbon population densities were 0.66 groups/km² using a 0.6 km listening radius, and 0.56 groups/km² using a 1 km listening radius.

WH-44: Paletwa and Kaladan river catchments, Rakhine state

Site location: 21.23695°N, 92.41162°E, Northern Rakhine, Ponnagyun township, Sittwe district, Rakhine state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 11 gibbon records were collected in Northern Rakhine in Paletwa and Kaladan river catchments area (Lynam, 2003, p. 57). The area lies between 21°05'-21°22'N and 92°21'-92°29'E and is located between and contains the northern Kalapanzin River catchment, Saingdin Ridge and northern Mayu Range. Elevation 216-760 m. Survey area: 177 km² (Lynam, 2003).

WH-45: Ywartharyar village, Kyaukpyu district, Rakhine state

Site location: Ywartharyar village (coordinates 20.09949°N, 93.60626°E, elevation 20 m), Rakhine mountain range, Ann township, Kyaukpyu district, Rakhine state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Ywartharyar Taw village on 10 Feb 2009. According to the interviewees, gibbons occurred around the village in the past, but no gibbon

calls were heard in the area since about ten years. The reason for the disappearance of the gibbons is believed to be deforestation due to timber extraction.

WH-46: Zee Kaing village, Kyaukpyu district, Rakhine state

Site location: Zee Kaing village (coordinates 19.28069°N, 94.20372°E, elevation 8 m), Rakhine mountain range, Ann township, Kyaukpyu district, Rakhine state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Zee Kaing village on 18 Jan 2009. According to the interviewees, gibbons occurred around the village in the past, but no gibbon calls were heard in the area since about ten years. The reason for the disappearance of the gibbons is believed to be deforestation due to timber extraction.

WH-47: Say Taw village, Kyaukpyu district, Rakhine state

Site location: Say Taw village (coordinates 19.19086°N, 94.27992°E, elevation 117 m), Rakhine mountain range, Ann township, Kyaukpyu district, Rakhine state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Say Taw village on 17 Jan 2009. According to the interviewees, gibbons occurred around the village in the past, but no gibbon calls were heard in the area since about ten years. The reason for the disappearance of the gibbons is believed to be deforestation due to timber extraction.

WH-48: Sandoway Chaung area, Rakhine state

Alternate spellings: Sandoway Chaung = Thandwe Chaung = Thandwe river

Site location: 18.57983°N, 94.57246°E, Thandwe township, Thandwe district, Rakhine state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

A survey of the area south of Taungup pass was carried out between 24 Jan and 16 Feb 1983 (Sayer *et al.*, 1983). “*Hylobates hoolock*. Hoolock. Heard at most localities visited both east and west of Taungup pass and along Sandoway chaung. They range in altitude from sea level to 3000 ft [910 m] and may be quite common.” (Sayer *et al.*, 1983, p. 11).

A short survey (2-12 Feb 1983) was conducted in the area between the Tandwe Chaung and the Ma-e Chaung, north of Taungup town in central Rakhine state, with special reference to elephants (Salter, 1983). “Several species of large mammals are common and widespread in the area, including ... gibbons (*Hylobates hoolock*)” (Salter, 1983, p. 6).

WH-49: Rakhine Yoma Elephant Range, Rakhine state

Alternate Spellings: Rakhine Yoma = Arakan Yoma. Yoma = hills

Site location: 18.44217°N, 94.71720°E, Gwa township, Thandwe district, Rakhine state

Forest classification: Wildlife Sanctuary

Gibbon status: Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 3 gibbon records were collected in Rakhine Elephant Range (Lynam, 2003, p. 57). The area lies between 18°01'–18°59'N and 94°36'–94°45'E on the Western side of the Rakhine Yoma Range. Elevation 77–1,041 m. Survey area: 146 km² (Lynam, 2003).

WH-50: Gwa area, southern Rakhine Yoma, Rakhine state

Site location: 17.58333°N, 94.75000°E, Gwa township, Thandwe district, Rakhine state

Forest classification: Reserved Forest

Gibbon status: Modern record (1980-2004), confirmed

A short survey of five days was done by Tony Htin Hla for FRED A (Forest Resource Environment Development and Conservation Association) on the Rakhine Yoma (= hills) en route to Gwa in November 2001, and at least 3 groups of hoolock gibbons consisting of 2 to 4 individuals were observed every day. The location is the “last mountain ridge on the road from Yangon to Gwa, after the “Hunting free zone”-village (coordinates 17°35'N, 94°45'E). Since many calls were heard daily, there seemed to be a healthy population of gibbons present in that area. This impression was also confirmed by interview information (Tony Htin Hla, personal communication to TG, 28 May 2010).

WH-51: Akyab, Rakhine state

Alternate spelling: Akyab = Sittwe

Site location: 20.32863°N, 93.48283°E, Sittwe township, Sittwe district, Rakhine state

Forest classification: None

Gibbon status: Historical record (before 1960)

Akyab is reported as a site for western hoolock gibbons (*H. hoolock*) in Blyth (1875) and Groves (1972, p. 66).

WH-52: Sandoway, Rakhine state

Alternate spelling: Sandoway = Thandwe

Site location: 18.45000°N, 94.38333°E, Thandwe township, Thandwe district, Rakhine state

Forest classification: None

Gibbon status: Historical record (before 1960)

Sandoway is reported as a site for western hoolock gibbons (*H. hoolock*) in Blyth (1875) and Groves (1972, p. 66).

Bago (= Pegu) region**WH-53:** Bagankwe village, Pyay district, Bago region

Site location: Bagankwe village (coordinates 18.65539°N, 94.81466°E, elevation 817 m), Rakhine mountain range, Okshitpin township, Pyay district, Bago region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Bagankwe village on 9 Dec 2008. According to the interviewees, about two to three gibbon groups occur west of the village and gibbon calls are usually heard at the village in the morning hours.

7.4 Eastern hoolock gibbon (*Hoolock leuconedys*)

Kachin state

EH-01: Chuhti village and near Htonlartam village, Putao district, Kachin state

Alternate spellings: Htonlartan = Htonlartam

Site location: Chuhti village (coordinates 27.61315°N, 97.68060°E, elevation 695 m), near Htonlartan village (coordinates 27.61102°N, 97.69259°E, elevation 689 m), Naungmung township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

A study on gibbon densities was conducted in the Naungmung area by WCS from May 2002 to May 2003 (Anonymous, 2003): “Two sites which appeared to be greater access to hunters near Namsabum and Htonlartam villages were selected as human disturbed plots. Other two study sites near Namhti camp and Maza camp where no human habitation but only travellers stay overnight were selected as control plots.” In order to estimate gibbon group densities, gibbon songs were monitored from fixed listening-points, using a 500 m listening radius. Unfortunately, the gibbon densities are not provided in the report. The results were summarized as “Generally, four to six gibbon group occupy one sq km area.”

Possibly during the same study, Rao *et al.* (2005) encountered 0.43 hoolock individuals per km during line transect surveys carried out between May 2002 and May 2003. Based on interview surveys, the authors also reported on hunting for gibbons.

Surveys of land cover, and for birds, in the “Northern Forest Complex of Myanmar” (including Naungmung area) by Renner *et al.* (2007), covering an area of about 27.260°-28.168°N, 97.400°-97.927°E, were carried out in 2001, 2004, and 2005. “We observed hoolock gibbons ... in the temperate rainforest areas, where red pandas *Ailurus fulgens*, gaur *Bos gaurus* and leopards *Panthera pardus* are also known to occur and were reported by local hunters.” (Renner *et al.*, 2007, p. 34).

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Chuhti village on 21 Feb 2009. According to the interviewees, there are about three gibbon groups near the village. Gibbon calls are usually heard from the village coming from three different directions.

Also during the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Htonlartan village on 21 Feb 2009. According to the interviewees, a gibbon group consisting of an adult pair occurs near the village. This group inhabits a small mountain near the village, and gibbon calls are usually heard from the village in the morning. Sometimes the gibbons come down close to the village. They are protected by the village authority. In the past, many gibbon groups occurred in this area, but the population decreased due to hunting.

EH-02: Barbulonhtan mountain range, Putao district, Kachin state

Site location: Barbulonhtan mountain range (coordinates 27.46387°N, 97.71036°E, elevation 1,187 m), near Namhti camp and Maza camp, Naungmung township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

Gibbons were recorded during a survey trip to the Naungmung area that was conducted from 19 Apr to 17 May 1998 (Saw Tun Khaing and Than Myind, 1998). Rabinowitz and Saw Tun Khaing (1998) reported that hoolock gibbons were “heard frequently and considered relatively abundant in the forests surrounding most village areas along the survey route north-east of Putao, until reaching the Nam Tamai River. Although not considered as a particularly valuable trade species, the skins were sold in Putao as shoulder bags, and the brain was considered good for headaches.” (Rabinowitz and Saw Tung Khain, 1998, p. 207).

A study on gibbon densities was conducted in the Naungmung area by WCS from May 2002 to May 2003 (Anonymous, 2003): “Two sites which appeared to be greater access to hunters near Namsabum and Htonlardam villages were selected as human disturbed plots. Other two study sites near Namhti camp and Maza camp where no human habitation but only travellers stay overnight were selected as control plots.” In order to estimate gibbon group densities, gibbon songs were monitored from fixed listening-points, using a 500 m listening radius. Unfortunately, the gibbon densities are not provided in the report. The results were summarized as “Generally, four to six gibbon group occupy one sq km area.” and “Thus, number of gibbon groups near Namhti camp was estimated as eight groups.”

Possibly during the same study, Rao *et al.* (2005) encountered 0.43 hoolock individuals per km during line transect surveys carried out between May 2002 and May 2003. Based on interview surveys, the authors also reported on hunting for gibbons.

Surveys of land cover, and for birds, in the “Northern Forest Complex of Myanmar” (including Naungmung area) by Renner *et al.* (2007), covering an area of about 27.260°-28.168°N, 97.400°-97.927°E, were carried out in 2001, 2004, and 2005. “We observed hoolock gibbons ... in the temperate rainforest areas, where red pandas *Ailurus fulgens*, gaur *Bos gaurus* and leopards *Panthera pardus* are also known to occur and were reported by local hunters.” (Renner *et al.*, 2007, p. 34).

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted on the slopes of the Barbulonhtan mountain range on 22 Feb 2009. Gibbon calls were heard from about 1 km away and from the same elevation as the survey team. According to the interviewees from Maza camp (located at the bottom of the mountain, 27.46786°N, 97.71662°E), there are about three to four gibbon groups in this area.

EH-03: Namsabum village, Putao district, Kachin state

Site location: near Namsabum village (coordinates 27.38715°N, 97.61788°E, elevation unknown), Naungmung township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

A study on gibbon densities was conducted in the Naungmung area by WCS from May 2002 to May 2003 (Anonymous, 2003): “Two sites which appeared to be greater access to hunters near Namsabum and Htonlardam villages were selected as human disturbed plots. Other two study sites near Namhti camp and Maza camp where no human habitation but only travellers stay overnight were selected as control plots.” In order to estimate gibbon group densities, gibbon songs were monitored from fixed listening-points, using a 500 m listening radius. Unfortunately, the gibbon densities are not provided in the report. The results were summarized as “Generally, four to six gibbon group occupy one sq km area.” and “Thus, number of gibbon groups near Namhti camp was estimated as eight groups.”

Possibly during the same study, Rao *et al.* (2005) encountered 0.43 hoolock individuals per km during line transect surveys carried out between May 2002 and May 2003. Based on interview surveys, the authors also reported on hunting for gibbons.

Surveys of land cover, and for birds, in the “Northern Forest Complex of Myanmar” (including Naungmung area) by Renner *et al.* (2007), covering an area of about 27.260°-28.168°N, 97.400°-97.927°E, were carried out in 2001, 2004, and 2005. “We observed hoolock gibbons ... in the temperate rainforest areas, where red pandas *Ailurus fulgens*, gaur *Bos gaurus* and leopards *Panthera pardus* are also known to occur and were reported by local hunters.” (Renner *et al.*, 2007, p. 34).

EH-04: Lansarhtu village, Putao district, Kachin state

Site location: Lansarhtu village (coordinates 27.51748°N, 97.94560°E, elevation 571 m), Naungmung township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Lansarhtu village on 23 Feb 2009. According to the interviewees, two to three gibbon groups occur north and northwest of the village.

EH-05: Rabot village, south of Naungmaung town, Putao district, Kachin state

Alternate spellings: Naungmung = Naungmong = Naungmaung = Nagmung; Rabot = Ratbaw

Site location: near Rabot village (coordinates 27.43183°N, 97.91131°E, elevation 534 m), Naungmung township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

In 1997, Rabinowitz (2001, p. 84) recorded hoolock gibbons near Ratbaw village: “Each morning, with the mist rising off the mountains, we would be serenaded by the cacophonous calls of Hoolock’s gibbons [*sic*].”

Gibbons were recorded during a survey trip to the Naungmaung area that was conducted from 19 Apr to 17 May 1998 (Saw Tun Khaing and Than Myind, 1998). Rabinowitz and Saw Tun Khaing (1998) reported that hoolock gibbons were “heard frequently and considered relatively abundant in the forests surrounding most village areas along the survey route north-east of Putao, until reaching the Nam Tamai River. Although not considered as a particularly valuable trade species, the skins were sold in Putao as shoulder bags, and the brain was considered good for headaches.” (Rabinowitz and Saw Tun Khaing, 1998, p. 207).

Surveys of land cover, and for birds, in the “Northern Forest Complex of Myanmar” (including Naungmaung area) by Renner *et al.* (2007), covering an area of about 27.260°-28.168°N, 97.400°-97.927°E, were carried out in 2001, 2004, and 2005. “We observed hoolock gibbons ... in the temperate rainforest areas, where red pandas *Ailurus fulgens*, gaur *Bos gaurus* and leopards *Panthera pardus* are also known to occur and were reported by local hunters.” (Renner *et al.*, 2007, p. 34).

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted around Rabot village on 23 Feb 2009. One gibbon group was heard calling at 07:15 am, more than 1 km away from the listening point.

EH-06: Babat village, Putao district, Kachin state

Site location: Babat village (coordinates 27.37301°N, 97.89057°E, elevation 519 m), Naungmung township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Babat village on 20 Feb 2009. According to the interviewees, gibbon calls are usually heard from the village coming from four directions (north, east, south and west).

EH-07: Near Ahtangar village and Naungmung town, Putao district, Kachin state

Alternate spellings: Naungmung = Naungmong = Naungmaung = Nagmung

Site location: Between Ahtangar village and Naungmung town (coordinates 27.25167°N, 97.82850°E, elevation 740 m), Naungmung township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted between Ahtangar village and Naungmung town on 20 Feb 2009. Calls of a gibbon group were heard at 10:36 am (coordinates 27.25167°N, 97.82850°E). The calling gibbon group was less than 1 km away.

EH-08: Gata Bum mountain, Putao district, Kachin state

Alternate spellings: Gata Bum = Gatabum

Site location: Gata Bum mountain (coordinates 27.23275°N, 97.78755°E, elevation 861 m), near Ahtangar village (coordinates 27.25836°N, 97.80324°E), Machbaw township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Gata Bum mountain from 27 Feb to 3 Mar 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 0.66 groups/km² using the 0.6 km listening radius, and 1.35 groups/km² using the 1 km listening radius. A gibbon pair was sighted near one of the listening posts during the survey.

EH-09: Alangar village, Putao district, Kachin state

Site location: Alangar village (coordinates 27.29027°N, 97.69021°E, elevation 438 m), Machanbaw township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Alangar village on 19 Feb 2009. According to the interviewees, gibbon calls are usually heard from the village coming from two directions (i.e. east and southeast of the village).

EH-10: River junction camp in Hponggun Razi Wildlife Sanctuary, Putao district, Kachin state

Alternate spellings: Hponggun Razi

Site location: River junction camp in Hponggun Razi Wildlife Sanctuary (coordinates 27.55279°N, 97.04440°E, elevation 1,177 m), near Zeyardam village (coordinates 27.57333°N, 97.09691°E), Putao township, Putao district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around the river junction in Hponggun Razi Wildlife Sanctuary from 9 to 13 Mar 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 4.20 groups/km² using the 0.6 km listening radius, and 3.35 groups/km² using the 1 km listening radius. Two gibbon groups were encountered near one of the listening posts during the survey.

EH-11: Gato mountain range near Hponggun Razi Wildlife Sanctuary, Putao district, Kachin state

Site location: Gato mountain near Hponggun Razi Wildlife Sanctuary (coordinates 27.53157°N, 97.14286°E, elevation 1,184 m), near Awaddam 2 village (coordinates 27.52085°N, 97.14096°E), Putao township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted on Gato mountain from 16 to 20 Mar 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 1.33

groups/km² using the 0.6 km listening radius, and 1.03 groups/km² using the 1 km listening radius. Three gibbon groups were sighted during the survey, each group at a different listening post.

EH-12: Way to Hponggun Razi, Putao district, Kachin state

Alternate spellings: Hponganrazi = Phonganrazi = Hpongkanrazi = Hponkan Razi = Phungan Razi

Site location: 27.52594°N, 97.23184°E, Putao township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the two bird-watching trips to the extreme north Kachin state (Hponggun Razi range) done in January 1998 and November 1999, many hoolocks were recorded along the way (Tony Htin Hla, personal communication to TG, May 2010). Several the birding trips to Hponggun Razi conducted by WATT (Wild-Bird Adventure Travels and Tours) after 1999 recorded hoolocks in that area (Tony Htin Hla, personal communication to TG, May 2010).

Gibbons were heard on 29 Nov 2002 in the Hponggun Razi area on the way from Zeyar dam to Camp 2 (river junction camp) at 1150 m (Eames *et al.*, 2002).

A gibbon record in Hponggun Razi Wildlife Sanctuary of 2003 is mentioned in Ministry of Forestry (2005, p. 6).

During a visit to Hponggun Razi in Nov 2005, gibbons were recorded on the way from Upper Shan Gaung village to Wasan Dang village: “All along the way we heard bird calls and cries of gibbons” (Myint Lwin *et al.*, 2006, p. 24-25).

During a bird-watching trip from 19 Dec to 31 Dec 2007, gibbon calls were heard daily on the way from Upper Shangaung village to Hponggun Razi (Saw Moses, 2008).

EH-13: Warlaimdam village, near Hponggun Razi, Putao district, Kachin state

Site location: Warlaimdam village (coordinates 27.47481°N, 97.17306°E, elevation 852 m), Putao township, Putao district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Warlaimdam village on 6 Mar 2009. According to the interviewees, two to three gibbon groups occur west of the village.

EH-14: Inkawhka river, Putao district, Kachin state

Site location: Inkawhka river (coordinates 26.92250°N, 97.63689°E, elevation 346 m), Putao township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at the road construction camp by Inkawhka river on 18 Feb 2009. According to the interviewees, gibbon calls are usually heard at the camp in the morning from two directions (i.e. north and west of the camp).

EH-15: Insiyan village, Putao district, Kachin state

Site location: Insiyan village (coordinates 26.89601°N, 97.66097°E, elevation 339 m), Putao township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted around Insiyan village on 18 Feb 2009. Gibbon calls were heard coming from three directions (i.e. north, south and west) in the morning between 10:00 and 11:00 am. It was estimated that the gibbon groups were located within a 1 km listening radius.

EH-16: Khinduyan village, Putao district, Kachin state

Site location: Khinduyan village (coordinates 26.80611°N, 97.62079°E, elevation 482 m), Samprabum township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted around Khinduyan village on 18 Feb 2009. Gibbon calls were heard coming from the west about 1 km away from the village at 07:30 am. According to interviewees from Khinduyan village, about two to three gibbon groups occur around the village.

EH-17: Intatkalot village, Putao district, Kachin state

Site location: Intatkalot village (coordinates 26.49506°N, 97.53404°E, elevation 717 m), Samprabum township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Intatkalot village on 8 Feb 2009. According to interviewees, gibbons occur on a mountain ridge north of the village about 1 km away. Gibbon calls are usually heard from the hillside farms, which lie between the village and the mountain ridge. The number of groups could not be estimated based on the interview information.

EH-18: Su Bum mountain, west of Mali Hka river, Putao district, Kachin state

Site location: Su Bum mountain (coordinates 26.27588°N, 97.57377°E, elevation 48 m), near Khagayanram village (coordinates 26.29674°N, 97.48997°E), Samprabum township, Putao district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Su Bum mountain from 11 to 15 Jan 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 2.87 groups/km² using the 0.6 km listening radius, and 2.23 groups/km² using the 1 km listening radius. During the survey, three gibbon groups were sighted near one listening post, and one gibbon group was observed near another listening post.

EH-19: Wayawbuk village area, Kachin state

Site location: Wayawbuk village area (coordinates 26.45167°N, 98.33991°E, elevation 1,749 m), Saw Law township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed only until Nov 2009

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, field and interview surveys were conducted at and around 29 villages and located east of N'mai Hka river near the China border in Feb and Mar 2010. Two survey teams were

formed and each team conducted a total of 16 one-day field surveys in that area. According to the interviewees from Wayawbuk village, about two to three gibbon groups inhabited the area around their village, but the gibbon population decreased after 1990 due to hunting. Gibbons reportedly occurred in this area until Nov 2009, when the last male gibbon was shot.

EH-20: Lwan Khong farm, east of N'mai Hka river, Kachin state

Site location: Lwan Khong farm (coordinates 26.10563°N, 98.26153°E, elevation 1,655 m), Saw Law township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around the Lwan Khong farm from 22 to 27 Jan 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 1.21 groups/km² using a 0.6 km listening radius, and 0.98 groups/km² using a 1 km listening radius.

EH-21: Kyi Nort village, east of N'mai Hka river, Kachin state

Alternate spellings: Kyi Nort = Kyi Nawt

Site location: Kyi Nort village (coordinates 26.09430°N, 98.24683°E, elevation 1,285 m), Saw Law township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Kyi Nort village from 14 to 19 Jan 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 2.17 groups/km² using the 0.6 km listening radius, and 2.05 groups/km² using the 1 km listening radius. A group consisting of three individuals (an adult pair and a juvenile individual) was observed twice during a pilot tour prior to the survey on 12 Jan 2009 and during the survey on 17 Jan 2009.

EH-22: Mt. Imawbum, Myitkyina district, Kachin state

Alternate spellings: Mt. Imawbum = Mt. Imaw Bum = Mt. Imawbon = Mt. Emawbon

Site location: 26.12591°N, 98.45336°E, Saw Law township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

Three expeditions were carried out by BANCA and BirdLife International in 2005, 2006 and 2007 to Mt. Imawbum to study the Eastern Himalayan endemic bird area (*sensu* Stattersfield *et al.*, 1998). All surveys recorded hoolock gibbons in lower elevation, *i.e.* below 2,000 meters (Tony Htin Hla, personal communication to TG, May 2010).

During a bird survey to Mt. Imawbum, Hoolock gibbons were heard on 8 Mar 2006 between Saw Law and Kyihtan villages (Ngwe Lwin, 2006).

EH-23: Kaung Hla village, east of N'mai Hka river, Myitkyina district, Kachin state

Site location: Kaung Hla village (coordinates 26.00444°N, 98.17445°E, elevation 388 m), in Chibwe township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted around Kaung Hla village on 1 Feb

2009. The field team visited this location for one day and tried to locate gibbons by systematically walking two transects through the forest from 7:00 am to 11:30 am. Two teams were formed to go in different directions (south-east and north-east of the village, respectively). Gibbon calls of a single group were heard by one team (north-east direction) singing from a distance of about 500 m.

EH-24: West bank of Ngaw Chang Hka river, Myitkyina district, Kachin state

Alternate spellings: Ngaw Chang Hka = Ngawchanka

Site location: West bank of Ngaw Chang Hka river (coordinates 25.96417°N, 98.31961°E, elevation 942 m), Saw Law township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted on the slopes above the west bank of the Ngaw Chang Hka river on 29 Jan 2009. Gibbon calls of a single group singing from the opposite slope of the Ngaw Chang Hka valley (10:32-10:59 am) were heard (position of field team: 25.96417°N, 98.31961°E, elevation 942 m).

EH-25: Sanka lake in Kamaing area, Mohnyin district, Kachin state

Site location: 25.51667°N, 96.73333°E, Mogaung township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During Pink Headed Duck surveys conducted from 10 Oct to 3 Nov 2005 in the Kamaing area, gibbons were heard on 24 Oct 2005 at Sanka lake (Htin Hla, 2005).

EH-26: Hopom mountain range, near Indawgyi lake, Mohnyin district, Kachin state

Site location: Hopom mountain range (coordinates 25.40161°N, 96.28788°E, elevation 744 m), near Tetlat village (coordinates 25.39119°N, 96.29818°E), Mohnyin township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted in the Hopom mountain range from 1 to 5 Jan 2010. Four listening posts were established in the survey area. Estimated gibbon population densities were 4.20 groups/km² using the 0.6 km listening radius, and 2.47 groups/km² using the 1 km listening radius. Four gibbon groups were sighted during the survey near three of the listening posts and near the campsite.

EH-27: Naung Khwin lake, NE of Indawgyi lake, Mohnyin district, Kachin state

Site location: Between Kaung Jar village and Naung Khwin lake (coordinates 25.31055°N, 96.35603°E, elevation 206 m), Mohnyin township, Mohnyin district, Kachin state

Forest classification: None, proposed Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

Gibbons heard daily on 3-5 Dec 2006 during Pink Headed Duck surveys at Naung Khwin lake (Htin Hla, 2006).

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a one-day field survey was conducted a field survey was conducted between Kaung Jar village and Naung Kwin lake on 19 Jan 2010. A group of gibbons consisting of an adult

pair and a juvenile of black colour and moving independently was encountered. Gibbon calls were also heard when the survey team was near the lake.

EH-28: Sezin village, near Indawgyi lake, Mohnyin district, Kachin state

Site location: Sezin village (coordinates 25.25673°N, 96.00585°E, elevation 195 m), Mohnyin township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Sezin village on 22 Jan 2010. According to the interviewees, gibbons occur east of the village near the mountain ridges.

EH-29: Saw mill, west of Indawgyi lake, Mohnyin district, Kachin state

Site location: Sawmill (coordinates 25.19551°N, 96.06864°E, elevation 183 m), Mohnyin township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a pilot field survey was conducted around sawmill on 21 Jan 2010. Gibbon calls from two directions were heard at the sawmill.

EH-30: Ohnyan mountain range, near Indawgyi lake, Mohnyin district, Kachin state

Site location: Ohnyan mountain range (coordinates 25.20824°N, 96.49177°E, elevation 221 m), near Chaungwa village (25.18354°N, 96.46325°E), Mohnyin township, Mohnyin district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted in the Ohnyan mountain range from 18 to 22 Jan 2010. Four listening posts were established in the survey area. Estimated gibbon population densities were 7.07 groups/km² using the 0.6 km listening radius, and 4.81 groups/km² using the 1 km listening radius. Gibbons were sighted daily. A total of 19 gibbon group sightings were made at this survey site, and gibbons were observed at each listening post.

EH-31: Nante camp, SW of Indawgyi lake, Mohnyin district, Kachin state

Site location: Nante camp (coordinates 25.01541°N, 96.18759°E, elevation 285 m), Mohnyin township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at Nante camp on 7 Jan 2010. According to the interviewees, two to three gibbon groups occur around the camp.

EH-32: Mine Naung village, near Indawgyi lake, Mohnyin district, Kachin state

Site location: Campsite (coordinates 25.00923°N, 96.30402°E, elevation 227 m) near Mine Naung village (coordinates 25.02670°N, 96.28032°E, elevation 181 m), Mohnyin township, Mohnyin district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted around Mine Naung village from 25 to 29 Jan 2010. Four listening posts were established in the survey area. Estimated gibbon population densities were 4.18 groups/km² using the 0.6 km listening radius, and 2.23 groups/km² using the 1 km listening radius. A total of five gibbon group sightings were made at this survey site.

EH-33: Salin mountain range, Gangaw Taung, Mohnyin district, Kachin state

Alternate spellings: Gangaw Taung = Kankaw Taung

Site location: Salin Range (coordinates 24.60854°N, 95.30875°E, elevation 362 m), near 10-Mile village (coordinates 24.67090°N, 96.26949°E), Mohnyin township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted in the Salin mountain range from 1 to 5 Feb 2010. Four listening posts were established in the survey area. Estimated gibbon population densities were 0.88 groups/km² using the 0.6 km listening radius, and 2.07 groups/km² using the 1 km listening radius.

EH-34: Dainzeinpar village, Bhamo district, Kachin state

Site location: 24.05000°N, 97.48000°E, Momauk township, Bhamo district, Kachin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

Three to four gibbon groups occur in the forest around the Dainzdinpar village in Momauk township. A Local Conservation Group (LCG) was formed in the village to conserve the forest and its wildlife. Eco Dev, a local development organization, supports the LCG to patrol and monitor their conservation area (Win Myo Thu and Myint Soe Oo, personal communication to Ngwe Lwin and Frank Momberg, September 2010).

EH-35: Gawlei village and Nam Tamai river, Putao district, Kachin state

Alternate spellings: Nam Tamai = Nantamaing; Gawlei = Goletu

Site location: 27.61667°N, 97.90000°E, Naungmon township, Putao district, Kachin state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

Goletu (= Gawlei) is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Jenkins (1990, pp. 28-29) lists one specimen (adult female skin and skull, ZD.1950.392) from that locality that is stored at the British Museum (Natural History). According to the museum records, it was collected on 7 Dec 1938 at an elevation of 3,500 ft (1,070 m).

Rabinowitz (2001, p. 87) records hoolock gibbons near Gaweilei, 85 miles from Putao, in 1997, but none east of the Nam Tamai: “After we crossed the Nam Tamai, the wildlife community changed abruptly. The ... Hoolock’s gibbon, and other species were left behind on the south side of the river” (Rabinowitz, 2001, p. 97-98). Rabinowitz and Saw Tun Khaing (1998) reported that hoolock gibbons were “heard frequently and considered relatively abundant in the forests surrounding most village areas along the survey route north-east of Putao, until reaching the Nam Tamai River. ... The Nam Tamai appeared to be a dispersal barrier for these gibbons, and none was heard or reported within the Hkakabo-Razi Protected Area.” (Rabinowitz and Saw Tung Khaing, 1998, p. 207).

EH-36: Kaunglaungpu, Putao district, Kachin state

Site location: 26.80179°N, 97.98786°E, Kaunglaungpu township, Putao district, Kachin state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 5 gibbon records were collected in Kaunglaungpu (Lynam, 2003, p. 57). The area lies in the Kran River and Phet River catchments between 26°44'-26°53'N and 97°53'-98°04'E. Elevation 61-2,767 m. Survey area: 326 km² (Lynam, 2003).

EH-37: 17 km west of Sumprabum, Putao district, Kachin state

Alternate spellings: Sumprabum = Sampara Bum

Site location: 26.47839°N, 97.52705°E, Sumprabum township, Putao district, Kachin state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 14 gibbon records were collected in Sumprabum (Lynam, 2003, p. 57). The survey area lies 15 km east of the Kumon Range and 17 km W of Sumprabum at 26°29'-26°36'N and 97°21'-98°28'E, though we believe the more eastern coordinate was meant to read 97°28'. Elevation 140-1,508 m. Survey area: 334 km² (Lynam, 2003).

EH-38: La Kan village, Ngaw Chang Hka river, Myitkyina district, Kachin state

Site location: La Kan village (coordinates 26.21024°N, 98.30074°E, elevation 726 m), Saw Law township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, an interview survey was conducted at La Kan village on 18 Feb 2010. According to the interviewees, gibbons occurred near La Kan village in the past until around 1985. The gibbon population began to decrease around 1975 due to hunting.

EH-39: 100 miles north of Myitkyina, Putao district, Kachin state

Site location: 26.80639°N, 97.73999°E, Sumprabum township, Putao district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Anonymous (1916) mentions one gibbon that was shot 100 miles [160 m] north of Myitkyina and donated by Mr. F. C. Lowis. Plotting the locality information on a map reveals that it is located north of Sumprabum, provided that the indicated distance was determined as the crow flies.

EH-40: Sumprabum, Putao district, Kachin state

Site location: 26.58333°N, 97.70000°E, elevation 1,220 m, Sumprabum township, Putao district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Sumprabum is the type locality for *Hylobates hoolock leuconedys* Groves (1967). The holotype was collected at an elevation of 4000 ft (1,220 m) at 26°33'N 97°34'E (Groves, 1967, p. 280). Jenkins (1990, pp. 28-29) also lists this specimen (adult male skin and skull, ZD.1950.391) that is stored at the British Museum (Natural History). She gives the coordinates 26°33'N 97°34'E. According to the museum records, the specimen was collected on 24 Dec 1938. Sumprabum is also listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66).

EH-41: Htingnan, Putao district, Kachin state**Alternate spellings:** Htingnan = Htingna**Site location:** 26.60000°N, 97.86667°E, Sumprabum township, Putao district, Kachin state**Forest classification:** None**Gibbon status:** Historical record (before 1960)

Htingnan is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Jenkins (1990, pp. 28-29) lists three specimens (ZD.1950.388, ZD.1950.389, ZD.1950.390) from that locality that are stored at the British Museum (Natural History). According to the museum records, they were collected between 2 Feb 1939 and 7 Apr 1939 at elevations ranging from 3,500 to 4,000 ft (1,070-1,220 m).

EH-42: Fort Hpimaw, Myitkyina district, Kachin state**Site location:** 26.00000°N, 98.63333°E, Chibwe township, Myitkyina district, Kachin state**Forest classification:** None**Gibbon status:** Historical record (before 1960)

Anthony (1941) reports gibbon from Fort Hpimaw during the Vernay-Cutting expedition of 1938-1939. According to Anthony (1941), "Hpimaw is a village in the main river valley (headwaters of the Moku River), but camp was located in a rest house higher up, on the site of the former Hpima Fort, at about 7,500 feet [2290 m]." The expedition was stationed in Fort Hpimaw on 20-27 Feb 1939. During the expedition, that also visited Pyepat and Htaw-gaw, "gibbons were fairly abundant from elevations of about 5,000 feet up to 8,000 feet or more [1,520-2,440 m]." Gibbons were recorded at unusually high altitudes: "They occur in regions where the pine is a dominant forest tree as well as in locations where the broad-leaf trees seemed to offer more in the way of a food supply. Apparently they work up unto the higher ridges very early in the spring for we heard them above Fort Hpimaw late in February while there was still much snow in the pass. At this time they must have been at 8,000 to 9,000 feet elevation [2,440-2,740 m]. We did not see or hear them in the warm zone forests of the lower foothills" Anthony (1941, p. 84).

EH-43: Htaw-gaw, Myitkyina district, Kachin state**Alternate spellings:** Htaw-gaw = Htawgaw**Site location:** 25.95000°N, 98.38333°E, Htaw-gaw village, Chibwe township, Myitkyina district, Kachin state.**Forest classification:** None**Gibbon status:** Historical record (before 1960)

Anthony (1941) reports that one gibbon was purchased "in flesh from native at Htaw-gaw" during the Vernay-Cutting expedition of 1938-1939. According to Anthony (1941), the locality was "located along crest of a ridge lying between the Ngawchang and Hkaingshaw rivers, at 6,025 feet [1,840 m]". The expedition was stationed in Hatw-gaw on 24-27 Dec 1938, and on 3-6 and 28-31 Mar 1939. Htaw-gaw is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66).

EH-44: Pyepat, Myitkyina district, Kachin state**Site location:** 25.93906°N, 98.22879°E, Chibwe township, Myitkyina district, Kachin state**Forest classification:** None**Gibbon status:** Historical record (before 1960)

Anthony (1941) reports that one gibbon was collected at Pyepat during the Vernay-Cutting expedition of 1938-1939. According to Anthony (1941), the collecting locality was "a government bungalow on the principal mule road one day's march northeast from the Laukhaung [25°54'N, 98°11'E] military post." The altitude was recorded as 6,300 ft (1,920 m), and the collecting dates were 21-23 Dec 1938, and 1-4 Apr 1939. During the expedition, that also visited Htaw-gaw, and Fort

Hpimaw, “gibbons were fairly abundant from elevations of about 5,000 feet up to 8,000 feet or more [1,520-2,440 m].”

Pyepat is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) that are stored at the American Museum of Natural History, New York (AMNH 112719, 112720).

EH-45: Dalu, Myitkyina district, Kachin state

Site location: 26.18385°N, 96.14702°E, Tanai township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 656) reports that gibbons were collected at Dalu during the Vernay-Hopwood Chindwin expedition of 1935: “McCann, while sitting under a *Ficus* in fruit, made an excellent collection of gibbons...”, and “McCann added to his previous day’s collection under the fig tree, and in the adjoining jungle secured four more gibbons...” He also reports the altitude as 800 ft (240 m). The expedition was stationed in Dalu on 4-18 Feb 1935. Carter (1943, p. 106) specifies that nine gibbons were collected there, of which one was “preserved entire”.

Based on his study of museum skins, Groves (1967) suggested that interbreeding between the Western and the eastern hoolock takes place around the headwaters of the Chindwin, and specifically mentioned Dalu (26.26°N, 96.08°E) as a site where interbreeding may occur (Groves, 1972, p. 67).

Marshall and Sugardjito (1986, p. 180) list three adult specimens (skins and skulls) of eastern hoolock gibbons (*H. leuconedys*) from Dalu that are stored at the American Museum of Natural History, New York (AMNH 112684, 112686, 112963).

EH-46: Tapa Hka, Mohnyin district, Kachin state

Alternate spellings: Tapa Hka = Tampa Hka = Daba Hka

Site location: 26.11667°N, 96.20000°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 652) reports that gibbons were collected at Tapa Hka during the Vernay-Hopwood Chindwin expedition of 1935: “Gibbons ... were secured by the party on the following day” [i.e. 2 Feb 1935].” He also reports the altitude as 800 ft (240 m). Carter (1943, p. 106) specifies that two gibbons were collected there.

Tapa Hka is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) from Tapa Hka that are stored at the American Museum of Natural History, New York (AMNH 112683, 112961).

EH-47: Tasu Bum, Mohnyin district, Kachin state

Alternate spellings: Tasu Bum = Tasubum

Site location: 26.00000°N, 96.15000°E, Mokaung township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 652) reports that gibbons were collected at Tasu Bum during the Vernay-Hopwood Chindwin expedition of 1935: “On January 31st the party secured specimens of ... gibbons.” He also reports the altitude as 4,200 ft (1,230 m). The expedition was stationed in Tasu Bum on 30 Jan - 1 Feb 1935. Carter (1943, p. 106) specifies that two gibbons were collected there, of which one was “preserved entire”.

Tasubum is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) from Tasu Bum that is stored at the American Museum of Natural History, New York (AMNH 112682).

EH-48: Zaulep Ga, Mohnyin district, Kachin state

Alternate spellings: Zaulep Ga = Taulep Ga

Site location: 25.99208°N, 96.13941°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Carter (1943, p. 106) reports that one gibbon was collected at Zaulep Ga during the Vernay-Hopwood Chindwin expedition of 1935.

Taulep Ga is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) from Zaulep Ga that is stored at the American Museum of Natural History, New York (AMNH 112960).

EH-49: Pumsin, Mohnyin district, Kachin state

Alternate spellings: Pumsin = Pumsim = Pumsem = Pumsin Bum

Site location: 25.98333°N, 96.15000°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 651) reports that “gibbons were collected” at Pumsin during the Vernay-Hopwood Chindwin expedition of 1935. He also reports the altitude as 3,900 ft (1190 m). The expedition was stationed in Pumsin on 28-30 Jan 1935. Carter (1943, p. 106) specifies that one gibbon was collected there.

Pumsin is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) from Pumsin Bum that is stored at the American Museum of Natural History, New York (AMNH 112953).

EH-50: N’bungtku, Mohnyin district, Kachin state

Alternate spellings: N’bungtku = N’bungka

Site location: 25.95000°N, 96.15000°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Carter (1943, p. 106) reports that two gibbons were collected at N’bungtku during the Vernay-Hopwood Chindwin expedition of 1935.

N’bungtku is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) that are stored at the American Museum of Natural History, New York (AMNH 112680, 112681).

EH-51: Gora, Mohnyin district, Kachin state

Site location: 25.87946°N, 96.19945°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Carter (1943, p. 106) reports that one gibbon was collected at Gora during the Vernay-Hopwood Chindwin expedition of 1935.

EH-52: Mansun, Mohnyin district, Kachin state

Site location: 25.80000°N, 96.25000°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 650) reports that “a number of gibbons” were collected at Mansun during the Vernay-Hopwood Chindwin expedition of 1935. He also reports the altitude as 3,200 ft (980 m). The expedition was stationed in Tawmaw on 21-26 Jan 1935. Carter (1943, p. 106) specifies that five gibbons were collected there.

Mansun is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) that are stored at the American Museum of Natural History, New York (AMNH 112674, 112676).

EH-53: Tawmaw, Mohnyin district, Kachin state

Site location: 25.73333°N, 96.31667°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 650) reports that gibbons were sighted at Tawmaw during the Vernay-Hopwood Chindwin expedition of 1935: “Gibbons were in evidence on all sides...” He also reports the altitude as 2,700 ft (820 m). The expedition was stationed in Tawmaw on 19-21 Jan 1935. Carter (1943, p. 106) specifies that two gibbons were collected there.

Tawmaw is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) stored at the American Museum of Natural History, New York (AMNH 112672).

EH-54: Lonkin, Mohnyin district, Kachin state

Alternate spellings: Lonkin = Lonkhin

Site location: 25.70000°N, 96.36667°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 649) reports that gibbons were collected at Lonkin during the Vernay-Hopwood Chindwin expedition of 1935: “As at Nanyaseik, there were large numbers of Hoolock gibbons, their howling in the mornings resound through these jungles. Very human as these gibbons are, it was hateful work shooting them for the collection.” The expedition was stationed in Lonkin on 13-19 Jan 1935. Carter (1943, p. 106) specifies that five gibbons were collected there (three of them preserved entire).

Lonkin is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) that are stored at the American Museum of Natural History, New York (AMNH 112670, 112671).

EH-55: Nanyaseik, Mohnyin district, Kachin state

Site location: 25.66667°N, 96.73333°E, Hpakan township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 648) reports that gibbons were collected at Nanyaseik during the Vernay-Hopwood Chindwin expedition of 1935: “Mr. McCann of the Bombay Natural History Society had already preceded us to Nanyaseik, our first collecting point. ... McCann had already collected specimens of ... the Hoolock Gibbon (*Hylobates hoolock*) ...”. The expedition was stationed in Nanyaseik on 10-13 Jan 1935. Carter (1943, p. 106) specifies that two gibbons were collected there.

Nanyaseik is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) that are stored at the American Museum of Natural History, New York (AMNH 112667, 112668).

EH-56: 25 miles west of Myitkyina, Mohnyin district, Kachin state

Site location: 25.34662°N, 96.96167°E, Mogaung township, Mohnyin district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

25 miles [40 km] west of Myitkyina is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Plotting the locality information on a map reveals that it is located near Mogaung city. The coordinates provided by Groves (1972, *i.e.* 25°20'N, 96°25'E), however, place the location much farther to the west (c. 100 km west of Myitkyina).

EH-57: Pitaung Wildlife Sanctuary, near Myitkyina, Myitkyina district, Kachin state

Site location: 25.33620°N, 97.27225°E, Myitkyina township, Myitkyina district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Historical record (before 1960)

During surveys in Kachin state in 1937, Kingdon Ward (1949, p. 10) recorded a gibbon in Pitaung Wildlife Sanctuary: “One hot afternoon we paid a visit to the game sanctuary a few miles from Myitkyina, but the only animal I saw was a white-browed gibbon which is coal black all over except for its frosty eyebrows, and a white patch where its tail would be if it had one.”

EH-58: 40 miles east of Bhamo, Bhamo district, Kachin state

Site location: 24.19453°N, 97.58045°E, Mansi township, Bhamo district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Anderson (1881, p. 26) mentions “the hilly country to the east of [the Irrawaddy] river at Bhamo” as a hoolock distribution area. This may be similar to the locality “40 miles [64 km] east of Bhamo” that is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Marshall and Sugardjito (1986, p. 180). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) from that site that are stored in the collections of the Museum of Comparative Zoology of Harvard University (H 30383) and at the Academy of Natural Sciences of Philadelphia (P 15128).

EH-59: 20-25 miles below Bhamo, Bhamo district, Kachin state

Alternate spellings: Bhamo = Bamaw

Site location: 24.16667°N, 97.00000°E, Bhamo township, Bhamo district, Kachin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Anderson (1879) mentions “the defile of the Irrawaddy below Bhamo” as a hoolock distribution area. “20-25 miles [32-40 km] below Bhamo” (c.24°10'N, 97°00'E) is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66), who suggests that this may be similar to Anderson's (1879) locality.

Sagaing region

EH-60: Nam Philin creek, near Htamanthi wildlife sanctuary, Chindwin lowlands, Sagaing region

Alternate spellings: Htamanthi = Tamanthi

Site location: Nam Philin creek (coordinates 25.69454°N, 95.65558°E, elevation 152 m), near Kaunghuin village (coordinates 25.67800°N, 95.41613°E), Homalin township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted at the Nam Philin creek from 30 Nov to 4 Dec 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 3.09 groups/km² using the 0.6 km listening radius, and 2.15 groups/km² using the 1 km listening radius. An adult male gibbon was sighted near one of the listening posts on 30 Nov 2009, and an adult gibbon pair was observed near another listening post on 3 Dec 2009.

EH-61: Nam Pagon creek, Htamanthi wildlife sanctuary, Chindwin lowlands, Sagaing region

Alternate spellings: Nam Pagon = Nam Pagan; Htamanthi = Tamanthi

Site location: Nam Pagon creek (coordinates 25.33253°N, 95.50488°E, elevation 208 m), near Swekhaungngaw village (coordinates 25.37467°N, 95.35980°E), Homalin township, Hkamti district, Sagaing region

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

Rabinowitz *et al.* (1995) recorded gibbons during rhinoceros surveys conducted in Htamanthi Wildlife Sanctuary during 1994: “Five days were spent in travel and interviewing local officials and hunters living along the Chindwin and Uyu Rivers before gaining access to the Tamanthi Wildlife Sanctuary. The traverse across the sanctuary was carried out between 2 and 14 March 1994, towards the end of the dry season. The survey started at Yebawmi, a village on the eastern boundary of the sanctuary where there had been recent reports of rhino tracks, and nearly 160 km were covered on foot in 8 days while crossing the sanctuary along Nam Pagon. Larger tributaries (Nam Tanbauk and Nam Kha), side streams, and surrounding ridges were also investigated for animal signs.” (Rabinowitz *et al.*, 1995, p. 125). “Hoolock gibbons were relatively common throughout the survey route, but other primates – macaques and langurs – were surprisingly scarce.” (Rabinowitz *et al.*, 1995, p. 126).

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 4 gibbon records were collected in Htamanthi Wildlife Sanctuary (Lynam, 2003, p. 57). The area is located between 25°16′-25°44′N and 95°19′-95°46′E. Elevation 149-335 m. Survey area: 526 km² (Lynam, 2003).

Biodiversity surveys for Htamanthi Dam hydroelectric project conducted in Sep 2006 also recorded hoolocks in the Htamanthi area (Su Su and Sein Aung Min, 2006, p. 28): “They were relatively common throughout the survey route. The team recorded these endangered species 7 times by sight and 6 times by vocalizations. ... Separate individuals were recorded (6 times) in all the surveyed areas. This species is still common within this area and mitigation should be considered for the long term survival of this endangered species.” In the list of mammals recorded during the surveys, hoolock gibbons are listed for each one of the seven survey sites (Su Su and Sein Aung Min, 2006, p. 33).

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted at the Nam Pagon creek from 21 to 25 Nov 2009. Four listening posts were established in the survey area. Estimated gibbon population densities were 1.55 groups/km² using the 0.6 km listening radius, and 2.07 groups/km² using the 1 km listening radius. Six adult gibbons (three males and three females) eating fruits and sunbathing on a tree were observed near one of the listening posts on 22 Nov 2009. On 23 Nov 2009, an adult pair was observed traveling near another listening post, and a gibbon group consisting of an adult pair, two young gibbons with black fur, and a yellow-brown infant being carried by its mother was encountered near another listening post.

EH-62: Nant Nint area, near Indawgyi lake, Hkamti district, Sagaing region

Site location: Nant Nint area (coordinates 25.10486°N, 95.88870°E, elevation 238 m), near Nant Nint village (N25.12265°N, 96.00695°E), Hkamti township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted in the Nant Nint area from 9 to 13 Jan 2010. Four listening posts were established in the survey area. Estimated gibbon population densities were 1.33 groups/km² using the 0.6 km listening radius, and 1.75 groups/km² using the 1 km listening radius. Eight gibbon were observed near one of the listening posts on 10 Jan 2010, including four adult-sized black gibbons, two adult females, and two black infants carried by the females. It is possible that two gibbon groups were meeting there of travelling together.

EH-63: Centre of Mahamyaing Wildlife Sanctuary, Mawlaik district, Sagaing region

Site location: 23.50238°N, 94.67638°E, Mawlaik township, Mawlaik district, Sagaing region

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 4 gibbon records were collected in Mahamyaing (Lynam, 2003, p. 57). The area is located between 23°31'–23°43'N and 94°51'–94°57'E. The area includes parts of Lawthar, Pyaungtha, Maingwan, Mahamyaing and Nonsabai Reserve Forests. Elevation 68-631 m. Survey area: 200 km² (Lynam, 2003).

A gibbon record in Mahamyaing Wildlife Sanctuary of 2002 is mentioned in Ministry of Forestry (2005, p.7).

During a joint project by the Nature and Wildlife Conservation Division, Forest Department, and the Wildlife Conservation Society (WCS) in 2004 and 2005, gibbon surveys were conducted in Mahamyaing WS (Anonymous, 2004; Brockelman, 2004, 2005; Brockelman and Rao, 2004; Gibbon Survey Team, 2005). Based on fixed listening post vocal surveys at 11 sites, there are approximately two groups per square kilometre in Mahamyaing WS. Average estimated gibbon population densities were 2.26 ±0.41 groups/km² using the 0.6 km listening radius, and 1.81 ±0.26 groups/km² using the 1 km listening radius. Based on this result, the total population was estimated at about 5,900 individual gibbons in Mahamyaing WS (Brockelman, 2005; Brockelman *et al.*, 2009).

EH-64: Nankamu, Katha district, Sagaing region

Site location: 24.65481°N, 95.59701°E, Banmauk township, Katha district, Sagaing region

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 6 gibbon records were collected in Nankamu (Lynam, 2003, p. 57). The area is located between 24°03'–25°15'N and 94°57'–96°12'E between Paungbyin and Pinlebu Townships. It includes parts of Sanda, Kaingshe and Paungbyin Reserved Forests. Elevation 56-640 m. Survey area: 243 km² (Lynam, 2003).

EH-65: Zephyu Taungdan foothills, Katha district, Sagaing region

Alternate spellings: Zephyu Taungdan = Zephutaungdan = Zibyu Taungdan

Site location: 24.20553°N, 95.18058°E, Pinlebu township, Katha district, Sagaing region

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

A survey of the Mu-Chindwin watershed was carried out between 11 Nov and 4 Dec 1982 (Blower and Maung Maung Than, 1982). Hoolock gibbons were recorded when crossing the Zibyu Taungdan, a mountain range on the way from Pinlebu town in the east to Settaw (on the east bank of the Chindwin river) in the west (Settaw is opposite to Taungdut village). Blower and Maung Maung Than, 1982, p. 6): “Gibbons (*Hylobates hoolock*) were heard calling on several occasions in the mornings between about 0800 and 0930 in the Dahli and Kyaukpya chaungs [rivers] and appear fairly common throughout the foothills of the Zibyu Taungdan.”

EH-66: S tip of Mahamyaing Wildlife Sanctuary, Kale district, Sagaing region**Site location:** 23.34170°N, 94.66378°E, Kalewa township, Kale district, Sagaing region**Forest classification:** Wildlife Sanctuary**Gibbon status:** Modern record (1980-2004), confirmed

During a bird-watching expedition in the Sagaing region, several groups were heard and one seen on 12 April 1995 at 23°20.502'N, 94°39.827'E (elevation about 450 m). These observations were “made in what may be the largest tract of primary forest remaining in Myanmar”, called Mahamyaing (not notified yet as a wildlife sanctuary) (King *et al.*, 1995).

EH-67: Hkamti, E bank, Hkamti district, Sagaing region**Alternate spellings:** Hkamti = H'kamti = Singkaling Hkamti = Zingkaling Hkamti**Site location:** 25.98612°N, 95.73225°E, Hkamti township, Hkamti district, Sagaing region**Forest classification:** None**Gibbon status:** Historical record (before 1960)

Based on information from G. C. Shortridge and the late S. A. Macmillan, who collected along the Chindwin river for the Bombay Natural History Society's Mammal Survey during June-August 1914, Wroughton (1916a, p. 296) reports that gibbons occur on both sides of the Chindwin river at Hkamti. He cites G. C. Shortridge as follows: “Plentiful in the Upper Chindwin. Occurring on the West bank of the river from below Kindat Northwards. In Zingkaling Hkamti state, it was equally plentiful on both sides of the river. It had evidently crossed over by way of the Hukawng Valley, above the source of the Chindwin, but the comparatively flat country south of the state, on the East bank, has not proved favourable for its extension further South.” Jenkins (1990, pp. 28-29) lists one eastern hoolock gibbon (*H. leuconedys*) (ZD.1937.3.24.2) from the east bank of Hkamti that is stored at the British Museum (Natural History). She references this specimen to Wroughton's (1916a, p. 296) report. According to the museum records, it was collected on 28 Jul 1914 at an elevation of 500 ft (150 m).

Supposedly based on specimens from the Bombay Natural History Society's Mammal Survey, Hkamti is also mentioned as a site for hoolock gibbons by Pocock (1939), although he does not specify on which side of the Chindwin river the gibbons were seen or collected.

EH-68: Singkaling Hkamti, 4 miles SE of Hkamti district, Sagaing region**Site location:** 25.95402°N, 95.82771°E, Hkamti township, Hkamti district, Sagaing region**Forest classification:** None**Gibbon status:** Historical record (before 1960)

Carter (1943, p. 106) reports that two gibbons were collected at 4 miles [6.4 km] southeast Singkaling Hkamti during the Vernay-Hopwood Chindwin expedition of 1935.

EH-69: Linhpar, E bank, Hkamti district, Sagaing region**Alternate spellings:** Linhpar = Limpa = Linhpa**Site location:** 25.68333°N, 95.43333°E, Hkamti township, Hkamti district, Sagaing region**Forest classification:** Wildlife Sanctuary?**Gibbon status:** Historical record (before 1960)

Carter (1943, p. 106) reports that one gibbon was collected at Limpa on the east bank during the Vernay-Hopwood Chindwin expedition of 1935.

Linhpa East is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the eastern hoolock gibbon (*H. leuconedys*) from “Linhpa east bank” that is stored at the American Museum of Natural History, New York (AMNH 112708).

EH-70: Kaunghein, E bank, Hkamti district, Sagaing region

Site location: 25.68333°N, 95.43333°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: Wildlife Sanctuary

Gibbon status: Historical record (before 1960)

Carter (1943, p. 106) reports that two gibbons were collected at Kaunghein on the east bank during the Vernay-Hopwood Chindwin expedition of 1935.

Kaunghein is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list two adult specimens (skins and skulls) of the eastern hoolock gibbon (*H. leuconedys*) from “Kaunghein, east bank” that are stored at the American Museum of Natural History, New York (AMNH 112711, 112712).

EH-71: Phawzaw, E bank, Hkamti, Sagaing region

Alternate spellings: Phawzaw = Phasaw

Site location: 25.52633°N, 95.49318°E, Hkamti township, Hkamti district, Sagaing region

Forest classification: Wildlife Sanctuary

Gibbon status: Historical record (before 1960)

Carter (1943, p. 106) reports that one gibbon was collected at Phawzaw on the east bank during the Vernay-Hopwood Chindwin expedition of 1935.

Phawzaw is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the eastern hoolock gibbon (*H. leuconedys*) from “Phawsaw, east bank” that is stored at the American Museum of Natural History, New York (AMNH 112713).

EH-72: Maungkan, E bank, Hkamti district, Sagaing region

Alternate spellings: Maungkan = Maungkau

Site location: 25.11755°N, 95.05804°E, Homalin township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Carter (1943, p. 106) reports that two gibbons were collected at Maungkan on the east bank during the Vernay-Hopwood Chindwin expedition of 1935.

Maungkau is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list three adult specimens (skins and skulls) of the eastern hoolock gibbon (*H. leuconedys*) from “Maungkan, east bank” that are stored at the American Museum of Natural History, New York (AMNH 112715-112717).

EH-73: Way from Maungkan to Homalin, Hkamti district, Sagaing region

Site location: 25.05656°N, 95.01224°E, Homalin township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Morris (1936, p. 668) reports that one gibbon was collected on the way from Maungkan to Homalin during the Vernay-Hopwood Chindwin expedition of 1935.

EH-74: Kawya, E bank, Hkamti district, Sagaing region

Site location: 25.00000°N, 95.00000°E, Homalin township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Carter (1943, p. 106) reports that one gibbon was collected at Kawya on the east bank during the Vernay-Hopwood Chindwin expedition of 1935. Although the site is stated to be on the east bank of the Chindwin river, Kawya is listed as a site for western hoolock gibbons (*H. hoolock*) in Groves (1972, p. 66). As we have not seen the specimen in question, we provisionally adhere to the original site description and assume the gibbon was caught on the east bank.

EH-75: Homalin, E bank, Hkamti district, Sagaing region

Site location: 24.91667°N, E95.01667°E, Homalin township, Hkamti district, Sagaing region

Forest classification: None

Gibbon status: Historical record (before 1960)

Based on information from G. C. Shortridge and the late S. A. Macmillan, who collected along the Chindwin river for the Bombay Natural History Society's Mammal Survey during June-August 1914, Wroughton (1916a, p. 296) reports that gibbons occur Homalin. He cites G. C. Shortridge as follows: "Plentiful in the Upper Chindwin. Occurring on the West bank of the river from below Kindat Northwards. In Zingkaling Hkamti state, it was equally plentiful on both sides of the river. It had evidently crossed over by way of the Hukawng Valley, above the source of the Chindwin, but the comparatively flat country south of the state, on the East bank, has not proved favourable for its extension further South." Shortridge's report suggests that the hoolocks on the east bank of the Chindwin do not occur south of Zingkaling Hkamti state, a Shan state lying to the south of the Hukawng Valley in the extreme north of the Chindwin district, extending on both sides of the river. Accordingly, the specimen(s) he collected at Homalin should be from the west bank.

Jenkins (1990, pp. 28-29), however, lists one adult male eastern hoolock gibbon (*H. leuconedys*) (ZD.1915.5.5.2) from the east bank of Homalin that is stored at the British Museum (Natural History). She references this specimen to Wroughton's (1916a, p. 296) report. According to the museum records, it was collected on 16 Jul 1914 at an elevation of 400 ft (120 m).

Presumably based on specimens collected for the Bombay Natural History Society's Mammal Survey, Homalin is also mentioned as a site for hoolock gibbons by Pocock (1939), although he does not specify on which side of the Chindwin river the gibbons were seen or collected.

Morris (1936, p. 669) reports that gibbons were collected at Homalin, east bank, during the Vernay-Hopwood Chindwin expedition of 1935: "On the 27th two gibbons were collected in a patch of evergreen jungle bordering a reservoir near Homalin... The stomach of a female gibbon shot at Homalin contained fifty-four fruits of *Pygeum* entire, while the alimentary canal contained numerous seeds of the same kind." The expedition was stationed in Homalin on 21-28 March 1935. Carter (1943, p. 106) specifies that four gibbons were collected at Homalin, east bank (one of which was "preserved entire").

Homalin is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) of the eastern hoolock gibbon (*H. leuconedys*) from "Homalin, east bank" that is stored at the American Museum of Natural History, New York (AMNH 112718).

Shan state**EH-76:** Momeik-Mabain, Kyaukme district, Shan state

Site location: 23.83175°N 96.75985°E, Mabein township, Kyaukme district, Shan state

Forest classification: Reserve Forest

Gibbon status: Modern record (1980-2004)

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, ten gibbon records were collected in Momeik-Mabain (Lynam, 2003, p. 57). The survey area is located between 23°45'-23°55'N and 96°43'-96°51'E and includes parts of Manpon, Nampa and Namme Reserve Forests. Elevation 130-599 m. Survey area: 340 km² (Lynam, 2003).

EH-77: Panlaung–Pyadalin Cave Wildlife Sanctuary, Taunggyi district, Shan state**Site location:** 21.12147°N, 96.35531°E, Ywangan township, Taunggyi district, Shan state**Forest classification:** Wildlife Sanctuary**Gibbon status:** Modern record (1980-2004), confirmed

A group of bird watchers visiting Padalin cave and Panlaung Wildlife Sanctuary in 1998 and 1999 heard hoolock gibbons in that sanctuary (Tony Htin Hla, personal communication to TG, May 2010).

A gibbon record in Panlaung-Pyadalin Cave Wildlife Sanctuary of 2002 is mentioned in Ministry of Forestry (2005, p.6).

EH-78: Pyaunggaung, Pyin Oo Lwin district, Shan state**Site location:** 23.00000°N, 96.46667°E, Mogoke township, Pyin Oo Lwin district, Shan state**Forest classification:** None**Gibbon status:** Historical record (before 1960)

Pyaunggaung was a locality where hoolock gibbons were collected for the Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon, as reported by Riley and Shortridge (1913, p. 714).

EH-79: Gokteik, Kyaukme district, Shan state**Site location:** 22.35000°N, 96.91667°E, Kyaukme township, Kyaukme district, Shan state**Forest classification:** None**Gibbon status:** Historical record (before 1960)

Gokteik was a locality where hoolock gibbons were collected for the Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon, as reported by Riley and Shortridge (1913, p. 714). Presumably based on specimens from the Bombay Natural History Society's Mammal Survey, Gokteik is also mentioned as a site for hoolock gibbons by Pocock (1939). Gokteik is listed as a site for eastern hoolock gibbons (*H. leuconedys*) in Groves (1972, p. 66). Marshall and Sugardjito (1986, p. 180) list one adult specimen (skin and skull) that is stored at the National Museum of Natural History, Washington, D.C. (USNM 257988). Jenkins (1990, pp. 28-29) lists one specimen (adult male skin and skull, ZD.1933.7.29.15) from that locality that is stored at the British Museum (Natural History). She references it to Riley (1914, p. 714), but probably means Riley and Shortridge (1913, p. 714). According to the museum records, this gibbon was collected on 26 Apr 1913 at an elevation of 2133 ft (650 m).

Mandalay region**EH-80:** Paunglaung, Naypyidaw-Tatkon Township, Naypyidaw district, Mandalay region**Site location:** 20.08854°N, 96.33982°E, Pyinmana Township, Naypyidaw district, Mandalay region**Forest classification:** None**Gibbon status:** Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 32 gibbon records were collected in Paunglaung Catchment (Lynam, 2003, p. 57). The area is located between 19°52'-20°17'N and 96°24'-96°35'E in Pyinmana Township, Mandalay Region. Elevation 152-1,905 m. Survey area: 343 km² (Lynam, 2003).

Kayin (= Karen) state**EH-81:** Htee Khaw Lay Ko, Mudraw (Pa-an) district, Kayin state

Site location: Htee Khaw Lay Ko (coordinates 18.57332°N, 96.97177°E, elevation 1,475 m) near Htee Mu Plaw village, Thandaung township, Mudraw (Pa-an) district, Kayin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted at Htee Khaw Lay Ko from 10 to 13 Apr 2010 (Saw Blaw Htoo and Grindley 2010). Four listening posts were established in the survey area. Estimated gibbon population densities were 0.88 groups/km² using the 0.56 km listening radius, and 0.6 groups/km² using the 1 km listening radius. Calls were heard on two days during the survey, and a group of three adults was recorded as observed, two black and one brown.

EH-82: Htee Ler Kee, Mudraw (Pa-an) district, Kayin state

Site location: Htee Ler Kee (coordinates 18.61600°N, 96.95873°E, elevation 1,599 m) near Baw Lay Der village, Thandaung township, Mudraw (Pa-an) district, Kayin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted at Htee Ler Kee from 14 to 17 Apr 2010 (Saw Blaw Htoo and Grindley 2010). Four listening posts were established in the survey area. Estimated gibbon population densities were 1.99 groups/km² using the 0.6 km listening radius, and 1.36 groups/km² using the 1 km listening radius. Calls were heard on one day during the survey, and a group of three adults was recorded as observed, two black and one brown.

EH-83: Plo Doh Kee creek, Mudraw (Pa-an) district, Kayin state

Site location: Plo Doh Kee Creek (coordinates 18.49950°N, 96.97725°E, elevation 1,622 m) near Pay Lay Pu village, Thandaung township, Mudraw (Pa-an) district, Kayin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, a field survey was conducted at Plo Doh Kee Creek from 18 to 21 Apr 2010 (Saw Blaw Htoo and Grindley 2010). Four listening posts were established in the survey area. Estimated gibbon population densities were 4.87 groups/km² using the 0.6 km listening radius, and 2.63 groups/km² using the 1 km listening radius. Calls were heard on two days during the survey, and three groups were recorded as observed: (1) group of three (adult male, one adult female and a black juvenile), (2) group of four (two adult males and two adult females), and (3) group of five (one adult male, two adult females, and two male juveniles).

EH-84: Khoe Kay, Dawna Range foothills, W bank of Salween river, Hpa-An district, Kayin state

Alternate spellings: Khoe Kay = Hokki

Site location: 18.23516°N, 97.54342°E, Hpapun township, Hpa-An district, Kayin state

Forest classification: None

Gibbon status: Recent record (2005-2010), confirmed

A research team from KESAN (Karen Environmental and Social Action Network) spent three months (Sep-Dec) of 2006, parts of 2007 and early 2008 conducting transect surveys and interviews at Khoe Kay (18°19'N, 97°35'E). During the survey, hoolock gibbons were heard calling from the Dawna Range foothills (KESAN, 2008, p. 49, 58).

EH-85: Opposite Mae Sam Laep (Thailand), W bank of Salween river, Hpa-An district, Kayin state

Site location: 17.97727°N, 97.68733°E, Hpapun township, Hpa-An district, Kayin state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

Marshall (1990) recorded (and tape-recorded) hoolock gibbons from the Thai-Myanmar border at Mae Sam Laep (Mae Sarieng district) across the Mekong river. He reports (Marshall, 1990, p. 93): “Unlike everybody else in Thailand, the local people and officials of the station all know the hoolock and lar gibbons that confront each other across the torrent. ... The hoolocks to the west sing only about once a week. But when they start, you are the captive audience of a fantastic concert. One family may start with a long series of single, dove-like monotones. Eventually the complicated polyphony begins and the notes are read off for each voice not from a score but from a genetic code. Other families join in one after another, each audible for up to four miles.

“The reason the gibbons persist in this most ideal spot for studying them is that the forest on both sides of the river is intact. It is evergreen forest on the north slopes and in the canyons, deciduous dipterocarp (teak) forest on the south slopes.

“The forest persists because it is a no-man’s land between the Karen Army, behind the Thai border, and the Burmese army, patrolling no farther east than the crest of the westward mountains. That leaves the whole east slope of that range untouched and untravelled, as a home for the hoolock.

“Now the Burmese and Thai armies have made a pact to clear-cut the entire forest. The Thai generals will get the valuable logs of which they have none left in their own country, and the Burmese Army will wipe out the buffer zone protecting the Karens. Human greed and warfare will drive to extinction the two species of gibbons, who have no voice in the dispute over their own home. Their voices will be preserved only on our stereo tapes.”

Marshall’s tape-recording locality is also mentioned in Marshall and Sugardjito (1986, p. 183): “West bank of Salween river, opposite Mae Sariang district (Thailand)”.

EH-86: Yado and Taho, NE of Toungoo, Kayin (= Karen) hills, Pha-An district, Kayin state

Site location: 19.10574°N, 96.74809°E, Thandaunggyi township, Pha-An district, Kayin state

Forest classification: None

Gibbon status: Historical record (before 1960)

Thomas (1892) names Yado and Taho (= Thao) in the Carin Hills (or “Karennee” hills), N.E. of Toungoo as a locality for hoolock gibbons.

Fry (1929, p. 639) reported that gibbons are “said to have been found in the area [Kayin Hills] in the past” but are not represented in the collection of the “Bombay Natural History Society’s Mammal Survey of India, Burma and Ceylon”, and none were heard or seen in the Kayin (= Karen) Hills.

Bago (= Pegu) region

EH-87: Bago Yoma, Bago region

Site location: c. 18.08945°N, 96.00025°E, Latpadan township, Thayarwaddy district, Bago region

Forest classification: This may be Reserved Forest, the exact location of the site is not known.

Gibbon status: Historical record (before 1960)

According to Tickell (1864, p. 196) the distribution of the white-handed gibbon (*Hylobates lar*) extends to the northern confines of Bago. It should be noted that Bago is located west of the Salween river. Therefore, if any gibbons occur there, they should be hoolock gibbons, not white-handed gibbons. Gibbons may cross rivers if the tree crowns on both sides are close enough that the gibbons can jump from one crown to the next. The Salween river in Bago region is very broad, and it is highly unlikely that white-handed gibbons were able to cross it so far downstream. Therefore, Tickell’s

(1864) identification of the gibbons in northern Bago as white-handed gibbons is suspect, and Groves (1972, p. 45) wondered whether Tickell was personally acquainted with gibbons from this area. Tickell's (1864) report was also cited by Anderson (1879, pp. 3 and 6). Anderson (1981, p. 29) changed the locality to "Lower Pegu", and he also added Arakan (= Rakhine state) to the list of localities of the white-handed gibbon (*H. lar*) in Myanmar. Pocock (1939, p. 24) suspects: "Anderson's record of it [the hoolock gibbon] from Pegu was, I suspect, due to his inability to distinguish it in the pale phase from *H. lar*."

Fry (1929, p. 639) reported that gibbons are "said to have been found in the area [Bago Yoma (= hills)] in the past", but he points out that no gibbons from Bago Yoma are represented in the collection of the "Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon", and none were heard or seen in the Bago Yoma. During a later survey of the southern Bago Yoma (UNDP/FAO, 1982), no gibbons were recorded.

The reports of the historical occurrence of gibbons in "the northern confines of Pegu" (Tickell, 1864) should be regarded with caution. The forest in the northern part of the Bago mountain range are of the Tropical dry deciduous type (Davis, 1960) and, therefore, should not be able to support gibbons. The southern part has Tropical moist forest, so if gibbons occurred in the Bago Yoma in historical times, it should have been in the south.

Mon state

EH-88: Kyaikhtiyoe Wildlife Sanctuary, Belin district, Mon state

Alternate spellings: Kyaikhtiyoe = Kyaik Htee Yoe

Site location: Kyaikhtiyoe Wildlife Sanctuary, Belin district, Mon state, 17.40129°N, 97.05866°E

Forest classification: Wildlife Sanctuary

Gibbon status: Modern record (before 1980-2004)

Several groups of gibbons were heard calling between 08:00 and 09:00 a.m. during an excursion conducted in around 1980 (Maung Maung Gyi, Yangon University, personal communication on 25 June 2010).

EH-89: Martaban, Thaton district, Mon state

Alternate spellings: Martaban = Mottama

Site location: 16.53°N, 97.60°E, Martaban, Thaton district, Mon state, ca. 16°32'N, 97°36'E

Forest classification: None

Gibbon status: Historical record (before 1960)

Anderson (1879, p. 3) reported that the hoolock gibbon is distributed as far south as Martaban, and he stated that "in Arracan and Martaban it is associated with *H. lar*; the latter, however, does not appear to extend into the northern portion of the Irawady valley". Martaban (= Mottama) is located in southern Myanmar (Thaton district, Mon state, 16°32'N, 97°36'E), close to the mouth of the Salween river. It is possible that Anderson did not use the name Martaban in order to refer to the town Martaban, but as a *pars-pro-toto* to refer to the Bay of Martaban, which also includes the mouth of the Sittoung river and the coastal areas of Bago region and Mon state.

As it is doubtful that white-handed gibbons were able to cross the Salween river and associate with hoolock gibbons (see discussion in the previous locality, Bago Yoma), and as there are no confirmed reports of gibbons in either Bago region or Mon state, Anderson's report on the historical occurrence of gibbons in this area should be regarded with caution.

7.5 Hoolock gibbon, uncertain species

UH-01: Wantoke Hill, Hukawng valley, Sagaing region

Alternate spellings: Hukawng = Hukaung = Hugawng

Site location: 26.40771°N 96.35080°E, Nanyun township, Hkamti district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Recent record (2005-2010), confirmed

The Forest Department and Wildlife Conservation Society (WCS) conducted gibbon surveys in the Hukawng valley from Dec 2005 to Jun 2006. The gibbons were “in tropical evergreen rainforest, semi-evergreen forest, tropical mixed deciduous-dominated forest, and sub-tropical broadleaf hill forest up to 1,400 m” (Saw Htun *et al.*, 2006, p. 7). Gibbons are hunted because “gibbon brains and heads are reported to be used in Traditional Chinese Medicine.” (Saw Htun *et al.*, 2006, p. 8). Various gibbon groups or individuals were sighted. Maximum group size seen was 4 individuals, but in the majority of sightings, only a single gibbon was seen. Gibbon groups consisted of 3 to 4 individuals on average (Saw Htun *et al.*, 2006, p. 6). All black individuals were identified as males, all light ones as females (Anonymous, 2006; Saw Htun *et al.*, 2006, p. 21). This explains why all juveniles sighted during the study were males.

During the Forest department/WCS study, fixed listening post surveys were carried out at 13 sites in Hukawng valley (Anonymous, 2006). Group densities were determined for a 0.6 km and a 1 km listening radius. Densities were determined for six locations in the Naga Hill area northwest of the Tanine river, and for seven localities in the Wantoke Hill area southeast of the Tanine. More gibbon songs were recorded in the Naga Hill area, though the gibbon densities were similar; 2.89 and 2.36 groups per km² in Naga Hill and 2.73 and 2.50 groups per km² in Wantoke Hill (at 0.6 and 1 km listening radius respectively). (These figures are not those originally reported in Saw Htun *et al.* (2006), but the subsequently revised figures in Brockelman *et al.* (*in prep.*); Warren Brockelman to MG *in litt.* 2012).

Despite the seemingly similarity in results, data for the Naga Hill site were collected during winter (*i.e.* the dry season), whereas those for Wantoke Hill were collected during summer (*i.e.* the rainy season), and seasonal factors may therefore mask greater differences in the results than are immediately obvious. According to hunter interviews conducted during our surveys between 2008–2010, gibbons sing more often during the dry season than during the rainy season. Indeed, all our original surveys for this status review were conducted during the dry season for this reason, as presumably were the surveys in Mahamyaing undertaken in 2004/5 by the Forestry Department and WCS (Gibbon Survey Team 2005; Brockelman *et al.*, 2009). Thus the Wantoke records may underestimate gibbon populations, or at least would be subject to different seasonal biases than all other density estimates we use to calculate the total hoolock population in Myanmar (Section 9).

The authors of the earlier WCS report (Anonymous, 2006, p. 7) provide interesting information on the uncertain taxonomy of the gibbons in the headwater area of the Chindwin: “According to primatological literature, there are two species of hoolock gibbons in the Tanine area, one with eye brows together west of the Tanine and one with eye brows separated to the east of the Tanine. Furthermore, east of the Tanine, the genital tufts are of white colour, but west of the Tanine, the genital tufts have no white colour. According to our observations, both species were observed in the survey area. Therefore, the difference between these two species should be studied in more detail.” (Anonymous, 2006). Unfortunately, this topic is not further elaborated upon in the final report of the project (Saw Htun *et al.*, 2006). The reliability of the species identification of the hoolock gibbons in the Naga Hill and the Wantoke Hill areas is discussed in more detail above (see Section 5.4).

UH-02: Hukawng valley NE, Kachin state

Alternate spellings: Hukawng = Hukaung

Site location: 26.64548°N, 96.74095°E, Tanai township, Myitkyina district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Modern record (1980-2004), confirmed

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, 7 gibbon records were collected in Hukawng Valley (Lynam, 2003, p. 57). The area lies “between 26°36’-26°42’N and 96°34’-96°53’E in the newly declared Hukawng Valley Wildlife Sanctuary”. Elevation 59-398 m. Survey area: 840 km² (Lynam, 2003).

UH-03: E Hukawng valley, Kachin state

Alternate spellings: Hukawng = Hukaung

Site location: 26.37614°N 96.80242°E, Tanai township, Myitkyina district, Kachin state

Forest classification: None

Gibbon status: Modern record (1980-2004), confirmed

During a bird-watching survey to Hukawng valley, gibbons were heard on 14, 15 Nov 2003 (Htin Hla, 2003b). Coordinates are available for 14 Nov 2003: 26°22’34.1”N, 96°48’08.7”E, 690 ft [210 m].

UH-05: Tanine, Hukawng valley, Kachin state

Alternate spellings: Tanine = Tanai, Hukawng = Hukaung

Site location: 26.47492°N 96.49642°E, Tanai township, Myitkyina district, Kachin state

Forest classification: Wildlife Sanctuary

Gibbon status: Modern record (1980-2004), confirmed

During a bird-watching survey to Hukawng valley, gibbons heard on 18 and 22 Nov 2003 (Htin Hla, 2003b). Coordinates are available for 18 Nov 2003: 26°28’29.7”N, 96°29’47.1”E, 690 ft [elevation not recorded]. This site is located near Tanine town.

7.6 Incorrect records

IR-01: S Taninthayi, Thayetchaung Township, Dawei district, Taninthayi region

Alternate spellings: Taninthayi = Tanintharyi = Tenasserim

Site location: Pe River Valley at 13°30’N and 98°38’E in Thayetchaung Township, Dawei district, elevation 63-612 m

Forest classification: Unknown

Gibbon status: Incorrect record

During surveys conducted 1999-2002 for the National Tiger Action Plan for Myanmar, three hoolock gibbon records were collected in S. Taninthayi (Lynam, 2003, p. 57). The area lies in the Pe River Valley, in a survey area of 285 km² (Lynam, 2003). Although the authors report hoolock gibbons from this site (Lynam, 2003, p. 57), this locality is deep in the range of white-handed gibbons (*Hylobates lar*).

IR-02: Kapá, Taninthayi region

Site location: 15°53’12”N, 98°12’E

Forest classification: Unknown

Gibbon status: Incorrect record

On 6 Feb 1859, gibbons were sighted at Kapá: “There were several Hoolocks (*Hylobatis lar*) ... on the huge trees over our heads...” (Tickell, 1859, p. 428). The gibbons are ambivalently identified as hoolock gibbons, but the scientific name provided by the author is that of the white-handed gibbon (*H. lar*). Maybe the author was not familiar with gibbon systematics. In any case, this locality is deep in the range of white-handed gibbons (*H. lar*).

8. Threats to hoolock gibbons in Myanmar

8.1 Introduction

Threats to hoolock gibbons in Myanmar are multiple and highly varied across the country, and many are not well documented. Here we attempt a qualitative assessment of threats, based on our own fieldwork and the limited available documented evidence.

In an international symposium on “Gibbon Diversity and Conservation” (Geissmann, 2002b), participants of the roundtable discussion identified the following top four threats for the global gibbon populations (Geissmann, 2003):

- Habitat loss and fragmentation
- Habitat degradation
- Hunting (food, medicine, sport)
- Illegal trade (pets, medicine)

Myanmar gibbons were not considered during that symposium, simply because the threats to gibbons in Myanmar had not been assessed prior to the present study.

Our own assessment comprises the results of non-standardised, subjective appraisals of the main threats at each of 25 survey sites visited between November 2008 and September 2010. In four survey areas (southern Rakhine state, the Naga Hills, Mt. Imawbum, and Indawgyi Lake) detailed threats assessments were undertaken by an additional team to the main gibbon survey team. These assessments are documented in the individual survey reports, available on request.

The main threats to each area we visited are listed individually in Appendices 2 and 3. Our results are summarised in Table 8.1, and indicate that the main threat to western hoolock in survey sites is habitat fragmentation, *i.e.* the reduction of larger contiguous areas of gibbon habitat into smaller “islands” through conversion of forest land to agriculture. The threats to eastern hoolock at survey sites are more varied, though the main threat is considered to be hunting, followed by habitat loss and fragmentation. In 25% of sites, an additional threat to eastern hoolock is habitat degradation, *i.e.*, the selective removal of some trees that reduce the carrying capacity for gibbons and may increase ease of hunting.

Table 8.1. Summary of main threats to gibbons at survey sites (see Appendices 2 and 3).

Species	Survey sites	Primary threat ^(a)			Minor threat	No threat
		Habitat fragmentation ^(b)	Habitat degradation ^(c)	Hunting	Hunting	
Western hoolock (<i>H. hoolock</i>)	9	7	–	–	2 (22%)	1 (11%)
Eastern hoolock (<i>H. leuconedys</i>)	16	4 (25%)	4 (25%)	7 (43%)	–	5 (31%)

^(a) Several threats were recorded at some sites, and ranked.

^(b) Caused exclusively by shifting cultivation in the survey sites.

^(c) Caused by logging, timber extraction or other forest product exploitation.

These results only indicate findings at sites visited by us. However, based on comparison with the limited documented evidence from Myanmar (see below), and comparable gibbon status reviews such as those from Vietnam (Geissmann *et al.*, 2000; Rawson *et al.*, 2011) and Laos (Duckworth, 2008), we believe this broad pattern to be valid as a preliminary assessment. However, the relative importance of these threats varies greatly throughout the known range of the genus *Hoolock* in Myanmar, and we attempt to examine these geographical differences in the following discussion. The

drivers of the main threats are complex, and a detailed analysis is not possible within the scope of this survey. However, some limited discussion of underlying and indirect threats is also offered.

Where possible, the following discussion refers to relevant English-language publications. Such literature is limited however, and should be treated with caution; the situation for wildlife and forests in Myanmar has been in turmoil since at least independence in 1948, and even detailed observations from specific sites can quickly become out-dated. In addition, the influence of both non-state armed groups and neighbouring countries is also highly changeable. All these factors, combined with Myanmar's great geographical area and diversity, make generalisations difficult.

8.2 Hunting

Gibbons are diurnal and produce long and loud calls. As a result, they can easily be located by hunters – although actually killing them takes some skill, and catching of wild adults alive is not only difficult but very risky for the gibbons (Brockelman and Kobayashi, 1971). In some areas of Southeast Asia, resident ethnic peoples have almost completely eliminated wildlife from nearby forests, with gibbons often one of the first species to become locally extinct due to their ease of location. In other areas, gibbons seem to live comfortably in close proximity to people. Both situations exist in Myanmar.

Hunting levels and the threat posed to particular species vary greatly between places. Rao *et al.* (2002) did not report hunting to be a threat in eight of 20 protected areas they assessed in Myanmar, despite that in six of those eight the presence of permanent human settlements itself was a major threat. On the other hand, although poaching had “decimated wildlife populations” in Htamanthi Wildlife Sanctuary, this did not seem to apply to hoolock gibbons, which were reported to be “relatively common” along survey routes (Rabinowitz *et al.*, 1995, p. 126). We too found good hoolock densities in the sanctuary (Appendix 5, sites Nam Pagon and Nam Pilin).

Our own assessment of 25 sites visited during field surveys (Appendix 2) indicates that hunting is some level of threat to western hoolock in four of nine sites, and to eastern hoolock in seven of nine sites (Fig. 8.1). We therefore identify hunting as putting pressure on the species in about 44% of the sites visited. Although sites were selected based on the presence of gibbons, the level of threat was not a consideration in site selection.

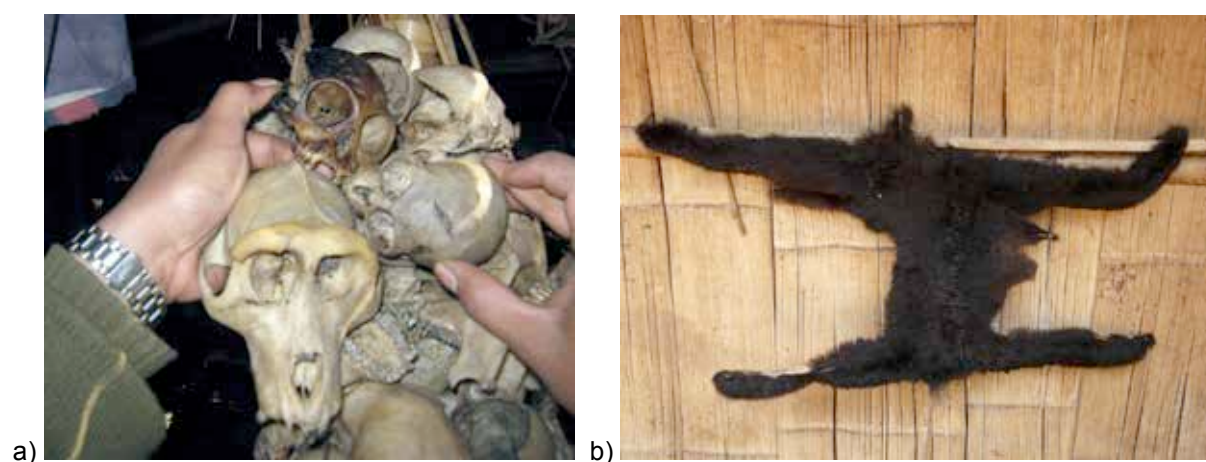


Fig. 8.1. (a) Skulls of various primates (including macaques, leaf monkeys and western hoolock gibbons) shot with crossbow at the timber extraction camp near Kwe Lay camp, Taung Up district, Rakhine state, 26 Dec 2008. (b) Skin of a male eastern hoolock gibbon hung out to dry, Kaung Hla village, east of N'mai Hka river, Myitkyina district, Kachin state, 31 Jan 2009 Photos: Ngwe Lwin and Thomas Geissmann, respectively.

In some cases there appears to be a clear relationship between level of hunting and proximity of settlements, which was observed near Putao in northern Kachin state (Rao *et al.*, 2005). In that case,

the overall hunting offtake of each species was determined largely by its relative abundance, suggesting that for subsistence purposes hunting was not species-specific.

This observation accords with anecdotal evidence from several parts of the country visited during surveys for this status review, during which we found only limited evidence of targeted hunting of gibbons, including in southern Kachin state, Rakhine and Kayin states. Compared to common targets of hunting, such as small deer species and wild pig, gibbons are relatively difficult to kill, and at an average of 7 kg per adult male (Geissmann, 1993, pp. 155-156), gibbons are also much smaller. They are therefore a relatively poor food source, and hunting pressure therefore would seem less likely to be determined by subsistence needs than other factors, particularly the presence of a market for gibbons and derivative products. However, in areas with a strong hunting ethos, or where forest users frequently carry guns (see below), opportunistic hunting of gibbons may still be a major threat. This seems to be the case in the Chin, Naga and Kachin hills in particular.

Hunting patterns across the country may be partially determined by ethno-geography. This has been suggested elsewhere: Tungtitiplakorn and Dearden (2002, p. 63), for example, note that “apparently the Hmong in Laos believe that a solitary gibbon should not be killed, as it may be a forest spirit. This belief is unknown amongst the Thai Hmong...” The authors suggest this explains why white-handed gibbons have been extirpated from much of northern Thailand. Cultural taboos against hunting gibbons have also been reported in Laos (Duckworth 2008).

We note there may be a special regard for gibbons in Myanmar among the ethnic Kayin (= Karen), who claimed cultural taboos against killing gibbons at the only site in that state (Saw Blaw Htoo and Grindley, 2010). Such informal prohibitions among the Kayin were also observed in one wildlife sanctuary in western Thailand, where researchers “found no reason to contradict Karen claims about never harming gibbons” (Steinmetz and Mather 1996, p. 32). They conclude that this special “respect” for the species may be due to observed similarities between gibbons and humans in the eyes of the Karen.

In other parts of the country there is clearly a ‘hunting culture’ that appears to be strongly linked to ethnicity. The Lisu for example are widely regarded (by others and among themselves) as great hunters, and large collections of trophies often adorn the walls of their homes. The Naga are also famed for their hunting prowess. In both Lisu and Naga areas we noted particularly high hunting pressure. These are both upland, mountain landscapes where shifting agriculture predominates. They are also predominantly Christian, a relatively recent religion introduced by western missionaries that does not carry the same attitudes towards nature as the animist or Buddhist beliefs it replaced.

Indeed at lower elevations in Myanmar, local ethnic groups seem less inclined to hunt. Lowland areas are also more likely to be Buddhist, but we are cautious about drawing a broad pattern of association between religion and hunting practices. This is especially the case when historical hunting levels and remaining abundance of wildlife are not comparable between areas dominated by different ethnic groups, and thus causality is far from clear. However, understanding why some people hunt and some do not could still help inform conservation measures designed to reduce this threat to the species, and religious beliefs would seem likely to play a part.

Hunting methods used in Myanmar seem largely similar to those reported from Vietnam (Geissmann *et al.*, 2000) and Laos (Duckworth, 2008). For example, surveys on the west border of the proposed Hkakaborazi protected area in 2002 and 2003 (Rao *et al.* 2005, p. 296) recorded 4,384 weapons being used in 220 hunting incidents, the most prevalent weapons being nylon and steel snares (72% of the total), bamboo traps (21%) and crossbows (5%). Guns and steel traps represented only 1% of the total each, although the figures probably reflect the fact that many more snares are used simultaneously than guns or crossbows.

However, as gibbons are entirely arboreal and diurnal, many forms of hunting commonly practiced in Southeast Asia – including snaring, trapping, using dogs or night spotting – are unsuited to their capture. On current evidence, therefore, it appears that the hunting of gibbons is largely with firearms and focused on daylight hours, particularly mornings. This does not mean that traps, night hunting or bow hunting are not being attempted in some situations, but that they are probably inefficient and certainly not widespread.

The type of guns in use for hunting in Myanmar include older bolt action rifles, and semi-automatic AK47 assault rifles, the latter of which we observed being used for hunting in eastern

Kachin state. We did not observe muzzle-loaded ‘black powder’ shotguns in use in Myanmar for hunting gibbons, but they are reported from Vietnam and Laos, and have been recorded in Myanmar in association with hunting (Rabinowitz *et al.*, 1995). We also observed in Kachin state the use of a machine-made double-barrelled shotgun, where a re-usable brass cartridge case was being hand filled with black powder, and fitted with a hand-made ignition cap. The hunter reported he would take only four of these cartridges on a hunting trip, and would have to refill them back home once they have been fired. This type of weapon would certainly be suitable for gibbon hunting.

Availability of firearms is highly variable across the hoolock range. Gun ownership is in theory strictly controlled by the state, and in areas we visited under their authority we generally only observed guns in the hands of government soldiers. Soldiers are undoubtedly tempted to hunt, be it for food, funds or fun, but we only had one report of this, from eastern Kachin state, where we interviewed a Thatmadaw soldier who had heard a gibbon near the road the previous day and shot it himself. Nearby, a former soldier also reported having used his army-issue gun for hunting, and having ‘rented’ it to neighbours for hunting. With low salaries for soldiers and a tradition of hunting in many militarized areas, it seems likely that gibbon hunting with ‘rented’ or borrowed army weapons may be quite widespread.

Armed conflict in many border areas has caused soldiers to be placed in remote areas where increased gibbon hunting may result. It has also lead to the displacement and destabilization of civilians who are then forced to adopt coping mechanisms, which may include hunting. Border conflict areas, particularly in the east of the Myanmar range of hoolock gibbons, including Kachin, Kayah and Kayin states, may therefore have suffered disproportionately from hunting, much as some have been subject to higher levels of logging and wildlife trade.

8.3 Wildlife trade

The illegal wildlife trade is considered one of the main threats to a wide range of species globally, particularly primates, and Myanmar is no exception. Although there has been little systematic study of the trade in Myanmar, available material and our own results give a preliminary indication of the situation.

There has long been trade in wildlife between Myanmar and its neighbours, notably in elephants and ivory (Shepherd and Nijman 2008), but also in other animals and animal products (TRAFFIC, 2008). However, due to dwindling wildlife resources in Myanmar’s Southeast Asian neighbours, Myanmar and bordering Laos are probably now “the most important source countries for a wide range of wild animal and plant species” within the Greater Mekong Subregion, which comprises most of mainland Southeast Asia, and Myanmar is also becoming increasingly important as a conduit country for wildlife products from the Indian subcontinent into the region (World Bank 2005, p. 4).

Myanmar’s growth in importance for wildlife trade is likely a result of several factors, including relative abundance of some trade species, long and largely uncontrolled borders, political instability, the ninth highest poverty level in the world (CIA, 2010), and, according to Transparency International (2009), the second highest rate of corruption in the world. Myanmar also shares a long border with China, a country with a large demand for a range of wildlife products (e.g. Reuters, 2007; TRAFFIC, 2007, 2008; World Bank, 2005).

We recorded strongest demand for gibbons in the wildlife trade in Kachin state, particularly near the border with China, and little elsewhere in the country. In Kachin, gibbons and other primates (mostly macaques) caught *ad hoc* during the year are stripped of their meat and entrails, and the brain case is opened and cleaned out. The carcass is then dried over the open fire present in most traditional houses. Access to larger towns from many areas can be highly seasonal, and most of the wildlife that is traded tends to be processed and preserved in the hunter’s village or camp in this way, and transported in bulk as opportunity arises. Buyers probably visit some areas, but this was not reported frequently (either in Kachin state or in other sites we surveyed). The dried animals then make their way to China via traders, truck drivers or the villagers themselves.

The international trade of gibbons we observed in Kachin state was small scale and unorganized, and only included carcasses, which are later ground up for use in traditional medicine by consumers in

China. No gibbon meat or skins were traded, the meat usually being eaten by the hunter and the skin kept as a trophy or used for some purpose, such as being made into a bag. The relative demand for gibbons is unknown, and they did not have a discernable market separate from macaques or leaf monkeys, which all tended to be traded as one product.

Also in Kachin state, Rabinowitz and Saw Tun Khaing (1998, p. 201) note that “As a result of a thriving cross-border trade in wildlife parts with China, skins, antlers and horns of larger mammal species present in the area were readily available in villages visited during the expedition.” They also observe that “Although [gibbons were] not considered as a particularly valuable trade species, the skins were sold in Putao as shoulder bags, and the brain was considered good for headaches” (Rabinowitz and Saw Tun Khaing, 1998, p. 207).

Our study did not include large areas of Kayin and Shan states, which have long borders with Thailand and, in the case of Shan state, also China (and a short border with Laos). There are currently no published reports on the significance of trade in gibbons across those borders, but a 2010 report from TRAFFIC indicates that much illegal wildlife trade, even of big wild cats, is rampant across these borders “in non-government controlled areas in northern Myanmar bordering China” (Oswell, 2010, p. iv). The report specifically notes that “Wildlife traders interviewed [between January 2001 and June 2010] in Mong La, Panghsang, Mong Mit, Mong Hsat, Keng Larb and Tachilek in the Shan and Wa states of northern Myanmar... openly admitted to dealing in prohibited wildlife” (pp. iv-v). These areas are in the range of the white-handed gibbon, not the hoolock gibbon, but wildlife passing through these locations may well be sourced from elsewhere in the country.

The prevalence of gibbons in this trade is to date undocumented, but over the past ten years the animals and their parts have been routinely observed in the trade between eastern Myanmar and Thailand and China, and in restaurants in border towns (Adam Oswell, pers. comm. to MG, July 2010). There is even some trade of live gibbons from Myanmar for the pet market and private zoos in both Thailand, China, and perhaps further afield, though there appears to have been a significant decline in gibbon pet trade through Thailand since the early 2000s (Adam Oswell, pers. comm. to MG, July 2010).

Outside of Kachin state, most rural trading areas visited during the survey showed some signs of wildlife trade. These included gold mine towns between Indawgyi lake and Htamanthi Wildlife Sanctuaries, close to an area studied previously by Rao *et al.* (2002), who noted that “Poachers... and commercial collectors of non-timber forest products travel from as far as 150 miles downstream of the Chindwin River, where lucrative markets for forest products exist” (p. 365). Yet to what degree gibbons are a part of this mostly domestic trade is not clear, as most bushmeat is probably from more abundant animals such as wild pig and muntjac, while gibbon trophies and whole animals were seen in trade by us only occasionally in areas away from the China border.

Little is known about internal commercial trade flows, with the main current observation being that large towns – particularly Yangon, Myawaddy, Mandalay, Tachilek, Monywa, Muse and Tamu – are important hubs (Tim Redford, pers. comm. to MG, 2010). It seems unlikely that there is a well established local market for gibbons, though the presence of resident and visiting ethnic Chinese in Myanmar does raise the possibility of demand being created inside the country as well as across the border, and some wild animals (pangolins) have recently been observed for sale in Chinese restaurants in Myanmar (Tim Redford, pers. comm. to MG, 2010), which seems to be a relatively new trend.

Apart from the cross-border trade in live animals mentioned above, there is clearly some domestic demand for pets (Fig. 8.2). During our field surveys we found at least eight individual gibbons kept in captivity by private citizens, in many cases as genuine ‘pets’ with clear bonds with their owners, rather than simply for show, as other wild caught animals are often kept.

The importance of this particular demand in the entire system of gibbon hunting is difficult to separate. In Kalimantan, Indonesia, many hunters “are opportunistic and when primates are encountered an adult female may be shot, its meat eaten, certain body parts kept for medicinal use, and any young taken to be sold as pets” (Nijman, 2005, p. 30). Anecdotal evidence from our field research suggests the situation in Myanmar is similar, and these pets may therefore be a secondary result of hunting of mothers rather than due to direct targeting by hunters.



Fig. 8.2. Hoolock gibbon pets. (a) Three eastern hoolock infants near Nan Mon village, Indawgyi Lake area, Kachin state, 29 Jan 2010. (b) Two eastern hoolock infants in Myitkyina, Kachin state, 1 Feb 2010. Photos: Thomas Geissmann.

Overall, it seems that the trade in gibbons (and other primates) in the north and east of the country is mostly a result of demand for use in traditional medicine in China. This puts disproportionate pressure on these populations of eastern hoolock, and this pressure seems set to extend to other parts of the country as local supplies dry up and access to other parts of the country improves. The relative importance of air and sea transportation routes cannot be determined at this time, but with long porous borders and established overland trade links – some of which are being upgraded, such as the route from Myitkyina to Tenghong in China – it seems likely these will be favoured for some time.

We found little evidence for a significant domestic trade in the species, which suggests that controlling international trade, particularly along Myanmar's eastern borders, is a priority for hoolock gibbon conservation.

8.4 Habitat loss

There is no overall consensus on the rate of loss of Myanmar's forests, though there is little question of an ongoing decline in extent and quality of the remaining forest, particularly since the 1990s. A number of causes of forest loss have been identified, although it is important to note that they are likely to overlap in space and time. Brunner *et al.* (1998) for example make a clear distinction between the threats to forests in lowland areas – agricultural conversion, fuelwood cutting and charcoal production – and those in the “frontier” (i.e. border) areas – primarily logging to fuel regional demand for timber, especially from India and China. Leimgruber *et al.* (2005) suggest three main threats are largely responsible for the observed loss: (1) conversion to permanent agriculture and degradation (including from fuelwood consumption, clear-cutting, and conversion to aquaculture), (2) shifting cultivation, and (3) conversion to commercial plantations.

Here, we look briefly at the evidence for the scale, location and nature of threats to gibbon habitats, based on published reports and observations made during the preparation of this status review.

Commercial, state-controlled logging

Myanmar Timber Enterprise (MTE) is part of the Ministry of Forestry, and retains control over much of the productive lowland forests with a focus on teak extraction, based on a 30-year rotation cycle system that intends to maintain a productive resource indefinitely. With a focus on common teak (*Tectona grandis*) and pyinkado (*Xylia xylocarpa*), the MTE is predominantly active in felling operations in the lowland teak forests of central Myanmar, particularly in Sagaing region but also in the Chindwin basin and Bago Yoma (= Bago mountains).

This form of commercial logging does not threaten gibbons directly, since it is largely targeted at teak. But indirect threats occur from fragmentation and small-scale secondary logging (e.g., of evergreen dipterocarp trees in mixed deciduous forest). There may also be an increase in hunting as access is improved, again in areas where evergreen forest co-exists with the target tree species.

The only such area visited by us was the semi-evergreen forests in areas of mixed teak forest mosaic west of Indawgyi lake in southern Kachin state, where long-term felling operations had resulted in a number of unsurfaced roads providing access to otherwise relatively intact semi-evergreen forest patches. Despite the increased access, gibbons were holding out in areas that were otherwise subject to secondary logging for the local timber and firewood markets.

State-sponsored hardwood logging may, therefore, be compatible with gibbon conservation, but we cannot speculate on how widespread this pattern is. The general unsuitability of teak forest for hoolock gibbons suggests, however, that commercial coups operated by MTE are probably not a conservation priority for the species on a national scale.

Commercial, non-state logging

Most areas of hoolock gibbon habitat in Myanmar are located outside of the lowland teak concessions, and are subject to different commercial logging pressures. By far the best-documented threat is uncontrolled exploitation of the northern border forests.

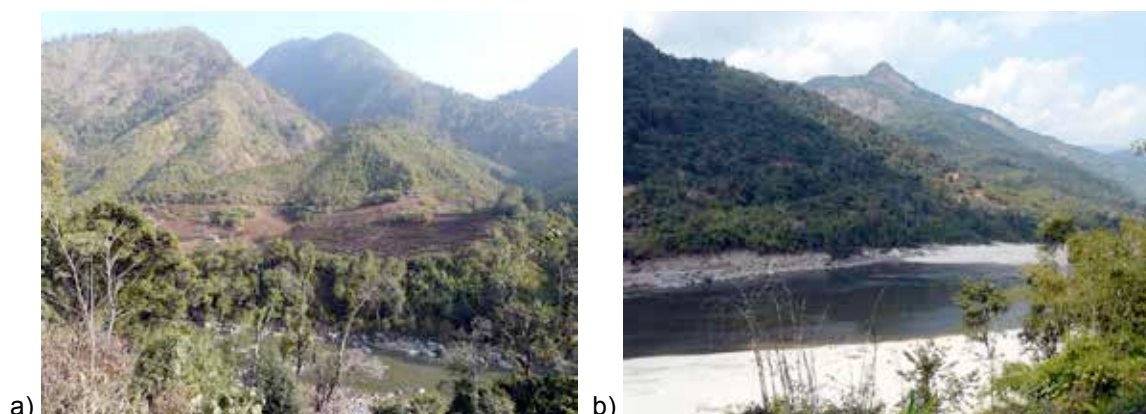


Fig. 8.3. Absence of primary forest: (a) along the Ngaw Chan Hka river near Ke Maw Zut (29 Jan 2009), and (b) along the N'mai Hka river between Chibwe and Kaung Hla (31 Jan 2009), both in the Saw Law area, Myitkyina district, eastern Kachin state. Photos: Thomas Geissmann.

Within the last two decades or so, logging bans were imposed in Myanmar's two eastern neighbours: Thailand in 1989 – when 258 logging concessions were revoked throughout the kingdom, making it the first country in Southeast Asia to enact a total ban (Yonariza, 2010) – and China in 1998. This led to an increased demand for timber at about the same time that the Myanmar military government began allowing ethnic armies that had signed ceasefire agreements to conduct commercial resource exploitation. Several of the 'ceasefire groups', as they are commonly known, used their new freedoms to raise money from timber sales, the impacts of which, in terms of increased logging, have been well documented subsequently (e.g., Brunner *et al.*, 1998; ERI and KESAN, 2003; Global Witness, 2003, 2005, 2009; Kahrl *et al.*, 2004; PKDS and KESAN, 2004).

Brunner *et al.* (1998, p. vii), for example, note: "satellite data show that forest clearing in Kachin state more than tripled between 1978-1989 and 1989-1996, and that logging is responsible for almost half the deforestation". However, the ceasefire areas are often in remote mountainous parts of the country, and thus effectively "beyond the reach of Burmese law" (Wyler, 2008, p. 1). For this reason, much of the logging along the northern and eastern borders in particular is not subject to regulatory control by the competent national authority, the Forest Department of the Ministry of Environmental Conservation and Forestry. This has raised questions over the legality and sustainability of such logging operations, and the country's ability to manage its forests (e.g., Global Witness, 2003, 2005, 2009).

The main conservation concern is that evergreen hardwoods and other commercially valuable species are being harvested at unmanaged and unsustainable levels along Myanmar's Thai and Chinese borders. Large-scale exploitation, including clear-felling and endemic overcutting (even where takeoff is agreed) is in marked contrast to "low impact harvesting methods that protected the forest" formerly practiced by Mon, Kayin and Kayah groups along the Thai border (Brunner *et al.*, 1998, p. 17). Meanwhile, demand for timber has little diminished while efforts to impel importing countries to control illegal and undeclared imports have seen little success, causing concern for future supplies even in the International Timber Trade Organization, a trade body (ITTO, 2004).

The situation is suitably summed up by Kahrl *et al.* (2005, p. 1), who note that "[t]he uncertain regulatory and contractual environment has oriented the border logging industry toward short-term harvesting and profits, rather than investments in longer-term timber production". This has exacted "a high ecological price" (Kahrl *et al.*, 2005).

Chinese logging operations were observed first hand by us on two occasions in Kachin state in 2010 in the lower-middle reaches of the N'mai Hka river. They were apparently designed to extract the maximum value at minimal cost, with little apparent consideration of environmental impact. In general, temporary roads are cut quickly into hillsides, with excess soil deposited on the downslope. Cutting crews then move in with chainsaws to fell trees on either side. Trees may be delimbed, topped and bucked (cut to length) *in situ*, before being winched up or down chutes to landing sites on the road. They may also be fully or partly processed at the landing.

In cases where small valleys and other obstacles prohibit direct access for winching, logs are dragged or lifted, presumably using high-lead and skyline cable methods. Timber is then loaded on 20-ton trucks for transport direct to the border or to a depot, depending on the quality of the logging roads and the operational set-up (Fig. 8.4). Most timber was cut to the width of the truck (about 2.5 m), though some larger trees are cut truck length (4-5 m).



Fig. 8.4. Trucks of Chinese logging companies carrying timber or, occasionally, charcoal, were encountered frequently in the Saw Law area, Myitkyina district, eastern Kachin state. These pictures were all taken on one day on the road crossing from Chibwe over the mountains to the Ngaw Chan Hka valley and going downstream to Saw Law. Photos: Thomas Geissmann, 12 Jan 2009.

It seems that trees as small as 25 cm diameter are being taken provided they are of commercially valuable species. While some logging in Kachin state is ‘clear cut’ (see also, e.g., Global Witness, 2003), we saw evidence of selective logging, with lesser value trees left standing except where they were accidentally damaged by the logging process or removed to facilitate extraction of other trees. This probably reflects the increasing transportation costs associated with logging operations that have, over at least seven years of operation, moved further up the N’mai Hka valley and to higher elevations while using the same border crossings.

Kahrl *et al.* (2005) indicate the economics of logging in these areas may be becoming increasingly unsustainable. Indeed the number of logging companies operating in a prime logging area of northeast Kachin state was reported to have decreased to four or five, from a high point of from up to 30 in the mid-2000s. Several independent truck stops confirmed reductions in traffic of 75% in the past three years alone.

The gibbon densities in the remnant forest patches in this part of Kachin state were among the lowest we recorded in the country, leaving them susceptible to a number of secondary threats, including hunting and genetic isolation through secondary logging and expansion of upland agriculture (Fig. 8.5). However, remaining forest tended to be in stream heads and along ridges, and could still form an important component of a managed landscape that provided for protection of gibbons if the necessary steps are taken soon.

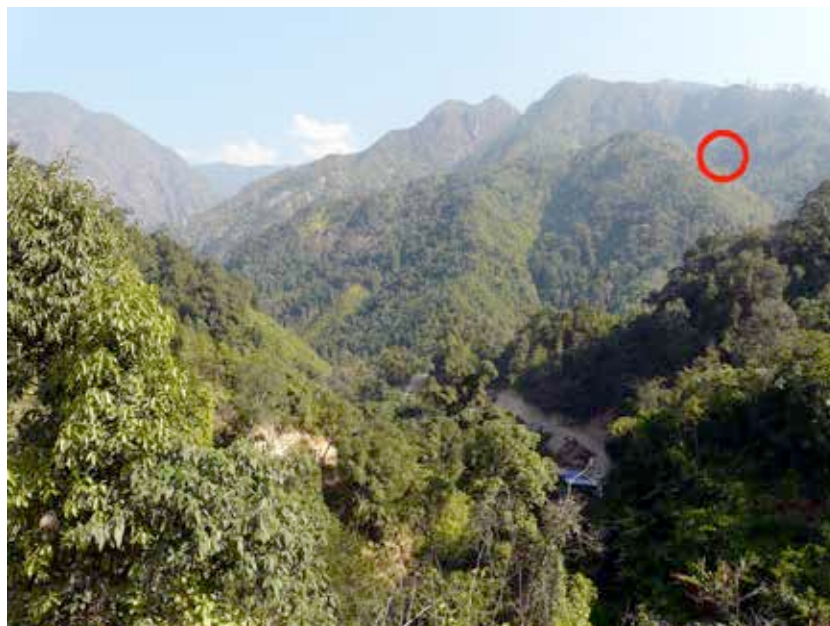


Fig. 8.5. Eastward view from slopes above the Ngaw Chan Hka valley, near Myo Maw, Saw Law area, Myitkyina district, eastern Kachin state. The few patches of remaining forest are often selectively logged, but some of them still support individual groups of gibbons. A group of gibbons was heard calling from the isolated patch of forest on the opposite slope of the Ngaw Chan Hka valley (red circle). Photo: Thomas Geissmann, 29 Jan 2009.

Small-scale logging

Small-scale logging is significant in some areas. Our own observations in several parts of Kachin state, for example, showed that local loggers would move in on roads constructed by large-scale loggers following commercial exploitation. Their goal was to extract smaller and lesser quality timber, including felled trees abandoned by the timber company as economically worthless, in some cases using donkeys to take sawn planks out. Root systems of mature felled trees have also been seen pulled from the ground. This material presumably was aimed at local markets rather than export, but we cannot be certain. In some parts of eastern Kachin state we visited, this secondary logging was followed with creation of hill rice fields and/or extraction of remaining live and dead wood for charcoal. These additional activities leave formerly forested hillsides entirely barren despite an initial logging which was ostensibly selective. In other areas, logged forest may stand a reasonable chance of

regrowth. However, only where inaccessible (mainly stream head or ridge top) forests remain connected would there be much chance that the eventual extirpation of any local gibbon populations might be averted.

Around Indawgyi lake, southern Kachin state, large old growth evergreen dipterocarps and likely other species are being cut for house construction and for chopping into firewood, which is sold on roadsides by volume. In semi-evergreen patches west of the lake, in an area subjected to state-sponsored teak harvesting, we observed one small-scale cutting enterprise with a small, diesel-powered mill. It made use of logging roads to extract and prepare planks for construction. This is done under 'licenses' issued locally and is meant to be in line with national prescriptions on minimum tree diameter, though it seemed unlikely that this small-scale operation was being closely monitored. However, of five sites in the forests adjacent to Indawgyi Lake we visited that were subject to small-scale logging, all retained gibbons, and it seems the small scale and selective nature of this logging does not immediately imperil the entirely local gibbon population.

Overall it appears that small-scale, local use of timber is only a threat to gibbon habitat where market demand pushes producers to commercialize on a large scale. This is likely to be a particular problem where ownership rights are unclear and a race to exploit common resources emerges, as is the case with commercial hunting.

Shifting cultivation

Shifting cultivation is widespread throughout the range of hoolock gibbons in Myanmar, particularly in upland areas less amenable to permanent agriculture (Fig. 8.6). Around a fifth of the total land area of the country is believed by the government to be affected by this form of agricultural use. The term "shifting cultivation" refers to combined rotational agriculture that incorporates swidden and fallow periods, with the duration of fallow periods ranging from over fifteen years down to just a few years, often supplemented with pioneer forest clearance where land availability allows.

This type of agriculture is predominantly rain fed, and dominated by hill ('dry') rice and maize. In many areas, vegetables and other secondary crops may be grown following the main crop, and woody perennials may be inter-planted. In some areas such as densely populated parts of Chin and Shan states, where land supply is tightly constrained, cultivators have developed more complex permanent upland agricultural systems based on perennial crops and terraced rice farming. Because gibbons need relatively intact mature forest to survive, it is in the less densely populated upland areas of western and northern Myanmar where shifting cultivation comes into direct conflict with the species.

Under certain conditions, particularly where there are low human population densities, shifting upland cultivation can be a productive and sustainable use of land compatible and possibly even favourable to biodiversity (Tordoff *et al.*, 2008). However, it is also associated with forest fragmentation, and is not amenable to intensification required by growing human populations.

Consequently the impact of shifting cultivation on hoolock gibbons is variable throughout Myanmar. In the Rakhine Yoma, within the range of the western hoolock gibbon, high demand for agricultural land has put shifting cultivation as the main threat to gibbons, as identified by us in five out of seven sites. Without moves to permanent hill agriculture or intensification and redistribution of lowland farmland, shifting cultivation seems likely to significantly impact on the remaining gibbon habitat. This could also be the case in the Chin Hills (Tony Htin Hla, pers. comm. to MG, 2011).

By contrast, in Kachin state we considered shifting cultivation to be the main threat in only two of ten sites. In the sites in the north of the state this is due to low overall human population densities, and the fact that long rotation periods with mature forest nearby may allow fallow fields to naturally regenerate to a level tolerable to gibbons within the usual agricultural cycle. A similar situation exists in the Naga Hills sites we surveyed, with the possible addition of net outward migration of youth allowing an overall reduction in land under shifting cultivation and a descent of villages from higher altitudes.



Fig. 8.6. (a) Campsite at Kyi Nort, Saw Law area, east of N'mai Hka river, Kachin state. Large areas around the site were logged in the 1990s and have remained under shifting cultivation since. Photo: Thomas Geissmann, 13 Jan 2009.

(b) Shifting cultivation in the study area at Goatsiyoe ridge, north-central Rakhine mountain range, Magway region. Photo: Ngwe Lwin, April 2009.

(c) View of the habitat at the Ye Paw Gyi survey site, Taung Up district, Rakhine state. In this area, patches of primary forest are located in the valleys, whereas the bamboo vegetation on the slopes of the mountains is interspersed with shifting cultivation lands, abandoned shifting cultivation lands, and permanent agricultural lands. Photo: Ngwe Lwin, Dec. 2008.

(d) Patches of former shifting cultivation on the western slopes of the Ngadanni Kyaw hills, near Chaung Tha village, Thandwe district, Rakhine state. Photo: Thomas Geissmann, 30 Nov. 2008.

(e) View of the habitat at the Do Kwe Chaung survey site, Thandwe district, Rakhine state, showing a patch of primary forest on a hill, while the lower slopes are covered with secondary vegetation resulting from shifting cultivation. Photo: Ngwe Lwin, Dec. 2008.

In survey sites in Sagaing region and Kayin state we noted no major threats, again due to low human population densities, despite shifting cultivation being the primary mode of agricultural production in these areas. This was particularly surprising in Kayin state, where upland gibbon habitat is a site for relocation of lowland villages affected by civil war. In these cases the local population is transient, and might therefore be expected to have a relatively larger impact on natural forest than permanent hill communities.

Unsurprisingly, the general impact of shifting cultivation on gibbon habitat appears to be closely related to the size of the human population, with low densities probably compatible with gibbon conservation. However, higher demand for land tends to lead to wider forest loss before higher-

intensity cultivation systems are adopted. By that time, the remaining forest tends to be too fragmented or otherwise degraded for gibbons to survive. Acknowledging this pattern may be key to identifying suitable development strategies in protected areas, buffer zones and other sites that might form the backbone of a national strategy for protection of gibbons and forest biodiversity more generally.

Conversion of forests

Conversion of forest for agro-industrial plantation has been noted as a significant threat to biodiversity in Myanmar (e.g., Tordoff *et al.*, 2005), and is believed to be increasing in scope and scale (BEWG, 2011). However, it seems at this time that the areas most threatened are the southern lowland evergreen forests, which are primarily being targeted to oil palm, and eastern lowland and low altitude forests, which are being targeted for rubber. Nearly all of these areas fall within the range of the white-handed rather than hoolock gibbon, and are therefore not considered in this assessment. More worryingly for hoolock gibbon, a large area of northern lowland forest and other natural habitat is being converted to cassava, sugar cane and other crops in the Hukawng Valley Tiger Reserve (KDNG, 2010), which may signal a new trend for lowland forest conversion in the north.

We did not notice a significant threat from commercial plantation during any of our field surveys and it is consequently not listed as a threat at any of those sites. However, the high demand for the target crops and weak protection for customary landowners or indeed protected or reserved forests mean that conversion of forests for commercial plantations has the potential to replace logging at the main threat to remaining hoolock gibbon habitat in much, if not all, of its range in Myanmar without appropriate safeguards being put in place.

9. Gibbon status

9.1 Gibbons in the protected area system

An annotated list of the established and proposed protected areas in Myanmar is presented in Appendix 4, including the available information on the presence of gibbon species. These data are summarised in Table 9.1.

Table 9.1. Distribution of protected areas (PAs) in gibbon ranges, and number where gibbons are confirmed.

Species	Number of PAs in range	Combined area (km ²)	Number of PAs where gibbons confirmed ⁽¹⁾	Combined area where gibbons confirmed (km ²)
Western hoolock (<i>H. hoolock</i>)	6	4,766	3	2,611
Eastern hoolock (<i>H. leuconedys</i>)	10	13,957	5	7,184
Hoolock, uncertain species	2	21,803	2	21,803
White-handed gibbon (<i>Hylobates lar</i>)	7	7,195	2	3,772
Totals	25	47,837	12	35,370

(1) From reliable records we define as either Modern (1980-2004) or Recent (2005-2010).

This status review indicates that gibbons have been recorded in 12 of the existing protected areas, representing ten of 18 parks within the range of hoolock gibbons, *Hoolock spp.*, and two of seven within the range of the white-handed gibbon, *Hylobates lar* (Table 9.1).

Eight existing protected areas have Recent Records of hoolock gibbons, and a further two have Modern Records (Table 9.2). In Myanmar, there are few protected areas within the range of the white-handed gibbon (*Hylobates lar*). The range of that gibbon in Myanmar lies predominantly in eastern border areas where fighting is widespread. Consequently, none of Myanmar's protected areas there have a Recent Record of the species, and only two have Modern Records. No protected areas have historical records of any gibbon species.

Table 9.2. Number of existing protected areas with gibbon records.

Species	No of records			Sub-total	Unsure
	Historical (before 1950)	Modern (1980-2004)	Recent (2005-2010)		
Western hoolock (<i>H. hoolock</i>)	0	1	2	3	0
Eastern hoolock (<i>H. leuconedys</i>)	0	1	4	5	1
Hoolock, uncertain species	0	0	2	2	0
White-handed gibbon (<i>Hylobates lar</i>)	0	2	0	2	4
Totals	0	4	8	12	5

The combined area of protected areas with hoolock records is just over 35,000 km² (Table 9.1), with by far the largest proportion (nearly 22,000 km²) being in the inter-species area (i.e., in the Hukawng valley). This total almost certainly does not accurately represent the extent of forest where hoolock gibbons remain extant, given the unsuitability of much of the protected forest estate, and that some of these records represent only single observations. The limited coverage of the national protected area system compared with the estimated available forest cover (see below) also suggest that

gibbon protection outside of the system is potentially more important for the conservation of the species in Myanmar. This is in marked contrast to the situation in other gibbon range states where protected areas are relatively more central to gibbon protection.

This simple analysis does suggest that hoolock gibbons are fairly well represented within the protected area network, as far as it goes, while white-handed gibbons are not. It does not, however, indicate how well the protected area network covers remaining populations or habitat that might hold remaining populations.

9.2 Population estimates for Myanmar

Introduction

In order to formulate our own estimate of the total hoolock population in Myanmar, we multiplied gibbon population density estimates from different hoolock sub-ranges identified during field surveys by the available area of suitable habitat, adjusted to 2010 equivalence. Below we explain the origin of the data and definitions employed in our population estimates and the method of analysis, and discuss the results.

Hoolock population density estimates

The available data points employed for our population estimate comprised hoolock density estimates from 28 sites. Three of these density estimates were compiled from published sources: one was taken from Forest Department and WCS work in Mahamyaing Nature Reserve (Brockelman, 2005; Brockelman *et al.*, 2009; Gibbon Survey Team, 2005), and two were from the same partnership's work in the Hukawng valley (Anonymous, 2006; Saw Htun *et al.*, 2006; Brockelman *et al.*, in prep.).

The remaining 25 hoolock density estimates were derived during this project and correspond to 25 sites surveyed by us. The individual sites are located in various states and regions of Myanmar. They are briefly described in Appendix 2 and mapped in Appendix 3. At each site, all gibbon songs were monitored simultaneously from four different listening posts during five consecutive days. Density of gibbon groups was estimated based on the triangulated positions of the calling groups. The density estimate for each site consists of the average data of the four listening posts used at that site. For each site, two different gibbon densities were calculated: one that includes all gibbon songs heard from a radius of 0.6 km around the listening posts, and one using a radius of 1.0 km. As a rule, the latter density tends to be lower, as some gibbon songs may be missed when using the larger radius. The method is described in more detail in Appendix 1.

Our estimates are from single listening areas at each site, but the three data points from Forest Department/WCS sources are derived from 11 listening areas in Mahamyaing Wildlife Sanctuary, six at the 'Naga Hill' site in the Hukawng valley, and seven at the 'Wantoke Hill' site, also in Hukawng. Since these combined density estimates represent averages, they can readily be incorporated in our analysis without disaggregation. A list of all density data points is provided in Appendices 5 and 6.

All the density estimates we used were in *groups* per square kilometre, not individuals. To calculate the size of populations (i.e. the number of gibbons in a population) we therefore required a figure for the average group size. 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). We base our estimates of density on an average of these figures, that is 3.3 individuals per group. Our density estimates are rounded to two significant figures.

Determining the current hoolock gibbon distribution range in Myanmar

Modern distribution ranges for both species of hoolock gibbons were determined and mapped by the authors based on the Myanmar hoolock gibbon records compiled in Section 7 and our understanding of the extent and quality of forest cover in Myanmar. This explains, for example, our

exclusion of the Bago Yoma (no recent records) and the far northeast of Kachin state (unsuitable habitat due to high-altitude). We consider that any small pockets of remaining hoolock gibbons that may persist outside of the range determined by the project are unlikely to be viable in the long term, and are therefore excluded from this analysis by definition.

Ten sub-ranges were created to take account of significant differences in forest type, gibbon densities and threats across the country. They will be described below. The sub-ranges are our smallest units of analysis for the purpose of population estimation. They should not be taken to indicate any taxonomic difference between hoolock gibbons in each sub-range nor geographical connections (or lack thereof) between sub-populations. Indeed, we do not attempt to identify sub-populations in this status review.

The sub-ranges are defined based on physical features (mountain ranges, rivers), 'WWF' Ecoregions (Olson and Dinerstein, 2002), the Priority Corridors identified in Tordoff *et al.* (2005), and the personal experience of the authors. The 'WWF' Ecoregions are mapped in Fig. 9.1, the Priority Corridors in Fig. 9.2.

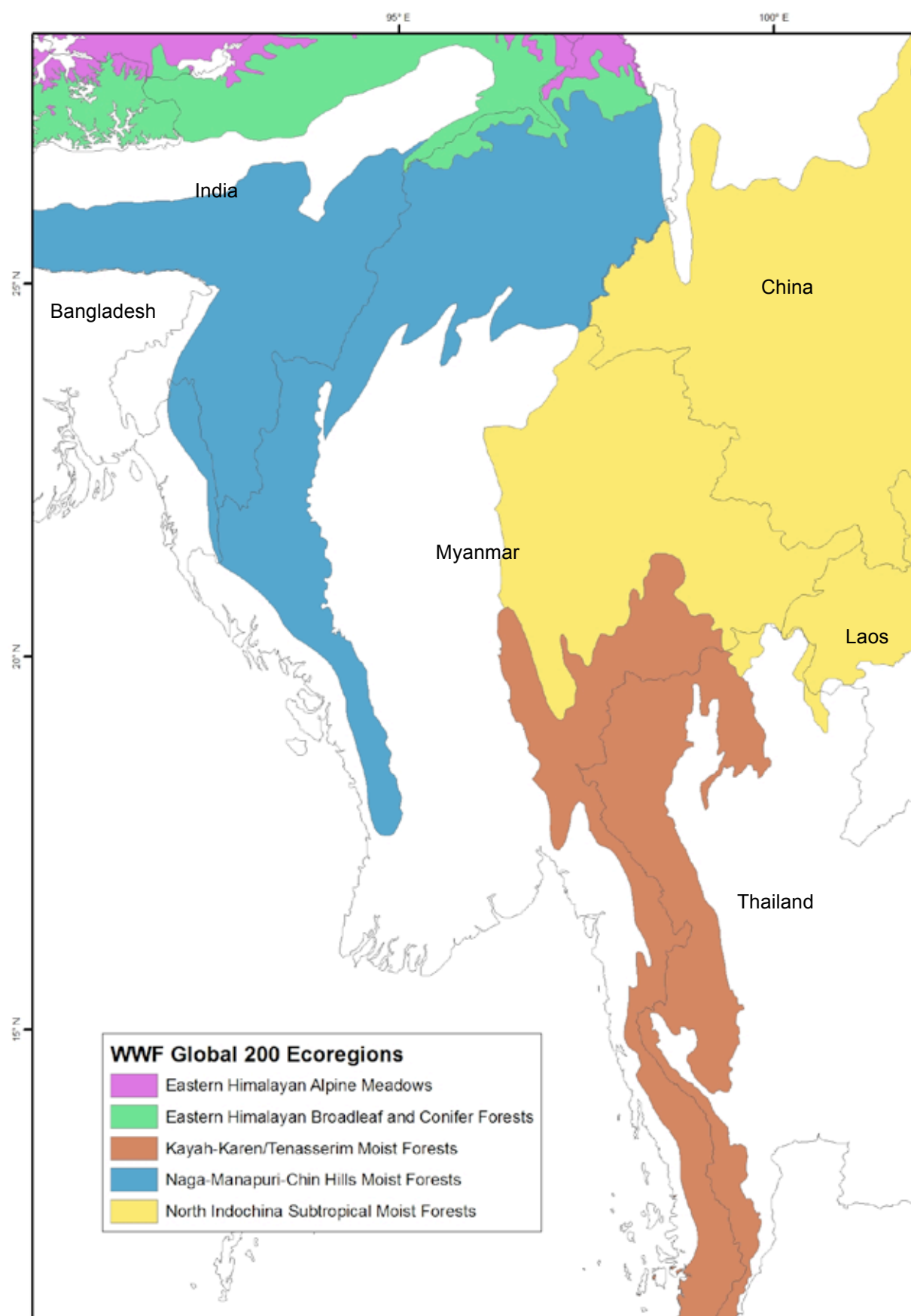


Fig. 9.1. WWG Global 200 Ecoregions in Myanmar (Source: WWF Ecoregion GIS shapefile data, based on Olson and Dinerstein, 2002).

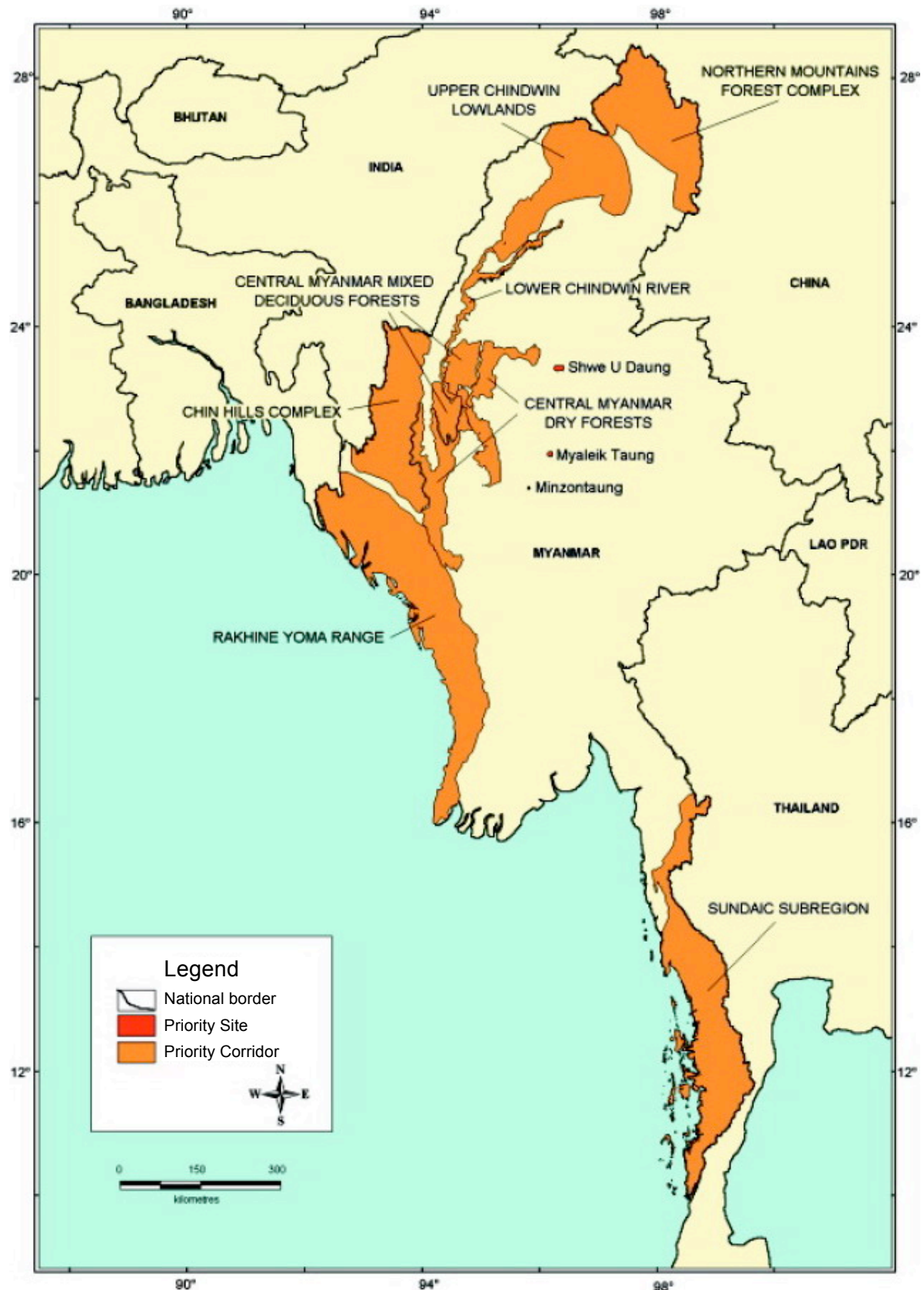


Fig. 9.2. Priority Corridors and additional Priority Sites for conservation investment in Myanmar (Source: reproduced from Tordoff *et al.*, 2005, p. xvii).

Sub-ranges for western hoolock gibbon

This section describes the locations and forest types of each of the ten hoolock gibbon sub-ranges defined in this study. The locations of the ten sub-ranges are indicated on the map in Fig. 9.3.

Southern and Central Rakhine Yoma

- Tropical lowland forests with patches of tropical and sub-tropical mountain forests
- Predominantly in southern Rakhine state but also including similar habitat in western Ayeyarwady and Bago regions
- Within the Mizoram-Manipur-Kachin Rain Forests Ecoregion

Northern Rakhine Yoma

- Tropical lowland forests in the south grading to tropical and sub-tropical mountain forests in the higher altitudes to the north
- Predominantly in northern Rakhine state but also including similar habitat in western Bago and Magway regions
- Within the Mizoram-Manipur-Kachin Rain Forests Ecoregion

Chin Hills Complex

- Roughly corresponding to the *Chin Hills Complex* region identified in Tordoff *et al.* (2005)
- Tropical broadleaf lowland and tropical and sub-tropical mountain forests in the upper Chindwin watershed but excluding the Hukawng valley (hoolock Transition Zone; see below)
- Within the Chin Hills-Arakan Yoma (= Rakhine Yoma) Montane Forests Ecoregion

Kabaw Valley and Ponnya Range

- Lowland evergreen forests in central and lower Sagaing, west of the Chindwin, and parts of similar remaining forest in contiguous low hills in Magway region
- Within the Mizoram-Manipur-Kachin Rain Forests Ecoregion

Naga Hills and West Chindwin Lowlands

- Forests west of the Salween above Kabaw valley and below the hoolock Transition Zone, and including Saramiti mountain
- Includes lowland and mountain forests, rhododendron, oak and mixed coniferous forests at high altitudes (some of which are excluded through selection of landcover classes)
- Lowland and mountain habitats are significantly different, but at this time the available data do not allow us to separate lowland and montane regions
- Within the Mizoram-Manipur-Kachin Rain Forests Ecoregion, though high altitude regions on the Indian border fall within the Northern Triangle Temperate Forests Ecoregion

Sub-range for hoolock gibbon, uncertain species

Transition Zone

- Hukawng valley and adjacent lowland forests
- Largely within the Northern Triangle Subtropical Forests Ecoregion
- The border of this area is rather ambiguous as it is not linked to any particular biological or geophysical feature

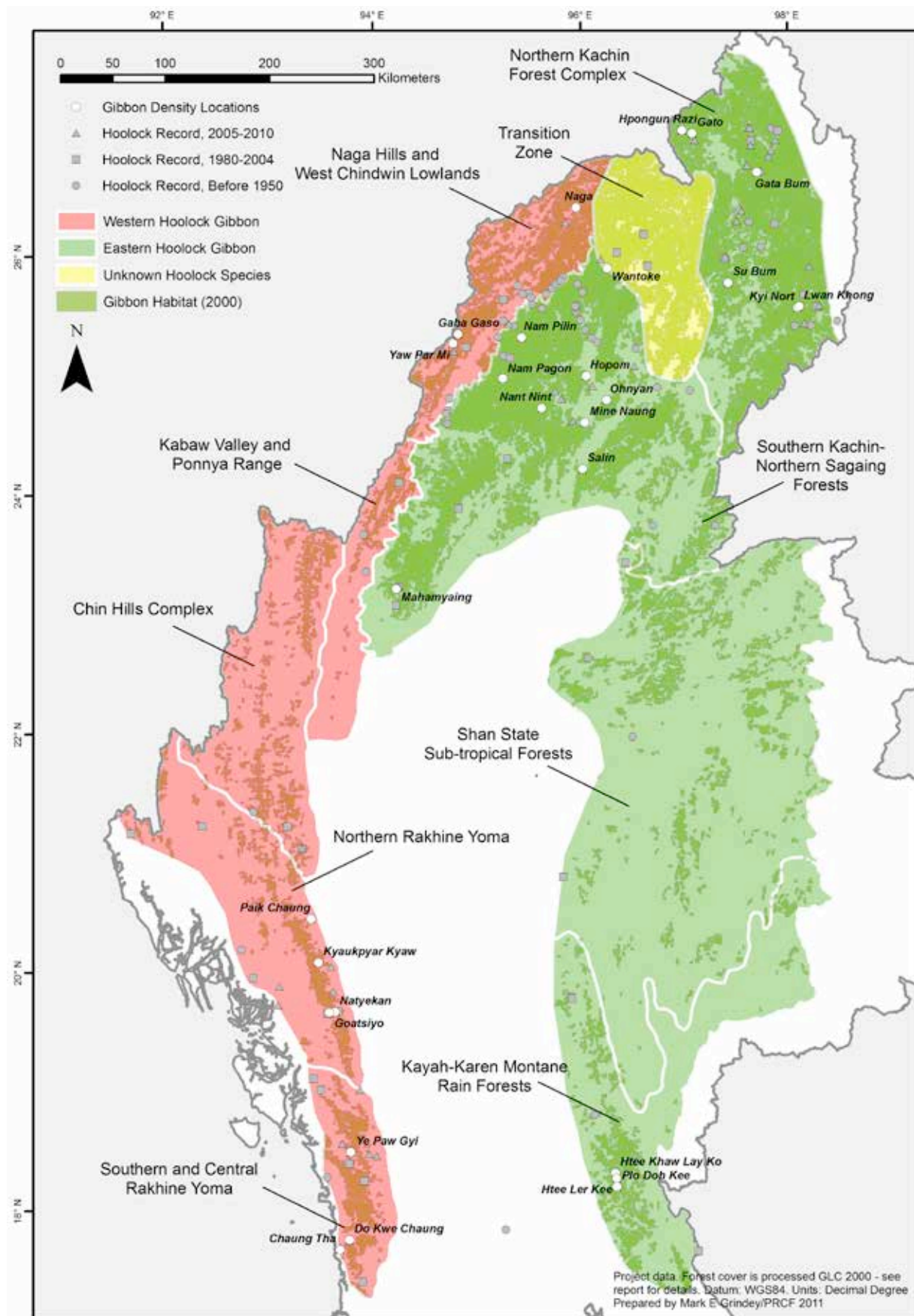


Fig. 9.3. The ten hoolock gibbon sub-ranges defined in this study. Density estimate locations (white symbols) and historic, modern and recent hoolock records (grey symbols) are also mapped. Darker shades in the background show the GLC 2000 layer for assumed gibbon habitat (see text).

Sub-ranges for eastern hoolock gibbon

Northern Kachin Forest Complex

- Includes lowland and mountain evergreen forests north and east of Myitkyina
- Note: Does not accord with the Northern Mountains Forest Complex identified by Tordoff *et al.* (2005)
- Largely within the Northern Triangle Subtropical Forests Ecoregion and the Northern Triangle Temperate Forests Ecoregion

Southern Kachin-Northern Sagaing Forests

- Lowland broadleaf evergreen and semi-evergreen forests, moist deciduous forest (including teak forest), and tropical mountain forests
- Chindwin lowlands from Mahamyaing Nature Reserve in the south to the hoolock Transition Zone and east to the north and east through the upper Ayeyarwady lowlands and Gangaw Taung (= hills) to the China border
- Falls with the Irrawaddy Moist Deciduous Forests and Mizoram-Manipur-Kachin Rain Forests Ecoregions

Shan State Sub-tropical Forests

- Highly fragmented lowland broadleaf evergreen forests west of the Salween river with patches of tropical mountain evergreen forest,
- Mostly within Shan state
- Corresponds largely with the Myanmar portion of the Northern Indochina Sub-tropical Forests Ecoregion

Kayah-Kayin Montane Rain Forests

- Northern section of the Dawna range west of the Salween river, plus mountains of south-central Shan state
- Corresponds to the Kayah-Kayin Montane Rain Forests Ecoregion within the southern section of the range of the eastern hoolock gibbon
- Roughly corresponds to the western projection of the Kayah-Kayin Montane Rain Forests Ecoregion

Estimation of hoolock gibbon habitat area

ESRI ArcMap 9.0 software was used for all stages of the following analysis.

To calculate the areas of available gibbon habitat, we used the land cover maps for South and South East Asia provided by the Global Land Cover 2000 (GLC 2000) Project (Stibig *et al.*, 2003). The GLC 2000 data are based on a dataset of 14 months of pre-processed daily global data acquired by the VEGETATION instrument on board the SPOT 4 satellite. The original data were collected in the late 1990s, and the dataset covers the whole of Myanmar.

Our landcover data (Stibig *et al.*, 2003) include 27 classes. Based on the class descriptions and the results of this status review, four classes were selected to best represent 'Hoolock Gibbon Habitat' for further analysis:

- Forest mosaics and degraded/fragmented forest
- Temperate mountain forests, broadleaved, evergreen, >1000 m
- Tropical lowland forests, broadleaved, evergreen, <1000 m
- Tropical and sub-tropical mountain forests, broadleaved, evergreen, >1000 m

All of the remaining 23 land cover classes from Stibig *et al.* (2003) were excluded from the analysis. These include: 'Coniferous mountain forests, evergreen, >1000 m'; 'Tropical mixed deciduous and dry deciduous forests'; 'Mangrove and swamp forests'; and various classes of regrowth, crop mosaic, shrubland, shifting cultivation, water, ice and snow, rock and unclassified (no data) areas. Some of these areas may be able to support gibbons, or may support gibbons where they are in mosaics with more suitable habitat types. However, we felt it important not to overestimate populations by inclusion of habitat types that would generally not support gibbons in significant numbers.

Elevation data were not available for the analysis. However, the GLC 2000 landcover classes we selected exclude high altitude evergreen and non-forest vegetation that are known not to support gibbons. We therefore believe the omission of an elevation dataset does not significantly constrain our analysis.

GLC 2000 is a raster dataset, with a pixel resolution of about $1150 \times 1150 \text{ m} = 1.32 \text{ km}^2$ (132 ha). We processed the original raster data by first clipping it with the Myanmar country boundary, then combining all pixels in the selected classes. The new 'gibbon habitat' layer was then converted into polygons that automatically excluded pockets of non-hoolock habitat.

We then removed polygons smaller than 5 km^2 (500 ha). We considered areas of this size too small to hold viable populations of gibbons in the ten or more years that passed between the satellite data collection (late 1990s) and the date of our population estimate (effectively 2010; see below). However, if we assume that an average gibbon home range covers an area of 40 ha, then the average forest fragment removed from the data (2.5 km^2) could theoretically support as many as six gibbon groups or about 20 gibbons. Overall, this might be assumed to make our density estimates more conservative than the reality.

Data preparation left 884 gibbon habitat polygons of over 5 km^2 within the range of hoolock gibbon in Myanmar. The areas of hoolock gibbon habitat inferred from the GLC 2000 data within the range of each species were then calculated by bisecting the habitat layer with the ranges and sub-ranges for each gibbon species and summing all final polygon areas.

The GLC 2000 data is actually from the late 1990s, and overall forest cover in Myanmar is known to be significantly less now. In order to adjust our estimate of gibbon habitat areas to 2010 equivalents we applied a multiplier of 0.572, based on the FAO (2010a) estimate for loss of closed canopy forest between 2000 and 2010 (42.8%). The resulting areas are taken to represent available gibbon habitat within each species sub-range in 2010. The assumed gibbon habitat is indicated in the background of Fig. 9.3. The estimated area of gibbon habitat is presented below.

Weaknesses in the analysis

We identify several ways in which our analyses may not truly represent the actual populations of the species within Myanmar. Their reliability depends on various factors, most important being: (1) the quality of our density estimates, (2) the degree to which our density estimates are representative of Myanmar's gibbon populations over large areas of similar habitat, and (3) the quality of our estimates of the remaining area of gibbon habitat in Myanmar in 2010.

We think that our hoolock density estimates, and those from the Forest Department and WCS used in the analysis (Anonymous, 2006; Brockelman, 2005; Brockelman *et al.*, 2009; Saw Htun *et al.*, 2006), are probably sound. Whether they are truly representative of hoolock densities in different parts of Myanmar is difficult to evaluate. Our own surveys tended to focus on areas that we believed from local information to hold gibbons. Habitat with zero or very low densities of gibbons was by the nature of the surveys automatically excluded, although several results nonetheless showed very low densities. On the other hand, due to access and safety requirements, and the fact that gibbon survey locations were based on local information, most of the density estimates are probably biased towards areas with higher than average human presence, which might be expected to correlate with reduced gibbon densities. Lastly, the short duration of each survey (five days per site) means seasonal or local factors suppressing gibbon calling, such as rain or early morning mist, will tend to make our density estimates lower than the true number.

Overall, we feel that due to the large number of possible factors affecting our density estimates it is impossible to say with any certainty whether they will tend to under- or over-estimate true densities over all sub-ranges.

It is also difficult to evaluate the quality of our estimates of remaining gibbon habitat in Myanmar. The landcover data we used (Stibig *et al.*, 2003) was from a regional analysis using data from the 1990s. The rate of forest loss we applied (42.8%; FAO, 2010a) was not calculated using the same forest cover data, and the landcover classes used in our forest cover analysis and the ‘closed canopy forest’ measured in FAO (2010) probably do not match. Forest loss in some forest classes within the range of the hoolock gibbons will undoubtedly be different from the national average, and anyway, geographical distribution of forest loss (and fragmentation) is certainly not even. Whether more or less gibbon habitat has been lost than the 42.8% figure for loss of ‘closed canopy forest’ nationally is an open question.

Lastly, our use of sub-ranges was intended to take account of regional differences in gibbon densities, either resulting from differences in habitat or differences in level of threats. However, the limited number of data points, and the non-random selection process (biased towards areas with good gibbon populations), will likely mean derived population estimates are likely to be over-estimates.

Results and discussion

Notwithstanding the constraints noted above, our data allows us to offer some insight into habitat area and possible hoolock populations for the whole of Myanmar. Our estimated areas of hoolock gibbon habitat of Myanmar by species are shown in Fig. 9.3. Table 9.3 summarises our overall estimate of available hoolock gibbon habitat by species range. Adjusted to 2010 equivalence, the available gibbon habitat represents about 9% of the total area of the country. The habitat of the white-handed gibbon (*Hylobates lar*) is not included in this calculation.

Table 9.3. Estimated areas of gibbon habitat within hoolock ranges in Myanmar, 2000 and 2010.

Species	Area of available habitat (km ²)	% of total land area ^(a)	Area of available habitat, 2010 equivalent (km ²) ^(b)	% of total land area, 2010 equivalent ^(b)
Western hoolock (<i>H. hoolock</i>)	22,890	3%	13,092	2%
Eastern hoolock (<i>H. leuconedys</i>)	74,427	11%	42,571	6%
Hoolock, uncertain species	13,677	2%	7,823	1%
Total	110,994	16%	63,486	9%

^(a) Myanmar total land area is 678,500 km².

^(b) Areas adjusted with an assumed 42.8% loss from 2000 to 2010 (FAO, 2010a).

Source: Forest cover from four GLC 2000 landcover classes (see text).

The estimated hoolock gibbon densities (groups/km²) for each of the 28 sites are listed in Appendix 5, and the average densities for each sub-range of the hoolocks is listed in Appendix 6. Using an average hoolock group size of 3.3 individuals, we then estimated the individual density of hoolock gibbons (also listed in Appendix 6).

Based on the adjusted ‘gibbon habitat area’ figures we estimated the size of the hoolock gibbon population for each sub-range using the 28 available density estimates. The results are summarized in Table 9.4.

Table 9.4. Estimated hoolock gibbon populations for each sub-range in Myanmar in 2010.^(a)

Species and sub-range	Estimated population size based on average densities	
	using a listening radius of 1 km	using a listening radius of 0.6 km
Western hoolock (<i>H. hoolock</i>)		
Southern and Central Rakhine Yoma	3,200	3,500
Northern Rakhine Yoma	17,000	23,000
Chin Hills Complex	23,000	25,000
Kabaw Valley and Ponnya Range	6,800	7,400
Naga Hills and West Chindwin Lowlands	32,000	54,000
Total	82,000	110,000
Eastern hoolock (<i>H. leuconedys</i>)		
Northern Kachin Forest Complex	89,000	100,000
Southern Kachin-Northern Sagaing Forests	150,000	190,000
Shan State Sub-tropical Forests	50,000	55,000
Kayah-Kayin Montane Rain Forests	16,000	26,000
Total	300,000	370,000
Hoolock, uncertain species		
Transition Zone	65,000	70,000
Total	65,000	70,000

^(a) All figures are calculated to two significant figures, including sub-totals. Species totals are rounded after addition to avoid compounding rounding error.

Our analysis suggests that within Myanmar there are from 310,000 to 370,000 eastern hoolock gibbons, 82,000 to 110,000 western hoolock gibbons, and 65,000 to 70,000 hoolocks of uncertain species in the Transition Zone (all figures calculated to 2 significant figures).

In combination, we therefore estimate a total hoolock population in Myanmar of 450,000 to 550,000 individuals.

Our estimate is comparable with the 452,000 hoolocks in Myanmar estimated by Chivers (1977, p. 581). However, Chivers (1977) also predicted an 80% reduction of the population for Myanmar by 1980. Compared to our population estimate for 2010, Chivers's prediction was overly pessimistic, never mind what he might have predicted in terms of population loss by 2010.

Ten years after Chivers, MacKinnon and MacKinnon (1987) proposed and estimate of 169,000 hoolocks in Myanmar. Their estimate also looks low compared to our population estimate, although their estimate of a range of about 60,000 km² of suitable habitat matches with ours. We estimate about 63,000 km² of suitable habitat within a total range of about 330,000 km², suitable habitat thus representing about 19% of the range. The main reason for the significantly lower population estimate published by MacKinnon and MacKinnon (1987) is their use of a gibbon density of 3 gibbons/km², whereas our overall average from 28 sites across the country is between 8.25 and 9.01 individuals/km² (Appendix 6; note that this is also the figure used for the transition zone density estimate since there are no records from that area).

9.3 Status of western hoolock gibbon (*Hoolock hoolock*)

Based on our range mapping (Fig. 9.3), the range of western hoolock in Myanmar is less than half that of eastern hoolock, and the estimated gibbon habitat of the western hoolock is less than one third that of the eastern hoolock (Appendix 6, summarized in Table 9.5). Furthermore, the average densities for the western hoolock are between 12% and 21% lower than those of the eastern hoolock (Table 9.6).

Table 9.5. Estimated hoolock gibbon populations in Myanmar, 2010.

Species	Range		Population (individuals)		Population (% of total)		Gibbon habitat ^(c)	
	Area (km ²)	% of total	Lower est. ^(a)	Upper est. ^(b)	Lower est. ^(a)	Upper est. ^(b)	Area (km ²)	% of total
Western hoolock (<i>H. hoolock</i>)	90,571	27%	82,000	110,000	18%	20%	13,092	21%
Eastern hoolock (<i>H. leuconedys</i>)	224,557	68%	300,000	370,000	68%	67%	42,571	67%
Hoolock, uncertain species	16,743	5%	65,000	70,000	14%	13%	7,823	12%
Totals	331,871	100%	450,000	550,000	100%	100%	63,486	100%

^(a) Derived from density estimates at 1 km listening radius.

^(b) Derived from density estimates at 0.6 km listening radius; note that in all cases except for “Hoolock, uncertain species” in the Transition Zone (i.e. Hukawng Valley) the estimated density at 0.6 km listening radius is higher than that at 1 km listening radius.

^(c) 2010 equivalent (see text).

Table 9.6. Average density figures for hoolock gibbons in Myanmar, by species.

Species	No. of contributing density estimates ('data points')	Groups per km ²	
		0.6 km listening range	1 km listening range
Western hoolock (<i>H. hoolock</i>)	10	2.33	1.63
Eastern hoolock (<i>H. leuconedys</i>)	17	2.65	2.06
Hoolock, uncertain species	1	2.73	2.50
Myanmar averages	28	2.54	1.92

We believe that the lower densities of western hoolock are probably due to higher rates of habitat degradation within the species' range, and higher human population densities putting greater hunting pressure on fragmented remaining populations. However, there are significant differences between the various sub-ranges of western hoolock, which we discuss here from south to north.

Southern and Central Rakhine Yoma sub-range

The average gibbon density from three data points was only 0.56 groups per km² (at 0.6 km listening radius), which was by far the lowest density for any of the sub-ranges. The main reason is habitat encroachment (and some hunting pressure) from communities living on the lower slopes bordering the coastal and central lowland plains, and due to the fact that two major roads connect the central plains to the coast by bisecting this section of the Rakhine Yoma (the road from Yangon to Gwa, and the road from Pyay to Taungup). However, multiple steep valleys mean it is almost impossible to venture far into this sub-range except for on established trails and by river, and most settlements appear to be on the lower slopes. We therefore suspect that significant areas of contiguous forest remain, notably within the Rakhine Yoma Elephant Sanctuary. Much of this 1,756 km² is relatively inaccessible and may well retain good populations of hoolock gibbons at densities much higher than our average for the sub-range would suggest. If so, the sanctuary could be one of the most significant refuges for the western hoolock globally.

Northern Rakhine Yoma sub-range

The average gibbon density from four data points was 3.14 groups per km² (at 0.6 km listening radius), which is the highest of any of the sub-ranges for either species. We note similar threats to the Southern and Central Rakhine Yoma, but consider the threat level to be higher due to the very narrow east-west extent of the gibbon habitat in this area. Figure 9.3 shows the gibbon habitat in this sub-

range to be less than 10 km wide in much of the south, and heavily fragmented in the north. (Since that map uses the GLC 2000 dataset for forest cover, the actual situation now is probably even worse than what Fig. 9.3 suggests.)

Overall, this area is increasingly under threat from encroachment from east and west and from further fragmentation. Yet, the southern part of this sub-range may still hold important numbers of the species. Further investigation is required to prioritise conservation actions within this sub-range.

Chin Hills Complex sub-range

We did not conduct any field surveys in this sub-range, as it was not prioritized during project planning due to a lack of any historical records except on the border with the Northern Rakhine Yoma sub-range. We therefore use the Myanmar average density for western hoolock in our population estimate for this sub-range. Our landcover analysis suggests there is more gibbon habitat (2,784 km²) remaining in this western hoolock sub-range than all but the *Naga Hills and West Chindwin Lowlands* sub-range (Appendix 6). However, our habitat mapping (Fig. 9.3) indicates the forest is highly fragmented and the individual patches of gibbon habitat are quite small, with only narrow corridors connecting them (and again, the situation is probably worse than our map based on data from the 1990s suggests).

Our population estimate for this sub-range of 23,000 to 25,000 individuals is almost certainly optimistic, as it is based on the Myanmar average density, which at 2.54 groups/km² is actually higher than the average for western hoolock (Table 9.6). In fact, based on the limited current evidence, this sub-region is probably the least important for the protection of the species, although we do not rule out the possibility that small but significant sub-populations may remain.

Kabaw Valley and Ponnya Range sub-range

We also did not conduct any new field surveys in this sub-range, and our assessment of the status of the hoolocks here is based on very limited information. This area is mostly under an elevation of 500 m, with some higher elevation areas occurring along the Ponnya mountains and between the Kabaw and Chindwin rivers. It is also the smallest of the sub-ranges we identify.

There are only two historical records (pre-1950) for hoolock gibbons in the central part of the sub-range, and our landcover analysis indicates very little gibbon habitat is likely to remain south of Mowlaik town (about 23.6°N). Indeed, we estimate only 819 km² of suitable habitat remains in this hoolock sub-range. This represents only about 6% of the estimated available habitat for the western hoolock (13,092 km²). However, more habitat seems to remain in the north of the sub-range, separated from the Indian border by the Kabaw valley, from where there are ten previous hoolock records, although density information is not available (Lynam, 2003)(record WH-09; see Section 7.3). Our analysis of landcover data shows at least one large area of intact gibbon habitat within this sub-range. Despite widespread commercial logging of lowland forests in the area, the critical condition of the species still argues for further surveys focused on the area near the Lynam (2003) records.

Naga Hills and West Chindwin Lowlands sub-range

The average gibbon density from three data points was 3.03 groups per km² (at 0.6 km listening radius), which is the second highest for western hoolock by a significant margin and the third highest for either hoolock species. The altitudinal range in this sub-range is impressive, with elevations ranging from 140 m along the Chindwin river to over 3,800 m at Saramiti Peak, the highest point on the Myanmar-India border. Gradients are also staggering; this altitude gain is achieved within less than 40 km. The sub-range is the highest for western hoolock gibbon, and contains the highest hoolock gibbon record made during our field research (2,300 m, on the trail below Saramiti peak).

The altitude may in part explain the relatively high forest cover, since human population densities and opportunities for commercial logging are both low. According to GLC 2000 landcover data (Stibig *et al.*, 2003), the area contains extensive gibbon habitat contiguous with India, ranging from lowland to mountain broadleaf evergreen forests. Swidden agriculture is a threat to habitat continuity, but our limited surveys indicated ridge and watershed forest being left largely intact and hunting pressure being quite low despite the reputation of the Naga as committed hunters. Further surveys

could help establish the importance of this sub-range for the preservation of the species, and particularly the degree of connectivity with the forests in the Transition Zone (Section 9.4).

9.4 Status of hoolock gibbon, uncertain species

Transition Zone sub-range

We did not conduct any original fieldwork in this sub-range. What is known comes primarily from work by the Forest Department and WCS in the Hukawng Valley Tiger Reserve from December 2005 to February 2006 (Anonymous, 2006; Saw Htun *et al.*, 2006; Brockelman *et al.*, in prep.). Here they surveyed gibbon densities in two areas, 'Naga Hill' (six listening sites) and 'Wantoke Hill' (seven listening sites). Both areas fall within the Hukawng Valley Tiger Reserve (= Wildlife Sanctuary) Extension, proposed in 2004, although we only consider the latter area to be in the hoolock Transition Zone (see Fig. 9.3).

Brockelman *et al.* (in prep.) estimate the gibbon density in the Wantoke Hill area at 2.73 groups per km² (at 0.6 km listening radius). This figure is higher than the comparable average densities for both western hoolock (2.33 groups per km²) and eastern hoolock (2.65 groups per km²) (see Appendices 5 and 6). However, it is only slightly higher than the Myanmar average of 2.54 groups per km² (at 0.6 km listening radius, $n = 28$ sites, Table 9.6).

The Wantoke Hill figure is itself an average of densities estimated at seven listening sites, all of which are relatively high, ranging from 1.87 to 3.85 groups per km². The average of seven sites gives a more robust result than most of the data points used in this status review, which are frequently based on only one listening site. The implication is that the Wantoke Hill site is unusually good for gibbons, which is further bolstered by the observation that the Forest Department/WCS surveys were conducted in the rainy season, when gibbons are much less likely to sing.

Saw Htun *et al.* (2006) do not comment on overall forest quality or extent within the tiger reserve. They do note, however, that hunting pressure in their two survey areas is high, driven particularly by wildlife trade to China, and that gibbon populations have 'become very rare' due to habitat loss and hunting (Saw Htun *et al.*, p. 8).

Since those surveys, other observers in the Hukawng Tiger Reserve Extension have documented two existing and emerging threats. These include at least three gold mines which we interpret to be within the Wantoke Hill survey area (KDNG, 2007), and the granting of agricultural concessions in the heart of the extension, covering a reported 809 km² and overlapping with the eastern portion of the survey area (KDNG, 2010). However, most of the rest of the Transition Zone is located in the northern, upland part of the original tiger sanctuary, which was not surveyed by Saw Htun *et al.* (2006) and for which we only have seven records, from Lynam (2003) (record UH-02 in Section 7.5). This part of the Transition Zone seems likely to be the most important for "hoolock, uncertain species", and therefore worthy of further research.

9.5 Status of eastern hoolock gibbon (*Hoolock leuconedys*)

Based on our range mapping (Fig. 9.3), the range of eastern hoolock in Myanmar is just over double that of western hoolock and the Transition Zone (hoolock, uncertain species) combined, as is the estimated area of gibbon habitat. Despite having a slightly higher average density than either the western hoolock or "hoolock, uncertain species" of the Transition Zone (Table 9.6), the estimated population of eastern hoolock nonetheless accounts for about 50% of all hoolocks (Table 9.5).

We believe that lower human population densities in the eastern hoolock range help explain the higher densities, itself being a result of the prevalence of higher altitude areas and, possibly, political instability that has suppressed development activities that would otherwise have expanded agriculture and improved access to upland areas. Lowland areas are also subject to less shifting cultivation and lower hunting pressure than seen in the range of the western hoolock, with large areas of lowland

evergreen forest (i.e., prime gibbon habitat) remaining. However, the quality of habitat and the types and levels of threats are not uniform over the eastern hoolock sub-ranges, which we discuss here from north to south.

Northern Kachin Forest Complex sub-range

The average gibbon density from six data points was 2.07 groups per km² (at 0.6 km listening radius), which is the lowest of the figures for the three eastern hoolock sub-ranges for which we have original data, and lower than the national average of 2.54 groups per km² (0.6 km listening radius). Three main reasons seem likely to explain the relatively low density.

Firstly, much of the lower elevation forests in the sub-range have been lost to shifting agriculture and logging, and remaining gibbon populations are, therefore, at relatively high altitudes compared with other parts of the country. As a result, most of the remaining gibbon habitat is probably sub-optimal for gibbons due to a dominance of mountain forests types, which include pines, rhododendrons and bamboos, on which gibbons cannot feed. Secondly, the harsh winter season in the north of Myanmar probably limits food availability for at least part of the year. Lastly, this sub-range suffers one of the highest hunting levels we recorded nationally, which is exacerbated by the proximity to China and the presence of Chinese logging, dam and mine operations, which all serve to improve access to the forest, and to improve access to remote areas to serve wildlife markets. Although perhaps sub-optimal, however, the remaining gibbon habitat is still extensive, and we estimate this sub-range could contain around 30% of the eastern hoolock population in Myanmar. Urgent steps are therefore needed to arrest the rate of forest loss – particularly to commercial logging – and to reduce hunting for the wildlife trade.

Southern Kachin-Northern Sagaing Forests sub-range

The average gibbon density from eight data points was 3.07 groups per km² (at 0.6 km listening radius). This is the second highest density of any sub-range (it is only topped by 3.14 groups per km² found at the Northern Rakhine Yoma sub-range (Appendix 6). Most of the forest in this sub-range is lowland broadleaved evergreen, which may naturally be able to support higher gibbon densities than any other part of the country. However, at over 65,000 km² this sub-range is the second largest in our analysis (after the Shan State Sub-tropical Forests), and our interpretation of the results is based on information from only a small number of locations.

The best-documented site for hoolock gibbons in the country lies in this sub-region, in the approximately 800 km² of closed canopy forest suitable for gibbons in Mahamyaing Wildlife Sanctuary. Here, Brockelman *et al.* (2009) estimate a population of between 4,000 to 8,000 individuals. In the earlier version of that report, Brockelman (2005) notes that eastern hoolock gibbon 'is relatively secure in Mahamyaing and areas north', but anecdotal reports (Htin Hla, 2010) suggest the area has since been subject to commercial logging and road construction. Given the commercial value of lowland forests and their relative ease of accesses throughout this sub-range, logging would appear to be a significant threat more widely in this sub-range.

The threat from hunting is perhaps a lesser problem. We recorded very low levels of hunting in surveys in Htamanthi Wildlife Sanctuary and around Indawgyi Lake Wildlife Sanctuary, and the Mahamyaing survey team noted that the (selective) logging they recorded at that time did not appear to be associated with increased poaching (Brockelman *et al.*, 2009).

An unquantifiable threat is from flooding of lowland forests associated with hydro-electricity dams proposed in the Chindwin and Ayeyarwady basins, although it is proving hard to monitor locations and status of proposed or approved projects (see, e.g., ERI, 2008).

Despite these gaps in our analysis, we still estimate a full 50% of Myanmar's remaining eastern hoolock gibbons could lie with this sub-range. While the actual population estimate (about 150,000 to 190,000 individuals) is open to debate, we do believe that the proportion reflects the global significance of the sub-region.

Shan State Sub-tropical Forests sub-range

We did not conduct any field surveys in this sub-range, due to the fact that there are records from only four locations in this vast region of the country, two from before 1960 and two from between the late 1990s and early 2000s (see Section 7). One of these sites, Momeik Mabein (= Momeik Mabain), was listed as a potential survey site during our preliminary evaluation and planning (Appendix 1). Due to its small area, however, it was not of sufficiently high priority to be surveyed thus far. Other areas in the sub-range would not have been possible to visit due to armed conflict, and this may explain the paucity of records from other sources, which would otherwise be surprising since considering the large size of the gibbon habitat.

Our estimates show that around 6,000 km² of gibbon habitat may remain, although this represents only 14% of all remaining habitat (42,571 km²) in the eastern hoolock's range. Should the security situation allow, further surveys would seem justified in some of the larger remaining forest blocks in this sub-range, but until that time conservation efforts for eastern hoolock should be directed elsewhere.

Kayah-Karen Montane Rain Forests sub-range

The average gibbon density from three data points was 2.71 groups per km² (at 0.6 km listening radius), which is above the average (2.54 groups per km² at 0.6 km listening radius) of all hoolock density estimates. A large portion of the sub-range falls within the mountains of south-central Shan state, within which our calculations show very little remaining gibbon habitat (see Fig 9.3). Indeed, we could find no gibbon records for this part of the sub-range, though this may also partly reflect the lack of access to Shan state noted above. The remainder of the sub-range follows the northern section of the Dawna mountain range and surrounding foothills, where forest cover may be relatively good. Overall this sub-range is estimated to hold only perhaps 3,000 km² of gibbon habitat, which is the smallest area of the eastern hoolock sub-ranges. However, this is theoretically still enough to support 15,000-26,000 gibbons at the average density for the species.

Armed conflict is almost certainly the main driver of what we assumed from limited evidence to be the main threats to the species in this sub-range: displacement of lowland rice farmers into upland areas, temporary villages with high dependence on forest resources, widespread presence of armed soldiers, and logging to underwrite the costs of fighting. This sub-range is not a priority for conservation of the species within Myanmar, but if, as our landcover data suggests, large areas of intact and contiguous forest remain in the south of the sub-range, then they are still important at the state level and for biodiversity conservation more generally.

9.6 General observations

Several *ad hoc* observations, which do not easily fit within the other sections of this report, have helped shape our overall view of the status of hoolock gibbons in Myanmar. These come from our own fieldwork, analysis of the literature and discussions with colleagues.

Our field results indicate that aggregated national forest cover figures do not necessarily provide a useful proxy for the status of the species. In fact, while gibbons are strongly associated with closed canopy evergreen forests, they are also able to survive in surprisingly degraded forests provided there are no unbroken gaps between small trees and other vegetation able to support their weight. During this survey, for example, gibbons were heard in previously logged lowland evergreen forest bisected by numerous cart tracks just to the north of Indawgyi Lake in Kachin state, and local residents said the population was well known and stable. Similar observations have been made on gibbons in Laos (Will Duckworth, pers. comm. to MG, 2011).

Indeed, our surveys indicate that 'quality' of forest *per se* may not be the main decisive factor for determining habitat carrying capacity, but rather the density of food trees and of sufficiently strong trees to enable brachiation. In many areas there is likely to be a strong positive relationship between logging and other human activity including hunting. Degraded forest certainly requires gibbons to spend time much lower to the ground than they would in undisturbed, mature evergreen forest. In the

Kachin example given above, gibbons were heard no more than four metres from ground level. Thus, while degradation may not necessarily render forest unsuitable for gibbons, but it may make it less suitable and the animals more vulnerable to hunting.

Our results do not suggest at what stage regenerating forest (e.g., during the fallow period in a swidden cycle, or following abandonment of a formerly cultivated area) is able to allow passage of gibbons or otherwise support (e.g., feed) a gibbon population, nor at what densities. We can, however, predict that regenerating or otherwise sub-optimal forest is only likely to support gibbons at lower densities and lower heights than fully mature forest, which in some cases will lead to a greater threat from hunting. In our population estimates we included only 'Forest Mosaics and degraded / fragmented forests' from the landcover data (Stibig *et al.*, 2003), but not other categories of degraded or recovering forest which might support gibbons. However, our own analysis indicates 85,768 km², or about 24% of the total estimated hoolock range in Myanmar, comprises 'Evergreen shrubland & regrowth / Abandoned shifting cultivation / Extensive shifting cultivation' (Stibig *et al.*, 2003). How many gibbons remain in this landcover type is an open question, but they have not been included in our population estimates.

In the rugged Naga Hills west of Htamanthi, our surveys indicated long-cycle swidden rotation of up to 15 years in a landscape mosaic that included traditionally protected watershed forests in stream heads. Thus, relatively intact forest suitable for gibbons lay on connected ridge tops, with patches of regenerating forests forming altitudinal corridors down spurs from the main ridge, some of which presumably could support gibbons. This human-dominated landscape appeared rather incompatible with the survival of gibbons, yet they were observed to persist, and it would seem likely also that some small adjustments to land use patterns could greatly improve the extent of contiguous old and regenerating gibbon habitat. To what extent this situation is representative of the extensive Naga Hills range is unclear, although gibbons are at very low densities on the Indian side of the range where livelihood practices are presumably similar.

9.7 Global population estimate

Earlier population estimates

Chivers (1977, p. 581) attempted what probably is the earliest estimate of the global population of the genus *Hoolock*. He estimated a population of 80,000 hoolocks in Assam and 452,000 hoolocks in Myanmar. In his study, "Assam" presumably stands for all of NE-India and may also include hoolocks from Bangladesh, although the author does not specify this. Chivers's global population estimate for the genus was the sum of the estimates for Assam and Myanmar and amounted to 532,000 individuals. Chivers also predicted a 99% reduction of the population for Assam and 80% for Myanmar, and a global population of 91,000 hoolocks, by 1980. This was an "optimistic" prediction "based on the assumption that similar actions [to conserve the species] are being taken as in Thailand, Malaysia, and Indonesia; if this assumption proves false the outlooks for hoolock ... are very gloomy" (Chivers, 1977, p. 582). In Chivers's study, "it is assumed that 50% of Myanmar remains forested, and that 33% of that area is stocked with 4 gibbons/km²; it is also assumed that only 20% of suitable habitat will remain in 15 years."

The global population of the genus *Hoolock* was estimated a second time by MacKinnon and MacKinnon (1987). The authors reported that only 56,378 km² remained of an original distribution area of 168,353 km², resulting in a habitat loss of 67%. Assuming a density of 3.0 gibbons/km², the global population was estimated as 169,000 hoolocks. Given that Chivers's earlier figure was almost three times higher, MacKinnon and MacKinnon (1987) regarded his estimate as "optimistic".

Revised global population estimate

Our results indicate that the vast majority of the global populations of both western and eastern hoolock gibbons remain within Myanmar (Table 9.7). Even using our most conservative estimates for

each species, Myanmar accounts for 100% of the global population of the eastern hoolock gibbon (to 3 significant figures) and at least 90% of the global population of the western hoolock gibbon.

Table 9.7. Country and overall population estimates for hoolock gibbons.

Country	Estimated population	Source
Western hoolock (<i>Hoolock hoolock</i>)		
Bangladesh	< 300	Islam <i>et al.</i> (2006); Islam <i>et al.</i> (2011)
India	6,350–7,850	Chetry and Chetry (2011); Das and Biswas (2009); Das <i>et al.</i> (2009), see also Section 4.2 of this report.
Myanmar	82,000–110,000	This report
Total	88,650–118,150	
Eastern hoolock (<i>Hoolock leuconedys</i>)		
China	< 200	Fan and Ai (2011); Fan <i>et al.</i> (2008), (2011); Fan, personal communication to TG (Sept 2010)
India: Arunachal Pradesh, south of Lohit river	+168	Das <i>et al.</i> (2006); Das and Biswas (2009)
India: Arunachal Pradesh, Mehao WS, i.e. north of Lohit river ^(a)	518	Chetry <i>et al.</i> (2010)
India: Assam, Tinsukia dist., Sadya sub-div.	33	Chetry <i>et al.</i> (2012)
Myanmar	300,000–370,000	This report
Total	300,558–370,558	
Hoolock, uncertain species		
Myanmar	65,000–70,000	This report

^(a) The authors counted 157 groups of gibbons. Using an average groups size of 3.3 individuals, we estimate a population size of 518 hoolock gibbons for Mehao WS. Gibbons from this area north of Lohit river were suggested to be a new, unnamed taxon (Das and Biswas, 2009), but were identified as eastern hoolock (*H. leuconedys*) by Chetry *et al.*, 2010). Until formal description of the new taxon, we follow Chetry *et al.* (2010).

9.8 Threat status and conclusion

Despite these seemingly impressive population figures – particularly for eastern hoolock – and a seeming lack of decline on previous estimates, threats to both species are varied and widespread, and in many places very intense. The Chinese and Bangladesh populations of both species are of course nationally significant in those countries, but their current contribution to global populations is very limited. Even the relatively more important hoolock population in India is highly fragmented (Molur *et al.*, 2005). Clearly, Myanmar represents by far the best chance of protecting significant numbers of each species. That said, the rate of forest loss for Myanmar (FAO, 2010) shows no immediate sign of slowing, never mind reversing. There can therefore be no complacency until forest loss and fragmentation are addressed, closely followed by hunting.

The current threat status of the two species is provided in Table 9.8. Based on our assessment of the conservation status of the species throughout Myanmar, we find no evidence to support a change in the threat status of either species at this time.

Table 9.8. Threat status for eastern and western hoolock and proposed changes.

Species	Status	Criteria ^(a)	Source	Proposed change in status
Western hoolock (<i>Hoolock hoolock</i>)	Endangered (EN)	A2acd+3cd+4acd	Brockelman <i>et al.</i> (2008)	None
Eastern hoolock (<i>H. leuconedys</i>)	Vulnerable (VU)	A3cd	Brockelman and Geissmann (2008)	None

^(a) From IUCN (2011). See also IUCN Standards and Petitions Subcommittee (2011) for definitions of criteria.

10. Recommendations

10.1 Overview

The main threats to hoolock gibbons in Burma are exploitation for food and trade, and forest degradation and loss due to logging and conversion to agriculture. Habitat fragmentation is also a concern, as it renders the remaining sub-populations ever smaller, leaving them less resilient to the other threats. Hoolock gibbon conservation in Myanmar therefore requires three main outcomes: (1) protection of sufficiently large blocks of forest to hold large populations of the species, ideally of several thousand animals each, (2) reduction of fragmentation in small remnant patches to ensure no individual sub-population is reduced below 30 groups, and (3) reduction in hunting pressure through awareness, regulation and law enforcement.

The western hoolock gibbon is in a serious condition at present, with global populations already very low and falling and suffering from severe habitat fragmentation. The priority for that species in Myanmar should be the immediate identification and protection of a number of core populations of at least 100 groups. The eastern hoolock remains in relatively high numbers, but the overall trend is very likely downwards accompanied by increasing threat from fragmentation. The current priority for this species would be the maintenance of several of the larger protected areas within its range (particularly Htamanthi, Mahamyaing and Indawgyi lake), and awareness raising to support reduced hunting and the maintenance of corridors between forest patches.

The following sections provide more detail on these and secondary priorities identified during the conducting of this review.

10.2 Hunting and wildlife trade

Reduction of hunting

It is unlikely that hunting for direct consumption is a big threat to Myanmar gibbons. Nevertheless, awareness raising should help reduce unnecessary hunting (e.g., where more abundant primates such as macaques are available). Hunting for trade is more problematic but is primarily conducted with firearms and better control of arms and their uses (particularly of military weapons) is essential. In the absence of good national controls, the most direct means of achieving this would be through collaboration with the military or ethnic armies in key sites.

Reduction of cross-border trade into China

Evidence suggests significant wildlife trade across the long Myanmar-China border, though the number of good roads is rather limited. Bottle necks for cross-border trade include Makhungan, Kangfang, Hpimaw, Laiza, Lweje, Muse, Kunlon, Man Panghpek, Namton and Mong La. Tougher controls at these points should target both incidental traders (e.g., local farmers, Chinese guest workers) and organised traders (e.g., local and Chinese businesspeople, organised gangs). It seems at this time that improved border enforcement would be more readily achieved through support to the Chinese authorities, particularly in Yunnan. The priorities are currently unclear, but the Wildlife Enforcement Network initiative of the Association of Southeast Asian Nations (www.asean-wen.org) provides a useful framework for cooperation and there are a range of identification guides in Burmese and Chinese that could be easily provided to border authorities. Awareness raising would appear to be an important first step on both sides of the border.

Reduction of internal trade

Eastern hoolock gibbons captured in the border areas probably travel directly by foot or road into China or Thailand, making them difficult to intercept en route except for at border crossings. However, there is likely to be some internal movement of animals from inland and the west of the country to both China, Thailand and to a lesser degree local markets. This trade can be controlled through supply side interventions including the use of military checkpoints to search for illicit wildlife. Police and civil society could play a role in controlling merchants who sell wildlife openly.

Reduction of trade to Thailand

Evidence is limited on the scale of this trade as the market for traditional medicines using gibbon parts is probably much smaller in Thailand than China. However, the pet trade could be an important source of demand from Thailand, and Thailand could also be a transit country. Controlling this trade would involve engagement with the border authorities, and since Thailand is taking a lead at implementing the ASEAN Wildlife Trade Action Plan and in the Wildlife Enforcement Network (WEN, an initiative of ASEAN), this would be a good starting point. Local police agencies should also be engaged.

Legislative reforms

The Myanmar Wildlife Law (SLORC, 1994) currently only lists the out-dated taxon *Hylobates hoolock*, and needs to be updated to recognise the genus *Hoolock* and both species of hoolock gibbons. This will clarify the protection status of each species and facilitate domestic and international control of trade. CITES enactment legislation needs to be developed, support for which could be found through the ASEAN WEN. Local law enforcement needs to encourage cooperation between police, forest department and protected area staff and potentially the army, as specified in the 1994 Protection of Wildlife and Conservation of Natural Areas Law. Stricter control of firearms among soldiers is needed to reduce hunting, and the army regional command self sufficiency policy should be revised to clearly exclude illegal hunting.

Reduction of demand

Demand from China is the single largest driver of illegal wildlife trade including trade in Myanmar's hoolock gibbons, and more effort is needed to address that. There is also a large and growing demand from Chinese people living temporarily or permanently in Myanmar, including investors, engineers, construction workers and small business operators. All of these individuals may consume wildlife in Myanmar or buy it to return to China as gifts or for sale. Significant demand reduction could therefore be achieved through cooperation with large employers of Chinese labourers and visa issuing agencies.

Demand from Thailand is less clear and would benefit from further research. It would particularly threaten eastern hoolock in Kayin and Kayah states.

Domestic demand for gibbons among Burmese is probably quite low but may still be significant, particularly for pets. The Myanmar gibbon pet trade may however be susceptible to awareness raising, based on our encounters with owners.

10.3 Population management

Western hoolock (*H. hoolock*)

Given the current low numbers of western hoolock, it seems likely the species would benefit significantly from active management in a small number of specific sites to ensure viable source populations can be maintained. Protected areas in its range are small and/or ineffective, but there may

be currently isolated populations (and even individual groups) that could be reunited either through habitat restoration or even the construction of aerial bridges, for instance where roads have created narrow physical barriers. More research is required to establish whether this is a top priority for the species, and what interventions are most suitable.

Eastern hoolock (*H. leuconedys*)

Overall there is currently no strong argument for population management of this species, though efforts should be encouraged where district or township authorities wished to restore degraded local populations.

10.4 Habitat loss and fragmentation

Improved control of logging of gibbon habitat

Remaining undisturbed gibbon habitat is dwindling, and much is or will be under pressure from state-sanctioned logging. Until there is more control of these activities in order to protect habitat core areas and corridors, only a complete cessation can realistically safeguard gibbons and much of the remaining biodiversity of the country.

Improved control of forest conversion

Two trends are driving conversion: (1) demand for agricultural land, and (2) clearance for commercial plantations. Addressing the former requires improved land use planning and zoning for multiple use, which would be politically feasible and could be piloted in a formerly logged upland area subject to pressure from shifting cultivation; one possibility is in a watershed management area where gibbons persist, such as the middle N'mai Hka river. Controlling conversion for commercial plantation of crops such as tapioca, rubber, palm oil or Barbados nut (*Jatropha curcas*) will be much more complex, and will require a more thorough understanding of the actors and processes involved. However, some influence is possible when products are intended for international markets, or which are exported for processing.

Control of hydropower development

A number of dams threaten to flood remaining hoolock habitat in the Chindwin lowlands (e.g. Htamanthi Wildlife Sanctuary), lowland and hill forests in the headwaters of the Ayeyarwady, and lowland forests along the Salween, plus there is an unknown number of actual or planned smaller dam projects on upland tributaries to these rivers. Such schemes result in direct loss of forest to reservoirs, illegal logging during clearance of the site, and indirect forest loss due to displacement of communities and economic activities. Such issues can only be fully accounted by a transparent planning process where environmental and social impacts are fully considered, though Myanmar is far from achieving this. Pressure may be brought to bear through the project owners, financiers or the governments or their countries of origin, primarily China, Thailand and India.

Improved watershed protection

Logging in upland areas affects downstream water users as well as impacting gibbons. This is a significant threat in much of the upland parts of the hoolock range. One solution is to establish financial transfers from downstream beneficiaries to upstream catchment managers and land users, which could create a disincentive for commercial logging. Options for complicated management arrangements are limited in Myanmar at present. However, dam operators do have an economic interest in protecting watersheds, and with proper planning this could represent a means of mitigating impacts on gibbons and biodiversity from dam construction, particularly in upland areas.

10.5 Protected areas system

Improved representation of gibbon habitat

As suggested in Section 2.3, formal protected area coverage in Myanmar's major biounits (*sensu* MacKinnon, 1997) is very low except for the Eastern Himalayan biounit, most of which is covered by Hkakaporazi National Park. To address this imbalance, BirdLife International and IUCN-WCPA South-East Asia (2007) prioritise increased protected area coverage within three biounits that overlap with remaining gibbon habitat: Burmese Coast (014), South Irrawaddy (09a) and Burma Transition (09c). These biounits had less than five percent coverage in the Myanmar protected area system at the time of the analysis (2007), but the situation is much worse if one discounts the parks with no active management on the ground.

The results of this review indicate a need for a thorough national review of the protected area system as the basis for all future planned expansion. The review should of course consider all national and international conservation criteria, but, as far as hoolock gibbons are concerned, would consider the inclusion of more evergreen forest in the Chindwin lowlands, in the area between Htamanthi and Indawgyi Lake, and in the Rakhine Yoma. Our findings also endorse the call for a Mali Hka protected area on the basis of its contribution to conservation of hill evergreen gibbon habitat (Dr Htin Hla, pers. comm. to MG, 2011).

Increased local participation in gibbon conservation

State/region level habitat and species protection are officially encouraged under Myanmar law, and are taking place in some locations at the hands of local groups and individuals. Local protection initiatives could be encouraged in at least three ways: (1) increasing local participation in protected area management, which may require legislative changes to allow benefit sharing for local communities; (2) creation of more state/region level protected areas, the legal status of which is unclear at present, and (3) expansion of other instruments for community resource management that might benefit gibbon habitat protection, including watershed management and community forestry.

Improved protection

Myanmar's protected areas are under-resourced even by regional standards, and this clearly needs to be addressed if they are to achieve their goals. Funding alone will not solve all the weaknesses in the current system, however. To be truly effective in the long term Myanmar's protected areas need to be seen as an essential component in wider land use planning, thus reducing conflict between protected and productive land. The state/region legislatures created in early 2011 may offer an opportunity for greater regional autonomy and collaboration between the line departments of relevant ministries, though it is still too soon to say.

10.6 Education and awareness

Promote national awareness and pride

The future of both currently recognised hoolock species undoubtedly lies with Myanmar, and this could be a rallying point for increasing support for the other measures necessary to protect the species. Although we conducted no quantitative analysis of awareness during the field research presented in this report, extensive anecdotal evidence suggests a generally low awareness of the conservation status of the species, their declining populations, and the various threats they face. National pride combined

with the gibbons' human-like appearance, loud songs and close association with primary forest make them ideal candidates for flagship species. Further research would be required to tailor a suitable message with the right audience, and should include an empirical assessment of values and behaviours among, at least, hunters, wildlife traders, police, local government officers, state/region level officers, and visiting workers (particularly from China).

Build primatology capacity

There is very little scientific capacity for primate research in Myanmar and this has to be regarded as an underlying impediment to fact-based decision making for hoolock gibbons and other species. Building a professional domestic scientific community focused on biodiversity conservation is a long-term goal, though considerable investment has already been made by a number of conservation and academic institutions towards this end. However, we would encourage, in particular, increased collaboration between national and international researchers and institutions, formal or otherwise, and increased exposure of Myanmar scientists to relevant fora such as regional seminars or the International Primatological Society Congress. Myanmar researchers should also be supported to publish their findings in international fora.

Increase civil society engagement

A wide range of civil groups (non-government and community based organisations, church groups etc.) work on issues that overlap with gibbon conservation, including land rights, community forestry, sustainable agriculture and education, environmental ethics and training. These groups probably already make a contribution to biodiversity conservation, and that can be encouraged through awareness raising, networking and by identifying win-win situations where sustainable rural development can support conservation.

Promote wild gibbons as a tourism attraction

Gibbons are well known, easily identified, and relatively easily seen in the forest, provided they occur in high densities or are habituated to humans. Tourism offers the chance to raise some income for protection, either by government agencies or local communities, and to educate visitors about the species. Several sites within the range of either hoolock species also allow for international visitors, who can potentially pay more money. Sites that warrant investigation for potential gibbon tourism as part of a larger experience include: (1) Natmataung National Park, which is the only site we deem suitable for western hoolock tourism at this time; (2) Indawgyi Lake Wildlife and forest patches around Myitkyina, both suitable for eastern hoolock, and (3) Bago Yoma, east of Yangon, also for eastern hoolock. Other sites could be of interest for domestic tourism. Indawgyi Lake Wildlife Sanctuary also has potential for awareness raising during the annual pagoda festival, which attracts tens of thousands of domestic visitors.

10.7 Research and field surveys

Distribution and status surveys, western hoolock gibbon

Several sites require further research for this species and due to its precarious status these surveys should be considered a top priority. Suggested survey sites are listed by geographical location, from north to south:

- North Naga Hills: There is also no data from this area. The status review workshop recommended surveys in forest located near Kehe and Nanyaung towns
- Lower Naga Hills: There is almost no data for this area. The status review workshop recommended surveys focused on forest south of Lashi town.

- Western Chindwin river: There is no data from this area current. The status review workshop recommended surveys in the Kabaw valley, Sagaing region.
- Natmataung National Park: This site is believed not to retain good populations but could still be a priority as it has the potential for tourism-based conservation and because there is a history of community conservation at the site.
- Kyaukpantaung Wildlife Sanctuary: This site is known to retain gibbons and could also be a priority for the species.
- Northern Rakhine state: Rapid assessments were conducted under this status review, in January 2009, but no detailed surveys have yet been conducted. Probably a relatively low priority site
- Rakhine Yoma Elephant Range: This site has so far resisted detailed study due to inaccessibility. This site could hold one of the largest populations of western hoolock left in the world.
- Southern Rakhine state: Not yet surveyed but surveys recommended during the status review workshop, June 2010

Distribution and status surveys, eastern hoolock gibbon

There are likely many small populations of eastern hoolock scattered throughout the country, and any new surveys should aimed at identifying the largest continuous populations. Suggested survey sites are listed by geographical location, from north to south:

- East central Kachin state: This site includes Bom Ba Bum Wildlife Sanctuary and the ‘triangle region’ between the N’mai Hka and Mali Hka rivers. The triangle region is currently off limits for surveys as it is in Kachin Special Region 2[please say what that means.], but is known to be well forested and could hold the largest intact block of mid-altitude subtropical montane evergreen forest within the Northern Mountains Forest Complex.
- Southwest Kachin state/Sagaing region: This site includes forests east of, and probably contiguous with, Htamanthi Wildlife Sanctuary, potentially making it one of the largest areas of intact lowland evergreen and semi-evergreen forest in the country.
- Northern Shan state: This large region has so far not been surveyed as it was not possible to gain access during the conduct of this status review. There are no historic records from the area, but anecdotal records from birdwatchers and an initial analysis of forest cover suggest both Kokein and Nang areas could be important. However, since Shan state is largely deforested any remaining gibbon populations would probably not qualify as nationally important.
- Kayah and Kayin states: This region includes three relatively large forest blocks in the Kayah-Karen montane forest ecoregion, of which only one (Ker Shor Ter) has been surveyed for gibbons, the other two being Megatha forest and the Nattaung block. Remaining gibbon populations could be of national significance, particularly if contiguous.

Other research

Several research needs for hoolock were identified during the status review and by participants in the review workshop in June 2010:

- Long-term behavioural ecology research in different habitats, including semi-evergreen forests on the border of the dry zone and high altitude populations
- Study pets, pet trade, private collections, zoos and wildlife parks
- Wildlife trade, with a focus on supply sides issues and domestic demand for gibbons
- Improved forest cover mapping so that population densities reported here can be used to evaluate possible sizes of subpopulations

- Understand better the dynamics of land cover transformations (transition from bamboo to evergreen forest) in Rakhine Yoma, if this site proves important for western hoolock conservation
- The status of the white-handed gibbon (*Hylobates lar*) in Myanmar is currently unknown and could be surveyed following the methodology presented here.
- Conduct surveys for siamangs (*Symphalangus syndactylus*) in the Tanintharyi region, as it unclear whether the species occurs in Myanmar or not.
- Little is known about the species boundary/intergrade zone, and more detailed research in this area could be of interest in better understanding the biological and ecological differences between the two hoolock species.

Monitoring

The status review presents an overall picture of the status of hoolock gibbons in Myanmar, and of population densities in a number of sites. Due to the high costs of density surveys they do not however represent a realistic baseline for monitoring the overall health of populations at key sites. A monitoring protocol should be developed to allow protected area managers and others interested in protecting the species to monitoring the impacts of interventions. The protocol would probably be based on fixed listening post surveys of gibbon call counts regularly taken from a statistically relevant number of locations.

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12. Appendices

Appendix 1. Field survey methodology

‘Forest Block’ prioritisation

The initial project activity was the prioritisation of ‘forest blocks’ believed to hold significant populations of hoolock gibbons. Since very little was documented about the specific distribution of the species, we conducted a planning workshop in Yangon in November 2008, with 25 participants from partner organizations BANCA and Yangon University, and representatives from WCS Myanmar.

‘Forest blocks’ were loosely defined as large areas of generally intact forest of similar type and composition, most of which covered at least 1,000 km². With no recent, comprehensive GIS forest cover data available to the project, the areas were identified based on the personal experience of the experts consulted during the planning, the experience of the project staff, and publicly available land-cover data for Myanmar from satellite imagery collected in the late 1990s (Stibig *et al.*, 2003).

The resulting list was updated in a project review in May 2009, resulting in a list of 15 regions of gibbon habitat where large, contiguous and breeding populations of gibbons were either known or believed to exist. A list of these forest blocks is presented in Table 12.1, and the location of each block is indicated in Fig. 12.1.

Table 12.1. List of forest blocks and final survey status.

#	Name of forest block	State/region ¹	Status
1	Southern Rakhine-Yoma	Rakhine state	Surveyed Oct-Nov 2008 by us
2	Central Rakhine Yoma	Rakhine state	Surveyed Dec 2008 by us
3	Northern Rakhine Yoma	Rakhine state	Surveyed Apr 2009 by us
4	Kyauk Pan Daung	Chin state	Survey planned ²
5	Mount Victoria/Natmataung National Park	Chin state	Survey planned ²
6	Mahamyaing Wildlife Sanctuary and environs	Chin state	Widely surveyed 2004/5; (Brockelman, 2005; Gibbon Survey Team, 2005)
7	Naga Hills (Saramiti foothills)	Sagaing region	Surveyed Nov 2009 by us
8	Chindwin Lowlands (including Htamanthi Wildlife Sanctuary)	Sagaing region	Surveyed Nov 2009 and Jan 2010 by us
9	Hukawng Valley	Kachin state	Surveyed in 2005/2006 (Anonymous, 2006; Saw Tun <i>et al.</i> , 2006)
10	Northern Forest Complex	Kachin state	Surveyed Jan-Mar 2009 by us
11	Gangaw Taung/Indawgyi Lake Wildlife Sanctuary	Kachin state	Surveyed Jan-Feb 2010 by us
12	Momeik Mabein	Shan state	Not surveyed
13	Mount Loi Sang	Shan state	Not surveyed
14	Kahya-Kayin Range	Karen state	Surveyed Apr 2010 by us
15	Northwest Rakhine / Bandula	Rakhine state	Rapid assessment from Dec 2008 to Jan 2009 by us

¹ The main state or region within which the area lies. Several sites overlap into neighbouring states/regions.

² Surveys planned by us under follow-up projects. Results are not included in this document.

Of these areas, only Mahamyaing Wildlife Sanctuary and the Hukawng Valley had received any recent gibbon survey attention – both conducted by the Forest Department in collaboration with the

Wildlife Conservation Society – and these sites were therefore considered low priority for new field surveys as part of this status review.

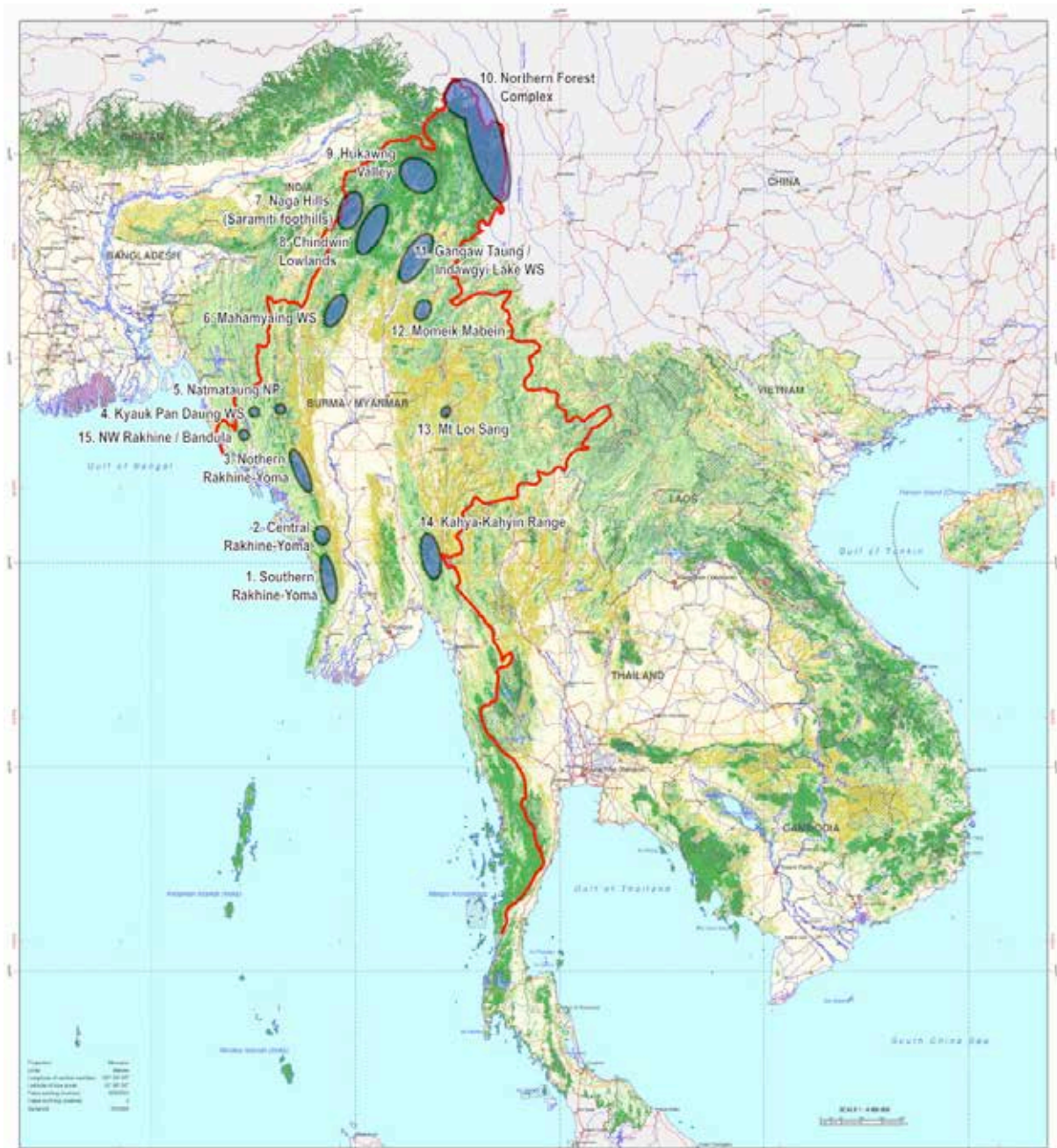


Fig. 12.1. Forest blocks identified as priorities for hoolock gibbon. Source: Project sketch based on the GLC 2000 land cover map (Stibig *et al.*, 2003).

Rapid assessments

Between October 2008 and April 2012, the project field research team undertook eleven two- to six-week expeditions to ten of the forest blocks. At each site the field team conducted a rapid, wide-ranging investigation to identify areas suitable for gibbon density estimates based on the following criteria:

- Presence of gibbons confirmed by the field team or by local people
- Site seemingly representative of the wider gibbon habitat in the area

- Site based surveys logistically feasible and within limitations of safety laid down at the start of the project

Gibbon records (villager reports, direct sightings, evidence of hunting) collected during the rapid assessments are reported in individual site reports, available on request from the authors. Confirmed reports are included within this status review.

Gibbon field surveys

Following rapid assessments, the field team sought to estimate gibbon densities at selected sites in each forest block. 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 simultaneously 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 region, 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 (Fig. 12.2). Listening for gibbon songs was carried out daily from at least 05:30 am to at least 10:30 am, but often longer.



Fig. 12.2. In order to reach the listening posts before dawn, observers have to leave the campsite when it is still dark and use torches or headlights to find the way through the forest to their respective posts, which usually are located on hilltops. Near Chaung Tha village, Thandwe district, Rakhine state, 29 Nov 2008. Photo: Thomas Geissmann.

Each listening post was manned by at one to two surveyors who monitored gibbon calls during five consecutive mornings. 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. When two surveyors were present on a listening post, compass bearing and distance estimates were checked by both of them. Song types distinguished in the protocol 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 14-20 min (Ahsan, 2001; Feeroz and Islam, 1992; Gittins and Tilson, 1984; Lan *et al.*, 1999; Tilson, 1979). If a song

interval (silence) was longer than five 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.

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 gibbons 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 region, 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.

Interview surveys

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 (Fig. 12.3). Both structured and unstructured interviews (*sensu* Bernard, 2006) were used, with individuals and, where possible, in informal focus groups of up to ten respondents.

Interviews focused mostly on gibbons, their distribution, population trends and threats. Where possible, other mammals, birds, reptiles and amphibians 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 of species encounters were identified. Questions were also asked about methods employed to kill or capture the animals, and what trade routes were used.



Fig. 12.3. Conducting interviews: (a) with a hunter on the road below Saw Law village leading down to the Ngaw Chang Hka river, Myitkyina district, Kachin state, 19 Jan 2009, and (b) at Sa Lu village, Taung Up district, Rakhine state, 14 Dec 2008. Photos: Thomas Geissmann and Saw Moses, respectively.

Appendix 2. Summary description of listening point survey sites

Table 12.2 presents a summary description of listening point survey sites used during the Hoolock Gibbon Conservation Status Review project. Scores are subjective assessments made by the Field Team following discussions with the project technical advisors. Scores are relative, and were awarded once all surveys had been completed in 2010.

Table 12.2. Summary description of listening point survey sites. The following scores are used in the table: 0 = None, 1 = Low, 2 = Medium, 3 = High.

State/region	Locality	Bio-diver-sity	Forest frag-men-tation	Gibbon density	Main threats	Threat level
Western hoolock (<i>H. hoolock</i>)						
Sagaing region	Gaba Gaso camp	2-3	3	1	Shifting cultivation (hunting much lower)	3
Sagaing region	Yawparmi village	2-3	3	1	Shifting cultivation (hunting much lower)	3
Magway region	Pyat Chaung	1-2	0	2	Hunting	1
Magway region	Kyaukpyar ridge	2	1	3	Hunting	1
Magway region	Goatsiyoe ridge	2	3	2-3	Shifting cultivation	3
Magway region	Natyekan range	2	2	2	Shifting cultivation	3
Rakhine state	Ye Paw Gyi village	2	3	2	Shifting cultivation, hunting	2
Rakhine state	Do Kwe Chaung	2	2	2	Shifting cultivation, hunting	1
Rakhine state	Chaung Tha village	1	3	1	Shifting cultivation	3
Eastern hoolock (<i>H. leuconedys</i>)						
Kachin state	Hponggun Razi WS	3	1	3	Hunting	1-2
Kachin state	Gato mountain	2-3	1	2	Shifting cultivation, hunting	1-2
Kachin state	Gata Bum mountain	2	1-2	2	Shifting cultivation, hunting	1-2
Kachin state	Su Bum mountain	2-3	1	3	Hunting	1-2
Kachin state	Lwan Khong farm	2	2	2	Logging, hunting, shifting cultivation	2-3
Kachin state	Kyi Nort village	2	2	2	Logging, hunting, shifting cultivation	2-3
Kachin state	Hopom range	2-3	1	3	Habitat degradation (fuelwood + construction timber)	2
Kachin state	Ohnyan range	2-3	1	3	Habitat degradation (fuelwood + construction timber) / expanding cultivation land (mustard farm)	2
Kachin state	Mine Naung village	2-3	1	3	Habitat degradation (fuelwood + construction timber)	2
Kachin state	Salin range	2	3	1	Hunting and habitat degradation (fuelwood)	2
Sagaing region	Nam Pagon creek	2-3	1	2	No major threat	1
Sagaing region	Nam Philin creek	2-3	1	2	No major threat	1
Sagaing region	Nant Nint area	2-3	1	3	Habitat degradation (fuelwood + construction timber)	2
Kayin state	Htee Ler Kee	2-3	1	3	No major threat	1
Kayin state	Htee Khaw Lay Ko	2-3	1	3	No major threat	1
Kayin state	Plo Doh Kee creek	2-3	1	3	No major threat	1

Appendix 3. Description of survey sites

Introduction

During the Hoolock Gibbon Conservation Status Review project of the Myanmar Primate Conservation Program, listening post field surveys, including a training survey, were conducted at 25 sites in order to estimate hoolock gibbon densities. These survey sites are described below. Maps showing the locations of the survey sites in each state or region are shown in Figs. 12.4–12.6 and 12.8–12.9. Numbers in the legends correspond with those in Appendix 5.

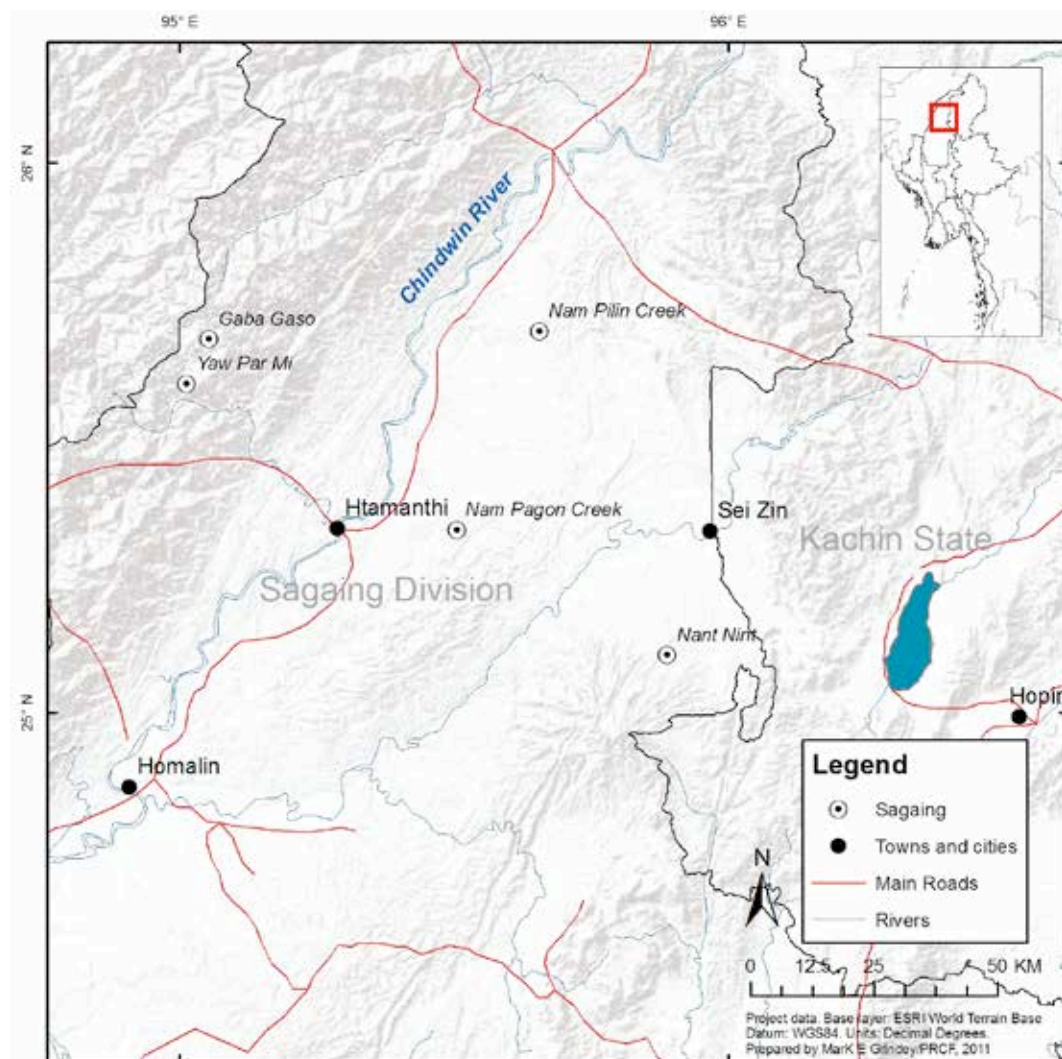


Fig. 12.4. Listening post survey sites in **Sagaing region**. Sites for the western hoolock gibbon (*H. hoolock*): 9. Yaw Par Mi village, 10. Gaba Gaso camp. Sites for the eastern hoolock gibbon (*H. leuconedys*): 18. Nam Pagon stream, 19. Nam Pilin stream, 21. Nant Nint stream.

Western hoolock gibbon (*Hoolock hoolock*)

Sagaing region, Naga Hills, near Saramati Mountain

- Field surveys were conducted at two sites (Gaba Gaso camp and Yaw Par Mi village) in October–November 2009 (Fig. 12.4).
- Elevation ranges of the survey areas were 1,400–1,750 m, and 1,400–1,780 m, respectively.
- Forest type in the survey area was evergreen forest and, above 700 m, montane forest.

- The main threats to gibbons were found to include habitat fragmentation and habitat degradation caused by shifting cultivation. Hunting also threatens the gibbons. Although the hoolock gibbon is not a target species, it is hunted opportunistically.

Magway region, northern and central Rakhine mountain range

- Field surveys were conducted at four sites (Pyat Chaung, Kyaukpyar (= Kyatpyar) ridge, above Goatsiyoe village, and the Natyekan mountain) in April-May 2009 (Fig. 12.5).

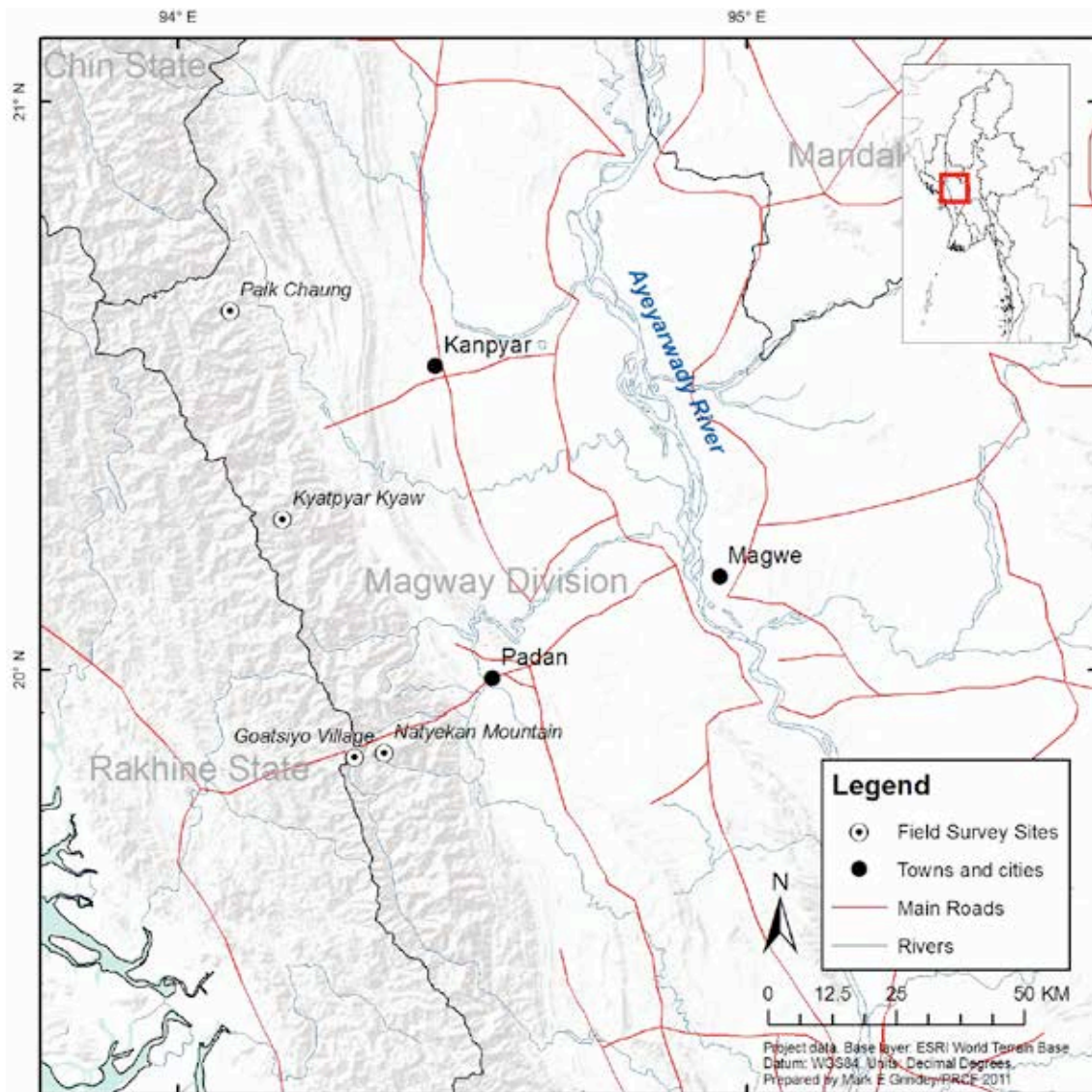


Fig. 12.5. Listening post survey sites in **Magway region**. Sites: 5. Natyekan mountain, 6. Goatsiyo village, 7. Paik (= Pyat) Chaung (=stream), 8. Kyatpyar (= Kyaukpyar) Kyaw (= ridge).

- Elevation ranges of the survey areas were 78-380 m, 96-640 m, 1,120-1,250 m, and 155-1,135 m respectively.
- Pyaik Chaung site was located in mixed Deciduous forest, whereas the three other sites were in Evergreen forest: Kyaukpyar ridge is located in a large block of primary Evergreen forest, and Goatsiyoe ridge and Natyekan mountain were in Evergreen forest with high fragmentation.
- No major threat to gibbons was detected in Pyat Chaung and Kyaukpyar ridge, although hunting remains a minor threat at both sites. Because no villages were located in the Pyat Chaung area, the forest was unfragmented there, whereas the forest was fragmented near the village at Kyaukpyar ridge due to shifting cultivation. At Goatsiyoe ridge and Natyekan

range, however, habitat fragmentation caused by shifting cultivation was found to be the main threat to gibbons.

Rakhine state, southern Rakhine mountain range

- Field surveys were conducted at three sites (Ye Paw Gyi village, Do Kwe Chaung, and Chaung Tha village) in November-December 2008 (Fig. 12.6).
- Elevation ranges of the survey areas were 700-750 m, 200-300 m, and 100-500 m a.s.l., respectively.
- All survey sites were located in Evergreen forest with high fragmentation and degradation.
- The main threat to gibbons was found to be habitat fragmentation caused by shifting cultivation. In addition, the forest around Chaung Tha village had suffered considerably during a storm in 2005.

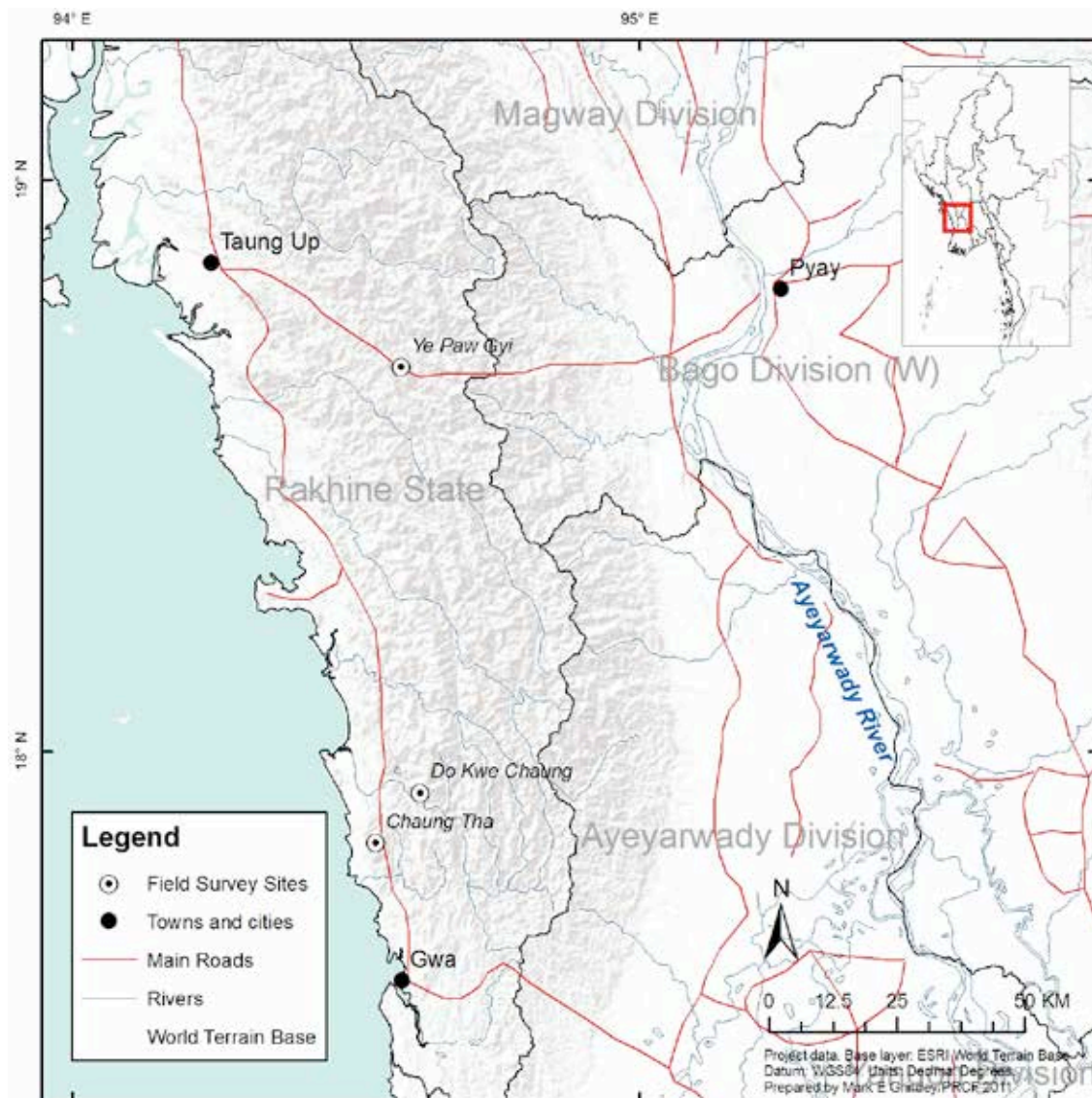


Fig. 12.6. Listening post survey sites in **Rakhine state**. Sites: 2. Chaung Ta village, 3. Ye Paw Gyi village, 4. Do Kwe Chaung stream. Note that the location of the roads are approximate.

Views of the habitat at selected survey sites for the western hoolock gibbon are shown in Fig. 12.7. The “WH”-codes for each locality correspond to those of Section 7.3.



Fig. 12.7. Habitat at selected survey sites for the western hoolock gibbon. (a) Pyat (Paik) Chaung near Bu village (WH-26, Appendix 5 No. 6), northeast Rakhine mountain range, Magway region. Mixed Deciduous forest. Photos: Ngwe Lwin, May 2009. (b) Kyaukpyar ridge (WH-27, Appendix 5 No. 7), northeast Rakhine mountain range, Magway region. Evergreen forest. Photos: Ngwe Lwin, May 2009. (c) Natyekan mountain range (WH-30, Appendix 5 No. 4), north-central Rakhine mountain range, Magway region. Evergreen forest with high fragmentation. Photos: Ngwe Lwin, Apr 2009. (d) Chaung Tha village (WH-42, Appendix 5 No. 1), in Boak Pyin creek. Evergreen forest with high fragmentation and degradation. Photos: Frank Momberg and Saw Moses, respectively, Nov 2008.

Eastern hoolock gibbon (*Hoolock leuconedys*)

Kachin state, Hponggun Razi area

- Field surveys were conducted at two sites (Hponggun Razi Wildlife Sanctuary and Gato mountain range) in March 2009 (Fig. 12.8).
- Elevation ranges of the survey areas were 1,180-1,430 m and 1,200-1,260 m a.s.l., respectively.
- Both survey sites were located in Evergreen and Mountain Evergreen forest.
- The main threat to gibbons at both sites was found to be hunting.

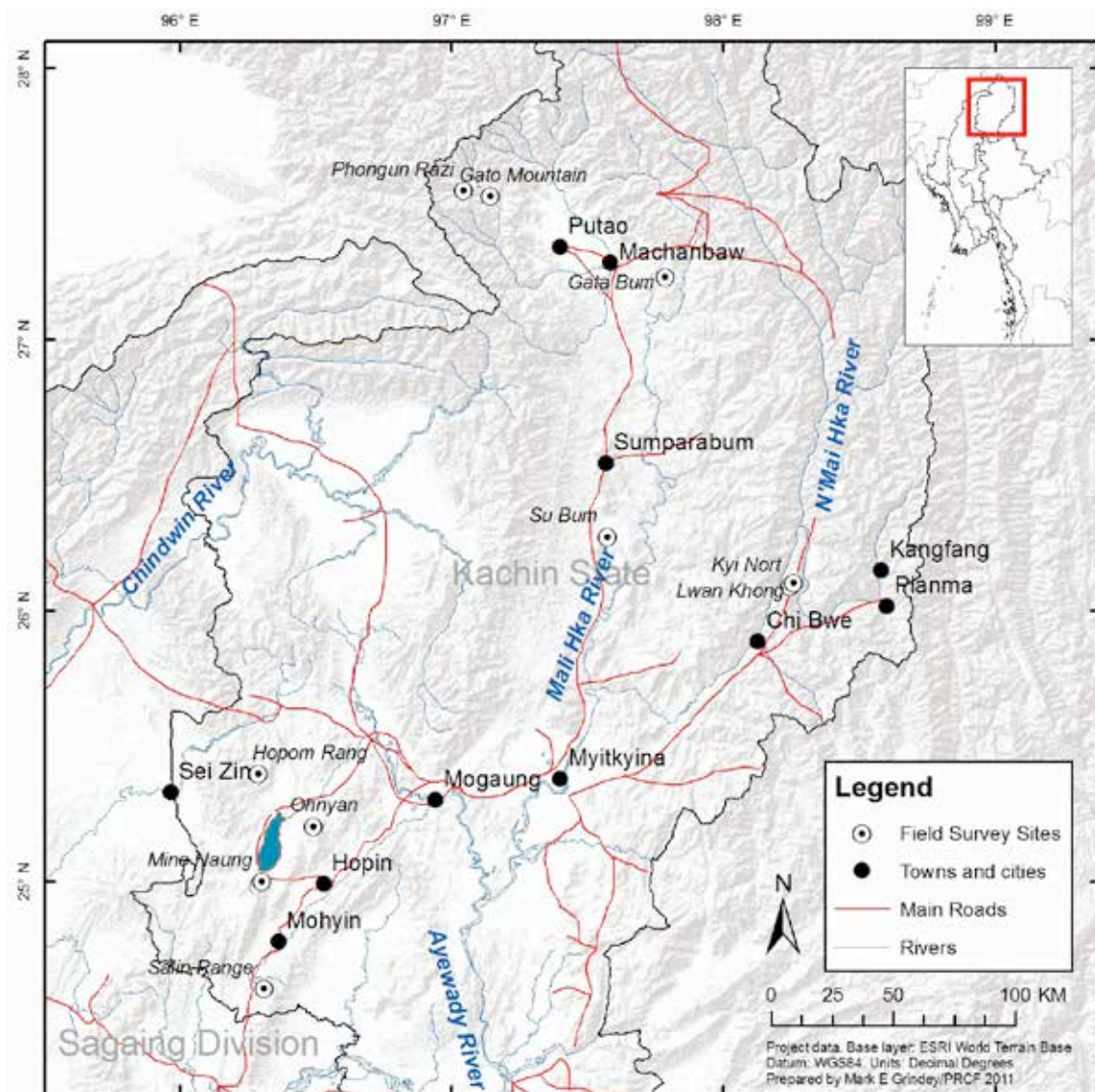


Fig. 12.8. Listening post survey sites in **Kachin state**. Sites: 12. Kyi Nort village, 13. Lwan Khong farm, 14. Su Bum (=mountain), 15. Gata Bum (= mountain), 16. Phongun Razi (= Hponggun Razi) mountain, 17. Gato mountain, 20. Hopom Rang mountain, 22. Ohnyan mountain, 23. Mine Naung village, 24. Salin mountain.

Kachin state, Naung Mong area, Gata Bum Mountain

- A field survey was conducted at one site (Gata Bum mountain) in March 2009 (Fig. 12.8).
- Elevation range of the survey area was 860-950 m a.s.l.
- The survey site was located in fragmented Evergreen forest.

- The main threats to gibbons were found to be both hunting and habitat fragmentation due to shifting cultivation. Village density in the survey area was low, however.

Kachin state, Sumprabum area, Su Bum Mountain

- A field survey was conducted at one site (Su Bum mountain) in February 2009 (Fig. 12.8).
- Elevation range of survey area was 480-660 m a.s.l.
- The survey site was located in Evergreen forest.
- The main threat to gibbons was found to be hunting. Although the forest habitat was of good quality in the study area, forests near villages are fragmented because of shifting cultivation.

Kachin state, eastern Kachin, Saw Law area

- Field surveys were conducted at two sites (Lwan Khong farm and Kyi Nort village) in January 2009 (Fig. 12.8).
- Elevation ranges of survey areas were 1,285-1,400 m and 1,655-1,840 m a.s.l., respectively.
- Both survey sites were located in Evergreen forest, which was fragmented by the shifting cultivation.
- The main threats to gibbons were found to be both hunting and habitat loss.

Kachin state, Indawgyi Lake area

- Field surveys were conducted at three sites in and near Indawgyi Lake Wildlife Sanctuary (near Hopom, Ohnyan, and Mine Naung villages) in January 2010 (Fig. 12.8).
- Elevation ranges of the survey areas were 860-1030 m, 220-300 m, and 240-560 m a.s.l., respectively.
- All survey sites were located in Evergreen forest.
- The main threat to gibbons in all survey areas was found to be habitat degradation. No shifting cultivation was observed.

Kachin state, Gangawtaung range

- A field survey was conducted at one site (Salin range) in February 2010 (Fig. 12.8).
- Elevation range of the survey area was 300-360 m a.s.l.
- The survey site was located in mixed Deciduous forest.
- The main threats to gibbons were found to be both hunting and habitat fragmentation.

Sagaing region, Chindwin lowland area, Htamanthi Wildlife Sanctuary

- Field surveys were conducted at two sites (Nam Pilin Creek and Nam Pagon Creek) in November-December 2009 (Fig. 12.4).
- Elevation ranges of the survey areas were 200-245 m and 145-180 m, respectively.
- Both survey sites were located in Evergreen forest.
- No major threat to gibbons was detected in the survey areas, but hunting and habitat degradation were serious threats in earlier times in particular when resin of the *thitkado* tree (*Cedrela febrifuga*) was permitted to be produced commercially in 2005 and 2006. Many people were working in that area at that time and were opportunistically hunting for food.

Sagaing region, Hkamti area

- A field survey was conducted at one site (Nant Nint area) in January 2010 (Fig. 12.4).
- Elevation range of the survey area was 250-300 m a.s.l.

- The survey site was located in mixed Deciduous forest.
- The main threat to gibbons was found to be habitat degradation; no shifting cultivation.

Kayin (= Karen) state

- Field surveys were conducted at three sites (Htee Ler Kee, Htee Khaw Lay Ko, and Plo Doh Kee Creek) in April-May 2010 (Fig. 12.9).
- Elevation ranges of the survey areas were 1,594-1,699 m, 1,463-1,580 m, and 1,618-1,770 m a.s.l., respectively.
- All survey sites were located in primary mountain Evergreen forest.
- No major threat to gibbons was detected in this area. Hunting pressure was low, and the area was under community management.

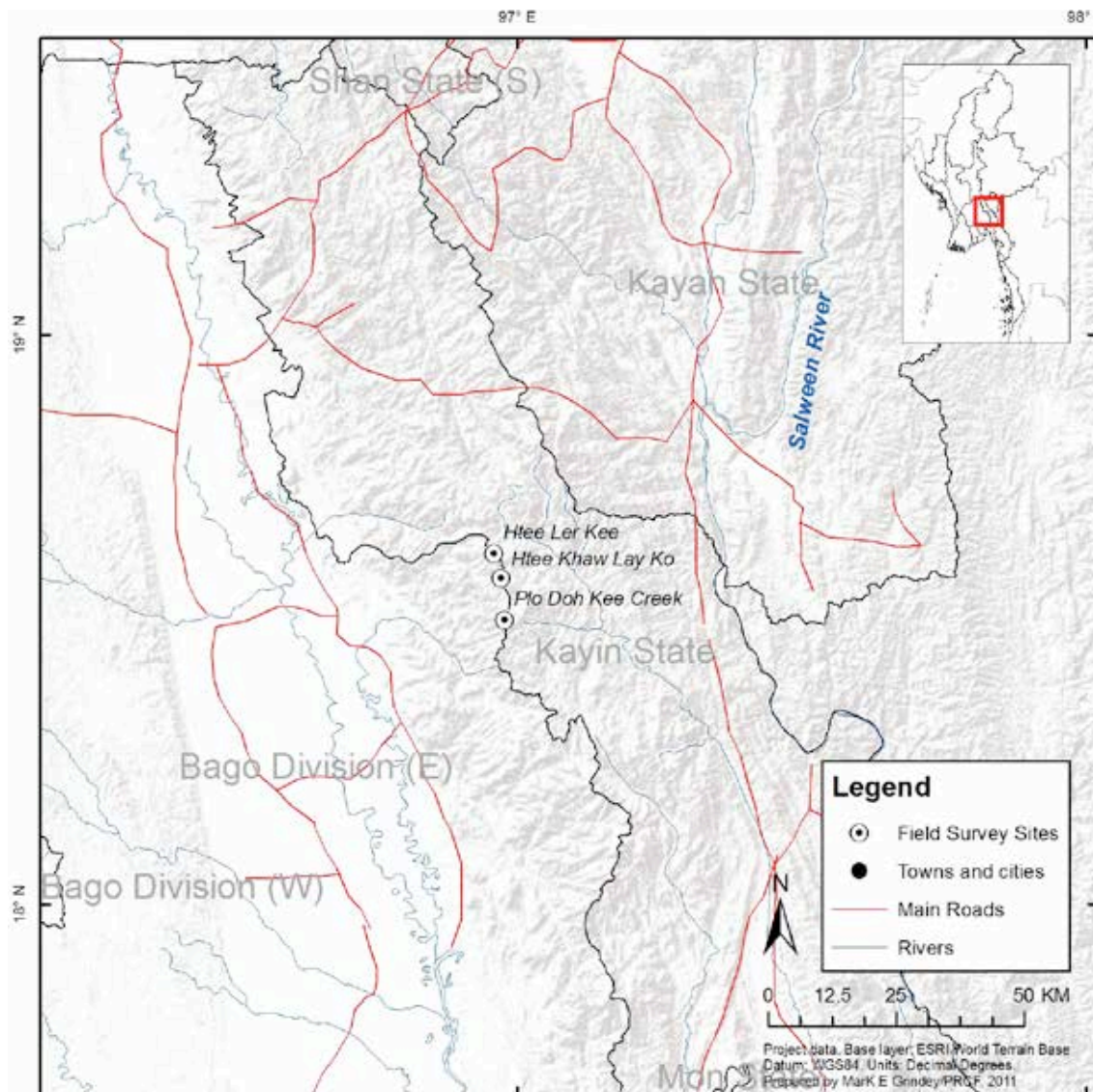


Fig. 12.9. Listening post survey sites in Kayin state. Sites: 25. Htee Khaw Lay Ko mountain, 26. Htee Ler Kee mountain, 27. Plo Doh Kee stream.

Views of the habitat at selected survey sites for the eastern hoolock gibbon are shown in Fig. 12.7. The “WH”-codes for each locality correspond to those of Section 7.4.



Fig. 12.10. Habitat at selected survey sites for the eastern hoolock gibbon. (a) Kyi Nort village (EH-21, Appendix 5 No. 11), east of N'mai Hka river, Kachin state. Evergreen forest with fragmentation by shifting cultivation. Photos: Thomas Geissmann, Jan 2009. (b) Ohnyan mountain range (EH-30, Appendix 5 No. 30), near Indawgyi lake, Mohnyin district, Kachin state. Evergreen forest with some degradation. Jan 2010. (c) Mine Naung village (EH-32, Appendix 5 No. 22), near Indawgyin lake, Mohnyin district, Kachin state. Evergreen forest with some degradation. Photos: Ngwe Lwin, Jan 2010. (d) Nam Pagon Creek (EH-61, Appendix 5 No. 17), Htamanthi wildlife sanctuary, Chindwin lowlands, Sagaing region. Evergreen forest. Photos: Ngwe Lwin, Nov 2009.

Appendix 4. Protected areas in Myanmar and likely occurrence of gibbons

Table 12.3 presents an annotated list of the nationally recognised protected areas in Myanmar, both gazetted and notified (proposed), taken from MoECA (2011). Entries are ordered by year of establishment from oldest to most recent. Available information on the presence of gibbon species in the protected areas in Myanmar is also provided.

Table 12.3. Annotated list of protected areas in Myanmar.

#	Year Est.	Name	Area (km ²)	General location	Gibbon records ⁽¹⁾			Hylo- bates lar
					<i>Hoolock</i>			
					<i>hoolock</i>	<i>leuco- nedys</i>	<i>sp.</i>	
Established (i.e., gazetted) protected areas								
1	1920	Taunggyi Bird Sanctuary	16.06	Shan State	—	—	—	—
2	1927/ 2006 ⁽²⁾	Pidaung Wildlife Sanctuary	122.07	Kachin State	—	—	—	—
3+4	1927	Shwe-U-Daung Wildlife Sanctuary	58.04 + 117.97	Mandalay Region + Shan State	—	?	—	—
5	1927	Pyin-O-Lwin Bird Sanctuary	127.25	Mandalay Region	—	—	—	—
6	1927	Moscov Islands Wildlife Sanctuary	49.18	Taninthayi Region	—	—	—	—
7	1928	Kahilu Wildlife Sanctuary	160.55	Kayin State	—	—	—	?
8	1935	Mulayit Wildlife Sanctuary	138.54	Kayin State	—	—	—	?
9	1939	Wethikan Bird Sanctuary	4.40	Magway Region	—	—	—	—
10	1940	Shwesehtaw Wildlife Sanctuary	464.28	Magway Region	—	—	—	—
11	1941	Chatthin Wildlife Sanctuary	269.36	Sagaing Region	—	—	—	—
12	1942/ 2002 ⁽²⁾	Kelatha Wildlife Sanctuary	23.93	Mon State	—	—	—	—
13	1970	Thamihla Kyun Wildlife Sanctuary	0.88	Ayeyarwady Region	—	—	—	—
14	1971	Minwuntaung Wildlife Sanctuary	205.88	Sagaing Region	—	—	—	—
15	1974	Htamanthi Wildlife Sanctuary	2150.73	Sagaing Region	—	R	—	—
16	1985/ 2001 ⁽²⁾	Inlay Wetland Bird Sanctuary	640.91	Shan State	—	—	—	—
17	1988	Moeyongyi Wetland Bird Sanctuary	103.60	Bago Region	—	—	—	—
18	1989	Hlawga Park	6.24	Yangon Region	—	—	—	—
19	1989	Alaungdaw Kathapa National Park	1402.79	Sagaing Region	—	—	—	—
20	1989	Popa Mountain Park	128.54	Mandalay Region	—	—	—	—
21	1993	Meinmahla Kyun Wildlife Sanctuary	136.70	Ayeyarwady Region	—	—	—	—

Table 12.3. (ctd.)

#	Year Est.	Name	Area (km ²)	General location	Gibbon records ⁽¹⁾			
					<i>Hoolock</i>			<i>Hylobates lar</i>
					<i>hoolock</i>	<i>leuco-nedys</i>	<i>sp.</i>	
Established (i.e., gazetted) protected areas								
22	1995	Lawkananda Wildlife Sanctuary	0.47	Mandalay Region	—	—	—	—
23	1996	Lampi Marine National Park	204.84	Taninthayi Region	—	—	—	—
24	1996	Loimwe Protected Area	42.84	Shan State	—	—	—	?
25	1996	Parsar Protected Area	77.03	Shan State	—	—	—	?
26	1998	Hkakaborazi National Park	3812.46	Kachin State	—	—	—	—
27	2001	Kyaikhtiyoe Wildlife Sanctuary	156.23	Mon State	—	—	—	—
28	2001	Minsontaung Wildlife Sanctuary	22.61	Mandalay Region	—	—	—	—
29	2002	Rakhine Yoma Elephant Range	1755.70	Rakhine State	M	—	—	—
30	2002	Panlaung-Pyadalin Cave Wildlife Sanctuary	333.80	Shan State	—	M	—	—
31	2003	Hponkanrazi Wildlife Sanctuary	2703.95	Kachin State	—	R	—	—
32	2004	Indawgyi Wetland Wildlife Sanctuary	814.99	Kachin State	—	R	—	—
33	2004	Hukaung Valley Wildlife Sanctuary	6371.37	Kachin State	—	—	R	—
34	2004	Bumhpabum Wildlife Sanctuary	1854.43	Kachin State	—	—	—	—
35	2005	Taninthayi Nature Reserve	1699.99	Taninthayi Region	—	—	—	M
36	2010	Natmataung National Park	713.54	Chin State	R	—	—	—
37+ 38	2010	Hukaung Valley Wildlife Sanctuary (extension)	4333.05 + 6669.22	Kachin State + Sagaing Region	—	—	R	—
Proposed (i.e., notified) protected areas								
1	2001	Kyauk Pan Taung Wildlife Sanctuary	132.61	Chin State	R	—	—	—
2	2002	Mahamyaing Wildlife Sanctuary	1180.39	Sagaing Region	—	R	—	—
3	2002	Taninthary National Park	2589.99	Taninthayi Region	—	—	—	M
4	2002	Lenya National Park	1766.37	Taninthayi Region	—	—	—	—
5	2004	Lenya National Park (extension)	1398.59	Taninthayi Region	—	—	—	—
6	2006	Shinpin Kyatthaut Wildlife Sanctuary	71.90	Bago Region	—	—	—	—
7	2008	Bawdithtaung Nature Reserve	72.52	Sagaing Region	—	—	—	—
					3	5	2	2

(1) H = Historical Record (before 1960); M = Modern Record (1980-2004); R = Recent Record (2005-2010); ? = Unsure

(2) Indicates renotification was made at the later date.

Appendix 5. Summary of gibbon density results used to estimate overall populations

#	Author (a)	Site name	Site type	State or region	No. of listening areas	Density (Groups/km ²)		Altitude (m)		Forest type ^(b)	Survey date	
						0.6 km radius	1 km radius	Min	Max		Year	Month
Western hoolock (<i>H. hoolock</i>)												
1	MPCP	Chaung Tha	Village	Rakhine	1	0.37	0.13	100	500	EGF	2008	Nov
2	MPCP	Ye Paw Gyi	Village	Rakhine	1	0.66	0.88	700	750	EGF	2008	Dec
3	MPCP	Do Kwe Chaung	Stream	Rakhine	1	0.66	0.56	200	300	EGF	2008	Dec
4	MPCP	Natyekan	Mountain	Magway	1	1.55	1.67	155	1,135	EGF	2009	Apr
5	MPCP	Goatsiyo	Village	Magway	1	3.54	2.63	1,120	1,250	EGF	2009	Apr
6	MPCP	Pyat Chaung	Stream	Magway	1	3.71	2.10	78	380	MDF	2009	Apr
7	MPCP	Kyaukpyar Kyaw	Mountain	Magway	1	3.76	3.02	96	640	EGF	2009	May
8	MPCP	Yaw Par Mi	Village	Sagaing	1	2.87	1.27	1,400	1,780	EGF/MEGF	2009	Oct
9	MPCP	Gaba Gaso	Stream	Sagaing	1	3.32	1.67	1,400	1,750	EGF/MEGF	2009	Nov
10	WCS	Naga	Mountain	Kachin	6	2.89	2.36	615	1,409	EGF/MEGF	2006	Dec-Feb
					Total = 15	Ave=2.33	Ave=1.63					
Eastern hoolock (<i>H. leuconedys</i>)												
11	MPCP	Kyi Nort	Village	Kachin	1	2.17	2.05	1,655	1,840	EGF	2009	Jan
12	MPCP	Lwan Khong	Farm	Kachin	1	1.21	0.89	1,285	1,400	EGF	2009	Jan
13	MPCP	Su Bum	Mountain	Kachin	1	2.87	2.23	480	660	EGF	2009	Feb
14	MPCP	Gata Bum	Mountain	Kachin	1	0.66	1.35	860	950	EGF	2009	Feb
15	MPCP	Hponggun Razi	Mountain	Kachin	1	4.20	3.35	1,180	1,430	EGF/MEGF	2009	Mar
16	MPCP	Gato	Mountain	Kachin	1	1.33	1.03	1,200	1,260	EGF/MEGF	2009	Mar
17	MPCP	Nam Pagon	Stream	Sagaing	1	1.55	2.07	145	180	EGF	2009	Nov
18	MPCP	Nam Pilin	Stream	Sagaing	1	3.09	2.15	200	245	EGF	2009	Nov
19	MPCP	Hopom Rang	Mountain	Kachin	1	4.20	2.47	860	1,030	EGF	2010	Jan
20	MPCP	Nant Nint	Stream	Kachin	1	1.33	1.75	250	300	MDF	2010	Jan
21	MPCP	Ohnyan	Mountain	Kachin	1	7.07	4.81	220	300	EGF	2010	Jan
22	MPCP	Mine Naung	Village	Kachin	1	4.18	2.23	240	560	EGF	2010	Jan
23	MPCP	Salin	Mountain	Kachin	1	0.88	2.07	300	360	MDF	2010	Feb
24	WCS	Mahamyaing	Wildlife Sanctuary	Sagaing	11	2.25	1.81	258	474	EGF/MDF	2004	Jun-Dec
25	MPCP	Htee Khaw Lay Ko	Mountain	Kayin	1	0.93	0.59	1,463	1,580	MEF	2010	Apr
26	MPCP	Htee Ler Kee	Mountain	Kayin	1	2.09	1.42	1,594	1,699	MEF	2010	Apr
27	MPCP	Plo Doh Kee	Stream	Kayin	1	5.12	2.76	1,618	1,770	MEF	2010	Apr
					Total = 27	Ave=2.65	Ave=2.06					
Hoolock, uncertain species												
28	WCS	Wantoke	Mountain	Kachin	7	2.73	2.50	206	450	EGF/MEGF	2006	Mar-May

(a) MPCP = Myanmar Primate Conservation Program (the authors); WCS = Wildlife Conservation Society Myanmar Program and Myanmar Forest Department

(b) EGF = Evergreen Forest, MEGF = Mountain Evergreen Forest; MDF = Mixed Deciduous Forest (including EGF component)

Appendix 6. Density and habitat data used in the hoolock population estimates

Unit of analysis ('sub-range')	No of data points (density estimates) used	Average estimated hoolock densities				Range km ²	Gibbon habitat w/in range ^(c)			Estimated popu-lation of individuals, 2010 ^(f)	
		Groups / km ² ^(a)		Individuals / km ² ^(b)			km ²	% of total			
		0.6 km radius	1 km radius	0.6 km radius	1 km radius				Total area	2000	2010 ^(d)
Western hoolock (<i>H. hoolock</i>)											
Southern and Central Rakhine Yoma	3	0.56	0.52	1.85	1.72	11,340	3,294	1,884	17%	3,200	3,500
Northern Rakhine Yoma	4	3.14	2.36	10.36	7.79	25,677	3,805	2,176	8%	17,000	23,000
Chin Hills Complex	None ⁽ⁱ⁾	2.54	1.92	9.01	8.25	25,805	4,867	2,784	11%	23,000	25,000
Kabaw Valley and Ponnya Range	None ⁽ⁱ⁾	2.54	1.92	9.01	8.25	10,630	1,432	819	8%	6,800	7,400
Naga Hills and West Chindwin Lowlands	3	3.03	1.77	10.00	5.84	17,119	9,492	5,429	32%	32,000	54,000
Sub-totals & averages	10					90,571	22,890	13,092	14%	82,000	110,000
Eastern hoolock (<i>H. leuconedys</i>)											
Northern Kachin Forest Complex	6	2.07	1.82	6.83	6.01	34,567	25,768	14,739	43%	89,000	100,000
Southern Kachin-Northern Sagaing Forests	8	3.07	2.42	10.13	7.99	65,206	32,808	18,766	29%	150,000	190,000
Shan State Sub-tropical Forests	None ⁽ⁱ⁾	2.54	1.92	9.01	8.25	90,602	10,679	6,108	7%	50,000	55,000
Kayah-Kayin Montane Rain Forests	3	2.71	1.59	8.94	5.25	34,182	5,172	2,958	9%	16,000	26,000
Sub-totals	17					224,557	74,427	42,571	19%	300,000	370,000
Hoolock, uncertain species											
Transition Zone	1	2.73	2.50	9.01	8.25	16,743	13,677	7,823	47%	65,000	70,000
Sub-totals	1					16,743	13,677	7,823	47%	65,000	70,000
TOTALS/GLOBAL AVERAGES	28	2.493	1.874	8.415	6.76	331,871	110,994	63,486	19%	450,000	550,000

^(a) Averages of all available density estimates per sub-range; rounded to two decimal places, as with the individual site estimates.

^(b) Based on an average of 3.3 individuals per group, to two decimal places.

^(c) Calculated from GLC (Global Landcover) 2000 data (see Section 9.2).

^(d) Based on a 42.8% loss of "gibbon habitat" on the GLC 2000 area (see Section 9.2). Rounded to nearest whole number.

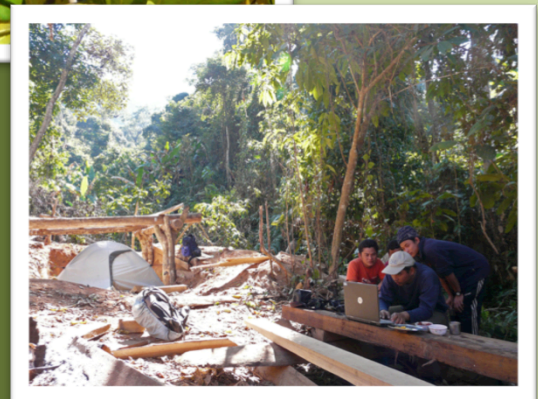
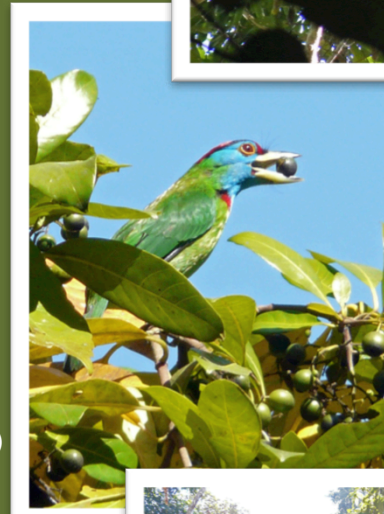
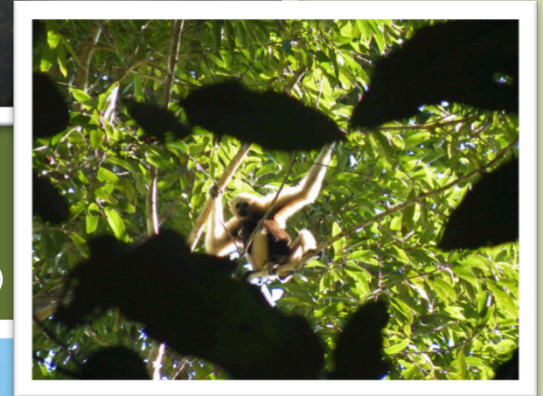
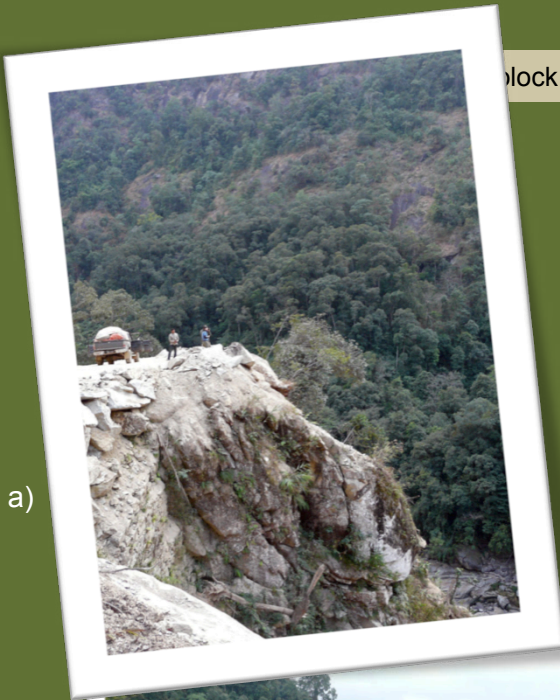
^(e) As a percentage of the total area of the range.

^(f) All rounded to two significant figures. Species totals are rounded after the addition of unrounded sub-range totals, to avoid compounding rounding error.

^(g) Derived from the density estimate (individuals/km²) at 1 km listening radius.

^(h) Derived from the density estimate (individuals/km²) at 0.6 km listening radius.

⁽ⁱ⁾ No density estimates exist for the sub-range, so we use the average of all 28 sites in Myanmar; rounded to 2 decimal places.



Photos:
Thomas Geissmann (a, b, d-i),
and Thet Naing Aung (c).

The Conservation Status of Hoolock Gibbons in Myanmar

Hoolock gibbons are small apes of South-east Asia, and Myanmar is believed to be their last stronghold. In Bangladesh, India, and China, most forests supporting the hoolock gibbons are small and highly fragmented. Myanmar, in contrast, is thought to have huge areas of hoolock gibbon habitat in good quality and to hold significant populations of both the western and the eastern hoolock gibbon. This report takes the first detailed look at the status of each Myanmar's hoolock species.

Until now, conservation actions for the hoolock gibbons in Myanmar were constrained by a lack of data on their distribution, population size and threats. We addressed this need by conducting a nationwide review of the status of the species based on: (1) a review of the taxonomic and ecological knowledge on both hoolock species throughout their range, (2) a compilation of a full annotated list of hoolock records, published and unpublished, for Myanmar, and (3) population estimates and threats assessments for both species throughout Myanmar based on various field surveys conducted by the authors for this project.

The resulting report gives a first picture of the conservation status of Myanmar's hoolock gibbons in a regional, national and international context.

