The Conservation Status of GIBBONS in VIETNAM

Fauna & Flora International
Conservation International

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Fauna & Flora International (FFI)

Established in 1903 in the UK, FFI acts to conserve threatened species and ecosystems worldwide, choosing solutions that are sustainable, are based on sound science and take account of human needs. In 2000, FFI published a status review of gibbons in Vietnam and for over a decade has been actively involved in conserving Vietnam's most endangered gibbons. Primate conservation is a core area of interest for FFI's programme in Vietnam.

Conservation International (CI)

Founded in 1987, CI builds upon a strong foundation of science, partnership and field demonstration, to empower societies to responsibly and sustainably care for nature, our global biodiversity, for the well-being of humanity. CI has worked on field surveys, technical publications, capacity development and fund dispersal over the past four years to help conserve Vietnam's threatened gibbons.

IUCN/SSC Primate Specialist Group

The Primate Specialist Group (PSG) is concerned with the conservation of more than 630 species and subspecies of prosimians, monkeys, and apes, carrying out conservation status assessments, the compilation of action plans, making recommendations on taxonomic issues, and publishing information on primates to inform IUCN policy as a whole. The PSG facilitates the exchange of critical information among primatologists and the professional conservation community.

Arcus Foundation

Founded in 2000 by Jon Stryker, the Arcus Foundation is a leading global foundation advancing pressing social justice and conservation issues. Through its programme for Great Apes in the Wild, Arcus works to ensure that viable populations of great apes are protected from extinction and living in habitats that are managed sustainably and holistically, as well as integrated with economic development objectives.

Nowak-Sprague SE Asia Biodiversity Initiative

The Nowak-Sprague SE Asia Biodiversity Initiative (NSSEABI) was created by the Nowak-Sprague family with the goal to preserve biodiversity and pristine places along with humanitarian goals in South-East Asia. The NSSEABI allocates grants to existing organizations, and has worked closely with Conservation International and Pathfinder International in Vietnam, focusing on primate conservation and human development projects.

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Conventions

This document uses the following conventions.

Chapters on the status of each gibbon species

The chapters describing the status of each species follow the same structure, beginning with a summary of the status and distribution of the species globally and in Vietnam, followed by a comparison with the status reported in Vietnam Primate Conservation Status Review 2000 Part 1: Gibbons (Geissmann et al. 2000). Key sites for the species conservation are identified and threats and ongoing conservation actions are summarised. A brief assessment of the priority conservation actions for each taxon is then provided. This is followed by a separate account for each site where records have been collected for the species. For completeness, where there has been sufficient information from a site since 2000 to indicate that gibbons are probably now absent from there, a short site account is also given. Finally, the chapters close with a table listing other sites where gibbons were considered provisionally or confirmed present between 1995 and 2000, i.e. in Geissmann et al. (2000), but for which this report has compiled no new information.

Naming conventions

This gibbon status review follows the taxonomy presented in the IUCN Red List of Threatened Species, which we have updated based on new information on the taxonomy of the *Nomascus* genus as described in Chapter 9.

There is much inconsistency over the general use of common species names in English for crested gibbons. This can be confusing to anyone except specialists in the field. Throughout this document, common names have been kept simple and consistent for clarity. Other commonly-used names are presented at the beginning of each species chapter. The term "crested" has been dropped when referring to a species for brevity and because all gibbons in Vietnam are crested gibbons. This should not cause any confusion with species of other gibbon genera.

Vietnamese species names follow the 2007 Vietnam Red Data Book (Ministry of Science and Technology & Vietnam Academy of Science and Technology 2007) and the Field Guide to the Large Mammals of Vietnam (Parr & Hoang Xuan Thuy 2008). Additional names are given where they are commonly used and known to the authors. The lists of Vietnamese names for the gibbon species are not intended to be exhaustive.

Conservation status

The internationally and nationally recognised conservation status and degree of legal protection of each species is presented based upon the following:

- IUCN Red List of Threatened Species
- 2007 Vietnam Red Data Book
- Decree 32/2006/NP-CP on Management of Endangered, Precious and Rare Forest Plants and Animals
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Site accounts

Accounts are given for all sites for which there is new information on gibbons since the publication of Geissmann et al. (2000). Some pre-2000 records and references are included for clarity and in a few cases where records were not picked up by Geissmann et al. (2000).

A site is defined in this report as a management unit rather than the extent of the habitat for a particular gibbon population. Where more than one site includes parts of the same gibbon population cross-references are made between sites so that the reader is aware of the broader context.

Each site account opens with a set of summary data followed by a narrative on the status and threats to the gibbon population. Records of the local gibbon population are described in chronological order beginning with the most recent. Where possible, population trends are stated and discussed. Threats to the gibbons at the site are then described, followed by conservation actions ongoing, planned and required. The summary data given at the beginning of each site account and compiled for all sites in Annex 1 are described below.

Location:

The district and province where the site is located.

Area:

The size of the area in hectares is provided and denotes the area under management rather than the area of forest suitable for gibbons. This is not ideal from the point of view of gibbon population management, but this is the data most readily available and using it ensures there is consistency across all site accounts.

Status criteria

Five numbered criteria are used to summarise the status of the gibbon species at each site, as follows:

1a: Confirmed record post 2000
1b: Provisional record post 2000
1c: No records post 2000

2a: Confirmed record between 1995 and 2000
(following conventions used in Geissmann et al. 2000)
2b: Provisional record between 1995 and 2000
(following conventions used in Geissmann et al. 2000)
2c: No records prior to 2000

3a: The site is known, thought or inferred to contain a population totalling ≥ 5% of the national population
3b: The site is known, thought or inferred to contain a population totalling < 5% of the national population
3c: The significance of the gibbon population at the site is unknown in a national context

4a: The site is known, thought or inferred to contain a population totalling ≥ 5% of the global population
4b: The site is known, thought or inferred to contain a population totalling < 5% of the global population
4c: The significance of the gibbon population at the site is unknown in a global context

5a: The gibbon population at the site is known, thought or inferred to be increasing
5b: The gibbon population at the site is known, thought or inferred to be stable
5c: The gibbon population at the site is known, thought or inferred to be declining
5d: The gibbon population at the site is provisionally extirpated
5e: The gibbon population at the site is confirmed extirpated
5f: The status of the gibbon population at the site is unknown

Date of most recent survey:

This refers only to biodiversity surveys likely to report gibbons, e.g. an amphibian-focussed survey might not record gibbons if they are present, but a general mammal survey would be expected to.

Date of most recent confirmed record:

Gibbon records are considered confirmed only if there is direct evidence (a specimen, sighting or vocalization heard) obtained by a reliable observer with associated reliable location data. It is considered provisional if the only evidence is from a specimen, sighting or vocalization reported second-hand.

Minimum population:

For each site, the gibbon population is given as the minimum number of groups which were confirmed from the site at the time of the most recent report, or where relevant and possible, a combined number from multiple reports. This does not necessarily represent the full population of the site. Gibbon groups rather than individuals are the preferred unit for presenting the size of the population. The number of groups is more likely to be recorded during a survey than the number of individuals, due to the practical ease of recording vocalisations compared to direct sightings. Where a number of individuals at a site has been recorded, that data is also presented.

Abbreviations and Acronyms

a.s.l.	above sea level
CI	Conservation International
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
CRES	Centre for Natural Resources and Environmental Studies
ENV	Education for Nature Vietnam
FFI	Fauna & Flora International
FPD	Forest Protection Department
ha	hectare
IUCN	International Union for the Conservation of Nature and Natural Resources
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
Lao PDR	Lao People's Democratic Republic (commonly referred to as Laos)
NGO	Non-governmental organisation
NR	Nature Reserve
NP	National Park
NPA	National Protected Area (used for protected areas in Laos)
pers. comm.	personal communication
PNR	Proposed Nature Reserve
REDD+	Reducing Emission from Deforestation and Forest Degradation, plus enhancing forest carbon stocks in developing countries
SFE	State Forest Enterprise
SHCA	Species and Habitat Conservation Area
US$	US Dollar
VND	Vietnamese Dong
WWF	World Wide Fund for Nature

Summary

In several respects, the status of gibbons in Vietnam can be considered to be an indicator for the general status of the nation's biodiversity and the natural environment. The geography of Vietnam lends itself to the extraordinary level of biodiversity for which it is known, and the diversity of gibbons in Vietnam is no exception. They can be found from the most northerly sub-tropical forests which experience cold winters at high altitudes to tropical monsoon lowland forests in the south.

This conservation status review of gibbons in Vietnam, updates a similar review which was carried out in 2000 by Geissmann et al. (2000). That milestone report drew from available literature, examinations of museum specimens and additional field surveys as a first attempt to document the status of gibbons in Vietnam. One decade later, this current report attempts to assess trends in the populations of each gibbon species in Vietnam and the effectiveness of efforts so far to conserve them. This status review is part of a broader set of initiatives in this region which include action plans in both Laos and Yunnan Province, China, and is thus also able to give a regional context. We have collated records of gibbons from all sites in Vietnam known to have gibbons and where information can be assessed to be reliable. With so much more work carried out on gibbons during the past ten years, this report provides a clearer snapshot of the status of gibbons in Vietnam than was possible a decade ago.

Conservation Status by Species

All gibbons in Vietnam belong to the genus of crested gibbons *Nomascus*. Current taxonomic understanding identifies seven species of *Nomascus,* all distributed east of the Mekong River (with the exception of a small population) in Cambodia, China, Laos and Vietnam, six of which are found in Vietnam (see Figure 1, page 7). The species in Vietnam being, from north to south:

1. Eastern black gibbon *Nomascus nasutus*
2. Western black gibbon *Nomascus concolor*
3. Northern white-cheeked gibbon *Nomascus leucogenys*
4. Southern white-cheeked gibbon *Nomascus siki*
5. Northern yellow-cheeked gibbon *Nomascus annamensis*
6. Southern yellow-cheeked gibbon *Nomascus gabriellae*

The **eastern black gibbon *N. nasutus*** is the only gibbon species in Vietnam for which prospects appear to have improved during the past decade. The species was rediscovered in 2002 on the border with China in Trung Khanh District, Cao Bang Province and conservation efforts so far appear to be driving a gradual population recovery. This is the only location globally where this species is currently known to exist and this population of only about 110 individuals is now restricted to approximately 1,000 hectares of limestone forest. It was previously distributed in north-east Vietnam, with the Red River and its delta forming a natural boundary to the west and south. Fortunately, at this location there have been very few records of hunting with guns and no records of gibbons being hunted since the population was discovered. *N. nasutus* is the only gibbon species in Vietnam for which it can be said with any confidence that there has been an increase in population. Despite, this, given the small size of its population and highly restricted distribution, *N. nasutus* should be uplisted from Endangered to Critically Endangered in the Vietnam Red Data Book. Globally it is listed as Critically Endangered on the IUCN Red List.

The **western black gibbon *N. concolor*** has been the most closely monitored gibbon species in Vietnam over the past decade. Within Vietnam it is distributed in the Hoang Lien mountain range between the Black and Red rivers. Globally most of the population of this species occurs further north in Yunnan Province, China and there is a small population in north-west Laos. In Vietnam, the population has undergone a population decline greater than 50% since surveys were first

carried out in 2000 and 2001. At Hoang Lien-Van Ban Nature Reserve, the gibbon population has dropped to a level where it is no longer viable and it is possible that the Mu Cang Chai-Muong La population, slightly to the south, would have undergone a similar decline without a concerted effort to protect them over the past ten years. The experience of FFI working in the Hoang Lien Mountains should be a wake-up call for the critical need for monitoring when working on species-level conservation for gibbons or other species. Given the small size of its population, its restricted distribution and large scale recent population declines with on-going threats, *N. concolor* should be uplisted from Endangered to Critically Endangered in the Vietnam Red Data Book. Globally it is listed as Critically Endangered on the IUCN Red List.

The **northern white-cheeked gibbon *N. leucogenys*** is distributed through a few areas of southern Yunnan Province, northern Laos and north-west to north-central Vietnam. Compared to ten years ago, this species is now considered to have a larger southerly distribution, as far as the Rao Nay River in Quang Binh Province. As a result of extensive survey work, during recent years a much clearer picture of the status of this species in Vietnam has emerged. All significant records of viable populations come from locations close or next to the Lao border and 79 groups have been confirmed reported since 2000. Throughout the country there may be at least 190 groups, of which most are at one location in Pu Mat National Park which probably maintains about 130 groups. This population is of global significance and may extend well into Laos. The population of gibbons in Vu Quang National Park and neighbouring forests remains largely unknown and could be very significant allowing us to speculate that the population of this species in Vietnam could be as high as 300 groups. Nevertheless, at all locations populations of *N. leucogenys* appear to be in decline, largely due to hunting, exacerbated by land conversion and forest fragmentation. It is known to have gone extinct relatively recently in several protected areas, and may be on the point of extinction in several other locations. Given the large scale recent population declines with on-going threats and few locations with viable populations, *N. leucogenys* qualifies for uplisting from Endangered to Critically Endangered in the Vietnam Red Data Book. Globally, there are very few individuals remaining in China, while populations in Laos are believed to be much larger, partly due to there being much larger areas of forest. Globally this species is listed as Critically Endangered on the IUCN Red List.

The **southern white-cheeked gibbon *N. siki*** is now understood to have a much more restricted range than previously thought, centred on Quang Binh Province in central Vietnam. Globally it is only otherwise found in neighbouring provinces of Laos. There is insufficient data to quantitatively assess trends for *N. siki* as a species in Vietnam, but all indications are that with hunting being a principle threat there has been an on-going population decline. Fortunately there remain relatively large populations in tracts of forest in Quang Binh Province along the border with Laos, particularly in Phong Nha-Ke Bang National Park. Information gaps for *N. siki* make the status of this species the most uncertain of all gibbon species in Vietnam, but given hunting pressures and its restricted range, it probably qualifies for the status of Critically Endangered in the Vietnam Red Data Book. Globally this species is listed as Endangered on the IUCN Red List.

The **northern yellow-cheeked gibbon *N. annamensis*** is a new species to the genus. It was described in 2010 following years of discussion and research about the taxonomic uncertainty of the gibbons distributed between the currently understood species boundaries for *N. gabriellae* and *N. siki*. *N. annamensis* is distinguished from these latter two species based upon differences in calls and genetic analysis. Morphologically it appears to be indistinguishable from *N. gabriellae*. Its range is understood to extend from the Thach Han River in Quang Tri Province to the Ba River in Phu Yen Province. This species is distributed through much of southern Laos east of the Mekong and north-east Cambodia. About 200 groups have been recorded throughout its range in Vietnam and there may be more in unsurveyed areas. The contiguous protected area of Dak Rong and Phong Dien Nature Reserves appears to hold the largest population with over 80 groups, but at much lower than natural densities as a result of previous hunting pressures. Song Thanh Nature Reserve and contiguous forests and the forests in and around Kon Ka Kinh National Park and Kon Cha Rang Nature Reserve may also have significant populations. All areas indicate declines in gibbon populations. Assuming that much of this decline has occurred over the past three

generations and will continue due to hunting and some land conversion of habitat, *N. annamensis* may also qualify for the status of Critically Endangered in Vietnam. There are large populations reported from north-east Cambodia and likely in southern Laos, where the status is less well known. Globally, this species has not yet been evaluated on the IUCN Red List.

The **southern yellow-cheeked gibbon *N. gabriellae***, is the most southerly distributed species in Vietnam and probably makes up more than half the gibbons in the country. There are at least 300 gibbon groups in just two areas: Bu Gia Map National Park and Cat Tien National Park and their respective surrounding forests. The complex of protected areas and surrounding forests on the edge of the Da Lat plateau extending from Chu Yang Sin National Park down to Hon Ba National Park potentially has a large population, but there is still inadequate data on most of these locations. Additionally *N. gabriellae* is recorded in numerous state forest enterprises and there are likely to be more populations as yet unrecorded. The threat from hunting in southern Vietnam may be rising due to increasing demand for gibbons as pets or for use in folkloric medicine. Drawing from past trends in population declines inferred for *N. gabriellae*, it may qualify for the status of Endangered in Vietnam. There are large populations remaining in south-west Cambodia and globally this species is listed as Endangered on the IUCN Red List.

Threats

Hunting with guns stands out as a primary threat to gibbons in Vietnam, and is surely the primary reason for recent population losses. The impact of hunting on gibbons in the recent past is undeniable and is illustrated by the presence of suppressed populations within areas of largely intact habitat, suggesting hunting is a primary threat. Being arboreal and relatively large, agile and conspicuous, with few non-human predators, makes gibbons particularly susceptible to gun hunting pressure. The low birth rate of gibbons compared to many other mammals means a population will take longer to recover from an intensive period of hunting pressure or, if there is sustained hunting pressure, a continuous population decline as births cannot replace the numbers being killed. Given this particular susceptibility, the health of a gibbon population can serve as a good indicator for a protected area of general levels of gun hunting pressure.

Broadly speaking gibbons are hunted opportunistically for local consumption, for the pet trade or for any number of a plethora of inconsistent beliefs about their apparent health-enhancing properties. Within the wildlife trade itself, gibbons appear to figure less significantly than many other species, which is not to say wildlife trade is not an issue for gibbons and an apparent increasing demand for gibbons in southern Vietnam is an important concern. Hunting has decimated gibbon populations in the north and the apparent rise in demand for gibbons as pets and for medicinal purposes could have similarly devastating consequences for the remaining relatively healthy populations in southern Vietnam.

Large-scale land use change would have caused dramatic past declines in gibbon populations throughout the country, particularly during the post-war period when the drive for economic development drove deforestation. Now most gibbons are reported from within the established protected area system, so in principle formal land-use has been stabilised for most forests where gibbons are found. In reality though, habitat loss clearly continues in protected areas, particularly through illegal logging, agricultural encroachment and infrastructure developments, such as hydropower dams or roads. The resulting improved access for hunters and reduced carrying capacity for local gibbon populations are major issues for gibbon conservation nationally. Habitat loss frequently also causes population fragmentation, leading to ever smaller and less viable sub-populations.

Without any further human threats, some gibbon populations may already be so small that they are effectively doomed to local extirpation by natural causes, such as adverse weather conditions, forest fires, disease outbreaks, skewed sex ratios and inbreeding depression. At least six sites are known to have populations which are probably in the final stages of local extirpation. Natural causes could also have catastrophic effects on critical gibbon populations, where numbers are low enough to be considered precarious, most importantly for *N. nasutus* and *N. concolor*.

Conclusions

While gibbons are afforded the highest level of legal protection as species in Vietnam, awareness of this fact by the general public and even government staff is very low and law enforcement is so weak as to render their legal status almost irrelevant. Conservation of gibbons, as with much biodiversity conservation in Vietnam, still requires the basics to start working. Obvious conservation needs include: raising awareness of the general public, local government and local communities; improved law enforcement both to tackle wildlife trade and hunting in forests; improved forest management; and participation of local communities in conservation. While this conservation status review does not attempt to proscribe detailed recommendations, we summarise below the main conclusions:

Five of the six gibbon species found in Vietnam require gibbon-focussed conservation interventions at priority sites in order to maintain viable populations into the long-term. Two of those species are perilously close to extinction in Vietnam. Local stakeholders, especially local government, need to be more aware and supportive of protecting these critically endangered populations.

Hunting and habitat loss through land conversion appear to have led to the dramatic recent declines in gibbon populations reported. Now, most known significant populations reside in protected areas, although populations within protected areas are still under significant threat from hunting and habitat loss.

Hunting needs to be seriously addressed, especially in protected areas throughout Vietnam. Hunting with guns is causing rapid declines and extirpations locally, even when gibbons are not specifically targeted.

Wildlife trade continues to be a serious issue for gibbons, especially in the south of Vietnam, for pets and as well as demand for primate-based folkloric medicine.

At some locations relatively healthy gibbon populations remain, where there has been a focussed effort to protect gibbons and where they are afforded some natural protection by their remoteness from human settlements or rugged landscapes which are difficult to access.

There is still very little monitoring data on gibbons, even though they are very suitable for biodiversity monitoring as an indicator species. Gibbon monitoring has been very important for conservation decision-making at Mu Cang Chai during the past decade.

Most gibbons reside within protected areas, including all the most important known populations for each species. The protected area system should be central to a national strategy for gibbon conservation. Nevertheless, most protected areas are clearly failing to perform their primary functions.

Further surveys in some areas would support an overall national strategy for gibbon conservation. Additional survey work is required in some areas assumed to be important but without population data. Nevertheless, there is now sufficient information for most of the important areas for gibbon conservation in Vietnam to have been identified and gibbon conservation interventions should be targeted at these sites.

The status of gibbons in state forest enterprises remains poorly known. These forests have great potential for harbouring large gibbon populations in southern Vietnam, but appropriate management plans are required which could benefit both biodiversity conservation and the wood production industry.

Finally, gibbons are wonderfully charismatic and benign creatures, which do not harm anyone's livelihoods, but charm us with their beauty, acrobatics and music, and they are our closest relatives in Vietnam. If nothing can be done to secure the long-term future of gibbons in Vietnam, what hope is there for the rest of Vietnam's biodiversity and the fragile environment its human population depends upon.

Chapter 1
Introduction

Female *N. nasutus* and young
Photo: Huang Tao

1 Introduction

Distributed throughout Vietnam, gibbons are our closest relatives found therein and are an indicator for how we, as humans, are managing to live in close proximity to the remarkable diversity of fauna and flora for which Vietnam is well renowned. There is a high diversity of gibbons in Vietnam and while the country is rapidly transforming in the name of economic development, Vietnam's gibbons are currently undergoing a crisis. Hunting and habitat loss over the past few decades have effectively decimated gibbons across the country. At best, remaining gibbon populations persist at significantly lower than natural densities, at worst, they have suffered local extinctions. Gibbons are often the first species to disappear from an area due to hunting with guns, yet they are often not deliberately targeted but part of the general catch as hunters opportunistically clear the trees of any visible non-human residents. The slow reproduction rate of gibbons means that populations decline rapidly from even low hunting pressure and population recovery, should it be allowed, is slow. Therefore, what happens to gibbons and why also matters for much of the wealth of biodiversity found in Vietnam and will become increasingly important as environments become further stressed from development pressures.

In 2000, Part One of the Vietnam Primate Conservation Status Review (Geissmann et al. 2000) began by sounding the alarm on the precarious fate of Vietnam's gibbons, many of which were then and inevitably are still, facing extinction. That milestone report drew from available literature, examinations of museum specimens and additional field surveys as a first attempt to document the status of gibbons in Vietnam. One decade later, this updated status review of gibbons in Vietnam assesses trends in the populations of each gibbon species in Vietnam and the effectiveness of efforts so far to conserve them.

All species of gibbons in Vietnam are crested gibbons of the genus *Nomascus*. These species are distributed from the northern-most extent of the country almost to Ho Chi Minh city in the south and are all listed as either Endangered or Critically Endangered on the IUCN Red List of Threatened Species (IUCN 2011). With the following six species of gibbon found in Vietnam, this is one of the most gibbon diverse countries in the world:

1. Eastern black gibbon - *Nomascus nasutus*
2. Western black gibbon - *Nomascus concolor*
3. Northern white-cheeked gibbon - *Nomascus leucogenys*
4. Southern white-cheeked gibbon - *Nomascus siki*
5. Northern yellow-cheeked gibbon - *Nomascus annamensis*
6. Southern yellow-cheeked gibbon - *Nomascus gabriellae*

Vietnam holds more species of *Nomascus* than any other country, i.e. all but one species, the Hainan gibbon *Nomascus hainanus*. This rich gibbon diversity is indicative of the rich biodiversity of Vietnam in general. Unfortunately, Vietnam's gibbon populations are in decline, and this is indicative of trends in wildlife populations within the country in general.

The past decade has seen a surge of interest in, and funding for, the biodiversity of Vietnam both from within country and internationally. At the same time Vietnam has experienced remarkable and wild economic growth, which is putting intense strain on the nation's natural resources and biodiversity. Unfortunately, field surveys continue to report dramatic decreases in populations of Vietnam's wildlife and all primate species are under very high pressure (Nadler 2010). Nevertheless, much more data is now available on gibbons than a decade ago and there have been some significant conservation efforts to turn around their fortunes in Vietnam. There is now greater in-country competency to study and survey gibbons, although there is still a lack of

experienced conservation practitioners or political will to sufficiently halt the on-going decline of gibbons (and other biodiversity) in most locations.

This timely status review of gibbons in Vietnam takes off from where Geissmann et al. (2000) left us in 2000 and collates and draws from the significant body of work on gibbons carried out by biologists and conservationists during the past ten years. Similar parallel efforts have been occurring regionally, which are relevant to this status review, as no gibbon species is entirely endemic to Vietnam. In 2005, a status review of Cambodia's gibbons was conducted and illustrated the importance of the country for conservation of *Nomascus gabriellae* and, retrospectively, *N. annamensis* which at that time had not been described (Traeholt et al. 2005). In 2008, a status review of gibbons in Laos (Duckworth 2008) acknowledged the international significance of the country for long-term conservation of all four species of *Nomascus* found there, especially for *N. leucogenys* and *N. siki*. In 2011, as a follow-up to that status review, a Gibbon Conservation Action Plan for Lao PDR was approved by the Lao government (MAF 2011). In Yunnan Province, China, a conservation action plan is being prepared by the Provincial Forestry Bureau for the western black gibbon *N. concolor*. Most of the global population of western black gibbons are found in Yunnan Province, which also holds the majority of China's gibbons. These efforts along with this status review for Vietnam cover most of the global range of crested gibbons. This status review draws on knowledge of the conservation status of crested gibbons outside Vietnam in order to give a regional and therefore global context.

Overall for gibbons in Vietnam, as with much wildlife in the region, the situation is bleak, but there remain signs of hope. Chapter 2 provides an overview of the conservation status of gibbons in Vietnam and outlines the main threats. In doing so, it also proposes revised categories for each gibbon species in the Vietnam Red Data Book. The six subsequent chapters focus on the status of each species in Vietnam and include site-by-site accounts of known gibbon records, population trends and priority conservation needs. Overall for most species there appear to have been population declines in Vietnam. Nevertheless for each species there remain sites with populations that are large enough to be viable for their long-term survival. The loss of any gibbon species in Vietnam is not necessarily inevitable.

The description of a new species, the northern yellow-cheeked gibbon *Nomascus annamensis* by Van Ngoc Thinh et al. (2010c) reflects greater scientific attention to gibbons during the past decade and improved understanding of the taxonomy of crested gibbons. In 2000, the gibbon status review highlighted the uncertainty surrounding the taxonomy of gibbons in the area of central Vietnam where *N. annamensis* has subsequently been described from. Chapter 9 includes a review of the latest taxonomic understanding for crested gibbons and is followed by a chapter on the ecology of crested gibbons.

This report collates records of gibbons from all sites in Vietnam known to have them and where information can be assessed to be reliable. Inevitably some sites will have been missed. Additionally, every year during the past decade newly-discovered populations of highly threatened primates have been brought to the attention of the conservation community in Vietnam. With so much more work carried out on gibbons during the past ten years, this report provides a clearer snapshot of the status of gibbons in Vietnam than was possible a decade ago. We have not attempted to analyse in detail the drivers behind threats to gibbons, nor do we proscribe detailed and comprehensive recommendations for gibbon conservation in Vietnam. This would be more appropriately carried out as part of a multi-stakeholder conservation action planning process and by collecting other detailed data sets, such as forest cover change, records of hunting violations and wildlife trade. Nevertheless, conclusions about the main threats to gibbons can be made and some initial recommendations for gibbon conservation are given, most of which apply to the challenge of biodiversity conservation in Vietnam in general.

In addition to collecting and referencing available literature, the data in this report have been supplemented by field surveys conducted at various locations in Vietnam, which were prioritised as representing important gaps in current knowledge. Preparations began in late 2009 during a two-day workshop of national experts spent assessing the status of each gibbon species and identifying sources of and gaps in information for sites across Vietnam. This led to a list of priority

areas for gibbon surveys. Subsequently, Fauna & Flora International and Conservation International released a call for proposals for grants for gibbon surveys which were selected based on these priorities. In April 2010, representatives and field staff of selected grant recipients attended a three day training workshop in Cat Tien National Park on gibbon survey techniques which resulted in appropriate survey methods designed for each selected site. Locations of subsequent surveys are shown in Table 1.

Table 1. Gibbon populations surveyed during 2010-11 as part of this status review

Species	Location	References
*Nomascus nasutus**	Than Sa-Phuong Hoang NR, Thai Nguyen Province	Luu Tuong Bach & Nguyen Van Truong (2011a)
*Nomascus concolor***	Mu Cang Chai SHCA, Yen Bai Province & Muong La District, Son La Province	Le Trong Dat & Le Minh Phong (2010)
Nomascus leucogenys	Muong Nhe NR, Lai Chau Province	Nguyen Manh Ha et al. (2010a)
*Nomascus leucogenys**	Long Luong Commune, Son La Province	Luu Tuong Bach & Nguyen Van Truong (2011b)
Nomascus leucogenys	Pu Mat NP, Nghe An Province	Luu Tuong Bach & Rawson (2011)
Nomascus siki	Ke Go NR, Ha Tinh Province & Khe Net NR, Quang Binh Province	Van Ngoc Thinh et al. (2010a)
Nomascus annamensis	Kon Ka Kinh NR, Gia Lai Province	Ha Thang Long et al. (2011)
Nomascus annamensis	Kon Cha Rang NR, Gia Lai Province	Luu Quang Vinh et al. (2010)
Nomascus gabriellae	Dong Nai NR, Dong Nai Province	Nguyen Manh Ha et al. (2010b)
Nomascus gabriellae	Ta Dung NR, Dak Nong Province	Hoang Minh Duc et al. (2010a)

Most of these survey reports can be downloaded from www.fauna-flora.org

* Short surveys conducted to follow up on reports to FFI from local forestry officials
** Conducted as part of ongoing monitoring.

A limiting factor identified during the compilation of this status review was the different approaches used to survey gibbons and the general lack of reliable density and population estimates from any site in Vietnam, despite considerable survey effort. In an attempt to address this concern, a software package and associated guidelines for surveying gibbons were developed in order to allow comparisons between sites and populations (Vu Tien Thinh & Rawson 2011). This package was used on several of the surveys mentioned in Table 1 and helped provide site-wide estimates of gibbon populations. It can be downloaded from www.fauna-flora.org.

In December 2010, a further workshop was held to discuss the status of *N. annamensis* and *N. gabriellae* which are most widespread in Vietnam, and therefore, on the merit of their better conservation status, less simple to assess. This workshop included most of the authors of this status review and other biologists with a wide knowledge of the status of gibbons in Vietnam.

This status review was prepared with individuals taking the lead on authorship for chapters as follows: Western black gibbon *Nomascus concolor,* Simon Mahood and Paul Insua-Cao; Eastern black gibbon *Nomascus nasutus*, Paul Insua-Cao; Northern white-cheeked gibbon *Nomascus leucogenys*: Ben Rawson and Nguyen Manh Ha; Southern white-cheeked gibbon *Nomascus siki*, Nguyen Manh Ha and Ben Rawson; Northern yellow-cheeked gibbon *Nomascus annamensis,* Van Ngoc Thinh; Southern yellow-cheeked gibbon *Nomascus gabriellae*, Ben Rawson; Classification and distribution of crested gibbons, Christian Roos and Thomas Geissmann; Ecology and behaviour of crested gibbons, Ben Rawson. The above co-authors and Hoang Minh Duc also prepared separate individual site records.

Chapter 2
The Conservation Status of Gibbons in Vietnam

Top: Family of *N. leucogenys*
Photo: Clare Campbell / Perth Zoo
Centre: Hunting guns in Mu Cang Chai SHCA
Photo: FFI
Bottom: Habitat destruction in Pu Huong NR
Photo: Luu Tuong Bach / CI

2 The Conservation Status of Gibbons in Vietnam

This chapter summarises and assesses the status of gibbons in Vietnam, drawing from detailed species-by-species and site-by-site descriptions in subsequent chapters. It reviews the status and trends in populations of each species and proposes a preliminary reassessment of the categories for listing them in the Vietnam Red Data Book. A rudimentary analysis of threats is made based mainly upon a synthesised understanding of what is known from sites maintaining gibbon populations in Vietnam and the direct and indirect threats leading to declining gibbon populations. It does not attempt a rigorous assessment of the drivers of these threats, which is outside the scope of this report.

2.1 Gibbon Populations Trends

All gibbons in Vietnam belong to the genus *Nomascus*, known as the crested gibbons. Current taxonomic understanding identifies seven species of *Nomascus,* all distributed east of the Mekong River in Cambodia, Laos, Vietnam and China; six of which are found in Vietnam (Figure 1), those species being, from north to south:

1. Eastern black gibbon
   Nomascus nasutus
2. Western black gibbon
   Nomascus concolor
3. Northern white-cheeked gibbon
   Nomascus leucogenys
4. Southern white-cheeked gibbon
   Nomascus siki
5. Northern yellow-cheeked gibbon
   Nomascus annamensis
6. Southern yellow-cheeked gibbon
   Nomascus gabriellae

N. nasutus is the only one of these species for which there are not large populations in neighbouring countries. Most of the global population of *N. concolor* is found in China. Laos undoubtedly has very significant populations of *N. leucogenys, N. siki* and *N. annamensis*, but of the four *Nomascus* range countries the gibbons in Laos are by far the most poorly documented (Duckworth 2008). Cambodia maintains large populations of *N. gabriellae* and a globally significant population of *N. annamensis*. Chapter 9 describes the distribution of each species of *Nomascus* in more detail.

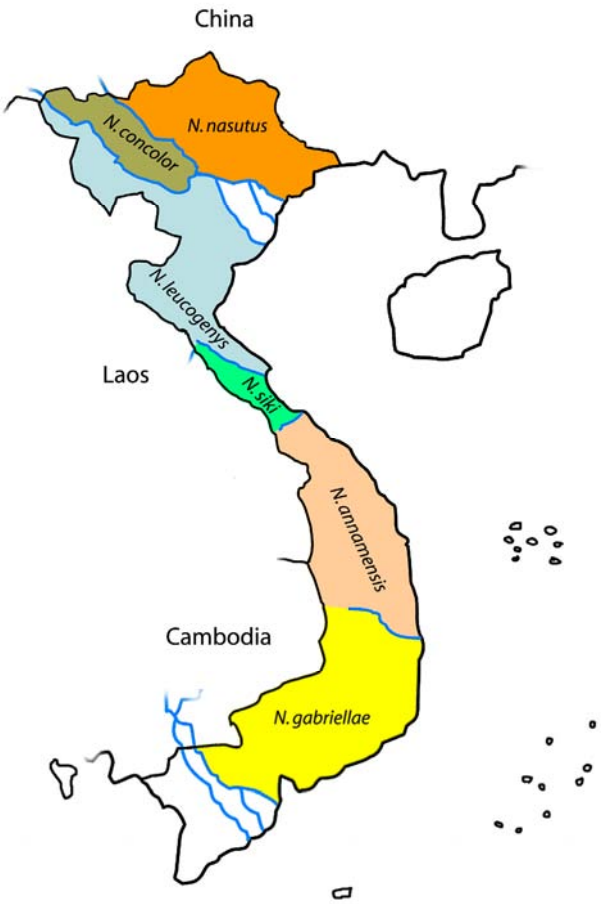


Figure 1. Distribution of the six gibbon species in Vietnam

See Section 9.3 for more details.

Generally the future for gibbons in Vietnam remains precarious, but the status of each gibbon varies dramatically and there is a marked difference between northern and southern Vietnam. For most sites there is insufficient information to make a qualified judgement on a population trend over the past ten years, other than recognising that the presence of hunting is most likely to be causing population declines. Although, for about a quarter of sites reported here, a declining gibbon population has been demonstrated with certainty and the reality is probably that gibbon populations are declining at most sites. Here we will look at some of the general trends for each species. For more details please refer to the relevant species chapters.

The **eastern black gibbon*, N. nasutus,*** was rediscovered in 2002 on the border with China in Trung Khanh District, Cao Bang Province and conservation efforts at this site so far appear to be demonstrating a gradual population recovery. This is the only location globally where this species is currently known to exist, although local extirpations in other areas may have occurred in the last 10 years. Fortunately, at this location there have been very few records of hunting with guns and no records of gibbons being hunted since the population was discovered. *N. nasutus* has, thus far, been turned around from the brink of extinction both in Vietnam and globally following its rediscovery. It is the only gibbon species in Vietnam for which it can be said with any confidence that there has been an increase in population, but that is mainly due to the entire population being so small, about 19 groups (including groups in China), and entirely in one place so it can be easily monitored, and conservation efforts can be very focussed.

There are few records of large gibbon population crashes occurring recently, but that may be more as a result of lack of data, than the reality of the situation on the ground. The most closely monitored gibbon populations in Vietnam are those of the **western black gibbon, *N. concolor,*** in the Hoang Lien Mountain range, which overall have undergone a population decline greater than 50% since surveys were first carried out in 2000 and 2001. At Hoang Lien-Van Ban Nature Reserve, the gibbon population has dropped to a level where it is no longer viable and it is possible that the Mu Cang Chai-Muong La population, slightly to the south, would have undergone a similar decline without a concerted effort to protect them over the past ten years. At the latter location, following a strong decline in the first half of the decade the population within Mu Cang Chai Species and Habitat Conservation Area (SHCA), at least, appears to have stabilised. The experience of FFI working in the Hoang Lien Mountains should be a wake-up call for the critical need for monitoring when working on species-level conservation for gibbons or other species. The population decline of this species, despite long-term conservation attention, is illustrative of the level of threat that gibbons are under in Vietnam generally.

For both *N. nasutus* and *N. concolor* the mid- to long-term prospects for their survival in Vietnam are far from certain, as they are both dependent upon the survival of single small populations. The prospects for gibbons appear to improve as we proceed south through the country, and for each of the other crested gibbon species there is more than one site with a potentially viable population.

A revised assessment of the distribution of the **northern white-cheeked gibbon, *N. leucogenys*,** indicates that it has a larger range than previously thought a decade ago, now extending further south (Van Ngoc Thinh et al. 2010e). During recent years, survey work, mainly led by Conservation International (CI) and the Centre for Natural Resources and Environmental Studies (CRES), can now give a much clearer picture of the status of this species in Vietnam. All significant records come from locations close or next to the Lao border and 79 groups have been reported since 2000. Throughout the country there may be at least 190 groups, of which most are currently known from Pu Mat National Park which probably maintains about 130 groups. These gibbons are now restricted to remote border areas, where they appear to be protected by the harsh mountainous terrain. This population is of global significance and may extend well into Laos. Muong Nhe Nature Reserve and Vu Quang National Park, again both on the border with Laos, may also hold significant populations of conservation priority. The population of gibbons in Vu Quang National Park and neighbouring forests remains largely unknown and may be sizeable allowing us to speculate that the population of this species in Vietnam could be as high as 300 groups. Nevertheless, at all locations populations of *N. leucogenys* appear to be in decline, largely due to hunting, exacerbated by land conversion and forest fragmentation. It is known to have gone

extinct relatively recently in several protected areas, and may be on the point of extinction in several more.

Compared to a decade ago, the **southern white-cheeked gibbon, *N. siki*,** is now understood to have a much more restricted range (Van Ngoc Thinh et al. 2010e). There is insufficient data to quantitatively assess trends for *N. siki* however all indications are that with hunting being a principle threat there has been an on-going population decline for the species in Vietnam. Fortunately there remain relatively large populations in tracts of forest mainly centred on Quang Binh Province and along the border with Laos, with significant populations likely to be occurring in the forest complexes of Phong Nha-Ke Bang National Park-Truong Son State Forest Enterprise and Khe Giua State Forest Enterprise-Bac Huong Hoa Nature Reserve. However, information gaps for *N. siki* make the status of this species the most uncertain of all gibbon species in Vietnam, although a minimum of about 100 groups are reported here from compiled records.

The **northern yellow-cheeked gibbon, *N. annamensis*,** was only recently described, which has led to a revision of the species affinity for several sites previously thought to hold *N. siki* or *N. gabriellae*. The range of *N. annamensis* has been fairly well-surveyed, particularly in Thua Thien Hue Province, which has been a focal area for the work of WWF. About 200 groups have been recorded throughout its range in Vietnam and there are likely to be more in unsurveyed areas. The contiguous protected area of Dak Rong and Phong Dien Nature Reserves hold the largest known population with over 80 groups, but at much lower than natural densities as a result of previous hunting pressures. Song Thanh and Ngoc Linh Nature Reserves in Quang Ngai and Quang Nam Provinces, and Kon Ka Kinh National Park, Kon Cha Rang Nature Reserve and surrounding production forests in Kon Tum Province may also hold significant populations.

The numbers of **southern yellow-cheeked gibbon, *N. gabriellae***, the most southerly distributed species, probably make up more than half the gibbons in Vietnam. There are at least 300 gibbon groups in just two areas: Bu Gia Map National Park and surrounding forests and the Cat Tien National Park-Dong Nai Nature Reserve complex and surrounding forests. The complex of protected areas and surrounding forests on the edge of the Da Lat plateau extending from Chu Yang Sin National Park down to Hon Ba National Park potentially has a large population, but there is still inadequate data on most of these locations. Additionally *N. gabriellae* is recorded in numerous State Forest Enterprises (SFEs) and there are likely to be more populations as yet unrecorded. Records in SFEs are likely to be under-represented as they fall outside of the protected area system and are therefore less likely to be the attention of biodiversity surveys.

There are no sites in Vietnam where a formerly viable gibbon population ten years ago can now be confirmed to be extinct. However there are several nature reserves, which had provisional records or very small populations documented by Geissmann et al. (2000), where gibbons have likely been extirpated. These include Kim Hy, Than Sa-Phuong Hoang, Xuan Son, Hang Kia-Pa Co, Pu Luong and Pu Hu Nature Reserves. Tragically two of these sites held the Critically Endangered *N. nasutus* for which any other additional populations, however small, would be very important for possible long-term genetic management of the species.

2.2 Protection Status for Vietnam's Gibbons

This section describes the recognition that gibbon species in Vietnam receive as protected species both nationally and internationally. While gibbons are afforded the highest level of legal protection as species in Vietnam, awareness of this fact by the general public and even government staff is low and law enforcement is weak, so as to render their legal status almost irrelevant. Nevertheless they are a starting point and indicate recognition of the need for protection of gibbons at the highest levels of government. In particular we have taken the opportunity to assess the current status listing in the Vietnam Red Data Book and suggest revisions based upon the findings of this conservation status review.

2.2.1 Decree 32/2006/NP-CP on Management of Endangered, Precious and Rare Forest Plants and Animals

Prime Minister's Decree 32/2006 classifies and defines the level of protection for protected wild animals and plants in Vietnam within two groups; I and II. Gibbons are classified under IB, the highest level of protection for animals which are "strictly banned from exploitation and use for commercial purposes, including plants and animals of scientific or environmental value or high economic value, with very small populations in nature or in high danger of extinction". *Nomascus concolor*, *N. leucogenys*, *N. nasutus* and *N. gabriellae* are all explicitly listed and it may be assumed that the listing of *N. leucogenys* covers *N. siki* as the sub-species *N. leucogenys siki*, as it is recorded in the Vietnam Red Data Book and elsewhere in literature from that time.

This decree is soon to be supplemented by a decree on "Criteria for Species Identification, Management and Protection of Species listed as Endangered, Precious, Rare and Prioritized for Protection", which brings formal levels of protection more into line with the categories and criteria of the Vietnam Red Data Book.

2.2.2 Vietnam Red Data Book

All gibbon taxa listed in the current 2007 Vietnam Red Data Book come under the category Endangered with the criteria A1cd C2a, which broadly indicates that there has been a 50% decline and severe fragmentation of the population of each species, and that the species is facing a very high risk of extinction in the wild. *N. nasutus* and *N. annamensis* are not directly referred to. *N. nasutus* falls within the distribution map presented for *N. concolor* and *N. annamensis* was not described as a distinct species at the time.

However, the actual population status and levels of threat of extinction vary widely for the different gibbon species in Vietnam, and with the more comprehensive information now available it is clear that this one category and set of criteria is inappropriate for all species. The national Red Data Book should clearly indicate relative levels of threat to each species and so support prioritisation of conservation measures through policy and direct action. A more appropriate categorisation for each gibbon species following the criteria of the Vietnam Red Data Book (See Annex 2) is proposed here. It is not intended to be definitive but to provide a starting point for future revisions of the Vietnam Red Data Book.

In proposing these categories and criteria, certain assumptions have to be made where there is large uncertainty in the available data. This uncertainty is compounded by the fact of a gibbon generation being long compared to most mammals. In this document a gibbon generation is considered to be about 15 years, following the standard used for gibbons on the IUCN Red List of Threatened Species. The low fecundity of gibbons means long periods of time need to be considered in order to track declines and forecast potential recovery. One generation, i.e. 15 years, is already long enough that sufficient records are not available to make quantitative analyses of population trends based on existing data, so past population trends need to be inferred. However, overall it is assumed with confidence that there have been drastic declines in gibbon populations within the last few gibbon generations, based upon the previous known extent of gibbon occurrence, land-use change and past and present levels of hunting pressure.

Eastern Black Gibbon - *Nomascus nasutus*

Proposed category and criteria: Critically Endangered A1cd, B1+2cd

The current population of *N. nasutus* in Vietnam is well documented. There has been a decline in the population of this species over the past three generations greater than 80%, based on the area of occupancy and extent of occurrence being reduced to one population in an area of about 1000 ha. Recent likely local extirpations, such as at Kim Hy and Than Sa-Phuong Hoang Nature Reserves, have no doubt been due to hunting and indicate continued recent declines. *N. nasutus* thus certainly qualifies for the status of Critically Endangered in Vietnam.

Western Black Gibbon - *Nomascus concolor*

Proposed category and criteria: Critically Endangered A1acd, C1+2a, D

There is strong quantitative evidence that the population of *N. concolor* has declined by more than 50% in half a generation and it can thus be confidently inferred that a decline of more than 80% has occurred during the past three generations. The area of occupancy and extent of occurrence of this species have been reduced, mainly due to the ongoing threats of hunting and habitat loss. The national population is less than 250 individuals and there has been an observed decline in numbers greater than 25% during the past generation. The national population probably has around 50 mature individuals with certainly no sub-population having more than that number. *N. concolor* thus certainly qualifies for the status of Critically Endangered in Vietnam.

Northern White-cheeked Gibbon - *Nomascus leucogenys*

Proposed category and criteria: Critically Endangered A1cd+2d

Estimations for the population size of *N. leucogenys* in Vietnam are quite confident. Assuming a current existing population of 300 groups at most, a loss of 1,200 groups over a 45 year period would therefore represent an 80% decline – the level of decline required to qualify for Critically Endangered status. Using assessments of gibbon density from Pu Mat National Park, this would mean that only 440,000 ha of forested area would need to have been cleared of gibbons in that time period. By considering the locations from where the species is known to have been extirpated (which are mainly protected areas) and gibbon habitat loss from land conversion, at least that level of decline of *N. leucogenys* can be readily assumed to have occurred during the past three generations. Without direct interventions focussed on curbing hunting, this decline will continue with the likelihood of additional gibbon extirpations at some sites. *N. leucogenys* certainly qualifies for the status of Critically Endangered in Vietnam.

Southern White-cheeked Gibbon - *Nomascus siki*

Proposed category and criteria: Critically Endangered A1cd

Our understanding of the status of *N. siki* is the least clear of the six gibbon taxa in Vietnam, because much larger populations may persist in several forests than is currently known and there is very little historic data to assess demographic trends. It can be argued that there has been a decline in population due to hunting and habitat loss from land conversion, by comparison with other gibbon species. There is no reason to believe that the issues facing gibbons in the few provinces where this highly range-restricted species resides would be radically different to provinces to the north and south. The population size is of a similar order to *N. leucogenys* and *N. annamensis* and by similar arguments *N. siki* probably qualifies for the status of Critically Endangered in Vietnam. A quantitative assessment of land use change across its range would help to improve the assessment of its status.

Northern Yellow-cheeked Gibbon - *Nomascus annamensis*

Proposed category and criteria: Critically Endangered A1cd

Data on *N. annamensis* is relatively good, because Thua Thien Hue Province has been well surveyed, although there may still be significant sub-populations in unsurveyed areas further south. Assuming group densities in the past of about 0.7 groups km^{-2} (based upon known group densities in north-east Cambodia; Rawson unpublished data) a population in the order of 2000 groups should remain in the forest areas where data for *N. annamensis* is known, whereas now only about 200 groups are confirmed, some of which are in small sub-populations of questionable viability. This population would only have been a sub-set of a previously larger population. Assuming that much of this decline has occurred over the past three generations and will continue due to hunting and some land conversion of habitat, especially in State Forest Enterprises, *N. annamensis* may also qualify for the status of Critically Endangered in Vietnam.

Southern Yellow-cheeked Gibbon - *Nomascus gabriellae*

Proposed category and criteria: Endangered A1cd, C1

N. gabriellae is by far the most populous gibbon species in Vietnam and has the lowest chance of extinction. Extrapolating from trends throughout the country, there is likely to have been a general decline in the national population, but to what extent is beyond the current scope of this report. An assessment of land use change would support a quantitative assessment of past and projected population declines. There still may be less than 2,500 mature individuals remaining and a population decline of more than 20% in the last two generations would be a realistic assumption, so *N. gabriellae* may qualify for the status of Endangered in Vietnam.

2.2.3 IUCN Red List of Threatened Species

The IUCN Red List of Threatened Species provides an assessment of the status of species in a global context. Gibbon species were most recently assessed for the IUCN Red List of Threatened Species in 2008 and the six species in Vietnam are categorised as follows:

1.	Eastern black gibbon *Nomascus nasutus*	Critically Endangered A2acd; C2a(i); D
2.	Western black gibbon *Nomascus concolor*	Critically Endangered A2cd
3.	Northern white-cheeked gibbon *Nomascus leucogenys*	Critically Endangered A2cd+3cd
4.	Southern white-cheeked gibbon *Nomascus siki*	Endangered A2cd
5.	Northern yellow-cheeked gibbon *Nomascus annamensis*	Not yet evaluated
6.	Southern yellow-cheeked gibbon *Nomascus gabriellae*	Endangered A2cd

Critically Endangered and Endangered are the categories indicating the two highest threat levels for extinction in the wild. For more detailed information on how species are listed consult IUCN Red List Categories and Criteria: Version 3.1. *N. annamensis* has not yet been evaluated, because it has only recently been described as a distinct species within the genus.

2.2.4 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Vietnam joined the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1994. This international agreement aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Species are listed in one of three appendices depending upon the level of protection they are evaluated as requiring to maintain wild populations. All gibbons are listed on Appendix I, the highest need for protection, for which trade is permitted only in exceptional circumstances.

2.3 Priority Sites for Gibbon Conservation in Vietnam

Protection of Vietnam's gibbons ultimately needs to occur through concentrated efforts in and around their habitats. The following sites are listed here to highlight that for each species there is at least one location where the species has a chance of survival in Vietnam, and to propose where investment in gibbon conservation could be most effectively targeted. Criteria for identifying

priority sites are; inclusion of at least one site for each species, the relative size of the local gibbon population compared to other sites, locations where conservation activities are focussed on reducing the threats to gibbons and the perceived relatively low level of decline or stability of the gibbon population. Altogether these criteria should lead to identifying sites where, given current knowledge, the gibbon population has the best chance of survival compared to other sites with that species. This list is not meant to be definitive, particularly as there remain areas in central and southern Vietnam where substantial unrecorded gibbon populations may remain. A more participatory prioritisation process, such as through preparation of a national action plan, could therefore refine this list.

Eastern Black Gibbon - *Nomascus nasutus*

Cao Vit Gibbon Conservation Area in Trung Khanh District, Cao Bang Province, maintains the only known population of this species in the world and is therefore of high international and national importance for gibbon conservation. FFI has been leading efforts to conserve this population since 2002 with apparent success.

Western Black Gibbon - *Nomascus concolor*

Mu Cang Chai Species and Habitat Conservation Area, Yen Bai Province and neighbouring **Muong La District**, Son La Province, is the only location with a viable population in Vietnam and thus has high national importance. Conservation efforts need to remain focused on Mu Cang Chai SHCA where most of the population remains, but should also be maintained in Muong La District, where many of the pressures come from. FFI has been leading efforts to conserve this population for more than a decade.

Northern White-cheeked Gibbon - *Nomascus leucogenys*

Pu Mat National Park, Nghe An Province, hosts a large gibbon population close to the Lao border that has been protected by the difficult access to the forest as a result of the steep, rugged terrain. This situation is likely to rapidly change due to the planned construction of roads through the national park into Laos. With the largest known population of this species in Vietnam, Pu Mat National Park is of high national importance. This population may be part of a larger population extending into Laos and given the uncertainty surrounding the status of *N. leucogenys* in Laos, Pu Mat National Park is also of high international importance. **Muong Nhe Nature Reserve**, Dien Bien Province, also appears to have a viable population, while preliminary data from **Vu Quang National Park** suggests a significant population may persist there also.

Southern White-cheeked Gibbon - *Nomascus siki*

Phong Nha-Ke Bang National Park, Quang Binh Province, maintains a large population of *N. siki* of as yet unknown proportions. Much of the national park is naturally protected by karst limestone forest, which is difficult to access, thus hindering a comprehensive survey effort to date. The population may be contiguous with gibbon groups in Hin Nam No National Protected Area in Laos. With possible links to Lao populations and given the uncertainty of the status of *N. siki* in Laos, this area is also considered of high international importance. Gibbons are also one of the flagship species of the Germany-funded project 'Sustainable Natural Resource Management of the Phong Nha-Ke Bang Region'. **Bac Huong Hoa Nature Reserve**, Quang Tri Province, has a significant population of *N. siki*, which may be part of a larger population extending into Khe Giua State Forest Enterprise in Quang Binh Province.

Northern Yellow-cheeked Gibbon - *Nomascus annamensis*

Dak Rong and Phong Dien Nature Reserves, in Quang Tri and Thua Thien Hue Provinces respectively, hold more than 80 groups of *N. annamensis* in a contiguous area of over 65,000 ha, making it an area of high national importance for conservation of the species. This is the largest

known population of the species in Vietnam and it appears to be stable. The effective protection of this population is probably at least partly due to recent international conservation efforts in the broader landscape implemented by WWF. The population of *N. annamensis* in **Song Thanh Nature Reserve** may be significantly larger than is currently known, and thus may represent another priority site for this species. **Kon Ka Kinh National Park**, **Kon Cha Rang Nature Reserve** and surrounding forest may also represent an important landscape for conservation of the species.

Southern Yellow-cheeked Gibbon - *Nomascus gabriellae*

Cat Tien National Park and its landscape, including surrounding State Forest Enterprises and parts of Dong Nai Nature Reserve, have a large population of *N. gabriellae*, which at least appears to be generally stable in Cat Tien National Park. This national park is one of the most secure in Vietnam in terms of its capacity to protect biodiversity and thus appears to offer an important location for long-term protection of this species. Another very large population of this species persists in **Bu Gia Map National Park** and surrounding forests. With the two largest known gibbon populations in Vietnam, these two areas are of high national and international significance for conservation for this species. The complex of protected areas on the Da Lat plateau, including **Chu Yang Sin National Park, Bi Dup-Nui Ba National Park, Phuoc Binh National Park and Hon Ba Nature Reserve**, and their environs together may also maintain an important gibbon population of as yet unknown size.

2.4 Overall Threats to Gibbons

2.4.1 Hunting

Hunting with guns stands out as a primary threat to gibbons at nearly all sites where they are known to be still present in Vietnam, and is surely the primary reason for recent population losses. Only in Phong Dien Nature Reserve and the Cao Vit Gibbon Conservation Area is hunting not reported to be currently a threat to the local gibbon population. But, given the threat of hunting reported throughout Vietnam, it can be assumed that at all locations there is always a threat from hunting, even if from outsiders making a one-off opportune hunting trip. The impact of hunting on gibbons in the recent past is undeniable. Even where there are still large gibbon populations in intact primary forest, they usually occur at much lower than expected population densities, suggesting hunting as the primary threat.

Gun hunting is the most critical issue for gibbon conservation in Vietnam. Gibbons are particularly susceptible to gun hunting pressure. Being arboreal and relatively large and agile, they have few non-human predators and are quite conspicuous and easy to find; initially from their loud and distinct calls, and then closer up from their active nature and visibility, in particular the bright colouration of the females. The low birth rate of gibbons compared to many other mammals means a population will take longer to recover from an intensive period of hunting pressure or, if there is sustained hunting pressure, a continuous population decline as births cannot replace the numbers being killed. The threat of females being removed to source infants as pets poses a particular problem. Gibbons may be the first primates to be lost in an area where gun hunting occurs. For example, this is the case at Than Sa-Phuong Hoang Nature Reserve where a population of Francois' langurs *Trachypithecus francoisi* still remains (Le Dinh Duy 2010), and gibbons appear to have been quite recently extirpated (Luu Tuong Bach & Nguyen Van Truong 2011a). Given this particular susceptibility, the health of a gibbon population can serve as a good indicator for a protected area of general levels of gun hunting pressure, unless gun hunting is particularly targeting other species. There are only very few locations in Vietnam where gibbon populations are likely to be large enough not to be seriously impacted by some level of hunting with guns.

Gibbons are rarely targeted beyond general wildlife hunting, but where there is local ownership of guns, this appears to have an immediate impact on gibbon populations. Gun confiscation programmes appear to have had an important impact on curbing the decline in local gibbon populations, such as at Mu Cang Chai SHCA and Pu Mat National Park; at least in the short term just after such programmes have been implemented and before local communities begin to acquire new weapons again.

Broadly speaking gibbons are hunted opportunistically for local consumption, for the pet trade or for any number of a plethora of inconsistent beliefs about their apparent health-enhancing properties. Trade surveys have shown that gibbons may also be hunted to order (WCS 2009). In some areas, primates are generally targeted for medicinal products, often referred to as "*cao*", which usually comprises ground-up and boiled primate bones as its main constituent. Gibbons are therefore targeted along with langurs, doucs and macaques, even though the product may be referred to as "*cao khi*", where *khi* means macaque. Demand for primate-derived medicinal products has been documented as a significant driver for hunting gibbons around Phong Nha-Ke Bang (Roberton 2004), in Quang Nam Province (Minh Hoang et al. 2005) and around Chu Yang Sin National Park (Le Trong Trai 2007). Around Chu Yang Sin National Park, production facilities are now being up-scaled to meet the demand for *cao*. The price of gibbons in the wildlife trade varies considerably over time and at different places as shown in Table 2.

Although gibbons appear to figure less significantly in wildlife trade data than many other species, wildlife trade does represent a threat for gibbons. The Hanoi-based NGO Environment for Nature-Vietnam (ENV) records about 2% of cases reported to its Wildlife Crime Hotline as involving live gibbons, less than langurs, lorises or macaques (Tran Thu Hang 2010). These cases would be destined to end up as pets or in private zoos. Particularly, in the southern provinces of Vietnam, there is a demand for captive gibbons, many of which are sourced from Cat Tien National Park, Dong Nai Nature Reserve and neighbouring forest areas and many traders are able to source gibbons on demand (WCS 2009). Of 41 cases of possession of gibbons reported to ENV between 2005 and 2009, 32 were from southern provinces (ENV 2010). Demand for primates as pets in Ho Chi Minh City is higher than demand for any other animal group as pets, although the pet trade there accounts for less than 3% of total wildlife trade (Do Thi Thanh Huyen et al. 2011). While the numbers of gibbons in the wildlife trade do not seem to account for the large documented declines in gibbon populations, it is important to bear in mind that every live gibbon in captivity represents many gibbons killed in the process of capture and transport (Nettelbeck et al. 1999). Normally gibbons are caught by shooting mothers who fall clutching their infants. If they survive the fall, the infants are taken (WCS 2009). One live gibbon therefore represents at least a dead female and more gibbons killed in failed attempts to capture a live infant.

In conclusion, hunting has decimated gibbon populations in the north of Vietnam, mainly for local consumption and due to the widespread availability of guns. The apparent rise in demand for gibbons as pets and for medicinal purposes could have similarly devastating consequences for the remaining currently healthier populations in southern Vietnam.

2.4.2 Habitat Loss and Degradation

Large-scale land use change would have caused dramatic past declines in gibbon populations throughout the country, particularly during the post-war period when economic development drove deforestation. At about 80% of the locations in this document holding gibbons now or in the recent past, habitat loss and degradation is reported to be an important issue. Now most gibbons are reported from within an established protected area system, so in principle formal land-use has been stabilised for most forests where gibbons are found. In reality though, habitat loss clearly continues with illegal logging given as a cause of habitat degradation from about half of sites discussed within this review and agricultural encroachment in about one quarter, even though most of the sites are protected areas. Habitat loss may also cause population fragmentation, leading to ever smaller and more non-viable sub-populations.

Table 2. Documented prices of gibbons and gibbon products

Location	Purpose	Price (VND)	Year	Reference
Muong La District	Dead	1.8 million	2010	Le Trong Dat and Le Minh Phong (2010)
Pu Hoat PNR	Live	1.5 to 3 million	1990s	Nguyen Manh Ha (2005)
Pu Hoat PNR	Live	1.5 million	2005	Nguyen Manh Ha (2005)
Pu Hoat PNR	Live	400,000	2009	Luu Tuong Bach & Rawson (2010)
Pu Mat NP	Live	800,000 to 3 million	2003	Roberton et al. (2003)
Cat Tien NP	Live	4 to 5.5 million	2007-2008	Nguyen Manh Ha (2009)
Chu Yang Sin NP	Live	3.5 million	2007	Le Trong Trai (2007)
Chu Yang Sin NP	Bile	150,000	2007	Le Trong Trai (2007)
Da Lat city	Live	5.5 million	2009	WCS (2009)
Bao Loc, Lam Dong, Sourced from Dong Nai, Cat Tien	Live	4 million	2009	Nguyen Manh Ha (2009)
Phong Nha-Ke Bang NP	Dead for local consumption	30,000 kg^{-1}	2004	Bottrill (2005)
Phong Nha-Ke Bang NP	Primate balm	300,000 to 600,000 kg^{-1}	2004	Roberton et al. (2004)

At about a third of sites, infrastructure developments, such as hydropower dams or roads, are cited as a significant threat to gibbons. The impacts these developments can create are increased access to forest for hunting, direct habitat loss and habitat fragmentation. In addition, at the time of construction, particularly for hydropower projects, an influx of construction workers can lead to a sudden increase in local demand for wildlife meat. Some key sites for gibbon conservation will be adversely threatened by infrastructure development, which could send some species on a rapid decline towards national extinction. The Mu Cang Chai SHCA-Muong La Watershed Protection Forest complex faces the twin threats of an approved hydropower project on one edge of the forest with incoming access roads and a road bisecting the forest from the other side. Another hydropower project is also planned there. These developments are the greatest threats to date for the only viable population of *N. concolor* in Vietnam. Planned roads through Pu Mat National Park may fragment and jeopardise what is by far the largest population of *N. leucogenys* in Vietnam. A major road is proposed through Chu Yang Sin National Park, potentially separating it from adjacent Bi Dup-Nui Ba National Park and so fragmenting the largest area of contiguous protected area forest in Vietnam. This road, along with a proposed system of trails, would facilitate access to over half the park's forest and form barriers between some of the gibbon groups known to be found in the national park.

Significant gibbon populations remain within State Forest Enterprises (SFEs), mainly in central to southern Vietnam, comprising nearly 300,000 ha, i.e. 15%, of managed forest areas recorded in this status review. As there have been no significant surveys in SFEs group densities and population figures remain unclear. There may be more SFEs holding significant gibbon populations. SFEs are subject to commercial logging, so inevitably a large area of gibbon habitat is under direct threat within such a management regime.

2.4.3 Small and Fragmented Populations

Despite the best conservation efforts some gibbon populations may already be so small that they are effectively doomed to local extirpation by natural causes, such as adverse weather conditions, forest fires, disease outbreaks, skewed sex ratios and inbreeding depression. At least six sites have populations which are probably in the final stages of local extirpation. These are Hoang Lien-Van Ban Nature Reserve for *N. concolor*; Long Luong Commune in Moc Chau District, Ben En Nature Reserve, Pu Huong Nature Reserve and Ke Go Nature Reserve for *N. leucogenys* and Ta Dung Nature Reserve for *N. gabriellae*. There may be several more that could be added to this list if there was adequate data. Natural causes could also have catastrophic effects on critical gibbon populations, where numbers are low enough to be considered precarious, most importantly for *N. nasutus* in the Cao Vit Gibbon Conservation Area and for *N. concolor* in the Mu Cang Chai -Muong La forest complex, where there are about 20 groups in each location, the only known viable population for each species in Vietnam, and for *N. nasutus* in the world.

2.4.4 Climate Change

In the longer term, the threat of climate change could pose a significant danger to *Nomascus* populations in Vietnam. The impacts climate change may have on gibbons are unknown, however there are a series of potential direct and indirect impacts that shifts in rainfall and temperatures, extreme weather events and sea level rise may have on Vietnam's gibbons. Increased global temperatures are also likely to result in biome shift, and it remains to be seen what the coverage and effectiveness of Vietnam's protected area system will be in light of this threat. Climate change will also likely alter fruiting phenology in a complex fashion as changes in rainfall and temperature occur, which poses a potentially serious, yet unquantified, threat to gibbon populations. Extreme weather events such as floods, drought and typhoons are also likely to impact food security for the rural poor through crop losses, with a subsequent increase in reliance on non-timber forest products within areas inhabited by gibbon populations. Additionally, an increase in sea levels and changing land-use patterns will impact gibbon populations indirectly through human migration caused by displacement and subsequent natural resource exploitation in gibbon habitats.

2.5 Concluding Remarks

Conservation of gibbons as with much biodiversity conservation in Vietnam still requires the basics to start working. It doesn't require hard science to list some basic conservation needs: raising awareness of the general public, local government and local communities; improved law enforcement both to tackle wildlife trade and hunting in forests; good forest management of both protected areas and state forest enterprises; and participation of local communities in conservation to bring poorer communities benefits and actively engage their support. Identifying detailed actions requires a broad discussion of stakeholders. Here we summarise the main conclusions drawn from this document.

Five of the six gibbon species found in Vietnam require gibbon-focussed conservation interventions at priority sites in order to maintain viable populations into the long-term. Two of those species are perilously close to extinction being restricted to single viable populations in Vietnam. Local stakeholders, especially local government, need to be more aware and supportive of protecting these critically endangered populations.

Hunting and habitat loss through land conversion appear to have led to the dramatic recent declines in gibbon populations reported. Now, most known significant populations now reside in protected areas, although populations within protected areas are still under significant threat from hunting and habitat loss.

Hunting needs to be seriously addressed, especially in protected areas throughout Vietnam. Hunting with guns is causing rapid declines and extirpations locally, even when gibbons are not specifically targeted.

Wildlife trade continues to be a threat to gibbon populations, despite constituting a relatively low proportion of all traded species. Demand for live captive gibbons as pets or for zoos is a serious concern, especially in the south of Vietnam. For every gibbon in captivity several more gibbons were probably killed in the process of capture and transport. In some areas there is also a growing demand for primate-based folkloric medicine.

At some locations relatively healthy gibbon populations remain. These populations are usually found where there has been a focussed effort to protect gibbons and where they are afforded some natural protection by their remoteness from human settlements or rugged landscapes which are difficult to access. There are more gibbons in larger populations the further south one goes.

There is still very little monitoring data on gibbons, even though they are very suitable for biodiversity monitoring as indicator species. Gibbon monitoring has been very important for conservation decision-making at Mu Cang Chai SHCA during the past decade and should be integrated into projects which deal with gibbon conservation and site-based wildlife monitoring programmes.

Most gibbons reside within protected areas, including all the most important known populations for each species. The protected area system should be central to a national strategy for gibbon conservation. Nevertheless, most protected areas are clearly failing to perform the main functions they are intended for, with on-going declines of gibbons and populations extirpated in the last decade in several protected areas.

Further surveys in some areas would support an overall national strategy for gibbon conservation. Additional survey work is required in some areas assumed to be important but without population data. Nevertheless, there is now sufficient information for most of the important areas for gibbon conservation in Vietnam to have been identified and gibbon conservation interventions should be targeted at these sites.

The status of gibbons in state forest enterprises remains poorly known. These forests have great potential for harbouring large gibbon populations in southern Vietnam. Appropriate management plans need to be developed, which could safeguard gibbons and other resident wildlife. In turn, good management of state forest enterprises would help to improve Vietnam's poor reputation as an exporter of processed wood products from unsustainably managed forests.

Finally, gibbons are wonderfully charismatic and benign creatures, which do not harm anyone's livelihoods, but charm us with their beauty, acrobatics and music, and they are our closest relatives in Vietnam. If nothing can be done to secure the long-term future of gibbons in Vietnam, what hope is there for the rest of Vietnam's biodiversity and the fragile environment its human population depends upon.

Chapter 3

Eastern black gibbon
Nomascus nasutus

Female *Nomascus nasutus*
Photo: Zhao Chao / FFI

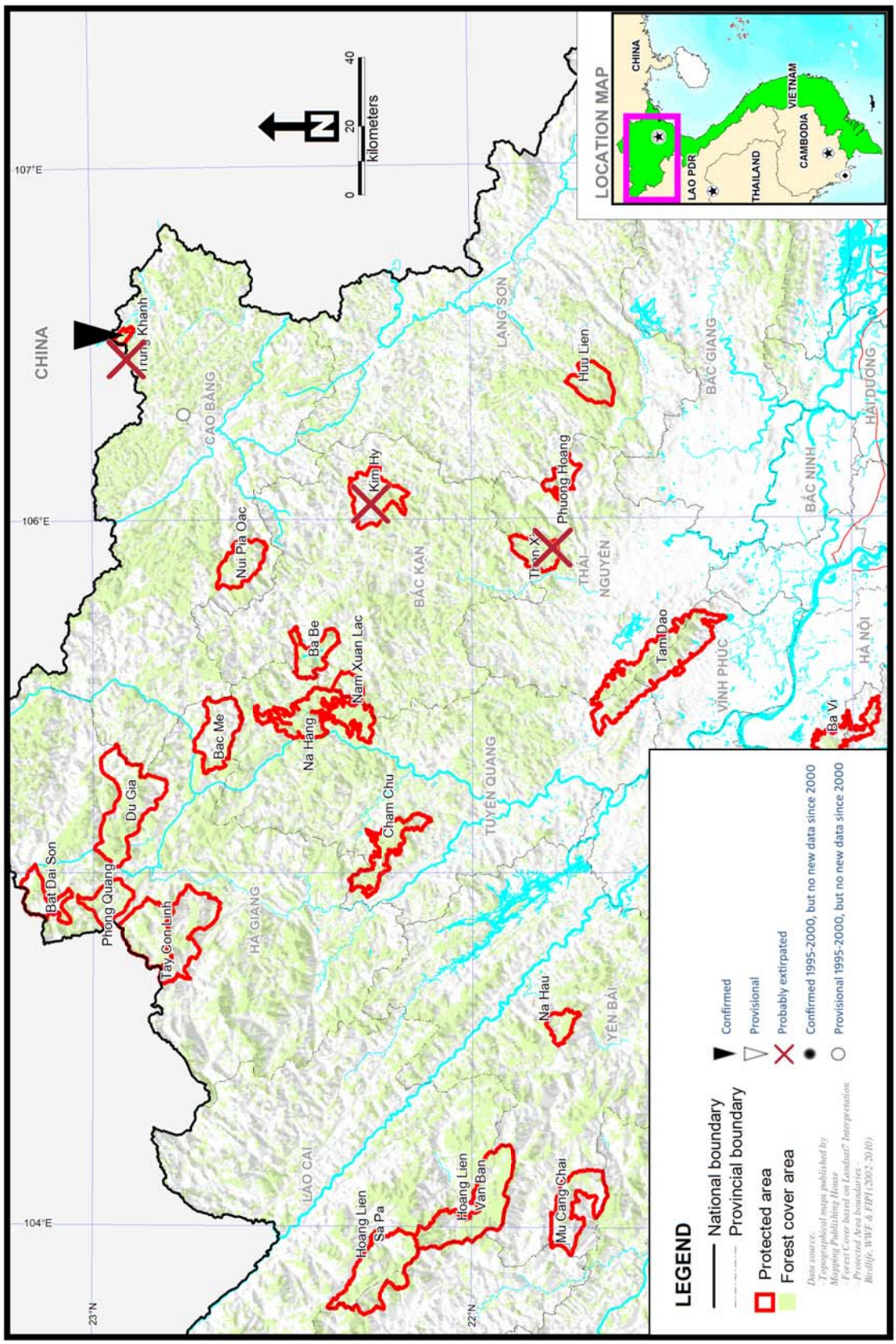


Figure 2. Map of records of *Nomascus nasutus* in north-east Vietnam

3 Eastern Black Gibbon *Nomascus nasutus* (Kunkel d'Herculais, 1884)

Other English names: eastern black crested gibbon, cao vit gibbon, cao-vit crested gibbon

Vietnamese names: vượn cao vít, vượn đen

IUCN Red List Category and Criteria: Critically Endangered A2acd; C2a(i); D (ver 3.1)

2007 Vietnam Red Data Book Category and Criteria: Endangered A1cd C2a (by distribution map assumed synonymous with *Nomascus concolor*)

Legislative status in Vietnam: Decree 32/2006 ND-CP: 1B

CITES: Appendix I (listed as synonymous with *Nomascus hainanus*)

3.1 Global Status and Distribution

Nomascus nasutus was previously classified as a sub-species *N. n. nasutus* of the nominate form of eastern black gibbon, but is now elevated to full species status, based on genetic evidence, fur colouration and vocalisations (Geissmann 2007b; Van Ngoc Thinh et al. 2010e; Mootnick & Fan Pengfei 2011). The entire known global population of *N. nasutus* is restricted to a single location along the Sino-Vietnamese border. Historically, *N. nasutus* was distributed from southern China to northern Vietnam, extending south to the Red River. Southern-most records are from Tam Dao National Park and Vinh Phuc and Quang Ninh Provinces in Vietnam (Geissmann et al. 2000). In China the species was considered extirpated since the 1950s (Bangjie Tan 1985) until 2006, when three groups were recorded in Guangxi Province along the Sino-Vietnamese border (Bosco Pui Lok Chan et al. 2008), part of the population already known from Vietnam.

3.2 Summary of Status and Distribution in Vietnam

3.2.1 Change in Status Since 2000

In 2000 there were unconfirmed local reports of *N. nasutus* from at least four localities, but no evidence to confirm that gibbons persisted in these sites (Geissmann et al. 2000), until in 2002 a population was discovered in Trung Khanh District, Cao Bang Province, on the Sino-Vietnamese border (La Quang Trung & Trinh Dinh Hoang 2002c). This is the only known population of *N. nasutus* and includes groups that range partly or entirely in the contiguous forests of Jingxi County in Guangxi Province, China (Fan Pengfei et al. 2010). No further reports of gibbons have been obtained from the other three localities and it is unlikely that gibbons persist in them.

3.2.2 Key Sites for Conservation

The transboundary population of *N. nasutus* in Trung Khanh District and neighbouring Guangxi Province in China is the only known population in the world.

3.2.3 Threats

The principle threats to this single population, and therefore the species, are habitat degradation and the vulnerability of the small population to genetic depression (due to low numbers of individuals) and stochastic events (such as disease and fire) which might cause a sudden catastrophic loss of many or all individuals.

3.2.4 Ongoing Conservation Actions

Fauna & Flora International, in partnership with the Forest Protection Department has been implementing a gibbon conservation programme in Trung Khanh District since 2003. This resulted in the establishment of the Cao Vit Gibbon Conservation Area in 2007, since when the area has been receiving additional conservation support.

3.2.5 Priority Conservation Actions

Continued long-term conservation support in Trung Khanh District is essential for survival of *N. nasutus*. The discovery of other *N. nasutus* populations would be globally significant, although this seems unlikely given that most recent historical sites have been surveyed. It is possible that scattered individuals have been over-looked; for example, before the gibbon population in Trung Khanh District was discovered it had been concluded that no gibbons remained in Trung Khanh on the basis of a biodiversity survey conducted in other communes of the same district (Tordoff et al. 2000b).

3.3 *Nomascus nasutus* Records in Vietnam

3.3.1 Cao Vit Gibbon Conservation Area

Location: Trung Khanh District, Cao Bang Province

Area: 1,656 hectares

Status criteria: 1a, 2c, 3a, 4a, 5a

Date of most recent survey: 2007

Date of most recent confirmed record: 2011

Minimum population: 17 groups of 94-96 individuals (part of a transboundary population of 19 groups of about 110 individuals)

Status

Gibbons were first recorded at this site in 2002, in Phong Nam, Ngoc Khe and Ngoc Con Communes, along the border with China (La Quang Trung & Trinh Dinh Hoang 2002c). A gibbon census in September 2007 recorded 17 groups of 94 to 96 individuals (Le Trong Dat & Le Huu Oanh 2008), in a total global population of 18 groups of 110 individuals including the groups in China (Insua-Cao et al. 2010). In 2009 Chinese researchers in Jingxi County, Guangxi Province observed the formation of a new group along the border and between 2007 and 2009, they monitored three groups ranging across the border and recorded five births and two juveniles (Fan Pengfei et al. 2010). The current global population is estimated to be 19 groups of over 110 individuals, including four groups which range partly or entirely in contiguous forest in China (Fan Pengfei et al. 2010).

Other gibbon surveys were undertaken at this site in 2007 (Trinh Dinh Hoang 2007), 2006 (Bosco Pui Lok Chan & Ng Sai-Chit 2006), twice in 2005 (La Quang Trung 2005; Vu Ngoc Thanh et al. 2005), 2004 (Trinh Dinh Hoang 2004) and three times in 2002 (Geissmann et al. 2002; La Quang Trung & Trinh Dinh Hoang 2002c, b). Differing survey efforts, objectives (e.g. training local patrol staff, rapid assessment), time of year and weather conditions preclude direct comparison of survey results, but available data indicate the population is increasing (Insua-Cao et al. 2010). The first population estimate in 2002 was of five groups of 26 to 28 individuals (Geissmann et al. 2002), considerably lower than the 2007 estimate, and in 2007, gibbons ranged over a wider area than in any previous surveys (Insua-Cao et al. 2010). There have been no records of gibbons being hunted since monitoring and enforcement patrols were established in 2003. The number of gibbons in the groups in China is increasing (Fan Pengfei et al. 2010). Currently, gibbon observations are

recorded on an *ad hoc* basis during community-based patrols and other conservation activities. Another gibbon census is planned for autumn 2012.

Threats and Conservation Actions

The small size of the site, limited extent of gibbon habitat and ongoing (but decreasing) degradation of habitat are the principle threats to *N. nasutus*. Local communities extract timber from the site for fuelwood, waterwheels, house construction and other domestic use, and they collect non-timber forest products and food for livestock (Insua-Cao et al. 2010). The small gibbon population is vulnerable to stochastic events such as fire, disease or reduced gene flow. Due to climate change, a warmer and drier seasonal climate is predicted for Vietnam (MRC 2009), which may impact the extent and composition of remaining gibbon habitat and could increase the risk of forest fire.

The Cao Vit Gibbon Conservation Area was designated in Trung Khanh District in 2007 (Decision 2536 dated 15 November 2006 of Cao Bang Provincial People's Committee). In 2009 a contiguous provincial nature reserve was designated in Jingxi County, China. FFI has worked with local government agencies and communities in both Trung Khanh District and Jingxi County since 2003 and 2006 respectively. This work has mainly comprised forest patrols, supporting local communities to reduce forest resource use, conservation planning and building local capacity for conservation management. Research on the ecology of *N. nasutus* was initiated in 2006 and is currently led by Dr. Fan Pengfei of the Institute of Eastern-Himalaya Biodiversity Research, Dali University. Recently the area has started to receive additional attention from the People, Resources and Conservation Foundation and the Biodiversity Corridor Initiative of the Asian Development Bank. Conservation priorities on both sides of the border are strengthening the capacity of protected area staff, expanding the area of suitable habitat (to enable growth of the gibbon population), maintaining and enhancing collaborative transboundary efforts, and implementing a long-term gibbon monitoring programme using consistent survey methods and sampling effort.

3.3.2 Lung Ri forest, Ngoc Chung, Phong Nam and Kham Thanh Communes

Location: Trung Khanh District, Cao Bang Province

Area: <300 hectares

Status criteria: 1b, 2c, 3b, 4b, 5d

Date of most recent survey: 2009

Date of most recent confirmed record: none available

Minimum population: provisionally extirpated

Status

Brief gibbon surveys were conducted in June and October 2009 at this site, which comprises a few hundred hectares of forest about five kilometres east of the Cao Vit Gibbon Conservation Area (Geissmann & Nguyen The Cuong 2009; Nguyen The Cuong 2009). No gibbons were recorded and there was only one local report of gibbon calls in the area, which was from two years earlier. These surveys were conducted as a result of a report from ornithologists that a gibbon vocalization may have been heard in April 2009 (A. W. Tordoff and J. Pilgrim pers. comm.). Being so close to the Cao Vit Gibbon Conservation Area it can be assumed that gibbons were present in this area quite recently.

Threats and Conservation Actions

It is unlikely that there are gibbons still present at this location given the limited extent of forest which is both degraded and fragmented, combined with a high level of use of forest resources by local communities. However, this forest may have importance as an extension to the forest of the Cao Vit Gibbon Conservation Area in the long-term future, even though it is not currently continuous with that area, so opportunities for obtaining further records should be taken where possible.

3.4 Locations where *Nomascus nasutus* is Now Considered Absent

3.4.1 Kim Hy Nature Reserve

Location: Na Ri District, Bac Kan Province

Area: 15,416 hectares

Status criteria: 1a, 2b, 3b, 4b, 5d

Date of most recent survey: 2009

Date of most recent confirmed record: 2001

Minimum population: provisionally extirpated

Status

A two-week gibbon survey in 2009 did not record any gibbons and local residents also reported they may no longer be present (Geissmann et al. 2009). In contrast, in 2001 and 2002 residents reported gibbons were still present (Geissmann & Vu Ngoc Thanh 2001; Dang Ngoc Can et al. 2002; La Quang Trung & Trinh Dinh Hoang 2002b, c). The most recent confirmed evidence for *N. nasutus* at this site is from 2001, when the remains of a recently shot female were recovered during a survey (Frontier Vietnam 2002) and genetically confirmed to be *N. nasutus* (Goldthorpe et al. 2002).

Threats and Conservation Actions

Intensive wildlife hunting, logging and mining occur in the reserve, making the possibility that gibbons persist very unlikely (Geissmann et al. 2009) and thus this site does not warrant further actions for gibbon conservation without further evidence to the contrary.

3.4.2 Than Sa-Phuong Hoang Nature Reserve

Location: Vo Nhai District, Thai Nguyen Province

Area: 17,477 hectares

Status criteria: 1c, 2b, 3b, 4b, 5d

Date of most recent survey: 2011

Date of most recent confirmed record: 1997 provisional

Minimum population: provisionally extirpated

Status

Responding to local reports of the possible presence of gibbons and Tonkin snub-nosed monkey *Rhinopithecus avunculus*, FFI conducted a short survey at this site in May 2011. Through interview

and field surveys, it was concluded that there was no evidence to indicate that gibbons persist here, although Tonkin snub-nosed monkey may remain (Luu Tuong Bach & Nguyen Van Truong 2011a). Research on Francois' langurs *Trachypithecus francoisi* in the same area in 2010 made no mention of gibbons (Le Dinh Duy 2010). A survey in the nature reserve in 2001 concluded that if gibbons were present they were unlikely to survive a decade (Geissmann & Vu Ngoc Thanh 2001).

Threats and conservation actions

There is now heavy hunting and logging pressure in this nature reserve. This could be an important location in northern Vietnam for primate conservation with the second largest known population of Francois' langurs in Vietnam and the possible presence of the Critically Endangered Tonkin snub-nosed monkey (Luu Tuong Bach & Nguyen Van Truong 2011a). Nature reserve staff are well motivated although under-resourced. External support to the nature reserve focussed on these two leaf-eating monkeys would be very significant for primate conservation while supporting protection of any gibbons - should they persist.

3.5 Sites with No New Data Since 2000

Sites which had confirmed or provisional records for *N. nasutus* between 1995 and 2000 as listed in Geissmann et al. (2000) and for which there have been no gibbon records since that time are listed in Table 3 below.

Table 3. Sites with no new data for *N. nasutus*

Site	Most recent record
Cao Bang Province	
Thang Hen forest	Last record by interview in 1999

Chapter 4

Western black gibbon
Nomascus concolor

Male *Nomascus concolor*
Photo: Zhao Chao

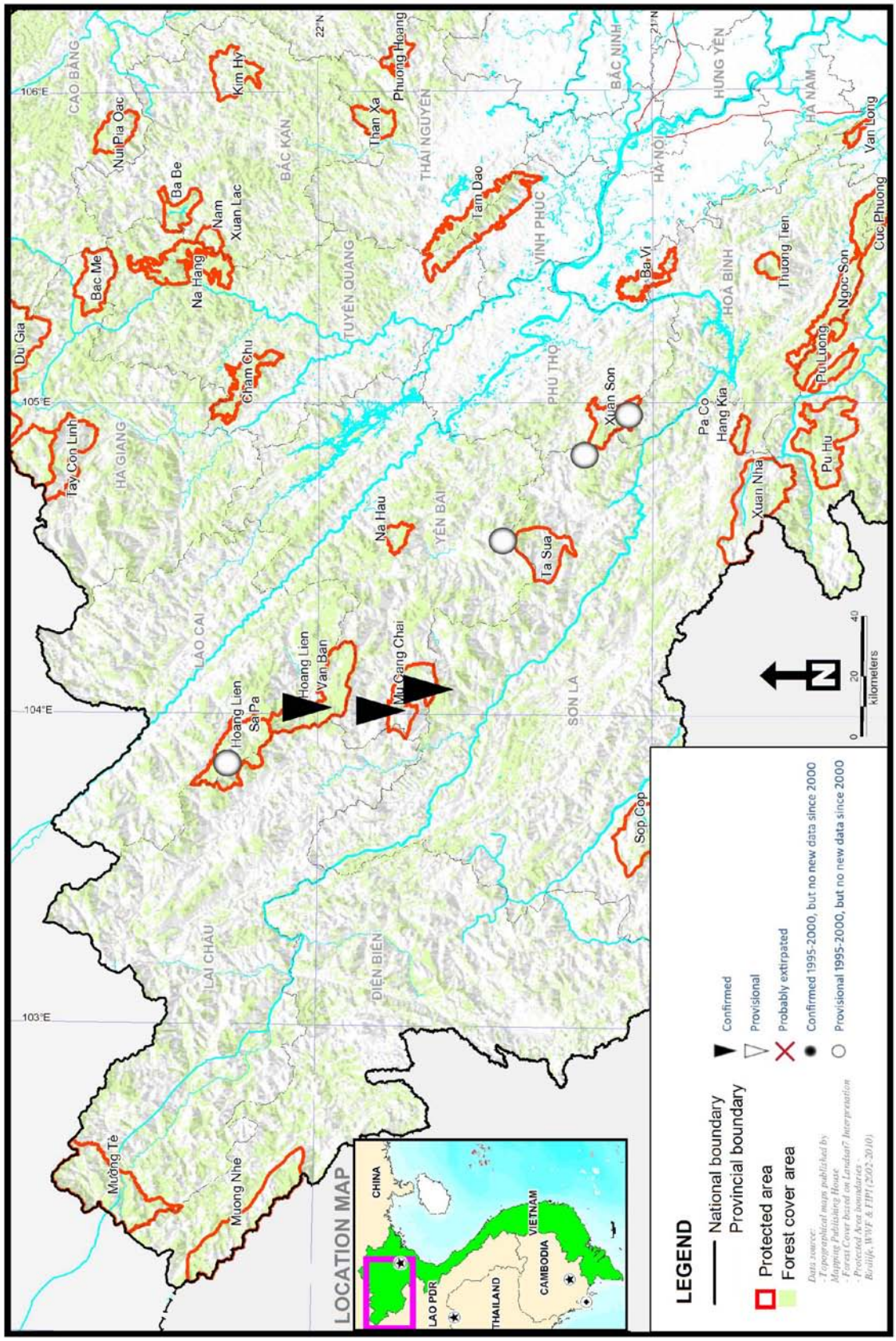


Figure 3. Map of records of *Nomascus concolor* in north-west Vietnam

4 Western Black Gibbon *Nomascus concolor* (Harlan, 1826)

Other English names: western black crested gibbon, black gibbon, black crested gibbon, Indochinese gibbon

Vietnamese names: vượn đen, vượn đen tuyền

IUCN Red List Category and Criteria: Critically Endangered A2cd (ver 3.1)

2007 Vietnam Red Data Book Category and Criteria: Endangered A1cd C2a

Legislative status in Vietnam: Decree 32/2006 ND-CP: 1B

CITES: Appendix I

4.1 Global Status and Distribution

Nomascus concolor currently has a discontinuous distribution over parts of south-west China, north-west Laos and north-west Vietnam, although over a millenium ago, *Nomascus* species may have occurred over a large area of south and central China, north to the Yellow River (Geissmann et al. 2000). Four subspecies of *Nomascus concolor* have been recognised, with three occurring in China (Ma & Wang 1986; Ma et al. 1988; Geissmann 1993, 1994, 1995; Groves 2001; Mootnick & Fan Pengfei 2011). But a recent phylogenetic analysis for the genus *Nomascus* argues there are only two subspecies, the nominate *N. c. concolor* and *N. c. lu*, with the latter restricted to Laos (Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010e). Only one remaining potentially viable population of *N. c. lu* is known, in Nam Kan National Protected Area in north-west Laos, where about 9 to 14 groups are being protected by a tourism project and little more is known about the local population (Robichaud et al. 2010).

Most of the global population of *Nomascus concolor* occurs in southern and central Yunnan Province of south-west China, including the only groups of *Nomascus* known to occur west of the Mekong River (still sometimes referred to as the sub-species *N. c. furgovaster*). There was no comprehensive assessment of the total population of *N. concolor* in Yunnan Province until recently, because field data results varied widely and no consensus could be reached (Jiang Xuelong et al. 2006). Workshops organized by Yunnan Forestry Bureau and Fauna & Flora International to prepare an action plan for this species in 2010 and 2011 have enabled the total population of *N. concolor* in Yunnan Province to be estimated at 1,100 to 1,300 individuals in more than 270 groups. The largest known populations are located along two parallel mountain chains, Wuliangshan and Ailaoshan in central Yunnan Province. Surveys in 2010 estimated 87 groups in Wuliangshan National Nature Reserve (Luo Zhonghua 2010) and 124 groups in Xin Ping County of Ailaoshan National and County Nature Reserves (Xin Ping Management Bureau of Ailaoshan National Nature Reserve 2010). Thirty-nine gibbon groups were recorded in Shuang Bai, Chu Xiong and Nan Hua Counties of Ailaoshan National Nature Reserve in 2005 (Chu Xiong Prefecture Nature Reserve Management Bureau 2006) and gibbons are known to be distributed in other parts of the nature reserve. Therefore overall the Ailao mountain range appears to hold the largest population of *N. concolor* globally.

Vietnam supports at most 5% of the global population of *N. concolor*. The species occurs in the north of the country between the Black and Red Rivers (known locally as Song Da and Song Hong respectively) (Groves 2001). Reports from west of the Black River persist but are unconfirmed (Bleisch et al. 2008b; Nguyen Manh Ha et al. 2010a). Extant populations appear to be restricted to two locations in the Hoang Lien mountain range; a block of contiguous forest extending from Mu Cang Chai Species and Habitat Conservation Area (SHCA), Yen Bai Province, into a watershed

forest in neighbouring Muong La District, Son La Province, and Hoang Lien-Van Ban Nature Reserve, Lao Cai Province.

N. concolor was considered to overlap with *N. leucogenys* in Vietnam and southern Yunnan (Dao Van Tien 1983; Ma & Wang 1986) however a reassessment suggested there was insufficient evidence of this (Fooden 1996; Geissmann et al. 2000) although the possibility still remains (see Muong Nhe site account in *N. leucogenys* chapter).

4.2 Summary of Status and Distribution in Vietnam

4.2.1 Change in Status Since 2000

Since the first gibbon status review in 2000 (Geissmann et al. 2000), new status surveys and conservation activities have been conducted for *N. concolor*, but a significant decline in the national population has nonetheless occurred. The current population in Vietnam is estimated to be 64-70 individuals, within a minimum of 22-25 groups. In 2000 the population was estimated to be less than 100 individuals (Geissmann et al. 2000), but baseline population estimates established in 2000-2001 at three sites, Hoang Lien-Van Ban Nature Reserve, Mu Cang Chai SHCA and Muong La Watershed Protection Forest gave a combined population estimate of about 53 groups and more than 140 individuals (see data in site records below). Since then, two to four census surveys have been conducted using consistent methods and experienced researchers at each site. In 2000-2001, these three sites supported similar numbers of gibbons, but over the past decade have experienced dramatically different declines in the numbers of gibbons and groups. The contiguous forest of Mu Cang Chai SHCA and Muong La supports the most gibbons with approximately 59 individuals within 20 groups. This population has declined by at least 50% over the past decade, but may now be recovering. In Hoang Lien-Van Ban Nature Reserve the local gibbon population is very fragmented and has only two to five groups remaining.

There are two recent anomalous vocalization records of *N. concolor* from one survey in Muong Nhe Nature Reserve (Nguyen Manh Ha et al. 2010a), west of the Black River, where the majority of the population is *N. leucogenys* (see Muong Nhe site account). However these records need to be treated with caution until confirmed.

4.2.2 Key Sites for Conservation

Mu Cang Chai SHCA and Muong La Watershed Protection Forest are treated here as two separate sites owing to differences in management regime, but the forest of these two sites is contiguous and the gibbon population extends between them. Due to a severe decline in gibbon numbers over the past decade in Hoang Lien-Van Ban Nature Reserve, the Mu Cang Chai SHCA-Muong La Watershed Protection Forest complex is now the only area in Vietnam where *N. concolor* has a realistic chance of survival. Even so, the population there is quite small and fragmented. There is a marked difference between population trends inside and outside Mu Cang Chai SHCA, which indicates that the protected area and conservation interventions have protected the gibbons when compared to the watershed protection forest in Muong La District (which still supports one third of the gibbon groups).

4.2.3 Threats

Gibbon hunting and deforestation are the principle threats to *N. concolor* in all sites where this species persists. Hunting is intense in Muong La Watershed Protection Forest, and if not halted will cause the local extirpation of remaining gibbon groups and the threat may then spill over into Mu Cang Chai SHCA. A new and key threat is the impending completion of a road from Mu Cang Chai Town to Che Tao Village, and another new road which will go through or close to Muong La Watershed Protection Forest and continue adjacent to Mu Cang Chai SHCA. Until recently the remoteness of both sites conferred some degree of protection, but the completion of these roads

will provide increased access to hunters and traders. A hydropower dam will be constructed in Muong La adjacent to Mu Cang Chai SHCA and there are plans for a second dam near this site. These dams may result in direct loss or degradation of critical gibbon habitat, and may also result in increased hunting for gibbons (and other wildlife) to meet the demand of construction workers.

4.2.4 Ongoing Conservation Actions

Mu Cang Chai SHCA was established by the Yen Bai provincial authorities in 2006, although the investment plan, including conservation actions to protect *N. concolor*, was prepared four years earlier (FIPI 2002). This investment plan was based upon extensive consultations with local stakeholders to establish a protected area that engaged local communities in collaborative management (Swan & O'Reilly 2004a). Conservation activities conducted by FFI at Mu Cang Chai SHCA have included gun confiscation, awareness campaigns, gibbon monitoring and formation of community patrol groups to protect remaining gibbon groups. In Muong La Watershed Protection Forest and Hoang Lien-Van Ban Nature Reserve similar activities have been conducted, although to a lesser degree and have not been sustained. FFI has now re-established patrol teams at Muong La and is developing a gibbon conservation action plan there.

4.2.5 Priority Conservation Actions

Continued funding and conservation actions at Mu Cang Chai SHCA are critical to maintaining the survival of *N. concolor* in Vietnam. Conservation plans at Mu Cang Chai SHCA need to be updated to address new threats from road and dam construction. Protection of contiguous forest in Muong La Watershed Protection Forest (particularly below 2,000 m elevation) is required as a buffer to the forests in Mu Cang Chai SHCA and to protect the gibbons which move between these sites. These watershed forests, formerly more extensive, are being logged and a priority is to halt logging. The protection of remaining forest in this area will largely depend on the support of the Son La Provincial People's Committee, which has approved the recent road and dam developments as well as agriculture and resettlement in and near these sites. In all sites, an immediate halting of hunting is required to protect gibbons.

4.3 *Nomascus concolor* Records in Vietnam

4.3.1 Hoang Lien-Van Ban Nature Reserve

Location: Van Ban District, Lao Cai Province

Area: 25,669 hectares

Status criteria: 1a, 2a, 3a, 4b, 5c

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: 2-5 groups

Status

The *N. concolor* population at Hoang Lien-Van Ban Nature Reserve is very small and has been severely reduced since 2000. In a 2009 survey only two gibbon groups with a minimum of five individuals were heard by researchers, although local residents reported an additional three groups, with at least six more individuals (Le Trong Dat 2009). These data are similar to a 2006 census, when 2-5 groups containing 5-12 individuals were recorded (Le Trong Dat & Le Huu Oanh 2006). In 2000-2001 the gibbon population at this reserve was at least 14 groups with a minimum

of 50 individuals (Swan & O'Reilly 2004b). Prior to 2000 the reserve (then called 'Ho Nam Mu forest') was thought to support up to nine gibbon groups (Geissmann et al. 2000).

Gibbons are currently distributed in two or three widely separated areas and potential for contact between groups is extremely low (Le Trong Dat 2009). Confirmed groups are in the northern Phinh Ho and Ho Nam Mu-Nam Dao Panh areas, with an additional unconfirmed group in the latter area. Two more groups are reported to persist in the Nam Nhu forest area. Only one male gibbon was confirmed during the 2009 survey, and the male of one of the three unconfirmed groups was reported to have been shot in 2009 (Le Trong Dat 2009). A skewed sex ratio may now exist amongst the few remaining gibbons in the reserve.

Despite similar survey results in 2006 and 2009, the small group size and ongoing hunting indicate that the gibbon population in the reserve is not increasing and is probably still in decline. Owing to the small population size in the reserve, the wide geographical separation between gibbon groups and ongoing hunting, the gibbon population in this reserve may soon be extirpated.

Threats and Conservation Actions

Hunting continues to be the primary threat to gibbons at Hoang Lien-Van Ban Nature Reserve, with at least one gibbon hunted in 2009 (Le Trong Dat 2009). The size and distribution of gibbon groups in the reserve renders them vulnerable to isolated hunting events. Cardamom cultivation and fuelwood collection are widespread in the reserve (Le Trong Dat 2009) and degrade gibbon habitats. Residents also hunt wildlife while tending their crops.

Conservation actions at this reserve since 2000 include gun confiscation, awareness campaigns and the establishment of community patrol groups (Swan & O'Reilly 2004b) and subsequent reserve designation in 2007 (Decision No. 399, dated 12 February 2007 of Lao Cai People's Committee). Le Trong Dat (2009) reported that awareness campaigns had succeeded in delivering the message that hunting gibbons was illegal but that this had not been sufficient to change the behaviour of hunters. Conservation activities at this site, largely supported by FFI, ended in 2007. Since that time community patrols have ceased to take place regularly, but ex-patrollers sometimes take part in patrols with protected area staff when called upon (Hoang Van Lam pers. comm.). At this point, investing further conservation funds to protect gibbons in this reserve would be a low priority, because the population is so small and fragmented that its chance of persistence is very low. It would appear that for *N. concolor*, conservation efforts in this reserve have failed. Although large areas of forest remain, the limited conservation actions that occurred could not prevent gibbons being hunted.

4.3.2 Mu Cang Chai Species and Habitat Conservation Area

Location: Mu Cang Chai District, Yen Bai Province

Area: 20,293 hectares

Status criteria: 1a, 2a, 3a, 4a, 5b

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 14 groups

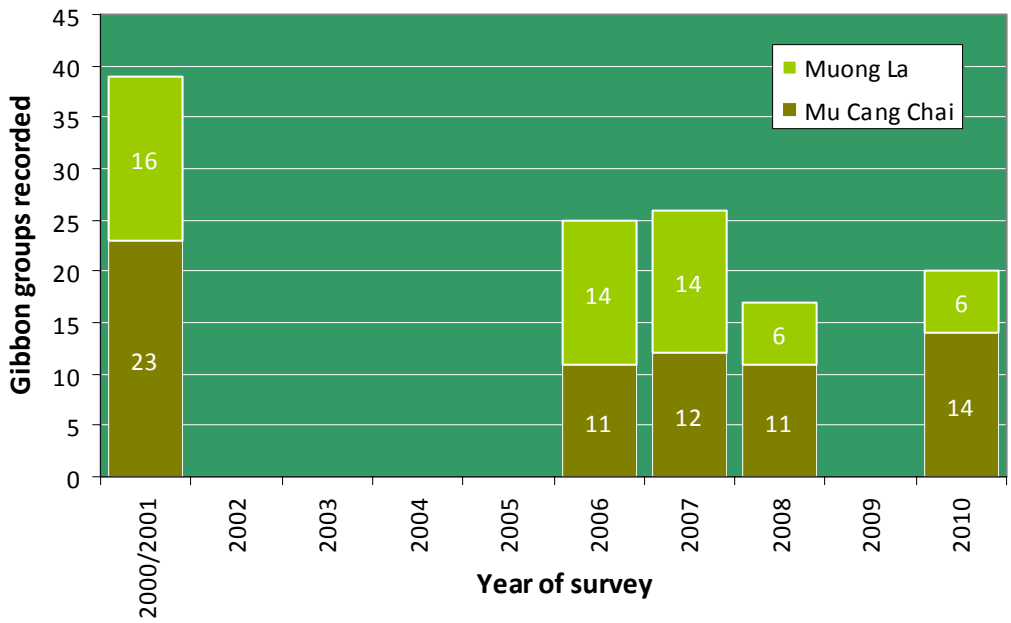
Status

Mu Cang Chai SHCA is the most important site in Vietnam for conservation of *N. concolor*. The gibbon population in this protected area, which is based largely in Che Tao Commune, is the best documented gibbon population in Vietnam having been surveyed four times since 2000 (Figure 4). The most recent census (April-May 2010) recorded at least 14 groups containing a minimum of 47 individuals (Le Trong Dat & Le Minh Phong 2010), within a population of 20 groups including

those in neighbouring Muong La District (see below). This is slightly higher than survey results in 2006, 2007 and 2008 (11 groups with >40 individuals; Le Trong Dat & Le Huu Oanh 2006, 2007; Le Trong Dat & Luong Van Hao 2008). These data indicate the gibbon population is stable or has increased slightly in Mu Cang Chai in recent years, although previous declines between 2000 and 2006 were significant despite conservation interventions described below. Now gibbon numbers are significantly lower than in 2000, when at least 23 groups were thought to be present within a total population of 39 groups (Le Trong Dat et al. 2000). The methods used for gibbon surveys from 2006 to 2010 were similar, with full surveys across Mu Cang Chai and Muong La conducted in the spring time. Therefore results are directly comparable. The figures from 2000 and 2001 are compiled from different surveys. Nevertheless, a severe decline appears to have occurred during the first half of the decade, despite on-going conservation efforts at the time.

The distribution of gibbons across the protected area is not even. Nine gibbon groups are located in the remote south, along the lower slopes of forested ridges separating Mu Cang Chai SHCA from Muong La District. Five groups are located north of Che Tao Village and are widely separated from the gibbons to the south. Of these five groups, four are located west of the road between Mu Cang Chai Town and Che Tao Village and the other group is east of this road (Le Trong Dat & Le Minh Phong 2010).

Figure 4. Gibbon survey results at Mu Cang Chai-Muong La over the past ten years



Graph based upon results compiled in Le Trong Dat & Le Minh Phong (2010). All figures for groups recorded are minimum estimates.

Threats and Conservation Actions

Hunting is the primary threat to gibbons at Mu Cang Chai SHCA. Hunting intensity is thought to have decreased since 2003, following a gun confiscation and awareness campaign (when 2,618 guns were confiscated; Swan & O'Reilly 2004a). However, in 2010, the number of gunshots heard in the forest during gibbon survey days had increased (Le Trong Dat & Le Minh Phong 2010). Ongoing loss and degradation of gibbon habitats is due to selective logging for *Fokienia hodginsii* and clearance for cardamom cultivation, livestock grazing and agriculture. The use of chainsaws to collect timber has increased (Le Trong Dat & Le Minh Phong 2010), suggesting that efficiency and/or quantity of timber extraction in and near the protected area has increased. Due to its remoteness, threats to this forest were less severe than other sites with *N. concolor*, but this will

soon change with the completion of two new district roads, which will link up with at least two villages partially enclosed by this horseshoe-shaped protected area. The impending construction of two hydropower dams will cause further loss and degradation of gibbon habitats and increase access to the site for hunters and traders. Dam construction workers are likely to hunt wildlife, including gibbons, for food, or purchase wild meat from local people, increasing hunting pressure on gibbons.

Since 1999, FFI has worked at the site and promoted *N. concolor* as a flagship species for conservation. The decline in gibbons between 2000 and 2006 in Che Tao Commune occurred despite it being the focal location for FFI's activities, which included a gun control programme, awareness campaigns, community-based patrols, livelihood initiatives in two villages, and community participation in zoning and establishing the protected area. The management board for Mu Cang Chai Species and Habitat Conservation Area was finally approved in 2006 (Decision No. 513/QD-UBND, dated 9 October 2006 of Yen Bai Provincial People's Committee). Attempts have been made to explain the gibbon decline in the first half of the decade and why hunting remained such a persistent threat (Swan unpublished data). Although not entirely conclusive, the main reasons were identified as a local propensity for hunting, weaknesses in the patrolling model, weak government support and unfocussed conservation interventions inhibiting effective responses to urgent and emerging conservation needs (Swan unpublished data). From 2007, FFI has focussed on maintaining and strengthening the patrols, which are now directly managed by protected area staff, and developing the model for local stakeholder involvement in managing the protected area. A continued focus on protecting the gibbons and their habitat is critical. Additional measures which are required are further participatory land-use mapping and participatory protected area boundary demarcation (to prevent forest encroachment in valleys close to villages) and training reserve staff in enforcement techniques to identify and address new threats from new roads and dams. FFI is currently supporting preparation of a conservation action plan for the combined Mu Cang Chai-Muong La gibbon population, recognising the importance of also addressing threats from Muong La District within a comprehensive framework for protection of the species at this location.

4.3.3 Muong La Watershed Protection Forest

Location: Muong La District, Son La Province

Area: 3-4,000 hectares

Status criteria: 1a, 2a, 3a, 4b, 5c

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 6 groups

Status

The *N. concolor* population in Muong La Watershed Protection Forest has been surveyed four times since 2000 (Figure 4), at the same time as surveys in Mu Cang Chai SHCA. The most recent census (April-May 2010) recorded at least six gibbon groups and a minimum of 12 individuals, within a population of 20 groups including those in Mu Cang Chai SHCA (Le Trong Dat & Le Minh Phong 2010). This is significantly less than in 2008 (also six groups but with >17 individuals; Le Trong Dat & Luong Van Hao 2008) and 2007 and 2006 (14 groups with >43 individuals; Le Trong Dat & Le Huu Oanh 2007), which was only slightly less than numbers present in 2001 (Le Trong Dat et al. 2000), suggesting that the main decline occurred during the latter half of the decade. Of the remaining six gibbon groups, three are located in Nam Pan and Hua Trai Communes, adjacent to the border with Mu Cang Chai SHCA (Le Trong Dat & Le Minh Phong 2010). The other three groups are in Ngoc Chien Commune, in forest which is already (or soon to be) isolated from Mu Cang Chai SHCA (Le Trong Dat & Le Minh Phong 2010). One valley, Nang Lu, had seven groups with more than 18 individuals in 2006, but only one group with two individuals in 2010 (Le Trong

Dat & Le Minh Phong 2010). These data indicate a severe decline in the gibbon population at Muong La Watershed Protection Forest in the later half of the decade, in contrast to the gibbon population decline at Mu Cang Chai, which occurred in the earlier half of the decade.

Threats and Conservation Actions

Hunting has probably caused the loss of many gibbons since the mid-2000s and it continues. In January 2010 a hunter shot one male gibbon and sold it to a wildlife trader in Muong La Town for VND 1,800,000 (about US$ 90) and in September 2009, the same trader purchased two gibbon skins and skeletons from hunters (Le Trong Dat & Le Minh Phong 2010).

Although designated as a watershed protection forest, the forest inhabited by gibbons has been extensively logged for high value timber species such as *Fokienia hodginsii* both legally and illegally (Le Trong Dat & Le Minh Phong 2010). For example, between 2001 and 2005 the Son La Provincial People's Committee approved an official logging quota of 4,394.9 m^3 of *Fokienia hodginsii*, of which 3,314.9 m^3 was harvested from the watershed forest according to official figures (Nguyen Phi Truyen & Osborn 2006). Watershed forest has also been cleared for agriculture and rubber plantations. The most intact remaining forest (in Nang Lu valley adjacent to Mu Cang Chai SHCA) is now zoned for agriculture (Nguyen Duy Luong & Nguyen Duc Tho 2010).

Hydropower development has led to forest clearance in the inundation zone and displacement of communities, which have been resettled in forest areas, causing further forest loss for agriculture and home construction (Nguyen Duy Luong & Nguyen Duc Tho 2010). Due to a lack of productive agricultural land many displaced people have turned to illegal logging as an income source. Primary forest is burnt so that only the large *Fokienia hodginsii* trees remain, enabling them to be more easily logged (Nguyen Duy Luong & Nguyen Duc Tho 2010). These developments have led to large changes in the extent and quality of remnant forest over the past several years. In some areas which were extensively forested in 2007, there now remains only a strip of forest a few hundred metres wide along the border with Mu Cang Chai SHCA (S. Mahood pers. comm.). Law enforcement in the area is low.

In 2004, FFI established a community-based gibbon monitoring group in Muong La similar to the model in Mu Cang Chai. These patrols continued until 2007, when they ceased following the end of project funding. In 2005, a gun confiscation and awareness campaign was conducted (1,800 guns were confiscated). The results of the gibbon survey in 2006 seemed to indicate that these conservation interventions were successful, although why it should be so with less intervention than in Mu Cang Chai remains unclear (Swan unpublished data). A serious decline then appears to have occurred from 2007 when patrolling ceased and increased migration to the area occurred due to the hydropower development. The patrol group was re-established by FFI in 2010, but pressures remain high.

Official approval for extensive timber extraction and agricultural, hydropower and forestry development within and near this watershed forest, characterize the current land use policies in Son La Province. If the remaining gibbons in this site are to be conserved, immediate changes in land-use are required. Critical actions include a halt to hunting and trade in gibbons and preventing conversion of remaining forests, especially the forests adjoining Mu Cang Chai SHCA. Further gun confiscation and awareness campaigns may be needed. Without these actions the *N. concolor* population in Muong La Watershed Protection Forest may soon be extirpated. In this case the main value of this area for gibbon conservation will be to act as a buffer to protect the more secure gibbon groups in Mu Cang Chai SHCA. Son La Forest Protection Department and FFI are currently preparing a conservation action plan for the combined Mu Cang Chai-Muong La gibbon population.

4.4 Locations where *Nomascus concolor* is Now Considered Absent

Since 2000, there have been no surveys conducted at sites other than the three listed above. Therefore it is not possible to determine whether gibbons have become extinct at any sites where they formerly occurred.

4.5 Sites with No New Data Since 2000

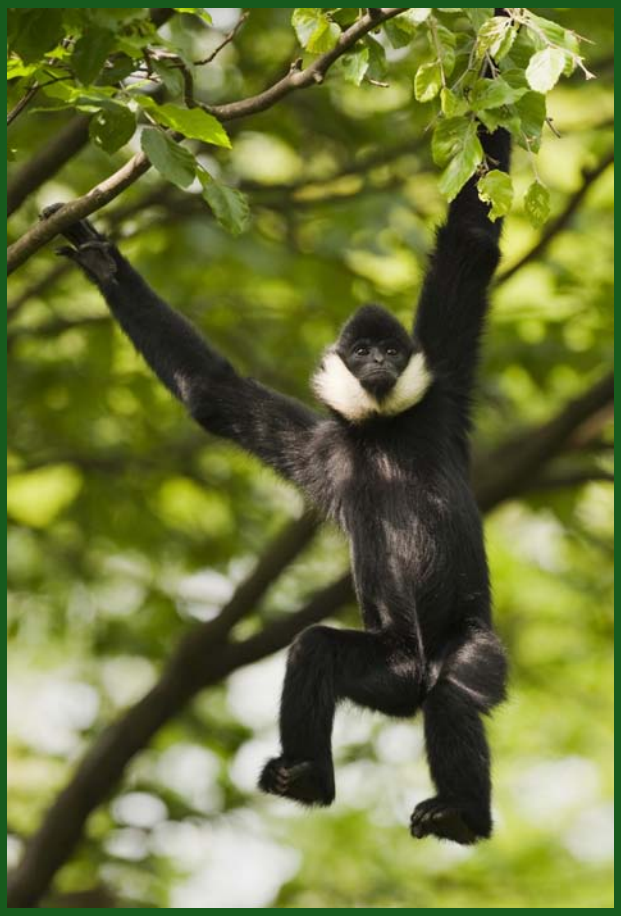
Sites which had confirmed or provisional records for *N. concolor* between 1995 and 2000 as listed in Geissmann et al. (2000) and for which there have been no gibbon records since that time are listed in Table 4 below.

Table 4. Sites with no new data for *N. concolor*.

Site	Most recent record
Lao Cai Province	
Hoang Lien Nature Reserve	Last record by interview in 1998 when gibbons were already considered very rare
Son La Province	
Pan Village	Last record by interview in 1999
Between Bac Yen, Phu Yen and Tram Tau (Yen Bai Province) Districts	Last record by interview in 1999
Phu Tho Province	
Xuan Son Nature Reserve	Last record by interview in 1999

Chapter 5

Northern white-cheeked gibbon
Nomascus leucogenys



Male *Nomascus leucogenys*
Photo: Terry Whittaker

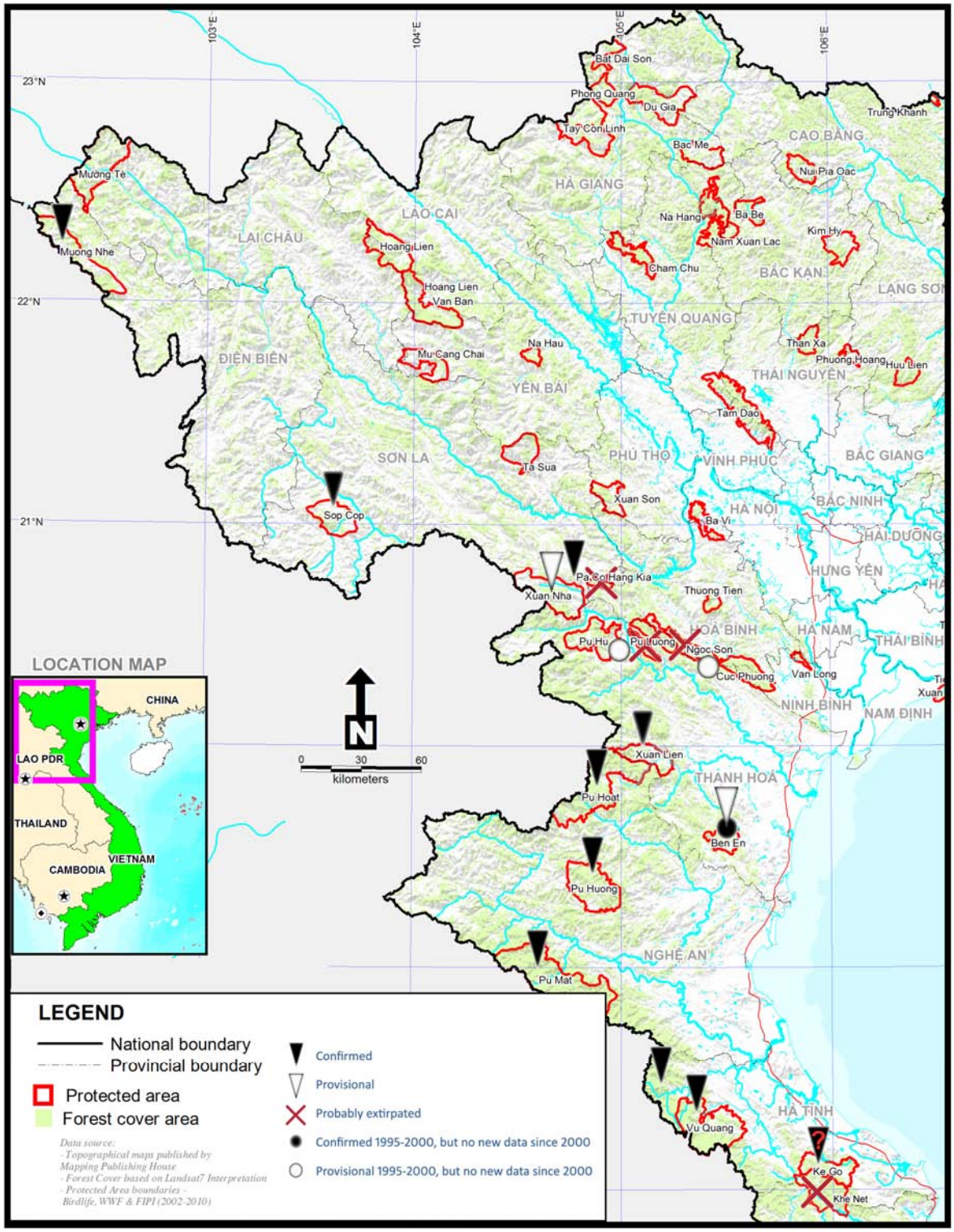


Figure 5. Map of records of *Nomascus leucogenys* in northern Vietnam

5 Northern White-cheeked Gibbon *Nomascus leucogenys* (Ogilby, 1840)

Other English name: northern white-cheeked crested gibbon

Vietnamese names: vượn má trắng bắc, vượn đen má trắng, vượn bạc má

IUCN Red List Category and Criteria: Critically Endangered A2cd+3cd (ver. 3.1)

2007 Vietnam Red Data Book Category and Criteria: Endangered A1cd C2a

Legislative status in Vietnam: Decree 32/2006 ND-CP: 1B

CITES: Appendix I

5.1 Global Status and Distribution

The IUCN Red List status for *Nomascus leucogenys* was recently revised from 'Data Deficient' to 'Critically Endangered' (Bleisch et al. 2008a). This species occurs in north-west Vietnam, northern Laos and southern Yunnan Province, China. It is restricted in the west by the Mekong River and limited in the east by the Black River (Groves 2001). In the north of its range, *N. leucogenys* was previously considered to overlap with *N. concolor* in Vietnam and Yunnan (Dao Van Tien 1983; Ma & Wang 1986) however a reassessment suggested there was insufficient evidence of this (Fooden 1996; Geissmann et al. 2000) although the possibility still remains (see Muong Nhe site account). In Laos, the extent of overlap with *N. concolor* is unclear and likely to be historical rather than current (Duckworth 2008). *N. leucogenys* was previously believed to occur as far south as the Ca River in Nghe An Province (Geissmann et al. 2000; Nguyen Manh Ha 2005), but based on genetic and vocal evidence, its range is understood to be further south to at least the Rao Nay River, near Vu Quang National Park (which supports *N. leucogenys*) and Khe Ve Nature Reserve (which probably supports *N. siki*) (Van Ngoc Thinh et al. 2010a; Van Ngoc Thinh et al. 2010e). In Laos, the southern limit of *N. leucogenys* is thought to be the Nam Kading River (Van Ngoc Thinh et al. 2010e). This southerly expansion in understanding of its global distribution (which has reduced the range of *N. siki*) includes several areas with significant gibbon populations.

In China, populations of *N. leucogenys* have severely declined over the past few decades, due largely to hunting (Fan Pengfei & Huo Sheng 2009). Populations in Yunnan are restricted to Xishuangbanna Prefecture, where they are presently known from two reserves, Mengla and Shangyong. Interview surveys in these sites in 2008 yielded only three reports of gibbons at separate locations, compared with the 1980s, when these sites supported nine confirmed groups with at least 36 individuals (Fan Pengfei & Huo Sheng 2009 and references therein). In the 1960s, at least 1,000 gibbons were estimated to persist in Xishuangbanna (Bangjie Tan 1985). The population in China may now be as few as 10 individuals in three groups, separated by large distances, and is unlikely to persist even in the short-term (Fan Pengfei 2010).

In Laos, the status of *N. leucogenys* is largely unknown, but available data and large tracts of forest remaining in some areas suggest Laos may hold the largest remaining populations of this species (Duckworth 2008). Significant populations may still persist in Nam Et-Phou Louey National Protected Area (NPA) (Duckworth 2008), Nam Xam NPA (where it has been recorded as locally common; Showler & Davidson 1998) and Nam Kading NPA north of the Kading River (Van Ngoc Thinh et al. 2010e). Local reports suggest the species persists in Phou Dendin NPA (Robichaud & Bounhom Sounthala 1995), although populations may be small (Duckworth 2008). Gibbons are commonly hunted in Laos, although the levels of threat and drivers vary from site to site (Duckworth 2008). Hunting pressure may be largely opportunistic rather than targeted, which still poses a considerable threat to these relatively conspicuous diurnal primates (Duckworth 2008). Further surveys are required in Laos to document remaining populations of *N. leucogenys*.

5.2 Summary of Status and Distribution in Vietnam

5.2.1 Change in Status Since 2000

At the time of the first Vietnam gibbon status review (Geissmann et al. 2000), existing data on *N. leucogenys* was limited to presence/absence for all listed sites, with no quantitative data on populations available. Since then, status surveys for *N. leucogenys* have been conducted in many of the protected areas which Geissmann et al. (2000) identified as potential strongholds. These surveys, conducted by a range of local and international agencies, have resulted in a clear understanding of priority areas for this species. A re-assessment of the range of *Nomascus* gibbons in Vietnam has also resulted in the expansion of the known southern range limits of *N. leucogenys*, to include Pu Mat and Vu Quang National Parks and some other protected areas previously thought to contain *N. siki* (Van Ngoc Thinh et al. 2010e).

5.2.2 Key Sites for Conservation

Based on current information, the most important site for conservation of *N. leucogenys* in Vietnam is Pu Mat National Park, with an estimated population of 130 groups and 455 individuals (Luu Tuong Bach & Rawson 2011). Other key sites with recently confirmed gibbon populations of significance include Muong Nhe Nature Reserve, which may also contain a sympatric population of *N. concolor*, and Vu Quang National Park. These sites are likely to be global as well as national priorities for the taxon. Lower priority sites include Pu Hoat, Xuan Lien and Pu Huong Nature Reserves. At two sites, Vu Quang National Park and Huong Son Forest, additional surveys are required to determine how large populations are and whether they can be effectively conserved. For most other sites, the species appears to have become extirpated or nearly so over the past decade.

5.2.3 Threats

Hunting and habitat loss are the principle threats to *N. leucogenys* in Vietnam, and have resulted in the confirmed extirpation of populations from at least four sites; Hang Kia-Pa Co, Ngoc Son-Ngo Luong and Pu Luong Nature Reserves, and Khe Net Proposed Nature Reserve, while in Ke Go Nature Reserve the population is so low they may no longer be viable (Van Ngoc Thinh et al. 2010a). Most remaining populations are isolated, internally fragmented and under severe pressure. Without effective conservation efforts it is likely that most Vietnamese populations will be extirpated in the near future.

5.2.4 Ongoing Conservation Actions

There are currently no conservation projects with a focus on *N. leucogenys* in Vietnam. The species receives incidental legal protection in the designated protected areas it occurs in, but given the severe threat status of *N. leucogenys* in Vietnam this is clearly insufficient to protect remnant populations.

5.2.5 Priority Conservation Actions

The permanent presence of forest guards dedicated to round-the-clock protection of individual gibbon groups, in Pu Mat National Park and Muong Nhe Nature Reserve, may be the only effective approach to ensuring that Vietnam retains populations of *N. leucogenys*. Site and landscape level projects are unlikely to be sufficient on their own. For example in Pu Mat, a large-scale integrated conservation and development project failed to halt declines in numbers of primates and other biodiversity (Grieser Johns et al. 2004). At this point, sustained commitment from all national agencies will be critical to conserving gibbon populations in Pu Mat National Park. The large extent of transboundary forest around Vu Quang, holds additional hope for the species in Vietnam, however additional survey effort is required to confirm this.

5.3 *Nomascus leucogenys* Records in Vietnam

5.3.1 Muong Nhe Nature Reserve

Location: Muong Nhe District, Dien Bien Province

Area: 45,581 hectares

Status criteria: 1a, 2b, 3a, 4c, 5f

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 16 groups

Status

Extensive gibbon surveys were conducted in this reserve in 2010 (Nguyen Manh Ha et al. 2010a). At least 16 gibbon groups were detected, of which 13 occurred in the northern part of the reserve near the border with Laos (Nguyen Manh Ha et al. 2010a). Few gibbons remain in the southern part of the reserve, due to hunting and habitat loss (Nguyen Manh Ha et al. 2010a). Prior to 2010, local reports had indicated at least three gibbon groups were present (Nguyen Duc Tu et al. 2001; Do Tuoc 2006). The reserve appears to contain one of the largest remaining populations of *N. leucogenys* in Vietnam.

Threats and Conservation Actions

Hunting is the principle threat to *N. leucogenys* in this site. Gibbons in the north of the reserve appear to be more secure than those in the south, due to more intact habitats, limited human access and increased protection afforded by international border security measures (Nguyen Manh Ha et al. 2010a). At least three instances of gibbon hunting at the site were reported since 2008, and many households own guns (Nguyen Manh Ha et al. 2010a). Given the national importance of this site for *N. leucogenys*, a focused programme of protection for remaining gibbon groups should be initiated as soon as possible. This should include dedicated ranger patrols and control of guns through confiscation and buyback schemes (Nguyen Manh Ha et al. 2010a). Further surveys are required to ascertain the total gibbon population in the reserve. *Nomascus concolor* may also occur in the reserve (Nguyen Manh Ha et al. 2010a), although vocal recordings and DNA analysis would be needed to confirm this.

5.3.2 Sop Cop Nature Reserve

Location: Sop Cop and Song Ma Districts, Son La Province

Area: 18,709 hectares

Status criteria: 1c, 2b, 3c, 4c, 5f

Date of most recent survey: 2011

Date of most recent confirmed record: 2011

Minimum population: ≥ 2 groups

Status

In November 2011, a group of five individuals was seen in an isolated forest of about 300 ha in Sai Khao Village, Muong Cai Commune, Song Ma District (Nguyen Manh Ha pers. comm.). This group is being protected by the Mong villagers. No gibbons were confirmed in the nature reserve itself at the time. This survey followed an earlier report by Son La Provincial FPD of the presence of

eight or nine individuals in that area, but within the nature reserve (U. Streicher pers. comm.). Results of a large mammal survey in June 2011 had led to the conclusion that the population of gibbons in the nature reserve is now extirpated, however one group of 3-4 individuals was recorded in the buffer zone in Sam Kha Commune, Sop Cop District (Nguyen Manh Ha et al. 2011a). These two communes are separated by about 30 km. Sop Cop Nature Reserve was established in 2002 and not assessed in the 2000 gibbon status review (Geissmann et al. 2000). Local reports of gibbons had previously been obtained during wildlife surveys in 1995 (Cao Van Sung & Nguyen Xuan Dang 1995; Duckworth & Hedges 1998).

Threats and Conservation Actions

Hunting, logging and land encroachment from agriculture are all common in the nature reserve. Forest fires from land encroachment also occur annually. As a result the forest area has diminished to approximately 4,000 ha and is now isolated from surrounding forests, including those in Laos (Nguyen Manh Ha et al. 2011a). From a conservation perspective there is little that can be done for the isolated groups unless the presence of more groups can be confirmed close by. The presence of other gibbons, especially in Sop Cop District and close to the Lao border deserves attention, as this area is next to Nam Et-Phou Louey National Protected Area, the largest protected area in Laos and recognised as a national priority site for conservation of *N. leucogenys* by the Lao government (MAF 2011). A small level of attention on protecting gibbons in Sop Cop District may raise awareness among the local government and local communities and lend support to protecting gibbons in the much larger transboundary landscape.

5.3.3 Xuan Nha Nature Reserve

Location: Moc Chau District, Son La Province

Area: 16,317 hectares

Status criteria: 1b, 2c, 3c, 4c, 5f

Date of most recent survey: 2011

Date of most recent confirmed record: N/A

Minimum population: provisionally extirpated (groups persist in the buffer zone)

Status

A ten day survey in June 2011, failed to record any gibbons in the nature reserve, but received reports of gibbons in the buffer zone (Nguyen Manh Ha et al. 2011a), which may be the gibbons in Long Luong Commune (see below). Over one hundred days of mammal surveys conducted from 2006 to 2010 also failed to record gibbons other than from local interviews (Nguyen Xuan Dang et al. in press). Similarly, reports from residents interviewed in 2003 and 2008 (Le Trong Trai 2005; Anon. 2008) suggested that some gibbons persist within, and possibly outside, the reserve, although brief visits to some of these areas failed to detect gibbons (Le Trong Trai 2005). It has nevertheless been reported that gibbons may persist in the buffer zone to the west (Do Tuoc pers. comm.). The remoteness of the site, steep terrain and limited human access, combined with contiguous forests between the reserve and Laos, may provide some security for gibbon populations, but given the mammal survey effort to date with no confirmed records, the chances of a significant remaining population do not appear good. Prior records for this site were considered unreliable in Geissmann et al. (2000).

Threats and Conservation Actions

Hunting and forest clearance due to shifting agriculture are the principle threats to *N. leucogenys* in this site (Le Trong Trai 2005; Anon. 2008; Nguyen Manh Ha et al. 2011a). Local communities commonly hunt with dogs and guns for subsistence and for the wildlife trade (Anon. 2008;

Nguyen Manh Ha et al. 2011a). The construction of a nearby hydropower dam, the 'Trung Son Hydropower Project' has recently been approved and is predicted to result in further clearance of forest for agriculture and illegal logging, increased wildlife hunting for trade, an increased incidence of forest fires and greater access to the reserve via the reservoir and new construction roads (Anon. 2008). Further status surveys for *N. leucogenys*, especially in the Pha Luong Mountains and surrounding buffer zone, are needed. A gun confiscation programme and other conservation actions are strongly recommended for this reserve and to protect gibbons in surrounding forests.

5.3.4 Long Luong Commune

Location: Moc Chau District, Son La Province

Area: undetermined

Status criteria: 1a, 2c, 3b, 4b, 5f

Date of most recent survey: 2011

Date of most recent confirmed record: 2011

Minimum population: 2 groups

Status

A short survey in April 2011 observed one of only two gibbon groups reported through local interviews to be in Long Luong Commune. The groups are located on either side of a valley used entirely for village lands and cultivation (Luu Tuong Bach & Nguyen Van Truong 2011b). This area is ensconced between Xuan Nha and Hang Kia-Pa Co Nature Reserves and this has been the only confirmed record of gibbons within that landscape during the past decade. Village interviews suggest the gibbons in Long Luong Commune are white-cheeked gibbons, although field observations were not able to confirm this (Luu Tuong Bach & Nguyen Van Truong 2011b). Museum specimens of *N. concolor* were apparently collected in nearby Long Sap Commune in 1963, sparking debate about *N. concolor* being found west of the Black River (Song Da) (Geissmann et al. 2000).

Threats and Conservation Actions

This population is no longer viable, being so small and the two groups separated from one another. In addition hunting is reported in the area, apparently from outsiders, and shifting cultivation leaves only small isolated patches of forest on rocky mountains.

About ten years ago local villagers of Mong ethnicity had agreed among themselves to protect the local gibbon groups because they were not perceived as causing any harm and there was a local superstition that killing gibbons can bring bad luck (Luu Tuong Bach & Nguyen Van Truong 2011b). Similar examples of village protection of local gibbons is reported to be widespread throughout neighbouring Laos, occasionally by Mong villages (Duckworth 2008; MAF 2011), but this is the only such case recorded in Vietnam in this status review. Regrettably, it is probably too late for support to this local interest in gibbon conservation to have any impact.

5.3.5 Pu Hu Nature Reserve

Location: Quan Hoa, Quan Son and Muong Lat Districts, Thanh Hoa Province

Area: 27,503 hectares

Status criteria: 1b, 2b, 3b, 4b, 5f

Date of most recent survey: 2003

Date of most recent confirmed record: N/A

Minimum population: unknown; possibly extirpated

Status

In 2009, the director of this reserve reported that four gibbon groups survived in the reserve and that one captive gibbon had been confiscated in 2009 (Nguyen Xuan Dang pers. comm.). In 2008, local reports of gibbons were obtained during wildlife surveys (Anon. 2008). In contrast, in 2003 no evidence that gibbons persist in the reserve was found during 20 days of interviews and fieldwork focused on gibbons (Nguyen Manh Ha 2005). Residents reported that gibbons had not been heard for five years, probably due to high hunting pressure, and Nguyen Manh Ha (2005) concluded that gibbons were extirpated from the reserve. Interview surveys in 2005 (Le Trong Trai 2005) and 2008 (Nguyen Xuan Dang pers. comm.) also returned no records. In 1998, a captive individual was present in the reserve (Anon. 1998).

Threats and Conservation Actions

Any surviving gibbons are probably under imminent threat of extirpation. In addition, the construction of the 'Trung Son Hydropower Project' is likely to have an impact on Pu Hu Nature Reserve and is predicted to result in further clearance of forest for agriculture and illegal logging, increased wildlife hunting for trade, an increased incidence of forest fires and greater access to the reserve via the reservoir and new construction roads (Anon. 2008). No conservation actions for gibbons are advocated at this time, given the need to focus financial and technical resources on sites with confirmed populations and the fact that further rapid assessments might not establish any new information. The reserve should be included in national planning efforts for gibbons, to raise staff awareness so that any further sightings will be documented and reported by reserve staff.

5.3.6 Xuan Lien Nature Reserve

Location: Thuong Xuan and Nhu Xuan Districts, Thanh Hoa Province

Area: 27,668 hectares

Status criteria: 1a, 2a, 3a, 4b, 5c

Date of most recent survey: 2007

Date of most recent confirmed record: 2007

Minimum population: ≥ 7 groups

Status

Surveys in 2007 (Le Huu Oanh & Rawson 2007), 2003 (Nguyen Manh Ha 2005) and 2002 (La Quang Trung & Trinh Dinh Hoang 2002a) confirmed the presence of a nationally significant population of this species in this reserve. Collectively these surveys identified 5-6 groups in Bat Mot Commune with interviews suggesting another 2-3 groups in Xuan Lien Commune; in total, at least 7-9 groups survive within Xuan Lien Nature Reserve. These groups are therefore part of a larger transboundary population with neighbouring Pu Hoat Nature Reserve in Nghe An Province (see below). In total, 10-12 groups have been recorded in the two reserves.

Threats and Conservation Actions

Habitat loss, due to previous development activities and ongoing conversion for agriculture and logging, are the principle threats to *N. leucogenys* in this site. Large areas of forest were inundated by construction of the Cua Dat reservoir, which has reduced lowland habitats in the reserve. Hunting pressure on gibbons is apparently low, which reserve staff accord to effective protection, but which may also reflect the rarity of gibbons in the reserve (Nguyen Manh Ha 2005). At least one gibbon was hunted in 2000 (Nguyen Manh Ha 2005) and another in 2007 (Vu Ngoc Thanh pers. comm.), the latter subsequently confiscated by reserve staff (Le Huu Oanh & Rawson 2007).

The reserve management board is interested in conducting conservation activities for gibbons (Le Huu Oanh & Rawson 2007) and should be supported to protect this remnant population.

5.3.7 Pu Hoat Proposed Nature Reserve

Location: Que Phong District, Nghe An Province

Area: 35,000 hectares

Status criteria: 1a, 2a, 3a, 4b, 5c

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 10 groups

Status

Four gibbon surveys have been conducted in this proposed reserve since 2002, which collectively suggest that at least 10 groups are present. In 2009 and 2010, five gibbon groups were recorded and the possible occurrence of 2-3 others was identified (Luu Tuong Bach & Rawson 2010). At least four groups were recorded in 2007 (Le Huu Oanh & Rawson 2007), at least three groups in 2003 (Nguyen Manh Ha 2005) and five groups in 2002 (La Quang Trung & Trinh Dinh Hoang 2002a). Most survey effort has focused on the northern part of the area, which is contiguous with Xuan Lien Nature Reserve and holds most gibbons. Differences in group numbers between surveys probably reflect differences in survey effort and location and some may be repeat sightings (Luu Tuong Bach & Rawson 2010). The southern and central parts of the reserve contain few gibbons and with little chance of long-term survival. The transboundary population of *N. leucogenys* between this area and Xuan Lien Nature Reserve is significant for Vietnam and collectively may comprise 10-12 groups (see account for Xuan Lien Nature Reserve above).

Threats and Conservation Actions

Hunting is the principle threat to *N. leucogenys* in this site. Hunters with guns and dogs, and trap lines, are frequently observed (Luu Tuong Bach & Rawson 2010). Gibbon hunting has been prevalent since at least the 1990s, when juvenile gibbons from the reserve were sold for VND 1.5-3 million per individual which sparked significant hunting for gibbons for the pet trade (Nguyen Manh Ha 2005). Over the past decade, at least five gibbons have been sourced from the reserve: two stuffed gibbons for sale in 2009, a live male gibbon for sale for VND 400,000 in 2010 (Luu Tuong Bach & Rawson 2010), a captive female for sale for VND 1.5 million and a reported juvenile which died in captivity in 2005 (Nguyen Manh Ha 2005). Illegal logging is widespread and agricultural encroachment is ongoing (Luu Tuong Bach & Rawson 2010). The northern part of the site, which supports the most gibbons, may be excised from the proposed reserve. Designation of the nature reserve is urgently required and should include the northern sector containing the gibbon population. This should be followed by a coordinated programme of active intervention to protect gibbons in this site and Xuan Lien Nature Reserve.

5.3.8 Ben En National Park

Location: Nhu Thanh and Nhu Xuan Districts, Thanh Hoa Province

Area: 15,800 hectares

Status criteria: 1b, 2a, 3b, 4b, 5c

Date of most recent survey: 1998

Date of most recent confirmed record: 1998

Minimum population: status unclear; possibly extirpated

Status

Information from park staff in 2009 suggests only one gibbon group remains, with 2-3 groups situated outside the park boundary (Le Trong Dat pers. comm.). Gibbons were recorded in 1997-1998 (Tordoff et al. 2000a), although all sightings and vocalizations may have been of the same group (A. W. Tordoff pers. comm.). This is the most recent documented gibbon record for the park, and on this basis Geissmann et al. (2000) concluded there was little chance that a large population of gibbons remained.

Threats and Conservation Actions

Extensive commercial logging occurred in the park until 1992 and since then, small-scale illegal logging has continued, with the result that few large trees remain (Tordoff et al. 2000a; Sam Van Hoang et al. 2008). The park is not considered a conservation priority for *N. leucogenys* and any remaining gibbons may soon be extirpated.

5.3.9 Pu Huong Nature Reserve

Location: Que Phong, Quy Chau, Quy Hop, Con Cuong and Tuong Districts, Nghe An Province

Area: 50,075 hectares

Status criteria: 1a, 2a, 3a, 4b, 5c

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: ≥ 7-8 groups

Status

Seven to eight gibbon groups were recorded during gibbon surveys in 2008 and 2009, and other groups may be present (Luu Tuong Bach & Rawson 2009a). In 2008, two gibbon groups were detected near the reserve (Van Ngoc Thinh (2008) and were probably some of the groups recorded in 2009 (Luu Tuong Bach & Rawson 2009a). In 2005, seven groups were detected in the same areas (Nguyen Manh Ha 2005). Remnant groups are under severe threat and gibbons may already be extirpated from the northern part of the reserve with only a population remaining near Pu Huong mountain (Luu Tuong Bach & Rawson 2009a).

Threats and Conservation Actions

The principle threats to *N. leucogenys* in this site are limited habitat due to previous extensive clearance of forest, ongoing loss and degradation of remnant habitats and hunting. Little forest cover remains below 800 m and the northern part of the reserve supports many local communities and is impacted by shifting cultivation, hunting and selective logging (Nguyen Manh Ha 2005; Luu Tuong Bach & Rawson 2009a). The southern part of the reserve is better protected and retains more intact forest and fewer settlements (Luu Tuong Bach & Rawson 2009a). Illegal selective logging of high-value timber occurs in the reserve (Nguyen Manh Ha 2005; Luu Tuong Bach & Rawson 2009a). The extent of gibbon hunting is unknown; one gibbon was reported to be hunted in 1999 (Nguyen Manh Ha 2005). No conservation activities are currently being conducted for this population.

5.3.10 Pu Mat National Park

Location: Anh Son, Con Cuong and Tuong Duong Districts, Nghe An Province

Area: 91,113 hectares

Status criteria: 1a, 2a, 3a, 4a, 5c

Date of most recent survey: 2011

Date of most recent confirmed record: 2011

Minimum population: 22 groups confirmed, 130 groups estimated

Status

Pu Mat National Park supports the largest tract of primary lowland tropical forest left in Vietnam (Grieser Johns et al. 2004). Gibbon surveys in 2010 detected at least 22 groups in the park, the most in a single site in Vietnam (Luu Tuong Bach & Rawson 2011). The total population was estimated to be 130 groups with 455 individuals using a randomised, stratified (by altitude) survey protocol with a park-wide density estimated to be 0.161 groups km^{-2} (Luu Tuong Bach & Rawson 2011). This survey used 18 listening posts across the park, including the most remote areas near the Lao border which had not been previously surveyed. The gibbon population at the site is almost exclusively found above 700 m a.s.l. (approximately 85% of groups), with the highest densities (0.271 groups km^{-1}) occurring above this altitude despite the majority of the park being under this elevation (Luu Tuong Bach & Rawson 2011). The remaining population of gibbons in Pu Mat National Park is largely found in areas close to the Lao border.

Previous survey work at the site detected two groups in 2007 (Ruppell 2008) which were not redetected in 2011 (Luu Tuong Bach & Rawson 2011). Primate surveys in 1999 and 2004 returned gibbon records for different areas of the park (Grieser Johns et al. 2004), although records are not georeferenced, limiting comparison with recent surveys. Grieser Johns et al. (2004) derived encounter frequencies for *N. leucogenys* in the park of 22.6/100 survey days in 1999 and 14.0/100 survey days in 2004, but these are based on a very small number of encounters and likely represent sampling bias rather than genuine population trends. Encounter rates reported by ranger patrols from 2000-2003 showed no clear trend (Grieser Johns et al. 2004). Numerous records are available prior to 2000 (Geissmann et al. 2000), although attributed to *N. siki* at the time.

Threats and Conservation Actions

Habitat loss due to shifting agriculture and illegal logging, and hunting, are the principle threats to *N. leucogenys* in this site (Nguyen Thanh Nhan 2004; Luu Tuong Bach & Rawson 2011). These threats are widespread (Grieser Johns et al. 2004) and have resulted in the extirpation of gibbons near human habitation (Luu Tuong Bach & Rawson 2011). Local hunters report they are increasingly forced to visit remote areas near the Lao border to locate gibbons (Roberton et al. 2003), and site-wide surveys suggest that this is true (Luu Tuong Bach & Rawson 2011). Gibbons have been reported to fetch as much as VND 3 million (approximately US$ 190 at the time) per individual in the area (Roberton et al. 2003). Hunting with guns may have declined in recent years due to gun confiscations (Roberton et al. 2003; Luu Tuong Bach & Rawson 2011). A patrol road is being built across part of the park by border police (Luu Tuong Bach & Rawson 2011), which may further impact gibbons.

Conservation actions at Pu Mat have included the Social Forestry and Nature Conservation Project (1998-2004), which implemented primate surveys and monitoring. Project personnel concluded that project activities had not halted the decline of primate populations in the park, although they may have slowed the decline (Grieser Johns et al. 2004). Dedicated protection of gibbons in the park is now required to ensure their survival (Luu Tuong Bach & Rawson 2011). Previous primate conservation efforts in the park clearly indicate the low levels of interest or commitment among

many stakeholders for primate conservation; nonetheless, efforts to raise awareness and support for primate conservation among communities and local agencies should be continued.

This is the highest priority site identified for protection of *N. leucogenys* in Vietnam and one of the most important for gibbons in Vietnam. This was also the conclusion reached in Geissmann et al. (2000). Given that the population may extend well into Laos, the gibbons in Pu Mat NP may be part of one of the largest global populations of the species.

5.3.11 Huong Son Forest

Location: Huong Son District, Ha Tinh Province

Area: 30,000 hectares

Status criteria: 1a, 2a, 3c, 4c, 5f

Date of most recent survey: 2011

Date of most recent confirmed record: 2011

Minimum population: ≥ 3 groups

Status

The most recent survey in 2011 confirmed at least three groups of gibbons in Son Kim 2 Commune and one group in Son Hong Commune and reports from interviews of a few gibbon groups in the border area with Laos (Nguyen Manh Ha et al. 2011b). Two gibbon groups were recorded in this site in 2005 (Truong Quang Hoc et al. 2005) and at least three groups were recorded in 2004-2005 (Nguyen Manh Ha 2005). In the late 1990s and early 2000s gibbons were recorded on several occasions, two groups in 2001 (Timmins & Trinh Viet Cuong 2001), calls heard in 2001 and an individual sighting in 2000 during surveys for Frontier Vietnam (N. Furey pers. comm.) and earlier still a single captive gibbon was recorded (Pham Nhat and Do Tuoc 1998).

Threats and Conservation Actions

Hunting and habitat loss and degradation are the principal threats to *N. leucogenys* in this site and were commonly seen in all parts of the forest (Nguyen Manh Ha et al. 2011b). Between 1987 and 1992 at least 10 gibbons were apparently hunted in this site by a single hunter (Truong Quang Hoc et al. 2005) and two captive juveniles were observed in 2005 (Nguyen Manh Ha 2005). Prior to its current designation the site was part of the Huong Son State Forestry Enterprise, and was subject to extensive commercial logging. Now the forest is administratively divided into two areas, one part managed by the Huong Son Forestry and Service Company and the other part designated as the 'Ngan Pho River Protection Forest'. Son Kim 1 and Son Kim 2 Communes are separated by a road leading into Laos. Som Kim 2 Commune is next to Vu Quang National Park (see below). Urgent conservation measures are required to protect the remaining gibbons at this site.

5.3.12 Vu Quang National Park

Location: Vu Quang, Huong Son and Huong Khe Districts, Ha Tinh Province

Area: 56,915 hectares

Status criteria: 1a, 2a, 3b, 4c, 5f

Date of most recent survey: 2011

Date of most recent confirmed record: 2011

Minimum population: ≥ 10 groups

Status

A 13 day survey in July 2011 reported at least 10 groups in the north-west of Vu Quang National Park, which may be part of a significantly larger population as the majority of the national park has not been surveyed (Nguyen Manh Ha et al. 2011b). This is much higher than previous records in 2001 and 2004, which recorded three gibbon groups in Huong Khe and Huong Son Districts and two individuals in captivity (Nguyen Manh Ha 2005). Vocalisations were commonly heard in the core zone during elephant surveys in 1993-1994 (Dawson & Do Tuoc 1997). Other fragmentary records from before 2000 are listed in Geissmann et al. (2000).

Threats and Conservation Actions

Hunting and loss of forest habitats due to illegal logging are the principal threats to *N. leucogenys* and other wildlife in this national park. Hunting does not appear to target gibbons, but they are nonetheless occasionally hunted (Nguyen Manh Ha et al. 2011b). Vu Quang National Park maintains a good area of evergreen forest connected with Huong Son forest (see above) to the north and Nakai-Nam Theun National Protected Area (353,200 ha) to the south-west in Laos, where gibbons there are reported to be *N. siki,* although the species needs to be confirmed (MAF 2011). With an apparently large population of *N. leucogenys* for Vietnam and being part of a much larger transboundary conservation landscape, this site should be considered a priority for conservation of *N. leucogenys* in Vietnam. Nakai-Nam Theun NPA is supported with annual payments of US$1 million until 2037 from hydropower dam revenues. In Vietnam, the border area with Nakai-Nam Theun NPA, including Vu Quang National Park, is subject to an FFI project to strengthen transboundary cooperation for biodiversity conservation between the two countries. Further surveys throughout the national park are needed to ascertain the status of gibbons there and to confirm the species based upon records of calls or (less likely) through genetic analysis. Gibbons should be a focal and indicator species for conservation activities in this landscape.

5.3.13 Ke Go Nature Reserve

Location: Huong Khe, Cam Xuyen and Ky Anh Districts, Ha Tinh Province

Area: 21,759 hectares

Status criteria: 1a, 2a, 3b, 4b, 5c

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: 4 groups (≥ 8 individuals)

Status

It is unclear whether the gibbons in this reserve are *N. siki* or *N. leucogenys* although vocal analysis provisionally suggests the former, (Van Ngoc Thinh et al. 2010a), assumptions about distributions of the taxa suggest the latter (Van Ngoc Thinh et al. 2010e). The population in the reserve is very low and near extirpation. In 2010 only four groups of about eight individuals were recorded in scattered locations in the nature reserve, during gibbon surveys covering 22 listening posts (Van Ngoc Thinh et al. 2010a). No more than one group was found at any one location, suggesting the remaining small population is highly fragmented and likely to be no longer viable.

Threats and Conservation Actions

Efforts by the reserve management board to control wildlife hunting have been unsuccessful (Van Ngoc Thinh et al. 2010a). Hunting in the reserve has been further facilitated through the construction of National Roads 21 and 22 (Van Ngoc Thinh et al. 2010a), which have increased hunter access. Logging and habitat clearance occurs in and around the reserve and is degrading gibbon habitats (Le Trong Trai et al. 1999b; Van Ngoc Thinh et al. 2010a). Together Ke Go Nature

Reserve and Khe Net Proposed Nature Reserve encompass more than 40,000 ha, with sufficient habitat to support a significant gibbon population if hunting and habitat loss are controlled and the current population was able to rebound despite likely demographic and genetic obstacles. Ranger patrols will be critical to protect the remaining individuals as, without protection, gibbons may soon be extirpated from this reserve.

5.4 Locations where *Nomascus leucogenys* is Now Considered Absent

5.4.1 Hang Kia-Pa Co Nature Reserve

Location: Mai Chau District, Hoa Binh Province

Area: 7,091 hectares

Status criteria: 1b, 2c, 3b, 4b, 5d

Date of most recent survey: 2009

Date of most recent confirmed record: N/A

Minimum population: provisionally extirpated

Status

Reports in 2009 from residents suggested that gibbons persist in this reserve, but field surveys failed to detect any (Le Khac Quyet & Luu Tuong Bach 2009). Reports collected in 2000 suggested that gibbons were rare in the reserve (Nguyen Xuan Dang et al. 2000). Le Khac Quyet and Luu Tuong Bach (2009) concluded there were no significant populations of gibbons or other large mammals left in the reserve.

Threats and Conservation Actions

Hunting and forest clearance due to shifting agriculture would have been the principle threats to *N. leucogenys* in this site (Duong Coi 1993; Nguyen Xuan Dang et al. 2000; Le Khac Quyet & Luu Tuong Bach 2009). Most valleys in the reserve support local communities and agricultural land, and surrounding forest has been heavily impacted by selective harvesting of timber, especially *Fokienia hodginsii* and *Burretiodendron hsienmu* (Nguyen Manh Ha pers. comm.). Any surviving gibbons are probably under imminent threat of extirpation (Nguyen Manh Ha pers. comm.).

5.4.2 Ngoc Son–Ngo Luong Nature Reserve

Location: Tan Lac and Vu Ban Districts, Hoa Binh Province

Area: 19,254 hectares

Status criteria: 1b, 2c, 3b, 4b, 5d

Date of most recent survey: 2007

Date of most recent confirmed record: N/A

Minimum population: provisionally extirpated

Status

A wildlife survey in 2007 concluded that gibbons were extirpated from the reserve and had been for more than 25 years, due to severe hunting and logging pressures (Le Trong Dat et al. 2008a). A survey in 2003 obtained local reports which indicated *N. leucogenys* might persist (Do Tuoc &

Duong Anh Tuan 2003). Although gibbons were not especially targeted by hunters, some hunters from Ngo Luong believed that drinking gibbon urine would improve their sexual vitality (Cano Alonso & Pham Quang Thien 2010).

Threats and Conservation Actions

In recognition of their likely extirpation and non-viability, gibbons have not been included as a focal species in the conservation plan for the nature reserve (Le Duc Minh & Cano Alonso 2010). No conservation actions are advocated at the current time.

5.4.3 Pu Luong Nature Reserve

Location: Quan Hoa and Ba Thuoc Districts, Thanh Hoa Province

Area: 17,662 hectares

Status criteria: 1c, 2b, 3b, 4b, 5e

Date of most recent survey: 2008

Date of most recent confirmed record: N/A

Minimum population: extirpated

Status

Geissmann et al. (2000) noted it was unlikely that a significant population of *N. leucogenys* remained in this reserve, based on interview surveys in 1998 which suggested the species had been extirpated for over a decade. Primate surveys since 2000, mainly for Delacour's langur *Trachypithecus delacouri*, have failed to record *N. leucogenys* (Nadler et al. 2004; Luong Van Hao & Le Van Hai 2008). Interviews of residents by Le Trong Dat found that gibbons had not been heard for 10-18 years (Nadler et al. 2004). On the basis of this data, Nadler et al. (2004) considered the species to be extirpated.

Threats and Conservation Actions

The species is not mentioned in the reserve's management plan or conservation needs assessment (Anon. 2004a, b) and no conservation actions are advocated at the current time. Reintroduction is not feasible due to continued hunting pressure.

5.4.4 Khe Net Proposed Nature Reserve

Location: Tuyen Hoa District, Quang Binh Province

Area: 23,534 hectares

Status criteria: 1a, 2b, 3b, 4b, 5d

Date of most recent survey: 2010

Date of most recent confirmed record: 2005

Minimum population: provisionally extirpated

Status

It is unclear whether the gibbons in this reserve would be *N. siki* or *N. leucogenys* (Van Ngoc Thinh et al. 2010e), with vocal analysis from neighbouring Ke Go Nature Reserve suggesting the former (Van Ngoc Thinh et al. 2010a) and assumed taxonomic boundaries suggesting the latter (Van Ngoc Thinh et al. 2010e). Surveys in 2010 did not detect any gibbons despite considerable survey effort across areas where gibbons were recorded in previous surveys (Van Ngoc Thinh et al.

2010a). In 2004, two groups were recorded during surveys and local interviews and this was surmised to comprise the total population (Nguyen Manh Ha 2005). In 2001, local residents also reported that only two groups were present, although none were seen during surveys (Le Trong Trai et al. 2001a). Gibbons may now be extirpated from this reserve.

Threats and Conservation Actions

Surveys over the past decade have documented uncontrolled wildlife hunting in the reserve. The site was intensively logged in the 1990s while designated as a state forest enterprise (Nguyen Manh Ha 2005) and illegal logging is ongoing (Van Ngoc Thinh et al. 2010a). Large areas of forest are now degraded and the area of suitable gibbon habitat has been reduced (Nguyen Manh Ha 2005). Should gibbons be rediscovered in the reserve, options for conservation are limited due to these factors. This nature reserve is contiguous with Ke Go Nature Reserve (see above) where a few scattered groups remain and the population is probably no longer viable.

5.5 Sites with No New Data Since 2000

Sites which had confirmed or provisional records for *N. leucogenys* between 1995 and 2000 as listed in Geissmann et al. (2000) and for which there have been no gibbon records since that time are listed in Table 5 below.

Table 5. Sites with no new data for *N. leucogenys*.

Site	Most recent record
Thanh Hoa Province	
Thach Tuong Commune	Last record by interview in 1999

Chapter 6

Southern white-cheeked gibbon *Nomascus siki*

Male *Nomascus siki*
Photo: Terry Whittaker

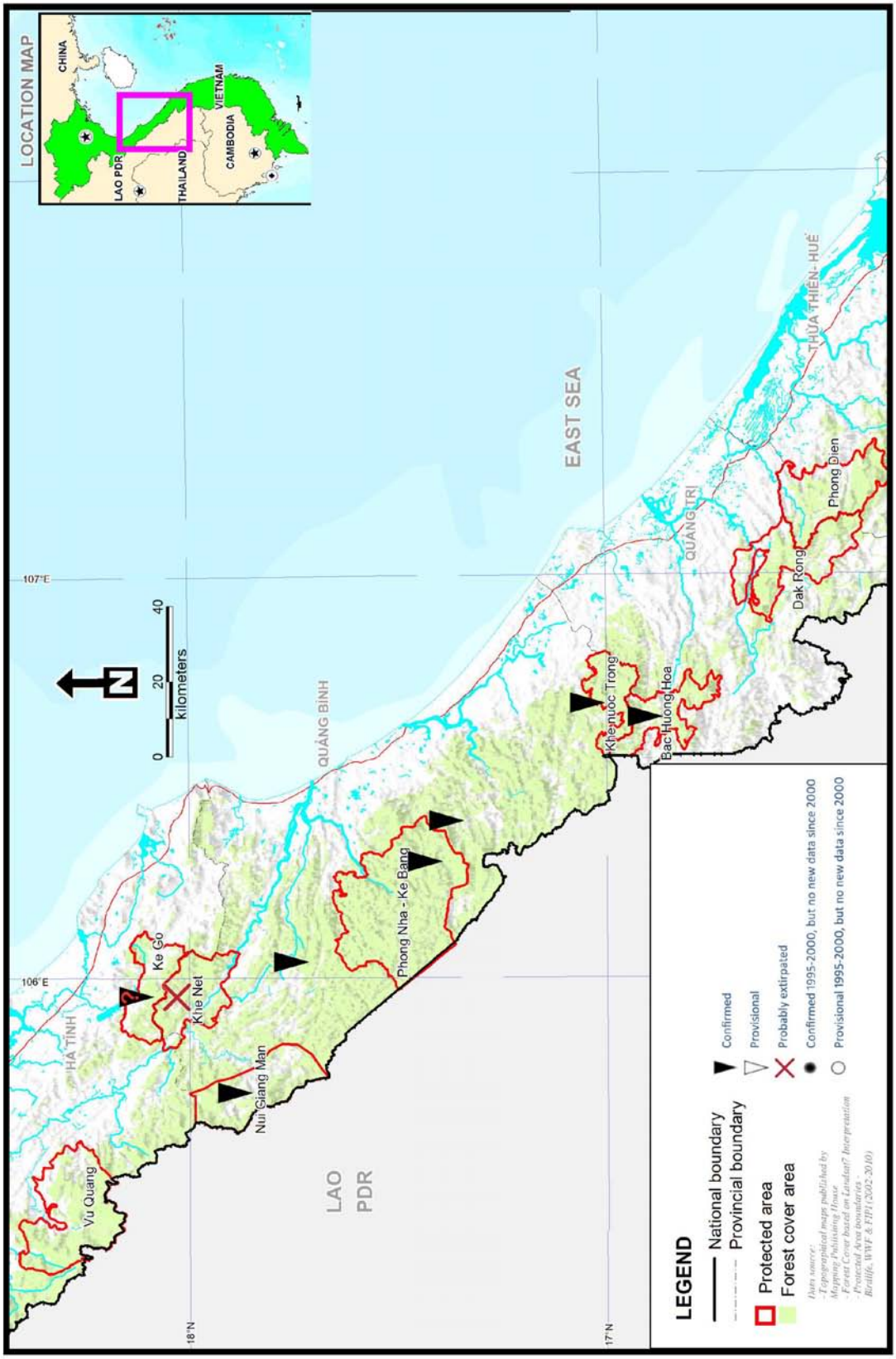


Figure 6. Map of records of *Nomascus siki* in central Vietnam

6 Southern White-cheeked Gibbon *Nomascus siki* (Delacour, 1951)

Other English names: southern white-cheeked crested gibbon, siki gibbon

Vietnamese names: vượn má trắng nam, vượn đen má trắng, vượn bạc má, vượn hót, vượn đen siki, vượn đen má hung

IUCN Red List Category and Criteria: Endangered A2cd (ver. 3.1)

2007 Vietnam Red Data Book Category and Criteria: Endangered A1cd C2a

Legislative status in Vietnam: Decree 32/2006 ND-CP: 1B (considered a sub-species of *N. leucogenys*)

CITES: Appendix I

6.1 Global Status and Distribution

Nomascus siki occurs within a small region of central Vietnam and Laos, where its range is limited by the Mekong River in the west and Vietnam's coastal agricultural areas in the east (Geissmann et al. 2000). The taxonomic status of *N. siki* has received inconsistent treatment by various authors and this warrants caution in the assessment of records for this species. *Nomascus siki* was originally considered a subspecies of *N. concolor* (Groves 1972; Dao Van Tien 1983), was later reclassified as a subspecies of *N. gabriellae* (Groves & Wang Yingxiang 1990) and then of *N. leucogenys* (Geissmann 1993, 1994, 1995; Geissmann et al. 2000; Roos 2004; Roos et al. 2007) and subsequently elevated to species status (Zhang 1997; Groves 2001; Mootnick 2006; Geissmann 2007b; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e; Mootnick & Fan Pengfei 2011; Van Ngoc Thinh et al. 2011). Based on genetic and vocal data throughout the range of *Nomascus* taxa, the distribution of *N. siki* has been revised, with a considerable reduction in its range (Van Ngoc Thinh et al. 2010e). The species may now warrant listing as 'Critically Endangered' and a reassessment of its IUCN Red List status is required. There is no global population estimate for *N. siki* populations in Laos although it is thought to be larger than in Vietnam (Geissmann et al. 2000; Duckworth 2008). All populations are threatened due to hunting and habitat degradation.

In Laos, *N. siki* is thought to occur from Nam Kading National Protected Area (NPA), south of the Kading River, in the north to at least Phou Xang He NPA in the south, and possibly further south to Dong Phou Vieng NPA (Van Ngoc Thinh et al. 2010e). No population estimates exist for the species in Laos, however there are several likely significant populations in areas under active management, including those in Nam Kading NPA and Nakai-Nam Theun NPA (athough species assignation is not yet clear for this site), and others in areas with good natural protection such as Phou Hin Boun NPA and Hin Nam No NPA (Duckworth 2008; Hallam pers. comm.).

In Vietnam, *N. siki* occurs in parts of Ha Tinh, Quang Binh and Quang Tri Provinces. Populations have been documented in six sites: two protected areas (Phong Nha-Ke Bang National Park, Bac Huong Hoa Nature Reserve), two proposed nature reserves (Khe Ve, Giang Man) and two state forest enterprises (Truong Son, Khe Giua).

6.2 Summary of Status and Distribution in Vietnam

6.2.1 Change in Status Since 2000

Considerable new information on the taxonomy, distribution and ecology of *N. siki* in Vietnam has been documented since the first Vietnam status review of gibbons (Geissmann et al. 2000). *Nomascus siki* was previously thought to occur in five provinces of north-central Vietnam, with northern and southern distribution limits thought to be the Ca River (Nghe An Province) and Bach Ma National Park (Thua Thien Hue Province) respectively (Dao Van Tien 1983; Geissmann et al. 2000; Pham Nhat 2002). However, as a result of its elevation to species status and the splitting of a new central Vietnamese form (*N. annamensis*), its national distribution has been reduced to a small region from Ha Tinh Province in the north to approximately the Thach Han River in the south (Van Ngoc Thinh et al. 2010c). The northern distributional limit of *N. siki* in Vietnam is unknown; the boundary region between *N. siki* and *N. leucogenys* appears to lie near Khe Net Proposed Nature Reserve (Quang Binh Province) and Ke Go Nature Reserve (Ha Tinh Province), but the taxonomic status of the gibbon populations in these sites has not yet been determined (Van Ngoc Thinh et al. 2010a; Van Ngoc Thinh et al. 2010e).

Since 2000, surveys for *N. siki* have been conducted in all sites in Vietnam where the species is known to occur. Despite this, few conservation activities to protect remaining populations have been initiated. There is currently no dedicated protection or monitoring of *N. siki* in any site in Vietnam. Uncontrolled hunting and habitat loss remain the greatest threats to *N. siki*. The species is in decline throughout its national range and there are no clear instances of conservation success, either directly or as part of other biodiversity initiatives. Populations in Phong Nha-Ke Bang National Park may be stable, but this is unclear as baseline data for some parts of the park have only become available in recent years.

6.2.2 Key Sites for Conservation

Two large forest complexes, the Phong Nha-Ke Bang National Park-Truong Son State Forest Enterprise and Khe Giua State Forest Enterprise-Bac Huong Hoa Nature Reserve complexes, support most of the known *N. siki* population in Vietnam. Collectively these sites extend between Quang Binh and Quang Tri Provinces, and are contiguous with forest in Laos where *N. siki* occurs including Hin Nam No NPA. Other populations comprise scattered and isolated groups in designated and proposed nature reserves. Khe Ve and Giang Man Proposed Nature Reserves support small populations, but they are isolated by rural development and cultivation.

6.2.3 Threats

Hunting continues to be the principle threat to *N. siki* in Vietnam and is resulting in the gradual extirpation of the species in some sites. There is no data on the numbers of individuals hunted over time and trends in hunting of this species (stable, increasing or decreasing) are unknown. It is clear that efforts over the past decade to control the hunting of gibbons (and much other wildlife) in Vietnam have largely failed. In most sites, the impact of hunting has been compounded by ongoing loss and degradation of forest habitats, as well as the very small size and isolation of most populations. Remnant gibbon groups are vulnerable to genetic depression due to low numbers of individuals and stochastic events such as disease and extreme weather events.

6.2.4 Ongoing Conservation Actions

Conservation efforts of the Forest Protection Department to manage forests and reduce illegal hunting/trade of wildlife has contributed important (but unquantifiable) aid for the survival of *N. siki*, however, to date, most *N. siki* populations receive little protection and continue to be hunted. Relatively extensive primate conservation efforts in Phong Nha-Ke Bang National Park including conservation awareness, primate rescue and research have been supported by several international organizations (Cologne Zoo, Frankfurt Zoological Society, FFI, KfW and WWF).

6.2.5 Priority Conservation Actions

Controlling the hunting of *N. siki* is the most important action for all remaining populations of this species in Vietnam. Hunting of gibbons is so prevalent that dedicated ranger patrols are required to protect remaining gibbon populations. The most important sites for active protection and monitoring of *N. siki* are Phong Nha-Ke Bang National Park and Bac Huong Hoa Nature Reserve, and funding and technical efforts should focus initially on these sites. In other sites with potentially key populations, especially Khe Ve and Giang Man Proposed Nature Reserves, new assessments of gibbon status are required to inform the development of protection measures. Within state forest enterprises which support *N. siki*, sustainable logging practices and the inclusion of biodiversity conservation in site logging plans is required. A national monitoring programme for *N. siki* should be implemented.

Surveys in Phong Nha-Ke Bang National Park, Bac Huong Hoa Nature Reserve, Giang Man Proposed Nature Reserve and Khe Giua State Forest Enterprise have been incomplete. These sites may support undocumented gibbon populations and further surveys are required to provide more complete population estimates.

6.3 *Nomascus siki* Records in Vietnam

6.3.1 Khe Ve Proposed Nature Reserve

Location: Tuyen Hoa and Minh Hoa Districts, Quang Binh Province

Area: 10,000 hectares

Status criteria: 1a, 2c, 3c, 4c, 5f

Date of most recent survey: 2004

Date of most recent confirmed record: 2004

Minimum population: ≥ 7 groups

Status

In 2004 at least seven groups of gibbons were recorded in this site, which is thought to hold the last remaining *N. siki* in Tuyen Hoa District (Nguyen Manh Ha 2005). The reserve and its gibbon population are isolated by cleared and cultivated lands and two highways, National Road No. 20 and the Ho Chi Minh Highway.

Threats and Conservation Actions

Hunting, logging and land encroachment from slash-and-burn agriculture are the principle threats to *N. siki* in this site (Nguyen Manh Ha 2005). Remaining forests outside the reserve are being rapidly cleared for cultivation. Establishment of a management board and implementation of ranger patrols are needed to protect the reserve.

6.3.2 Giang Man Proposed Nature Reserve

Location: Minh Hoa District, Quang Binh Province and Huong Son District, Ha Tinh Province

Area: 60,000 hectares

Status Criteria: 1a, 2c, 3c, 4c, 5f

Date of most recent survey: 2004

Date of most recent confirmed record: 2004

Minimum population: ≥ 5 groups

Status

Little is known of the status of gibbons in this site, although five gibbon groups were recorded in 2003 and 2004 (Le Khac Quyet 2003; Nguyen Manh Ha 2005). Much of the site is forested and remains to be surveyed so the site may contain a considerably larger population than is known.

Threats and Conservation Actions

Hunting, logging and land encroachment are the principle threats to *N. siki* in this site. Forest outside the site is being rapidly cleared for cultivation and its gibbons are increasingly isolated. Local communities rely heavily on forest resources in the proposed reserve for subsistence, including collection of non-timber forest products, illegal logging and wildlife trade which includes primates (Le Khac Quyet 2004). There is currently little management activity to protect the forest or its wildlife. Legal designation, establishment of a management board and implementation of ranger patrols are urgent priorities for this site.

6.3.3 Phong Nha-Ke Bang National Park

Location: Bo Trach and Minh Hoa Districts, Quang Binh Province

Area: 85,754 hectares

Status criteria: 1a, 2a, 3a, 4a, 5f

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: ≥ 50 groups

Status

No complete census of *N. siki* in Phong Nha-Ke Bang National Park has been undertaken, but the park clearly supports one of the largest *N. siki* populations in Vietnam and possibly globally. At least nine gibbon or other primate surveys were conducted between 1997 and 2009 in the park, but surveys were conducted in different areas, varied in objectives and utilised different methods (Nguyen Xuan Dang et al. 1998; Le Khac Quyet et al. 2002; Ruppell 2007; Haus et al. 2009; Le Trong Dat et al. 2009). Haus et al. (2009) reported a site wide population estimate of 18±18 groups, however small sample size (only 1 group recorded), non-random sampling protocol and further survey work demonstrate this estimate is erroneous. A survey in early 2009 in the south-east of the park recorded 37 groups with 101 individuals over less than 5,400 ha, yielding a group density of 0.69 groups km^{-2} (Le Trong Dat et al. 2009). This area contains non-limestone primary forest and may be more suitable habitat than the limestone karst forest which dominates the rest of Phong Nha-Ke Bang National Park. Ruppell (2007) recorded 13 groups of gibbons between km 40 and km 52 of the main service road in the park. Collectively, these records suggest at least 50 groups occur in the park, but this does not include the large park interior, which comprises largely inaccessible limestone karst formations and may contain significant numbers of gibbons. Despite

these vagaries, the park's *N. siki* population is among the most well-documented for the species. The park is contiguous with Hin Nam No NPA in Laos and collectively they form the largest area of continuous limestone karst mountains in Indochina. Due to its relative inaccessibility this region probably provides a good level of protection to wildlife in general.

Threats and Conservation Actions

Hunting and habitat loss due to illegal logging are the principle threats to *N. siki* in this site. Little direct evidence of hunting of *N. siki* has been documented, but intensive hunting of other primates occurs (Le Khac Quyet et al. 2002; Nguyen Phi Truyen & Roberton 2004; Roberton 2004; Ruppell 2007; Haus et al. 2009). Macaques are targeted for the production of monkey bone balm and gibbons may also be hunted for this reason (Roberton 2004). Illegal logging targets high-value timber species, and rising timber prices have resulted in increasing numbers of people entering the park to extract timber. Conservation activities are hindered by increasing tensions between the park management board and local communities over the board's attempts to control wildlife hunting and logging in the park.

The park has received small but continuous international support for primate conservation over the past decade. FFI has conducted wildlife trade studies and community awareness projects to raise local support for conservation of gibbons and other primates. Cologne Zoo, FFI and Frankfurt Zoological Society have supported the funding and training of ranger patrols with primates as priority species for protection. Cologne Zoo and Frankfurt Zoological Society have supported primate re-introduction and wildlife rescue/rehabilitation in the park. From 2008-2015, a large project, 'Sustainable Natural Resource Management of the Phong Nha-Ke Bang Region' (funded by the German Development Bank (KfW) and German Technical Cooperation) is being implemented and has gibbons among its flagship species for biodiversity conservation.

6.3.4 Truong Son State Forest Enterprise

Location: Quang Ninh District, Quang Binh Province

Area: 40,156 hectares

Status: 1a, 2c, 3c, 4c, 5f

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: ≥ 10 groups

Status

Biodiversity surveys in this site in 2006 recorded nine groups of gibbons from around areas of human habitation (Le Trong Dat & Le Thien Duc 2006) and in 2009 one additional group was recorded (Le Trong Dat et al. 2009). The site is contiguous with Phong Nha-Ke Bang National Park and Khe Giua State Forest Enterprise and may support a relatively large population of *N. siki* (Le Trong Dat & Le Thien Duc 2006), although this remains to be confirmed.

Threats and Conservation Actions

Hunting and large-scale commercial logging are the principle threats to *N. siki* at this site. Most of the site has been selectively logged, and illegal logging by local communities is common (Le Trong Dat & Le Thien Duc 2006; Le Trong Dat et al. 2009). As a state forest enterprise, the site is not subject to conservation regulations applied to protected areas. For this site and Khe Giua State Forest Enterprise, sustainable logging practices and the inclusion of biodiversity conservation in site logging plans is required. Conservation planning at landscape level is required to consolidate the protection of gibbon populations in the overall forest complex

encompassing the Truong Son and Khe Giua State Forest Enterprises and Phong Nha-Ke Bang National Park.

6.3.5 Khe Giua State Forest Enterprise

Location: Le Thuy District, Quang Binh Province

Area: 150,000 hectares

Status criteria: 1a, 2c, 3c, 4c, 5f

Date of most recent survey: 2004

Date of most recent confirmed record: 2006

Minimum population: ≥ 4 groups

Status

In January 2006, one group of gibbons was heard close to the Khe Giua SFE guard station along the Ho Chi Minh Highway (A.W. Tordoff pers. comm.). Between 2000 and 2005 at least four groups of *N. siki* were recorded in this site (Le Manh Hung et al. 2002b; Nguyen Manh Ha 2005), but surveys only covered the south-west (about 20,000 ha of the site). Additional populations may occur in other areas. The site is connected with the Bac Huong Hoa Nature Reserve and Truong Son State Forest Enterprise.

Threats and Conservation Actions

Hunting and large-scale commercial logging are the principle threats to *N. siki* in this site. As a state forest enterprise, the site is not subject to conservation regulations applied to protected areas. Areas in the eastern portion of the enterprise may no longer be suitable for gibbons due to logging. Levels of human disturbance in parts of the forest are high (Nguyen Manh Ha 2005). Gold mining camps are located along the border of the state forest enterprise. Illegal logging by local communities is common, and intensive wildlife hunting is conducted by local communities, logging staff and miners (Le Manh Hung et al. 2002b; Nguyen Manh Ha 2005). The Ho Chi Minh Highway intersects part of the site, which has increased access for hunters and illegal transport of wildlife and timber. Sustainable logging practices and the inclusion of biodiversity conservation in site logging plans is required, particularly to control wildlife hunting. The 19,188 ha Khe Nuoc Trong Nature Reserve is being established comprising parts of this SFE.

6.3.6 Bac Huong Hoa Nature Reserve

Location: Huong Hoa District, Quang Tri Province

Area: 25,200 hectares

Status criteria: 1a, 2c, 3a, 4c, 5f

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: ≥ 23 groups

Status

Surveys have been relatively extensive in this nature reserve. In 2008 and 2009, 11-15 gibbon groups (25 to 40 individuals) were recorded over about 10,000 ha of this reserve (Nguyen Manh Ha & Nguyen Ngoc Tuan 2008). In 2007-2008 Le Trong Dat et al. (2008b) recorded 23 groups in five communes included in Bac Huong Hoa Nature Reserve, with some additional groups found in surrounding communes. Previously, gibbons had been reported by local residents and occasional

field records (Le Manh Hung et al. 2002a; Dang Ngoc Can 2004; Mahood & Tran Van Hung 2008). The reserve is contiguous with Khe Giua State Forest Enterprise and together they form one of the most important landscapes for *N. siki* in Vietnam, encompassing over 180,000 ha of forested lands.

Threats and Conservation Actions

Much of the forest in the reserve remains relatively intact and gibbons do not appear to be intensively hunted, although local communities frequently hunt other wildlife, extract timber and collect non-timber forest products (Le Manh Hung et al. 2002a; Le Trong Dat et al. 2008b; Nguyen Manh Ha & Nguyen Ngoc Tuan 2008) . Aside from gibbon surveys, no other gibbon conservation activities have been implemented in the reserve. Priority conservation actions for this site include a complete gibbon census and ranger patrols to reduce wildlife hunting and logging. These activities should be coordinated with similar efforts in the adjacent Khe Giua State Forest Enterprise and Khe Nuoc Trong Nature Reserve.

6.4 Locations where *Nomascus siki* is Now Considered Absent

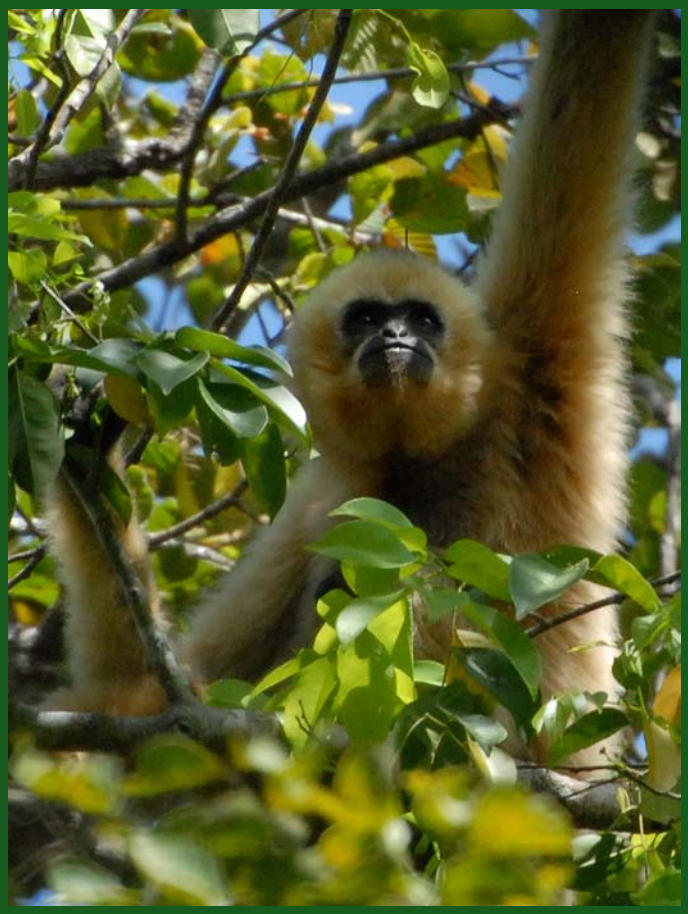
There are no confirmed or provisional extirpations of *N. siki* post 2000 based on survey data.

6.5 Sites with No New Data Since 2000

All locations in Vietnam known to support *N. siki* have been surveyed at least once since 2000.

Chapter 7

Northern yellow-cheeked gibbon
Nomascus annamensis



Female *Nomascus annamensis*
Photo: Ben Rawson / CI

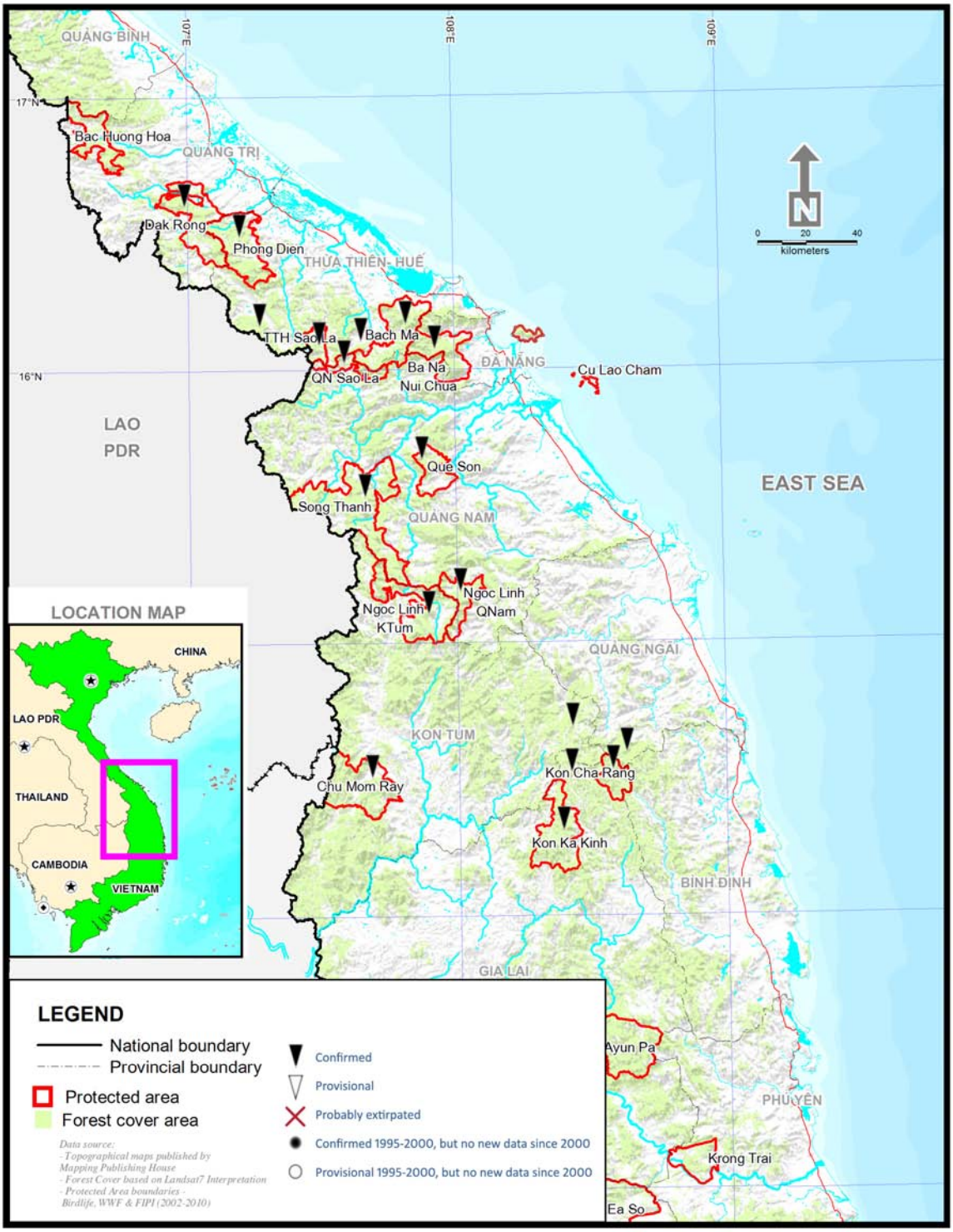


Figure 7. Map of records of *Nomascus annamensis* in central Vietnam

7 Northern Yellow-cheeked Gibbon *Nomascus annamensis* Van Ngoc Thinh, Mootnick, Vu Ngoc Thanh, Nadler & Roos, 2010

Other English names: northern buff-cheeked crested gibbon; annamites crested gibbon

Vietnamese name: vượn Trường Sơn

IUCN Red List Category and Criteria: not evaluated

2007 Vietnam Red Data Book Category and Criteria: not evaluated

Legislative status in Vietnam: Not listed in Decree 32/2006 ND-CP

CITES: Appendix I

7.1 Global Status and Distribution

Nomascus annamensis is the most recently described *Nomascus* gibbon species (Van Ngoc Thinh et al. 2010c). The species was previously treated as either *N. gabriellae*, which it resembles morphologically, or *N. siki* which it resembles vocally (Konrad & Geissmann 2006; Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010d). Based on both genetic and vocal analysis, the species was determined to be distinct from both of these forms and subsequently described (Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e). For a full discussion of the taxonomy of this species see Chapter 9. *Nomascus annamensis* occurs east of the Mekong River, in central and southern Laos and Vietnam and north-east Cambodia.

In Laos, *N. annamensis* occurs in the central and southern provinces of Attapu, Champasak, Salavan, Savannakhet and Xekong (Van Ngoc Thinh et al. 2010e). Laos may support the largest global populations of *N. annamensis*, although there is little population data for the country (Duckworth 2008). In Cambodia, *N. annamensis* occurs north of the Srepok River (about 13°30′ N) in Stung Treng and Rattanakiri Provinces (Van Ngoc Thinh et al. 2010b). The largest Cambodian population may be in Virachey National Park (Traeholt et al. 2005; Rawson 2010), while the contiguous Veun Sai-Siem Pang Conservation Area forest block south of this park supports approximately 500 groups (B. Rawson unpubl. data).

In Vietnam, *N. annamensis* is distributed from approximately the Thach Han River (about 16°40′-16°50′ N) in Quang Tri Province in the north of its distribution to the Ba River (about 13°00′-13°10′N), which flows through Gia Lai and Phu Yen Provinces, in the south.

7.2 Summary of Status and Distribution in Vietnam

7.2.1 Change in Status Since 2000

Nomascus annamensis is the only 'new' gibbon species to be described since the first Vietnam status review of gibbons (Geissmann et al. 2000). Over the past decade, considerable new information on the status and distribution of gibbons considered to be *N. siki* and *N. gabriellae* was collected as part of research on vocalizations and its genetic status (Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2010e). This has resulted in the subsequent description of *N. annamensis* and confirmation of its occurrence in at least nine provinces (Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e), and in at least 11 designated protected areas, two proposed nature reserves and two watershed management areas.

7.2.2 Key Sites for Conservation

The largest known population of *N. annamensis* in Vietnam occurs in Dak Rong and Phong Dien Nature Reserves (Nguyen Manh Ha 2007, 2009). These reserves are contiguous and together contain approximately 80,000 ha of forested areas suitable for gibbons. These nature reserves and surrounding districts in Quang Tri and Thua Thien Hue Provinces have been subject to considerable biodiversity surveying and monitoring over the past decade, so in some way it is not surprising that the largest known population is in this area. Two other forest complexes where less survey work has been carried out may also support important populations of *N. annamensis*; these are the Song Thanh and Ngoc Linh Nature Reserves in Quang Ngai and Quang Nam Provinces, and Kon Ka Kinh National Park, Kon Cha Rang Nature Reserve and surrounding production forests in Kon Tum Province.

7.2.3 Threats

Hunting and habitat loss are the principle threats to *N. annamensis* in Vietnam. The species is hunted to supply commercial demand from the pet trade and zoos, traditional medicine and local consumption (Nguyen Manh Ha 2005; Van Ngoc Thinh et al. 2007; Nguyen Quang Hoa Anh et al. 2010). However, the threat from the pet trade may be less than for *N. gabriellae*, as a genetic analysis of confiscated yellow-cheeked gibbons showed only 8% (N=80) were *N. annamensis*, with the remainder being *N. gabriellae* (C. Roos pers. comm.). Loss and fragmentation of forest habitats due to legal and illegal logging, conversion for agriculture, and construction of roads and hydroelectric dams, is occurring throughout the national range of *N. annamensis* (Nguyen Manh Ha 2005; Nguyen Quang Hoa Anh et al. 2010). Several dams are planned or already built near reserves which support this species. Road construction in and near reserves with *N. annamensis* is causing loss and fragmentation of gibbon habitats and increasing access for hunters.

7.2.4 Ongoing Conservation Actions

Most *N. annamensis* populations receive little protection. A five-year (2011-2015) conservation project by WWF in the 'Central Annamites' and 'Southern Laos' landscapes includes *N. annamensis* as a priority species for the development of protection and monitoring activities (WWF 2010).

7.2.5 Priority Conservation Actions

Controlling the hunting of *N. annamensis* is the most important action for all remaining populations of this species in Vietnam. Environmental impact studies should be conducted for all proposed dam and road construction projects in sites with confirmed populations of *N. annamensis*, and measures to avoid or mitigate development impacts should be implemented by relevant district and provincial agencies. Further research is required on the distributional boundaries between *N. annamensis* and *N. siki*, which remain unclear (see account for *N. siki*).

7.3 *Nomascus annamensis* Records in Vietnam

7.3.1 Dak Rong Nature Reserve

Location: Dak Rong District, Quang Tri Province

Area: 37,640 hectares

Status criteria: 1a, 2a, 3a, 4b, 5f

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 56 groups

Status

This site is contiguous with Phong Dien Nature Reserve in Thua Thien Hue Province (see below). Collectively these sites encompass some of the largest remaining areas of lowland evergreen forest in the Annamite ranges (Le Trong Trai et al. 1999d). Recently surveys carried out in the previously unsurveyed border area between Dak Rong and Phong Dien Nature Reserves recorded 20 groups which, when compiled with earlier records, suggest that at least 56 groups of *N. annamensis* persist in Dak Rong Nature Reserve alone (Nguyen Quang Hoa Anh et al. 2010). In 2006, 12 groups were recorded during a survey (Nguyen Manh Ha 2007). Surveys in 2003-2004 recorded 21 groups directly, with as many as 30 estimated for the site as a whole (Nguyen Manh Ha 2005). The Dak Rong-Phong Dien Nature Reserves complex may support one of the largest populations of *N. annamensis* in Vietnam and is of conservation significance for this species (Nguyen Manh Ha 2007; Nguyen Quang Hoa Anh et al. 2010).

Threats and Conservation Actions

Intensive hunting of wildlife occurs in the reserve and may be a principle threat to *N. annamensis*, although the extent of any gibbon hunting is unknown. Illegal extraction of timber is ongoing as is illegal gold mining (Nguyen Quang Hoa Anh et al. 2010) A hydroelectric dam is currently proposed for construction within the core zone of the reserve. It would flood more than 50 ha of forest (Nguyen Quang Hoa Anh et al. 2010) and cause associated threats such as habitat loss due to construction or widening of access roads and hunting by construction workers. An environmental impact assessment for this dam proposal and the development of mitigation measures to avoid or offset impacts to gibbon habitats is urgently required and should involve raising the awareness of decision-making agencies about the global conservation values of the reserve. The most effective approach for gibbon conservation in these two reserves should entail joint management activities, including ranger patrols, gibbon monitoring and the exchange of survey data.

7.3.2 Phong Dien Nature Reserve

Location: Phong Dien and A Luoi Districts, Thua Thien Hue Province

Area: 30,262 hectares

Status criteria: 1a, 2a, 3a, 4b, 5f

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 26 groups

Status

This site is contiguous with Dak Rong Nature Reserve in Quang Tri Province (see above). In 2010 surveys conducted close to the border with Dak Rong Nature Reserve, returned nine new records, which suggested a total known population of 26 groups when including previous records (Nguyen Quang Hoa Anh et al. 2010). Between 2005 and 2007, 17 groups were recorded during primate surveys (Van Ngoc Thinh et al. 2007) and only two groups were recorded in 2003 (Nguyen Manh Ha 2005). Together Dak Rong and Phong Dien Nature Reserves may support one of the largest national populations of *N. annamensis* and this area is of high conservation importance for this species.

Threats and Conservation Actions

Hunting with guns is apparently now uncommon in the province (Van Ngoc Thinh et al. 2007), however gibbon numbers were considered by local hunters to have declined in the decades prior to 2001 as a result of hunting pressure for local consumption and medicine (Le Trong Trai et al.

2001b). Illegal logging is still common however and may pose a threat to gibbon habitat at the site (Van Ngoc Thinh et al. 2007; Nguyen Quang Hoa Anh et al. 2010). Few conservation activities are currently being implemented in the reserve. The most effective approach for gibbon conservation in this reserve should entail joint management activities with Dak Rong Nature Reserve, including ranger patrols, gibbon monitoring and the exchange of survey data.

7.3.3 A Luoi Watershed Protection Forest

Location: A Luoi District, Thua Thien Hue Province

Area: 29,838 hectares

Status criteria: 1a, 2c, 3c, 4b, 5f

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: ≥ 8 groups

Status

This site was originally part of a state forest enterprise and was logged between 1985 and 2005, before being designated as a watershed protection forest. Eight gibbon groups were recorded in the site in 2007 (Van Ngoc Thinh et al. 2007). Some additional groups occur in A Luoi District outside of this site and Phong Dien Nature Reserve (Van Ngoc Thinh et al. 2007; Nguyen Quang Hoa Anh et al. 2010). Survey coverage of the site is not complete and the total gibbon population is unknown.

Threats and Conservation Actions

Intensive hunting and loss of forest habitats due to illegal logging are the principle threats to *N. annamensis* in this site (Van Ngoc Thinh et al. 2007). Due to its designation as a watershed protection forest the site is not managed for biodiversity conservation, staff are not trained in wildlife management and no rangers are present. A priority is to identify ways in which biodiversity conservation may be included within the management objectives and activities for the site. Potential approaches include working with the management board to raise awareness of conservation values, drafting new objectives into annual management plans, and provision of ranger patrols to work alongside staff.

7.3.4 Thua Thien Hue Saola Nature Reserve

Location: A Luoi and Nam Dong Districts, Thua Thien Hue Province

Area: 12,153 hectares

Status criteria: 1a, 2c, 3a, 4b, 5f

Date of most recent survey: 2007

Date of most recent confirmed record: 2010

Minimum population: ≥ 14 groups

Status

This site borders the Saola Nature Reserve in Quang Nam Province (see below). Recent surveys suggest at least 14 gibbon groups occur in this reserve (Van Ngoc Thinh et al. 2007; Nguyen Quang Hoa Anh et al. 2010), although survey coverage is incomplete and the total gibbon population is unknown.

Threats and Conservation Actions

Hunting and loss and disturbance of forest habitats due to highway construction, illegal logging, collection of non-timber forest products and gold mining are the principle threats to *N. annamensis* in this site. Part of the Ho Chi Minh Highway was constructed within the core zone of the reserve and caused loss and fragmentation of gibbon habitat. Illegal gold mining in the core zone of the reserve is causing human disturbance of forest habitats as well as stream pollution. The reserve is part of an ongoing landscape conservation project by provincial agencies and WWF to strengthen protected area management and livelihoods for local communities, and has included gibbon surveys, conservation education programmes and training of rangers.

7.3.5 Quang Nam Saola Nature Reserve and surrounding areas

Location: Dong Giang and Tay Giang Districts, Quang Nam Province

Status criteria: 1c, 2c, 3b, 4b, 5f

Area: 11,732 hectares

Date of most recent survey: 2005

Date of most recent confirmed record: 2005

Minimum population: unknown

Status

To the north, this site borders the Saola Nature Reserve in Thua Thien Hue Province (see above) and was only gazetted in April 2011. No gibbon surveys have been conducted in this site and surveys focused on saola *Pseudoryx nghetinhensis* in parts of the reserve have not detected gibbons to date (N. Wilkinson; B. Long pers. comm.) and interview surveys for wildlife returned no records of gibbons (B. Long pers. comm.). Gibbons occur in nearby localities in Quang Nam Province (Minh Hoang et al. 2005) and it is likely they also occur within this site. In 2005, 30 gibbon groups were recorded in 13 widespread locations in nearby localities (Minh Hoang et al. 2005) and in 1997, gibbons were documented within Dong Giang District and other nearby districts (Wikramanayake et al. 1997). The status of any gibbon populations is unknown and it appears that the population actually within this reserve is insignificant (B. Long pers. comm.).

Threats and Conservation Actions

The site is unlikely a priority for gibbon conservation and gibbon surveys are not required (B. Long pers. comm.). For any gibbon groups which do exist at the site, hunting will almost certainly be a critical threat; hunting is widespread in Dong Giang and Tay Giang Districts, but reportedly decreasing, possibly due to the decline or extirpation of primates and other wildlife (Minh Hoang et al. 2005). Few conservation actions are currently being implemented in this site, however WWF has begun providing support for ranger patrols (N. Wilkinson pers. comm.). The establishment of a management board, strengthened ranger patrols and conservation education activities will be important actions for site management.

7.3.6 Nam Dong Watershed Protection Forest

Location: Nam Dong District, Thua Thien Hue Province

Area: 17,604 hectares

Status criteria: 1a, 2c, 3b, 4b, 5f

Date of most recent survey: 2007

Date of most recent confirmed record: 2007

Minimum population: ≥ 4 groups

Status

This site originally comprised two state forest enterprises (Khe Tre and Nam Dong) and was subjected to commercial logging before it was re-designated as a watershed protection forest in 2005. Four gibbon groups were recorded in the site in 2007 (Van Ngoc Thinh et al. 2007). Survey coverage of the site is not complete and the total gibbon population is unknown.

Threats and Conservation Actions

Intensive hunting of wildlife and loss of forest habitats due to illegal logging and collection of fuelwood and non-timber forest products are the principle threats to *N. annamensis* in this site (Van Ngoc Thinh et al. 2007). Due to its designation as a watershed protection forest the site is not managed for biodiversity conservation; staff are not trained in wildlife management and no rangers are present. A priority is to identify ways in which biodiversity conservation may be included within the management objectives and activities for the site. Potential approaches include working with the management board to raise awareness of conservation values, drafting new objectives into annual management plans, and provision of ranger patrols to work alongside staff.

7.3.7 Bach Ma National Park

Location: Phu Loc and Nam Dong Districts, Thua Thien Hue Province and Dong Giang District, Quang Nam Province

Area: 37,487 hectares

Status criteria: 1a, 2b, 3b, 4b, 5f

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 8 groups

Status

In 2007, five gibbon groups were recorded in an area of 1,000 ha in Bach Ma National Park (Van Ngoc Thinh et al. 2010d). Previously, eight groups were recorded in 2001, including two solitary males, in an area of 600 ha (Tallents et al. 2001a; Geissmann et al. 2007). Based on surveys in 1990-1991, Eames and Robson estimated a total population for the park of 23-30 animals. Survey coverage of the site is not complete and the total gibbon population is unknown as are populations trends, although two groups detected in 1991 were not redetected in 2001 (Robson et al. 1991; Tallents et al. 2001a).

Threats and Conservation Actions

Intensive hunting and loss of forest habitats due to illegal logging, collection of fuelwood and non-timber forest products are the principle threats to *N. annamensis* in this site and large areas of the park have been deforested due to these activities (Tordoff et al. 2004). Priority actions include technical training of the management board and other staff, to increase capacity for management, patrolling, and monitoring of primates and other threatened wildlife.

7.3.8 Ba Na-Nui Chua Nature Reserve

Location: Hoa Vang District, Da Nang Province

Area: 38,210 hectares

Status criteria: 1a, 2b, 3c, 4b, 5f

Date of most recent survey: 2006

Date of most recent confirmed record: 2006

Minimum population: unknown

Status

Gibbons were heard calling in the reserve in 2006, during a brief, general wildlife survey (Nguyen Vu Khoi and Vu Ngoc Thanh unpublished data). This is the only data available on gibbons in this reserve since the 2000 gibbon status review (Geissmann et al. 2000). Information prior to 2000 suggests gibbons occurred in the centre of the reserve (Anon. 1994b; Ghazoul et al. 1994), but little other data was collected. The reserve is managed as a mountain retreat resort, which may provide some incidental protection from hunting and has also resulted in the persistence of some relatively intact forest. It seems likely that gibbons persist in the reserve.

Threats and Conservation Actions

Some parts of the reserve have been cleared for agriculture, while other areas were degraded by Agent Orange herbicides during the American War in Vietnam and now support grasslands (Hill et al. 1996). A gibbon survey is required to assess the population size and status of *N. annamensis* in the reserve.

7.3.9 Que Son Proposed Species and Habitat Conservation Area

Location: Nong Son District, Quang Nam Province

Area: 18,765 hectares

Status criteria: 1a, 2c, 3c, 4c, 5f

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: unknown

Status

Gibbons were heard calling on one occasion and seen on another in this area in August 2009, during a survey for the Critically Endangered grey-shanked douc langur *Pygathrix cinerea* (Nguyen Thi Tien & Hoang Minh Duc 2010). Otherwise, only three sightings of gibbons between 2003 and 2008 reported by local people have been recorded (Wright 2008).

Threats and Conservation Actions

Hunting and logging are considered to be the main threats to primates and other wildlife (Wright 2008; Nguyen Thi Tien & Hoang Minh Duc 2010). Currently, the area is further threatened by the construction of the Khe Dien reservoir and a road that would bisect the forest. In 2007, a proposal to establish a 18,765 ha species and habitat conservation area was submitted to protect the local elephant population and large population of grey-shanked douc langurs, which had recently been discovered (Quang Nam People's Committee 2007) . However, this proposed protected area is still awaiting final approval and financial support from the Provincial People's Committee. A gibbon survey is required to assess the population size and status of *N. annamensis* in the area.

7.3.10 Song Thanh Nature Reserve

Location: Nam Giang and Phuoc Son Districts, Quang Nam Province

Status criteria: 1a, 2c, 3a, 4c, 5c

Area: 93,249 hectares

Date of most recent survey: 2004

Date of most recent confirmed record: 2004

Minimum population: ≥ 15 groups

Status

Song Thanh Nature Reserve has been identified as a priority for gibbon conservation in Quang Nam Province, where gibbons have been extirpated from a large number of sites (Minh Hoang et al. 2005). Primate surveys have confirmed gibbons in the centre of the reserve and in the eastern periphery of the reserve where 17-18 groups were detected, including two groups just outside the reserve border (Minh Hoang et al. 2005). Additional groups are likely to persist in areas adjacent to the reserve, but interviews with local communities suggest gibbon populations are declining (Minh Hoang et al. 2005).

Threats and Conservation Actions

The main threat to gibbons in Song Thanh Nature Reserve is hunting. Gibbons are commonly hunted in the area, both by locals and outsiders, predominantly for food, medicine and pets (Minh Hoang et al. 2005). Infrastructure development also poses a threat. Several roads, including the Ho Chi Minh Highway, bisect the site and several dams are proposed in the area which may impact the reserve as a result of the inundations and associated infrastructure (Quang Nam People's Committee 2005; Anon. 2007).

As part of the Management of Strategic Areas for Integrated Conservation (MOSAIC) Project implemented by WWF and the Forest Protection Department, primate conservation activities were integrated into management plans of Song Thanh Nature Reserve (Anon. 2005), including primate monitoring (Minh Hoang et al. 2005), village protection teams and "no hunting" agreements set-up with local communities in key primate hotspots (Minh Hoang et al. 2005). Together Ngoc Linh Proposed Nature Reserve (Quang Nam), Ngoc Linh Nature Reserve (Kon Tum) and Song Thanh Nature Reserve represent an important landscape for long-term conservation of *N. annamensis* in Vietnam.

7.3.11 Ngoc Linh Proposed Nature Reserve

Location: Bac Tra My, Nam Tra My and Phuoc Son Districts, Quang Nam Province

Area: 18,430 hectares

Status criteria: 1a, 2c, 3a, 4b, 5f

Date of most recent survey: 2005

Date of most recent confirmed record: 2005

Minimum population: ≥ 13 groups

Status

This site is contiguous with Ngoc Linh Nature Reserve in Kon Tum Province (see below). In 2005, 13 gibbon groups were recorded in part of the proposed reserve (Minh Hoang et al. 2005). No other information is available on the status of gibbons in this site.

Threats and Conservation Actions

Surveys are required to clarify the status of gibbons in this site. Hunting may be a threat to gibbons but its extent is unknown. Few conservation actions are being implemented. Legal designation of the site as a nature reserve and the establishment of a management board, ranger patrols and conservation education activities will probably be important actions for gibbon conservation in this site.

7.3.12 Ngoc Linh Nature Reserve

Location: Dac Glei and Dac To Districts, Kon Tum Province

Area: 41,424 hectares

Status criteria: 1a, 2a, 3b, 4b, 5f

Date of most recent survey: 2006

Date of most recent confirmed record: 2006

Minimum population: unknown

Status

This site is contiguous with Ngoc Linh Proposed Nature Reserve in Quang Nam Province (see above). The presence of gibbons in this reserve and in adjacent forests was confirmed in 2006 (Abramov et al. 2006) and 1999 (Le Trong Trai et al. 1999c) respectively. This is the only information available on gibbons for this site. It seems likely a small gibbon population persists in the reserve.

Threats and Conservation Actions

This reserve together with Ngoc Linh Proposed Nature Reserve and Song Thanh Nature Reserve (see above) form a large forest complex, which represents an important area of habitat for *N. annamensis* in Vietnam. The issues for conservation of gibbons in this site remain unknown. Surveys are required to assess the size, status and threats to gibbon populations and develop conservation actions.

7.3.13 Kon Plong District

Location: Kon Plong District, Kon Tum Province

Area: 65,077 hectares

Status criteria: 1a, 2c, 3c, 4b, 5f

Date of most recent survey: 2000

Date of most recent confirmed record: 2009

Minimum population: ≥ 4 groups

Status

One group was heard in Kon Plong District in 2009 (S. Mahood pers. comm.) and at least four groups were heard during baseline biodiversity surveys in production forest covering an area of 65,077 ha in 2000 (Eames et al. 2001).

Threats and Conservation Actions

Gibbons were only detected in unlogged forest in Kon Plong District (Eames et al. 2001), suggesting that logging regimes may have a significant impact on the species distribution. At the time, logging was occurring at unsustainable levels and hunting in the area remained a significant threat (Tordoff 2002). Ngoc Linh Nature Reserve, Kon Cha Rang Nature Reserve and Kon Ka Kinh National Park are contiguous with Kon Plong District and in 2001 improved management across this landscape was already considered a necessity (Eames et al. 2001). Production forest in the district is managed by several commune State Forest Enterprises. From 2011 to 2014, FFI is engaged in a REDD+ project in Hieu Commune, next to Kon Cha Rang Nature Reserve, to improve forest management for biodiversity and develop a payment mechanism for maintaining carbon stocks there (FFI 2011).

7.3.14 Chu Mom Ray National Park

Location: Sa Thay and Ngoc Hoi Districts, Kon Tum Province

Status criteria: 1a, 2b, 3a, 4b, 5f

Area: 56,621 hectares

Date of most recent survey: 2007

Date of most recent confirmed record: 2007

Minimum population: ≥ 14 groups

Status

Surveys in 2007 documented 14 groups and an estimated 54 individuals in only the eastern portion of this site, with gibbon song heard daily (Vu Ngoc Thanh et al. 2007). Gibbons were also recorded during fauna surveys in 2005 (Dang Huy Huynh 2005). Survey coverage of the site is not complete and the total gibbon population is unknown.

Threats and Conservation Actions

Hunting, and degradation of forest habitats due to clearance for agriculture and settlement, are the principle threats to *N. annamensis* in this site (Vu Ngoc Thanh et al. 2007). No conservation actions for gibbons are currently being implemented. Key actions include surveys to complete coverage on the gibbon status for the entire park and an increase in patrol effort and conservation education activities (Vu Ngoc Thanh et al. 2007).

7.3.15 Kon Ka Kinh National Park

Location: K'Bang, Dak Doa and Mang Yang Districts, Gia Lai Province

Status criteria: 1a, 2a, 3a, 4b, 5c

Area: 41,780 hectares

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: 9 groups confirmed, 42 groups estimated

Status

Site-wide gibbon surveys conducted in 2010 recorded nine groups from 18 listening posts (Ha Thang Long et al. 2011). Population estimates were made for the whole site based on density and available habitat, which estimated a population of 42 groups (95% confidence interval of 27-76

groups) and 148 individuals (95% confidence interval of 93-265) for the park (Ha Thang Long et al. 2011). This is one of the largest populations for *N. annamensis* known in Vietnam, however interviews with local people report that there are fewer gibbon groups than even five years ago, suggesting a downward population trend (Ha Thang Long et al. 2011). In 2007 gibbons were recorded from two locations in the south of the national park during general biodiversity surveys (Birdlife International Vietnam Programme 2008).

Threats and Conservation Actions

Clearance of forest for agriculture poses the greatest threat to gibbons in Kon Ka Kinh National Park, with hunting with guns being a smaller threat (Ha Thang Long et al. 2011). Gun hunting may have reduced over recent years due to increasing rarity of target species and improved enforcement (BirdLife International 2008). Implementation of a proposed biodiversity corridor within SFEs (see next site record) between Kon Ka Kinh National Park and Kon Cha Rang Nature Reserve would provide a larger overall area for gibbons and other species (Ha Thang Long 2007; Anon. 2010; Ha Thang Long et al. 2011).

7.3.16 Dakroong and Tam Lap State Forest Enterprises

Location: K'Bang District, Gia Lai Province

Area: 14,250 hectares

Status criteria: 1a, 2c, 3c, 4b, 5f

Date of most recent survey: 2008

Date of most recent confirmed record: 2008

Minimum population: ≥ 8 groups

Status

In December 2007 one group of gibbons was heard calling in Dakroong SFE and in March and April 2008 gibbons were heard from four listening posts. Local people report that gibbons are often heard. In Tram Lap SFE two groups were heard in the north close to the border with Kon Tum Province. These records come from biodiversity surveys conducted by Birdlife International across the broader landscape of Kon Ka Kinh-Kon Cha Rang (BirdLife International 2008). This area between the two protected areas had not been surveyed before and these records are indicative of a larger, possibly contiguous, population within the broader landscape, particularly with Kon Cha Rang Nature Reserve.

Threats and Conservation Actions

The northern parts of these two forest blocks are proposed as a 14,250 ha biodiversity corridor (BirdLife International 2008) between Kon Ka Kinh National Park (see above) and Kon Cha Rang Nature Reserve (see below) even though national legislation for biodiversity corridors has not yet been promulgated, which would guide implementation (Anon. 2010). This area has high forest cover and is important for watershed protection, which makes it less appropriate for logging (BirdLife International 2008). Logging, both illegal and legal, has direct impact on habitats, but inclusion of the SFEs in the proposed biodiversity corridor with appropriate management plans would help to address those threats, along with the required capacity building and awareness raising for staff the SFEs. A recently constructed road traverses Tram Lap SFE area and facilitates access for hunting and illegal logging (Breese 2010). It may also form a barrier for gibbon dispersal. Other infrastructure developments include a hydropower dam in Dakroong SFE and a planned bauxite mine in the south of Tram Lap SFE (BirdLife International 2008).

7.3.17 Kon Cha Rang Nature Reserve

Location: K'Bang District, Gia Lai Province

Area: 15,900 hectares

Status criteria: 1a, 2a, 3a, 4b, 5c

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: 13 groups confirmed, 20 groups estimated

Status

At least 13 gibbon groups persist in the northern part of this reserve, over an area of approximately 4,000 ha (Luu Quang Vinh et al. 2010). The entire reserve is estimated to support 20 groups, with an estimated density of 0.53 groups km^{-2} for the area where gibbons persist (Luu Quang Vinh et al. 2010). No gibbons were detected in the central portion of the reserve, and the southern portion was not surveyed due to interview reports stating gibbons no longer occurred there (Luu Quang Vinh et al. 2010). In 2008, two gibbon groups were recorded in the same area close to Tram Lap SFE during general biodiversity surveys (BirdLife International 2008).

Threats and Conservation Actions

In 2010, residents stated that many wildlife, including gibbons, were in decline due to intensive hunting, which is the principle threat to the species in this site (Luu Quang Vinh et al. 2010). In addition to residents, non-local hunters from An Lao District in Binh Dinh Province also visit the reserve to hunt wildlife (Luu Quang Vinh et al. 2010). The apparent absence of gibbons in the central and southern parts of the reserve may be due to previous extensive logging when the reserve was formerly part of a state forest enterprise. Logging access roads may also have facilitated hunting and subsequent extirpation of gibbons in those areas (Luu Quang Vinh et al. 2010). No specific conservation actions for gibbons are currently being implemented in the reserve. Priority actions include dedicated ranger patrols to protect gibbon groups and construction of ranger posts in the northern part of the reserve, a gun confiscation programme and conservation education activities (Luu Quang Vinh et al. 2010). Protection of gibbons in the proposed biodiversity corridor in Dakroong and Tram Lap SFEs (Anon. 2010) should help maintain a larger population than just those inside the nature reserve. Two dams and a bauxite mine are proposed to be built in the nature reserve (Birdlife International Vietnam Programme 2008), and although away from known gibbon habitat there may be consequences for gibbons.

7.3.18 Ba Nam Commune, Ba To District

Location: Ba To District, Quang Ngai Province

Area: approximately 10,000 hectares

Status criteria: 1a, 2c, 3c, 4c, 5f

Date of most recent survey: 2011

Date of most recent confirmed record: 2011

Minimum population: ≥ 3 groups

Status

From 28 May to 10 June 2011, an estimated three groups were heard from a campsite in Ba Nam Commune, during an insect and herptile survey led by the NGO Wildlife At Risk (Nguyen Vu Khoi 2011).

Threats and Conservation Actions

This forest area is under the management of Western Ba To Watershed Management Board and appears to be contiguous with Kon Cha Rang Nature Reserve, therefore the gibbons present could be part of a larger population (see above). There are frequent incursions into the forest by people and hunting is perceived as a threat (Nguyen Vu Khoi 2011).

7.4 Locations where *Nomascus annamensis* is Now Considered Absent

There are no confirmed or provisional extirpations of *N. annamensis* post 2000 based on survey data.

7.5 Sites with No New Data Since 2000

There is new data for all sites which had confirmed or provisional records for gibbons within the range of *N. annamensis* between 1995 and 2000, as listed in Geissmann et al. (2000).

Chapter 8

Southern yellow-cheeked gibbon
Nomascus gabriellae

Male *Nomascus gabriellae*
Photo: Terry Whittaker

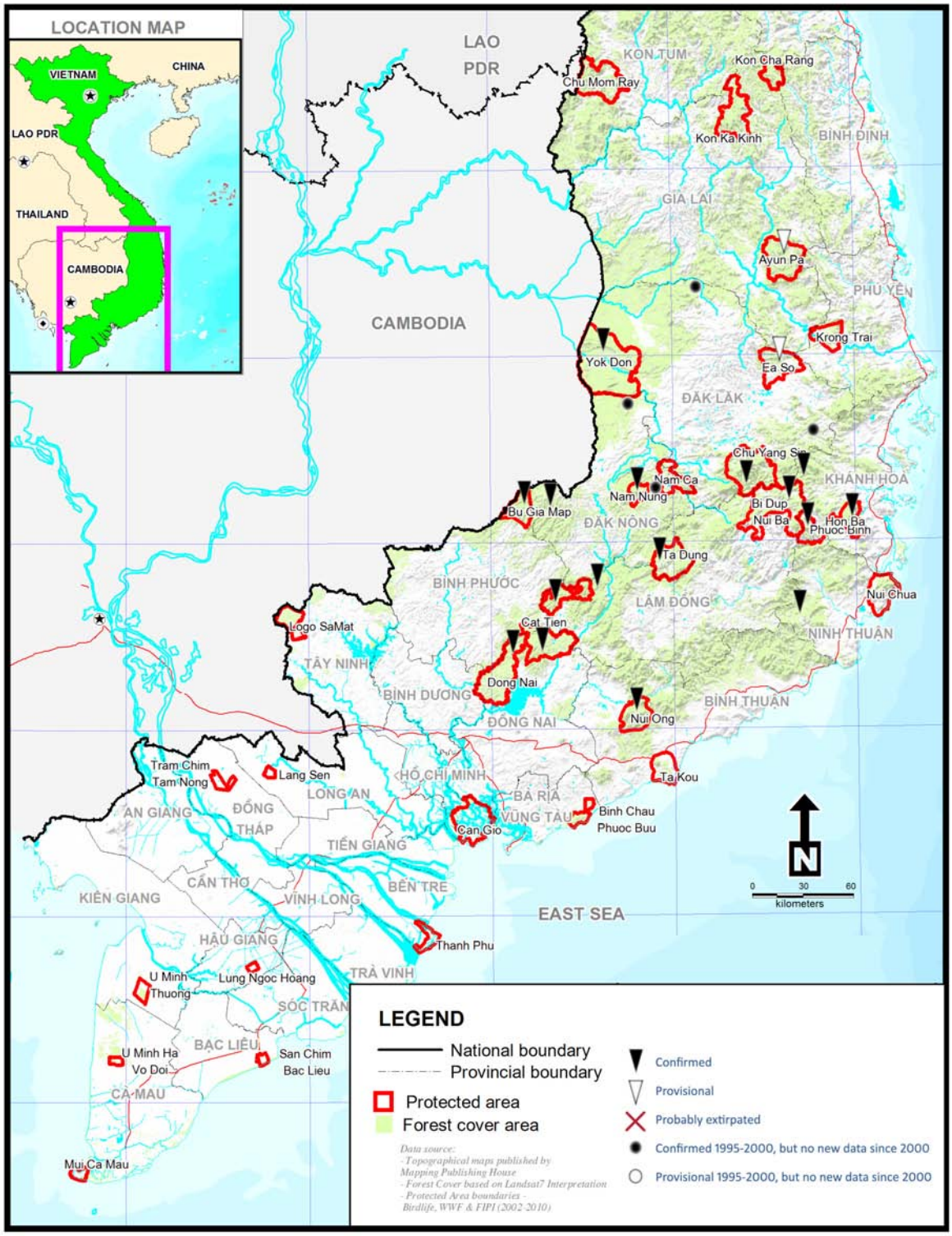


Figure 8. Map of records of *Nomascus gabriellae* in southern Vietnam

8 Southern Yellow-cheeked Gibbon *Nomascus gabriellae* (Thomas, 1909)

Other English names: yellow-cheeked crested gibbon, buff-cheeked gibbon, red-cheeked gibbon

Vietnamese names: vượn má vàng, vượn đen má vàng, vượn đen má hung

IUCN Red List Category and Criteria: Endangered A2cd (ver 3.1)

2007 Vietnam Red Data Book Category and Criteria: Endangered A1cd C2a

Legislative status in Vietnam: Decree 32/2006 ND-CP: 1B

CITES: Appendix I

8.1 Global Status and Distribution

Nomascus gabriellae was formerly thought to have a global distribution covering eastern Cambodia, southern Vietnam and southern Laos (Groves 2001; Geissmann et al. 2008). The species is no longer thought to inhabit Laos, due to a recent taxonomic split and subsequent description of a new species, *N. annamensis*, whose distribution covers a considerable portion of what was formerly thought to support *N. gabriellae* (Van Ngoc Thinh et al. 2010e). In Cambodia, *N. gabriellae* occurs east of the Mekong River and south of the Srepok River (Van Ngoc Thinh et al. 2010e). The actual biogeographic barrier between *N. gabriellae* and *N. annamensis* in Cambodia may be the dry deciduous dipterocarp forests of this region instead of rivers (Traeholt et al. 2005; Rawson In press) as is the case for gibbons in Thailand (Srikosamatara & Doungkhae 1982).

In Vietnam, the most northern record of *N. gabriellae* is at A Yun Pa Nature Reserve (Van Ngoc Thinh et al. 2010e). It is separated from *N. annamensis* further north by the Ba River, which runs through Gia Lai and Yen Phu Provinces at approximately 13°00-13°10 N (Van Ngoc Thinh et al. 2010c). In the south, the current distribution of *N. gabriellae* extends to $11^0$1'39-$11^0$3'15 N, in Nui Ong Nature Reserve.

The *N. gabriellae* populations in Cambodia have been relatively well documented and suggest that Cambodia holds the most globally significant populations of this species (Rawson In press). Gibbon surveys have been conducted in Seima Protected Forest (Clements et al. 2008; Rawson et al. 2009) and Phnom Prich Wildlife Sanctuary (Phan Channa & Gray 2009), with spot surveys conducted in other key protected areas (Traeholt et al. 2005). Seima Protected Forest holds the most significant population in any protected area, with estimates of group density ranging from 0.71 groups km^{-2} (Rawson et al. 2009) to 0.74 groups km^{-2} (Clements et al. 2008) and estimates of 646-972 and 432-832 groups in different parts of the core area by these authors respectively. Phnom Prich Wildlife Sanctuary holds a smaller population due to naturally fragmented habitat and limited amounts of evergreen forest, with a density range of 0.12-0.19 groups km^{-2} and a total population of 15-273 groups (Phan Channa & Gray 2009). Other sites with potentially important populations but less survey effort and no effective protection include Snoul Wildlife Sanctuary and Nam Lyr Wildlife Sanctuary (Traeholt et al. 2005).

8.2 Summary of Status and Distribution in Vietnam

8.2.1 Change in Status Since 2000

Little was understood about the status of *N. gabriellae* in the first Vietnam status review of gibbons (Geissmann et al. 2000). It was assumed to be the most common of the crested gibbons

in Vietnam (Geissmann et al. 2000), which appears to remain true. Cambodia was not thought to hold significant populations at that time, but based on considerable survey effort in Cambodia and Vietnam since then, Cambodia is now considered to have larger and less fragmented populations than those in Vietnam. Taxonomic studies of *N. gabriellae* have resulted in the description of a new species, *N. annamensis*, and have subsequently resulted in a significant down-sizing of the global range of *N. gabriellae*, so a reassessment of the IUCN Red List status of the species is necessary (Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e).

No population data were available for any gibbon taxa in the 2000 gibbon status review (Geissmann et al. 2000), but *N. gabriellae* populations have almost certainly declined in most sites in Vietnam since 2000. Hunting and habitat loss are ongoing in virtually all sites which still support *N. gabriellae*. Gibbon surveys have been undertaken in many sites since 2000 and sufficient baseline data now exist for monitoring *N. gabriellae* populations in some of these sites.

8.2.2 Key Sites for Conservation

Cat Tien and Bu Gia Map National Parks support the largest *N. gabriellae* populations in Vietnam. The conservation importance of these sites is enhanced by their connectivity with adjoining forests which also support gibbons. At Cat Tien National Park, the *N. gabriellae* population is supplemented by gibbons in Dong Nai Nature Reserve and adjacent state forest enterprises, comprising Vinh An, Ma Da and Hieu Liem SFEs in the south-west (Vu Van Dzung 2002) and Da Teh, Loc Bac and Bao Lam SFEs in the north and north-east (Nguyen Xuan Dang et al. 2004; Nguyen Xuan Dang & Osborn 2004a, b). These are also connected with Ta Dung Nature Reserve and the Da Lat Plateau. At Bu Gia Map National Park, gibbon populations are partly contiguous with those in other Vietnamese sites as well as Seima Protected Forest in Cambodia (Clements et al. 2008; Rawson et al. 2009; Rawson In press). Both Cat Tien and Bu Gia Map National Parks should form the focus of national conservation efforts for *N. gabriellae* in Vietnam. The status of gibbons in the Bi Dup-Nui Ba-Chu Yang Sin-Phuoc Binh forest complex and surrounding forests has been poorly surveyed, but it is one of the largest contiguous areas of protected forest in Vietnam and there are numerous gibbon records. This may also represent a priority landscape for conservation of the taxon and additional population survey work here is recommended to determine its value.

8.2.3 Threats

Hunting for commercial wildlife trade is the principle threat to *N. gabriellae* in Vietnam. Females with infants are targeted for the pet trade (WCS 2009). Gibbons are commonly held as pets in hotels and private zoos in southern Vietnam, and it is likely that most of these individuals are sourced from the wild (WCS 2009). Gun prevalence is a major concern in areas with gibbons, as ground-based hunting methods (trapping, snaring) do not impact this species. Based on interview surveys with traders, at least 24 *N. gabriellae* were traded in Dong Nai Province in 2007-2008, and were sourced from Cat Tien National Park and Dong Nai Nature Reserve (WCS 2009). Considering that only infants are traded (mothers are shot) (WCS 2009), that only one in 20 individuals may reach the trade (Nettelbeck et al. 1999) and that gibbon reproductive rates are low (see Traeholt et al. 2005 for a summary of life history parameters), it is clear this trade presents a severe threat to *N. gabriellae* populations in Vietnam.

Habitat loss and degradation is also a major factor impacting *N. gabriellae*. Agricultural encroachment and legal and illegal logging in and around protected areas and state forest enterprises is reducing available habitat for gibbons (Geissmann et al. 2008), removes food trees and reduces landscape connectivity between forest blocks. This is compounded by habitat degradation caused by defoliants sprayed during the American War in Vietnam (Geissmann et al. 2000). On-going infrastructure development in and around protected areas is also reducing the size and quality of gibbon habitat and is increasing access for hunters. These activities result in extensive forest loss and fragmentation, and presumably also isolation of gibbon groups.

8.2.4 Ongoing Conservation Actions

Conservation efforts for *N. gabriellae* are currently implemented in several sites. At Bu Gia Map National Park, a threat assessment for the species, environmental education activities and training of park staff in gibbon survey techniques is being conducted (Bu Gia Map NP 2010). At Cat Tien National Park, similar activities were conducted in 2004-2006 (Nguyen Xuan Dang et al. 2005). In 2008, the Dao Tien Endangered Primate Species Centre was established to rehabilitate confiscated gibbons and other endangered primates (Kenyon et al. 2010) and receives support from international experts. From August 2011, gibbons are being released back to the wild from this facility. The release of captive gibbons warrants caution and requires strict protocols (e.g. Eudey 1991-1992; Baker 2002; Cheyne 2004) and is currently not a priority for *N. gabriellae* in Vietnam. However extensive field work, protection and education conducted alongside the releases is helping to improve the situation for the species in Cat Tien and its surroundings and the availability of a placement option for confiscated gibbons has increased the readiness of FPD enforcement officers to confiscate illegally kept gibbons (U. Streicher pers. comm.).

8.2.5 Priority Conservation Actions

Conservation efforts for *N. gabriellae* should focus on reducing gibbon hunting and habitat loss in and around Bu Gia Map and Cat Tien National Parks and maintaining connectivity of gibbon populations in these and other landscapes, such as on the Da Lat plateau. Specific actions should include gun control, law enforcement against hunting and wildlife trade and improved forest management in both protected areas and nearby SFEs. The maintenance of large forest blocks is important given the likely inability of gibbons to persist in small forest fragments (Gray et al. 2010). Because most hunting is to supply commercial trade, enforcement efforts and awareness campaigns should focus on wildlife traders, private zoos and tourist locations.

8.3 *Nomascus gabriellae* Records in Vietnam

8.3.1 A Yun Pa Proposed Nature Reserve

Location: A Yun Pa and Krong Pa Districts, Gia Lai Province

Area: 44,268 hectares

Status criteria: 1b, 2a, 3c, 4c, 5f

Date of most recent survey: 2000

Date of most recent confirmed record: 1998

Minimum population: unknown

Status

The last confirmed record at this site comes from 1998 when one local interviewee claimed a gibbon song was heard (Tran Quang Ngoc et al. 2001). A Yun Pa Proposed Nature Reserve was not included in Geissmann et al. (2000) and no other information on gibbons is known from this reserve.

Threats and Conservation Actions

Hunting and habitat degradation were the major threats to gibbons in this reserve (Tran Quang Ngoc et al. 2001). Hunting levels were high and access to the entire reserve relatively easy (Tran Quang Ngoc et al. 2001). Parts of the site have been commercially logged and local communities continued to extract valuable timber species (Tran Quang Ngoc et al. 2001).

8.3.2 Yok Don National Park

Location: Buon Don, Ea Sup and Cu Jut Districts, Dak Lak Province

Area: 115,545 hectares

Status criteria: 1a, 2c, 3b, 4b, 5f

Date of most recent survey: 2007

Date of most recent confirmed record: 2007

Minimum population: unknown

Status

Most of Yok Don National Park is comprised of dry deciduous dipterocarp forest which is not suitable habitat for gibbons and *N. gabriellae* is considered to be a rare resident (Eames et al. 2004). Only two confirmed records are from this park, one in 2007 (Nguyen Hao Hoa unpublished data) and another in 2002-2003 (Eames et al. 2004), both from Yok Don Mountain. Unconfirmed local reports are available prior to 2000 (Le Xuan Canh et al. 1997), which were not included in Geissmann et al. (2000).

Threats and Conservation Actions

Hunting wildlife with guns (Eames et al. 2004) and illegal logging on Yok Don Mountain are key threats to *N. gabriellae* at the site. The park appears to be a low conservation priority for *N. gabriellae* compared with sites with larger populations and more appropriate habitat. Actions should focus on implementing effective management to reduce hunting and habitat loss, particularly at Yok Don Mountain.

8.3.3 Ea So Nature Reserve

Location: Ea Kar District, Dak Lak Province

Area: 22,000 hectares

Status criteria: 1b, 2b, 3b, 4b, 5f

Date of most recent survey: 2006

Date of most recent confirmed record: 2006

Minimum population: unknown

Status

Biodiversity surveys during the past ten years and more suggest gibbons are largely extirpated from the reserve (Le Xuan Canh et al. 1997; Nguyen Cu 2000; Tordoff et al. 2004), however, according to interview surveys, gibbons may still persist in evergreen forest in the north-west of the reserve, which connects with forest in Gia Lai Province.

Threats and Conservation Actions

The park no longer appears to warrant conservation efforts for *N. gabriellae*. A status survey in the north-west of the reserve should be conducted to confirm this but is not a high priority.

8.3.4 Chu Yang Sin National Park

Location: Lak and Krong Bong Districts, Dak Lak Province

Area: 58,947 hectares

Status criteria: 1a, 2c, 3c, 4c, 5c

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: ≥ 8 groups

Status

In 2010, eight groups of *N. gabriellae* were recorded in a small area of 2,500 ha within the park (BirdLife International 2010), providing the first recent evidence the species persists here. These data suggest the park may support a significant population of *N. gabriellae*.

Threats and Conservation Actions

Infrastructure development, logging and hunting are key threats to wildlife in this park (BirdLife International 2010). A recent influx of Mong ethnic communities has led to an increase in gun ownership and hunting around the park (BirdLife International 2010). There are no records of gibbons hunted or traded from this site, although *N. gabriellae* is a target species for hunters with guns (Le Trong Trai et al. 2008). From 2006-2009, the park was the focus of a GEF project to strengthen management, which included wildlife surveys and capacity building of local management agencies. Further support is required for activities which would also assist *N. gabriellae* conservation, including park expansion and improved management capacity and law enforcement (BirdLife International 2010). Gibbon population surveys are needed to further determine the value of the site for gibbon conservation.

8.3.5 Bi Dup-Nui Ba National Park

Location: Lac Duong and Dam Rong Districts, Lam Dong Province

Area: 63,938 hectares

Status criteria: 1a, 2c, 3c, 4c, 5c

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 25 groups

Status

Recent biodiversity surveys in this site reported that at least 25 gibbon groups occur (Mahood et al. 2009; Luu Hong Truong & Le Khac Quyet 2010). The presence of *N. gabriellae* was listed for the park in 2002, although no details were provided (Institute of Ecology and Biological Resources 2003; Nguyen Truong Son et al. 2005). The size of the gibbon population in the park is unclear and may be relatively large due to expansive areas of potential habitat.

Threats and Conservation Actions

Hunting with guns and automatic rifles, agricultural encroachment, illegal logging, exploitation of non-timber forest products, economic development and forest fire are key threats to biodiversity in this park (Bidoup - Nui Ba National Park 2010) and threaten *N. gabriellae* and its habitats. In 2010, four live gibbons were confiscated from a company in Di Linh District, which were thought

to have been caught in the park. Construction of Highway No. 723 was completed in 2007 and bisects the park. This has removed several hundred hectares of forest, fragmented the remaining forest and increased access for hunters. There is currently a project in the park focusing on the conservation status of gibbons and black-shanked douc langur *Pygathrix nigripes* (Van Ngoc Thinh pers. comm.).

8.3.6 Khanh Hoa State Forest Enterprise and Tram Huong Forestry Company

Location: Khanh Vinh District, Khanh Hoa Province

Area: c. 25,000 hectares

Status criteria: 1a, 2c, 3c, 4b, 5f

Date of most recent survey: No survey

Date of most recent confirmed record: 2009

Minimum population: unknown

Status

Nomascus gabriellae was confirmed to occur in Khanh Vinh District of Khanh Hoa Province in 2009 (Hoang Minh Duc pers. comm.). The forest block where gibbons were observed is about 25,000 ha in size and is contiguous with Bi Dup-Nui Ba (Lam Dong Province) and Chu Yang Sin (Dak Lak Province) National Parks. The gibbon population size is unknown but may be of national significance. The site is managed by a SFE and utilized for timber logging.

Threats and Conservation Actions

Hunting and large-scale commercial logging are the principle threats to *N. gabriellae* in this site. As a state forest enterprise, the site is not subject to conservation regulations. Logging occurs in forest blocks where gibbons have been recorded. Illegal logging by local communities is also common. Gibbon habitats have been fragmented by construction in 2007 of Highway No. 722 through part of the site. Priority actions include the development of sustainable logging practices and inclusion of biodiversity conservation in logging plans, a halt to illegal logging and hunting, and status surveys to clarify the population size and locations of *N. gabriellae*.

8.3.7 Hon Ba Nature Reserve

Location: Cam Lam and Khanh Son Districts, Khanh Hoa Province

Area: 20,978 hectares

Status criteria: 1a, 2c, 3c, 4b, 5f

Date of most recent survey: 2005

Date of most recent confirmed record: 2005

Minimum population: unknown

Status

The occurrence of *N. gabriellae* in this reserve was confirmed in 2005, when gibbons were heard calling (Craik 2005). The investment plan for this site also reports the presence of gibbons (Hon Ba Nature Reserve 2005). No gibbons were observed during a biodiversity survey in 2003 (Tordoff et al. 2004). The reserve was officially established in 2005, but no other surveys or management actions have been implemented.

Threats and Conservation Actions

Hunting and habitat loss due to road construction and tourist development on Hon Ba Mountain are principle threats to *N. gabriellae* and other wildlife in the reserve (Tordoff et al. 2004). In January 2011 an adult *N. gabriellae* was confiscated from a wildlife trader and was suspected to have been caught in the reserve, and in 2009 five black-shanked douc langurs *Pygathrix nigripes* were poached in the reserve (Hoang Minh Duc pers. comm.). Priority actions include the establishment of management activities to reduce hunting and habitat loss, and a survey to establish the status of *N. gabriellae* in the reserve.

8.3.8 Phuoc Binh National Park

Location: Bac Ai District, Ninh Thuan Province

Area: 19,814 hectares

Status criteria: 1a, 2c, 3c, 4b, 5f

Date of most recent survey: 2009

Date of most recent confirmed record: 2009

Minimum population: ≥ 4 groups

Status

Gibbon surveys in different parts of the reserve in 2010 and 2007 recorded four groups (Hoang Minh Duc 2010) and two groups (Do Tuoc & Dang Thang Long 2007) respectively. The authors noted the reserve probably cannot support a large gibbon population due to limited suitable habitat, however it may be important as part of the Da Lat Plateau landscape. The presence of gibbons was mentioned in 2002 but with no other details provided (Anon. 2002).

Threats and Conservation Actions

Hunting with guns (including automatic rifles), agricultural encroachment, illegal logging, exploitation of non-timber forest products, economic development and forest fire are key threats to biodiversity in the reserve (Phuoc Binh National Park 2008) and threaten *N. gabriellae* and its habitats. Hunting of other wildlife has been observed (Hoang Minh Duc 2007) and hunting of gibbons has been reported in the last decade (Hoang Minh Duc pers. comm.). From 2008-2010, six community-based patrol teams were operating, but ended due to a lack of funds. Other actions have included capacity building of the management board and conservation awareness campaigns. New actions should include the re-establishment of patrol teams and expansion of the reserve to include Tan Tien SFE, to increase the size and connectivity of forest blocks available for gibbons in this area.

8.3.9 Ninh Son State Forest Enterprise

Location: Ninh Son District, Ninh Thuan Province

Area: 30,332 hectares

Status criteria: 1a, 2c, 3c, 4b, 5f

Date of most recent survey: 2007

Date of most recent confirmed record: 2007

Minimum population: ≥ 6 groups

Status

In 2007, six gibbon groups with 18-20 individuals were recorded at this site (Le Dinh Thu & Do Tuoc 2007). Most gibbons in this site are probably located in evergreen forest near the borders with Lam Dong Province.

Threats and Conservation Actions

Hunting at the site focuses on large ungulates and civets, not primates (Le Dinh Thu & Do Tuoc 2007). Commercial and illegal logging is causing the loss and fragmentation of gibbon habitats. Priority actions include the development of sustainable logging practices and inclusion of biodiversity conservation in logging plans, a halt to illegal logging, and surveys to clarify the local status of *N. gabriellae*.

8.3.10 Nam Nung Nature Reserve

Location: Krong No and Dak G'Long Districts, Dak Nong Province

Area: 10,499 hectares

Status criteria: 1a, 2a, 3b, 4b, 5f

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 11 groups

Status

Gibbon surveys in the reserve in late 2011 returned 11 groups, mostly in the southern and central parts of the reserve and the reserve as a whole may contain 30 groups (Dong Thanh Hai pers. comm.). These surveys follow up on surveys earlier in 2010 when *N. gabriellae* was confirmed to occur in this reserve (Dong Thanh Hai et al. 2011). The reliability of records from the 1990s (Anon. 1994a) is unclear (Tordoff et al. 2004). Reports of gibbons from Krong No District (which partly includes the reserve) compiled by Geissmann et al. (2000) were from Brickle et al. (1998), but the given coordinates for these reports are outside the reserve boundaries. The small size of the reserve suggests it does not hold a large gibbon population.

Threats and Conservation Actions

Hunting with guns, agricultural encroachment, illegal logging and exploitation of non-timber forest products are key threats to biodiversity in this park (Nam Nung Nature Reserve 2008) and threaten *N. gabriellae* and its habitat. A small project to strengthen management capacity and a community awareness campaign was conducted in the reserve in 2009 funded by the Vietnam Conservation Fund. A new project at the site is currently underway, led by the Forestry University of Vietnam, which is assessing gibbon status and threats and training local protection staff (A. Sheridan pers. comm.). Priority actions include surveys to clarify the local status of *N. gabriellae* and reserve expansion to encompass Dak Mol and Nam Nung SFEs, where gibbons are also reported (Do Tuoc pers. comm.).

8.3.11 Ta Dung Nature Reserve

Location: Dak G'long District, Dak Nong Province

Area: 18,893 hectares

Status criteria: 1a, 2b, 3b, 4b, 5c

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: 6 groups confirmed, 12 groups estimated

Status

A site-wide gibbon survey in 2010 recorded six groups of *N. gabriellae* and two lone males. The total population of the reserve based on density and available habitat was estimated at 12 groups with a range of 8-18 groups and a population estimate of 31-73 individuals (Hoang Minh Duc et al. 2010a). Suitable forest habitat for *N. gabriellae* appears to cover 10,000 ha (53%) of the reserve but within this, the forest is fragmented (Hoang Minh Duc et al. 2010a). Provisional records of *N. gabriellae* in the reserve were made by Dang Huy Huynh et al. (2000).

Threats and Conservation Actions

Hunting with guns, habitat loss and hydropower and road construction are key threats to *N. gabriellae* at this site (Hoang Minh Duc et al. 2010a). Signs of wildlife hunting were observed in all areas surveyed (Hoang Minh Duc et al. 2010a). Gibbon trophies seen in nearby towns probably originate from the reserve (Hoang Minh Duc et al. 2010a). A small project to strengthen management capacity and a community awareness campaign was conducted in 2009. New actions should address gibbon hunting and trade and the inclusion of biodiversity conservation needs in planning logging and road and hydropower construction.

8.3.12 Quang Truc Commune

Location: Tuyen Duc District, Dak Nong Province

Area: 49,200 hectares

Status criteria: 1a, 2a, 3c, 4c, 5f

Date of most recent survey: No survey

Date of most recent confirmed record: 2010

Minimum population: unknown

Status

Two calls of *N. gabriellae* were heard in 2010 (Hoang Minh Duc et al. 2010b). The commune is adjacent to forest in Bu Gia Map National Park, where *N. gabriellae* occurs at relatively high densities (Hoang Minh Duc et al. In prep). No status surveys for gibbons have been conducted in the commune, which is located along the national border with Cambodia where additional groups may occur. The size and viability of the *N. gabriellae* population is unknown.

Threats and Conservation Actions

Hunting, large-scale commercial logging, illegal logging and road construction are the principle threats to *N. gabriellae* in the commune. Approximately 28,000 ha of the commune (57%) is forested and located in the Quang Truc Protection Forest and Quang Truc, Quang Tin and Quang Tan SFEs. Forest in SFE lands are not subject to conservation regulations and logging may occur in sites with gibbons. During construction of a road along the national border, hundreds of soldiers were deployed to the commune as workers and military border stations are also situated along this road (Hoang Minh Duc pers. comm.). Hunting is by local communities and military personnel (the latter frequently hunt wildlife; Ha Thang Long & Le Thien Duc 2001). In 2010, hunting with guns was frequently observed in the commune and nearby Bu Gia Map National Park. Conflict is high between local people and forest rangers, and some rangers have been attacked (Hoang Minh Duc pers. comm.). Priority actions include improved community outreach and conflict

resolution, the development of sustainable logging practices in SFEs, a status survey for gibbons, and conservation awareness campaigns for military personnel and communities in the commune.

8.3.13 Bu Gia Map National Park

Location: Bu Gia Map District, Binh Phuoc Province

Area: 25,926 hectares

Status criteria: 1a, 2c, 3a, 4a, 5c

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: 88 groups confirmed, 124 groups estimated

Status

Bu Gia Map National Park supports one of the largest known populations of *N. gabriellae* in Vietnam. In 2010, a population census over an area of 16,500 ha using 36 listening posts returned a park-wide group density estimate of 0.54 km^{-2} (95% confidence interval of 0.51-0.58) (Hoang Minh Duc et al. In prep). Based on total suitable habitat of 22,800 ha, the total number of groups inside the national park is estimated to be 124 (95% confidence interval of 122-132) (Hoang Minh Duc et al. In prep). A previous density estimate was calculated at 0.72 groups km^{-2} (Hoang Minh Duc et al. 2010b). In 2007, at least 200 individuals were estimated to occur in the park (Luu Hong Truong et al. 2007). A relatively high gibbon population and 22,800 ha of suitable habitat makes Bu Gia Map National Park one of the most important areas for *N. gabriellae* in Vietnam.

Threats and Conservation Actions

Hunting with guns, agricultural encroachment, illegal logging, exploitation of non-timber forest products and infrastructure development are key threats to biodiversity in this park (Bu Gia Map NP 2009) and threaten *N. gabriellae* and its habitat. The construction of a road in Quang Truc Commune has probably increased hunting access to the park and has also partly isolated the gibbon population in the park and Quang Truc Commune from populations in Cambodia. In 2009 and 2010, at least 15 black-shanked douc langurs *Pygathrix nigripes* were hunted in the park following road construction. Priority actions include continued monitoring of the park's *N. gabriellae* population and development of transboundary conservation efforts with Seima Protected Forest in Cambodia.

8.3.14 Cat Tien National Park

Location: Tan Phu District, Dong Nai Province, Cat Tien and Bao Lam Districts, Lam Dong Province and Bu Dang District, Binh Phuc Province

Area: 73,878 hectares

Status criteria: 1a, 2a, 3a, 4a, 5b

Date of most recent survey: 2005

Date of most recent confirmed record: 2010

Minimum population: ≥ 149 groups

Status

Cat Tien National Park is one of the most important and well-documented locations for *N. gabriellae* in Vietnam. Despite numerous pre-2000 records (summarised in Geissmann et al. 2000), the first population estimates were not made until surveys were conducted in 2004-2005. In a

park-wide census, 149 groups were detected at an estimated density of 0.52 (±0.47) to 0.72 (±0.08) groups km^{-2} (Kenyon 2007). Cat Loc sector had a lower density than the rest of the park, probably because of hunting pressure and habitat degradation (Kenyon 2007). Using the raw data of Kenyon (2007), we (BMR) estimate the total *N. gabriellae* of the park may exceed 300 groups (derived by applying a correction factor of 0.92 to Kenyon's raw counts, and re-calculating gibbon density assuming a 1.5 km listening radius and stratified by park sector). The park is contiguous with several SFEs and Dong Nai Nature Reserve, which also supports a small population of *N. gabriellae*. This landscape complex is probably the highest priority for conservation of *N. gabriellae* in Vietnam.

Threats and Conservation Actions

Hunting of gibbons was common in the park prior to the 1990s but has reportedly been reduced, possibly because of increased enforcement effort (Nguyen Xuan Dang et al. 2005). In contrast, local traders identify decreasing gibbon populations as the reason for reductions in trade volumes (WCS 2009). From 2007-2008 at least 24 gibbons were traded in Dong Nai and Lam Dong Provinces, to fulfill orders for pets or private zoos, and the park was identified as a major source area (WCS 2009). Gibbons are sold for US$ 230-320 (WCS 2009). Some illegal logging occurs in the park (Morris et al. 2004) and most of the park has been commercially logged (Polet 2003) which has probably lowered the carrying capacity for gibbons. Large areas within the park are zoned as agricultural land where park management has no authority (Polet 2003) and shifting cultivation also occurs (Nguyen Xuan Dang et al. 2005). The park's buffer zone is ineffectual and now largely deforested (S. Mahood pers. comm.), with development taking precedence over conservation.

From 1998-2004 a conservation project was implemented in the park, which included management planning, enforcement, biodiversity surveys, boundary demarcation, resettlement and tourism promotion (Polet & Ling 2004). From 2004-2005, community awareness campaigns were conducted around the park including 22 schools in five districts, which focused on gibbon conservation (Nguyen Xuan Dang et al. 2005). In 2008, the Dao Tien Endangered Primate Species Centre was established in the park. The centre's objective is to house confiscated primates prior to release in the park (Kenyon et al. 2010) and at least five *N. gabriellae* may be released in 2011 (M. Kenyon pers. comm.). Despite these considerable efforts, ongoing conservation assistance is required to ensure the continued survival of *N. gabriellae* in the park. This should include regular population monitoring, law enforcement to reduce gibbon trade, targeting of known gibbon traders and private zoos outside the park, a reduction in forest clearance and funding to maintain the primate centre.

8.3.15 Loc Bac State Forest Enterprise

Location: Bao Lam District, Lam Dong Province

Area: 34,851 hectares

Status criteria: 1a, 2c, 3c, 4b, 5c

Date of most recent survey: 2004

Date of most recent confirmed record: 2004

Minimum population: ≥ 4 groups

Status

At least 4-5 groups are confirmed to occur in this site, which is part of a larger landscape containing *N. gabriellae* populations (Nguyen Xuan Dang & Osborn 2004b). Over 24,000 ha (69%) of the SFE is zoned as production forest and is logged, and only 8,800 ha (25%) is zoned as protection forest. The *N. gabriellae* populations are unprotected and probably in decline.

Threats and Conservation Actions

Hunting, logging of gibbon habitat and clearance of forest for dam and infrastructure development and agriculture threaten *N. gabriellae* in this site (Nguyen Xuan Dang & Osborn 2004b). Priority actions include the establishment of a nature reserve in part of the SFE (Nguyen Xuan Dang & Osborn 2004b).

8.3.16 Dong Nai Nature Reserve

Location: Vinh Cuu, Dinh Quan, Trang Bom and Thong Nhat Districts, Dong Nai Province

Area: 100,303 hectares (including 32,400 ha of Tri An Reservoir)

Status criteria: 1a, 2c, 3c, 4b, 5f

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 17 groups

Status

Surveys in 2010 recorded 15 groups of *N. gabriellae* with at least 31 individuals (Nguyen Manh Ha et al. 2010b). Gibbons have been extirpated in some parts of the reserve, probably due to intensive hunting and logging over the past few decades (Nguyen Manh Ha et al. 2010b). Most gibbons persist in areas close to Cat Tien National Park, and this is probably due to better habitat and protection spill-over from the park. Reserve staff report that the distribution of gibbons and other wildlife in the reserve is expanding, which may be due to improved protection (Nguyen Manh Ha et al. 2010b). In August 2011, two groups of gibbons were released into this reserve and are being monitored. If this proves successful more gibbons will be introduced here from the Dao Tien Rescue Centre with a view to establishing another gibbon population (U. Streicher pers. comm.).

Threats and Conservation Actions

Hunting and logging are the key threats to *N. gabriellae* in this reserve, with gibbons for the wildlife trade still often sourced from this location, with an estimated minimum of five animals traded per year (WCS 2009). Forest quality is poor in areas previously logged under state forest enterprises and may not be currently suitable for gibbons. Several roads bisect the park and agricultural encroachment is occurring along these (Nguyen Manh Ha et al. 2010b). Management has apparently improved over the past several years, and there are plans to reclaim agricultural lands and increase law enforcement to protect wildlife (Nguyen Manh Ha et al. 2010b).

8.3.17 Nui Ong Nature Reserve

Location: Binh Thuan District, Binh Thuan Province

Area: 25,468 hectares

Status criteria: 1a, 2b, 3c, 4b, 5f

Date of most recent survey: 2010

Date of most recent confirmed record: 2010

Minimum population: ≥ 3 groups

Status

This reserve supports the southern-most populations of *N. gabriellae* in Vietnam. In 2009 and 2010, at least three groups of *N. gabriellae* were recorded (Hoang Minh Duc 2010). The total *N. gabriellae* population is unknown. In 2009, biodiversity surveys were conducted in the reserve which did not target mammals. Although the researchers recorded incidental observations of other wildlife they did not hear or see gibbons (J. Rowley pers. comm.). Gibbons were previously reported from the reserve but with no other details provided (Anon. 2000).

Threats and Conservation Actions

Hunting with guns, agricultural encroachment, illegal logging, exploitation of non-timber forest products and forest fire are key threats to biodiversity in this park (Nui Ong Nature Reserve 2009) and threaten *N. gabriellae* and its habitats. The reserve is surrounded by six communes with over 40,000 people. Wildlife meat, including from primates, is sold at restaurants near the reserve (Hoang Minh Duc 2010). A small project to strengthen management capacity and a community awareness campaign was conducted in the reserve in 2008. Since 2008, nine community-based patrol teams have operated to prevent forest fire, encroachment, illegal logging and hunting. External funding for the reserve is confirmed until at least 2012 to continue these activities. The reserve management board has proposed to expand the reserve and an upgrade to national park status, in order to receive more support.

8.4 Locations where *Nomascus gabriellae* is Now Considered Absent

There are no confirmed or provisional extirpations of *N. gabriellae* post 2000 based on survey data.

8.5 Sites with No New Data Since 2000

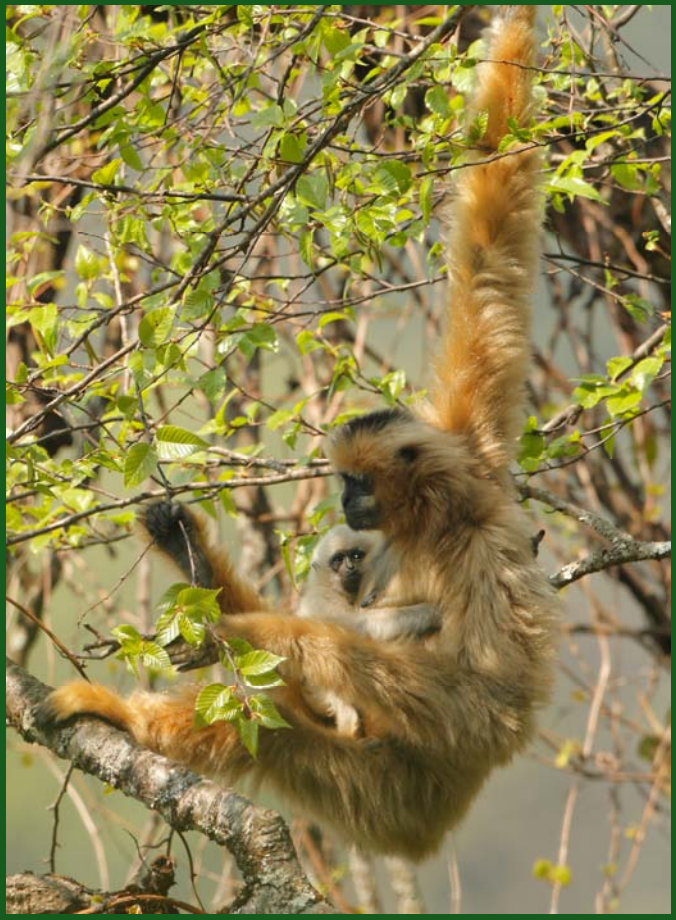
Sites which had confirmed or provisional records for *N. gabriellae* between 1995 and 2000 as listed in Geissmann et al. (2000) and for which there have been no gibbon records since that time are listed in Table 6 below.

Table 6. Sites with no new data for *N. gabriellae*.

Site	Most recent record
Dak Lak Province	
Ea Sup Ea H'leo Districts	Gibbons heard during green peafowl surveys in 1998.
Ea Trang Commune, M'drak District	Gibbons heard during green peafowl surveys in 1998
Dak Nong Province	
Krong No District	Gibbons heard during green peafowl surveys in 1998
Cu Jut District	Gibbons seen during elephant surveys in 1999 & 2000

Chapter 9

Classification & Distribution of Crested Gibbons



Female *Nomascus concolor* with infant
Photo: Zhao Chao

9 Classification and Distribution of Crested Gibbons

9.1 Classification and Phylogeny of the Gibbons (Hylobatidae)

Gibbons constitute the primate family Hylobatidae, which together with great apes and humans form the superfamily Hominoidea (Napier & Napier 1967; Groves 1989; Geissmann 1993, 1995; Fleagle 1999; Groves 2001; Geissmann 2003). They share a number of common derived characteristics with other members of the Hominoidea, including, among others, 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, and a relatively broad iliac blade (e.g. Fleagle 1999; Geissmann et al. 2000; Geissmann 2003). Among hominoids, gibbons form the sister group to great apes and humans (Figure 9). According to molecular data, Hylobatidae diverged from great apes and humans 16-22 million years ago (Goodman et al. 1998; Chan et al. 2010; Van Ngoc Thinh et al. 2010b; Israfil et al. 2011).

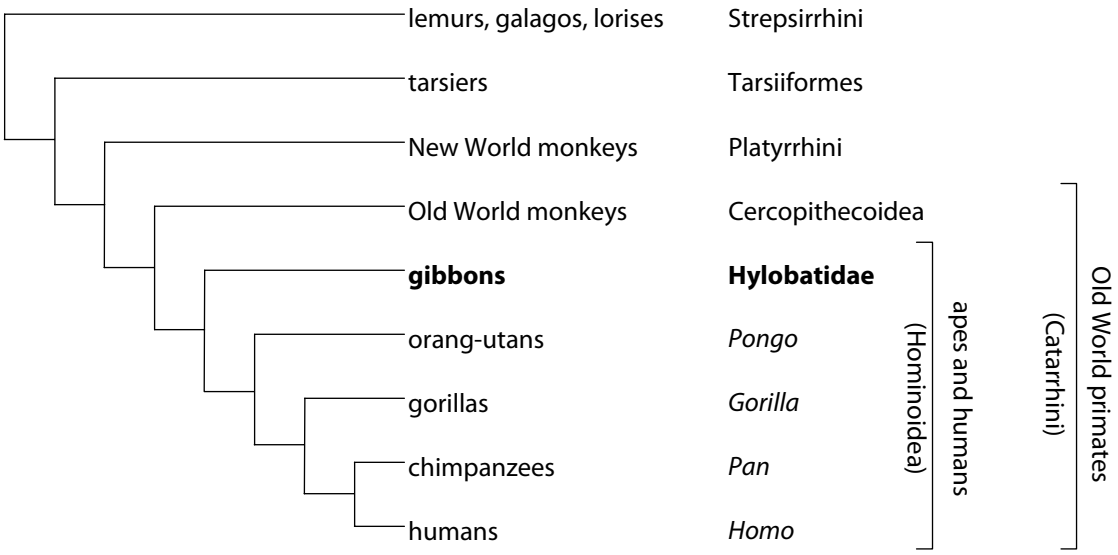


Figure 9. Systematic position of the gibbons (Hylobatidae) within the primate order

Within Hylobatidae, there is now consensus that four major lineages have to be recognized (Geissmann 1995; Groves 2001; Roos & Geissmann 2001; Geissmann 2002a, 2003; Brandon-Jones et al. 2004; Mootnick & Groves 2005; Mootnick 2006; Geissmann 2007b; Van Ngoc Thinh et al. 2010b). In early studies, gibbons were divided into only two major lineages or genera, with one (*Symphalangus*) including the siamang, and the other (*Hylobates*) all the remaining species (Schultz 1933; Simmonetta 1957; Napier & Napier 1967). Only when gibbons were studied in more detail, did it become obvious that gibbons have to be divided into four major clades, which were originally recognized as subgenera of the genus *Hylobates* (Prouty et al. 1983; Marshall & Sugardjito 1986; Geissmann 1994, 1995; Rowe 1996; Nowak 1999; Groves 2001). Later these subgenera were elevated to generic status, and this arrangement is now widely adopted (Roos & Geissmann 2001; Geissmann 2003; Brandon-Jones et al. 2004; Mootnick & Groves 2005; Takacs et al. 2005; Mootnick 2006; Geissmann 2007b; Roos et al. 2007; Chan et al. 2010; Matsudaira & Ishida 2010; Van Ngoc Thinh et al. 2010b; Israfil et al. 2011; Kim et al. 2011).

Although the monophyly of the Hylobatidae and of the four genera is widely accepted, phylogenetic relationships among genera are far from being resolved. Nearly all possible relationships have been proposed (for an overview see Geissmann 1993, 2002a; Takacs et al.

2005), thus suggesting that the four gibbon genera emerged during a short time period. According to molecular data, this radiation might have happened 5-9 million years ago (Goodman et al. 1998; Chan et al. 2010; Matsudaira & Ishida 2010; Van Ngoc Thinh et al. 2010b; Israfil et al. 2011).

The phylogenetic relationships among members of the four genera and their taxonomic classification are still largely disputed. We follow here the classification recently presented in Van Ngoc Thinh et al. (2010b) with some modifications (Table 7).

Table 7. Classification of the Hylobatidae

Genus	Species and Subspecies	
	Common name	Scientific name
Hoolock	Western hoolock gibbon	*H. hoolock*
	Eastern hoolock gibbon	*H. leuconedys*
Hylobates	Kloss's gibbon	*H. klossii*
	Pileated gibbon	*H. pileatus*
	Javan gibbon	*H. moloch*
	Agile gibbon	*H. agilis*
	Bornean white-bearded gibbon	*H. albibarbis*
	Müller's gibbon	*H. muelleri*
	Northern grey gibbon	*H. funereus*
	Abbott's grey gibbon	*H. abbotti*
	Lar gibbon	*H. lar*
	Malayan lar gibbon	*H. l. lar*
	Yunnan lar gibbon	*H. l. yunnanensis*
	Carpenter's lar gibbon	*H. l. carpenteri*
	Mainland lar gibbon	*H. l. entelloides*
	Sumatran lar gibbon	*H. l. vestitus*
Nomascus	Western black gibbon	*N. concolor*[1]
	Western black gibbon	*N. c. concolor*
	Laotian black gibbon	*N. c. lu*
	Hainan gibbon	*N. hainanus*
	Eastern black gibbon	*N. nasutus*
	Northern white-cheeked gibbon	*N. leucogenys*
	Southern white-cheeked gibbon	*N. siki*
	Northern yellow-cheeked gibbon	*N. annamensis*
	Southern yellow-cheeked gibbon	*N. gabriellae*
Symphalangus	Siamang	*S. syndactylus*

[1] *N. c. furvogaster* and *N. c. jingdongensis* provisionally included in *N. c. concolor*

9.2 Classification and Phylogeny within the Crested Gibbons (Genus *Nomascus*)

The number of taxa to be recognized within the genus *Nomascus* and their taxonomic classification is a matter of debate. Traditionally, crested gibbons were combined in the single species *N. concolor* (Simmonetta 1957; Napier & Napier 1967; Groves 1972; Chivers 1977; Haimoff et al. 1982; Marshall & Sugardjito 1986). However, studies based on morphological, genetic and acoustic data during the last 30 years suggested that more than one species should be recognized (Dao Van Tien 1983; Groves 1984; Ma & Wang 1986; Fooden 1987; Ma et al. 1988; Geissmann 1989; Groves & Wang Yingxiang 1990; Geissmann 1993; Groves 1993; Geissmann 1994, 1995, 1997; Geissmann et al. 2000; Groves 2001; Geissmann 2002a, b; Roos 2004; Takacs et al.

2005; Mootnick 2006; Geissmann 2007b; Monda et al. 2007; Roos et al. 2007; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2010e; Mootnick & Fan Pengfei 2011; Van Ngoc Thinh et al. 2011).

First, all light-cheeked gibbons (*N. leucogenys*) were separated from the black gibbons (*N. concolor*) mainly because of anatomical differences, especially in the size of the baculum (Dao Van Tien 1983; Ma & Wang 1986; Ma et al. 1988). Subsequently, a species-level differentiation between *N. leucogenys* and *N. gabriellae* was proposed by Groves (1993) and Groves and Wang Yingxiang (1990). In their classification, *N. siki* was suggested as a subspecies of *N. gabriellae*, but later recognized as a subspecies of *N. leucogenys* (Geissmann 1993, 1994, 1995; Geissmann et al. 2000; Roos 2004; Roos et al. 2007). Recently, *N. siki* was given full species rank (Zhang 1997; Groves 2001; Mootnick 2006; Geissmann 2007b; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e; Mootnick & Fan Pengfei 2011; Van Ngoc Thinh et al. 2011). Acoustic and genetic data further suggested that among light-cheeked gibbons four, not three, taxa should be recognized (Geissmann 1997; Geissmann et al. 2000; Geissmann 2003; Konrad & Geissmann 2006; Geissmann 2007b; Ruppell 2009; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2010e; Van Ngoc Thinh et al. 2011) and consequently Van Ngoc Thinh et al. (2010c) described this additional taxon as *N. annamensis*.

Until the 1990s, gibbons with all-black males were still combined in the single species *N. concolor* (e.g. Groves 1993; Geissmann 1995). Based on prominent differences in vocalization, a separation of *N. nasutus* (with *N. hainanus* as subspecies) from *N. concolor* was proposed (Geissmann 1997; Geissmann et al. 2000; Geissmann 2002b). Groves (2001) separated *N. hainanus* as a species, but kept *N. nasutus* as a subspecies of *N. concolor*. Recent acoustic and genetic data clearly suggest that *N. nasutus* and *N. concolor* are distinct on species level (Geissmann 1997; Geissmann et al. 2000; Roos 2004; Bosco Pui Lok Chan et al. 2005; Takacs et al. 2005; Geissmann 2007b; Monda et al. 2007; Roos et al. 2007; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2010e; Van Ngoc Thinh et al. 2011) as are *N. hainanus* and *N. nasutus* (Geissmann et al. 2000; Bosco Pui Lok Chan et al. 2005; Geissmann 2007b; Roos et al. 2007; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010e). Within *N. concolor,* four subspecies *N. c. concolor, N. c. furvogaster, N. c. jingdongensis* and *N. c. lu* have been recognized (Ma & Wang 1986; Ma et al. 1988; Geissmann 1993, 1994, 1995; Groves 2001; Mootnick & Fan Pengfei 2011). However, neither morphological (Geissmann 1989; Geissmann et al. 2000; Geissmann 2007a) nor acoustic data (Geissmann 2007a) support this division. Similarly, genetic data suggest a monotypic species, *N. concolor*, although *N. c. lu* might be distinct on a subspecies level (Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010e). Whether *N. concolor* is indeed monotypic needs further analyses. Combining the available information, we propose a classification of crested gibbons into seven species (*N. hainanus, N. nasutus, N. concolor, N. leucogenys, N. siki, N. annamensis* and *N. gabriellae*), while *N. concolor* consists provisionally of two subspecies (*N. c. concolor* and *N. c. lu*). The species of crested gibbons recognized in this review all differ among each other in their calls (Van Ngoc Thinh et al. 2011).

In contrast to the unclear phylogenetic relationships among gibbon genera and various *Hylobates* taxa, the phylogeny within *Nomascus* is well resolved (Figure 10). According to genetic data (Roos et al. 2007; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010e), *N. nasutus* and *N. hainanus* form a sister group to the remaining species. Among the latter, *N. concolor* branched off first. Within *N. concolor*, a division occurred between *N. c. concolor* and *N. c. lu*. Among the four southern species, a major division occurred between the white-cheeked gibbons (*N. leucogenys, N. siki*) and yellow-cheeked gibbons (*N. annamensis, N. gabriellae*), before finally both clades split into respective species. This branching pattern is also supported by acoustic data (Geissmann et al. 2000; Geissmann 2002b; Van Ngoc Thinh et al. 2011), and suggests that the genus originated in the north and successively migrated to the south and its current distribution (Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010e). These range expansions might have started 4.2 million years ago and ended 0.5 million years ago (Van Ngoc Thinh et al. 2010b).

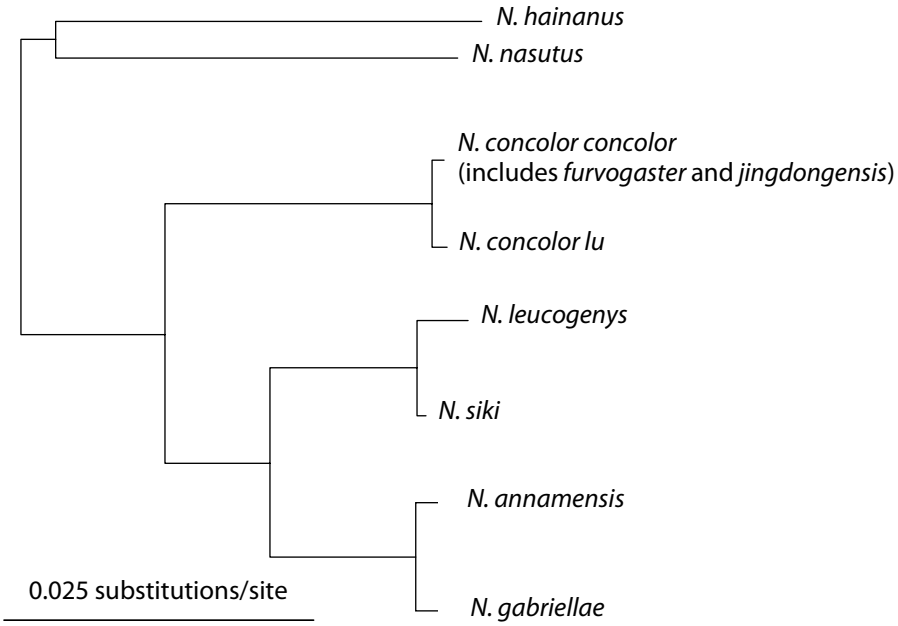


Figure 10. Phylogenetic relationships among crested gibbons

Based on mitochondrial cytochrome b sequence data (adapted from Van Ngoc Thinh et al. 2010e).

What is *Nomascus annamensis*? Prof. Colin Groves, Australian National University

40 years ago, only one species of Indochinese gibbon was recognised, *Hylobates* (*Nomascus*) *concolor*, with six subspecies (Groves 1972). 30 years later, Thomas Geissmann (2002b) was recognising multiple species, and urging that *Nomascus* be recognised as a full genus. Apart from the sharply different colour patterns, vocalisations were beginning to be recognised as strikingly different in the different taxa, and molecular data indicating their separation were not far behind (Roos 2004).

It was vocalisations that provided evidence that even the Geissmann/Roos multi-species model might be insufficient. Populations of what were supposed to be *Nomascus gabriellae* in northernmost Cambodia proved to have vocalisations noticeably different both from *N. gabriellae* and from the more northerly *N. siki* (Konrad & Geissmann 2006). Recently, a combination of vocalisations, including those of Konrad & Geissmann (2006) and genetic data (Van Ngoc Thinh et al. 2010e) enabled Van Ngoc Thinh et al. (2010c) to characterise a new species, *Nomascus annamensis,* with distribution extending from northern Cambodia into central Vietnam and south-central Laos.

Some characteristics of the external phenotype were included in the type description, but these are admittedly variable. The deep orange cheek patches of the type specimen and at least one other specimen in the black phase (i.e. adult male and juveniles of both sexes) are not constant, and may be merely buff-toned as in *N. gabriellae*. In general, they are intermediate between those of its southern neighbour *N. gabriellae* (not extending upward beyond the level of the lower margin of the hairless eye-rings) and those of its northern neighbour *N. siki* (extending well under the chin, where they nearly meet in the midline). The pale phase (i.e. adult female) cannot be distinguished from *N. gabriellae*.

Given these phenotypic features, the new species is essentially diagnosed by vocalisations and genetics. Is this a satisfactory basis for distinguishing species? According to the Phylogenetic Species Concept, now overwhelmingly adopted by mammalian taxonomists in general, and primate taxonomists in particular, a species must be distinguished from others by fixed heritable differences (see for example Groves 2001). Vocalisations have been shown, especially by Geissmann in various publications, to be heritable in gibbons, and of course DNA sequences are heritable by definition. It seems extraordinary that, in the 21st century, new species of apes are still being identified, but there is no reasonable doubt that *Nomascus annamensis* is a perfectly valid species.

9.3 Distribution of the Crested Gibbons (Genus *Nomascus*)

Gibbons are distributed throughout the tropical rain forests of South-East Asia (e.g. Groves 1972; Chivers 1977; Marshall & Sugardjito 1986; Geissmann 1995), while crested gibbons are restricted to Indochina and southern China (Figure 11). The Mekong River represents the western border of their distribution and separates them from gibbons of the genus *Hylobates*. Only in the northernmost part of the distribution, in western Yunnan province, crested gibbons (in this case *N. concolor*) are found west of the Mekong River. A small area of sympatry probably existed between this species and *Hylobates lar* in south-west Yunnan (reviewed in Geissmann et al. 2000). While Chinese gibbons today are restricted to southern Yunnan, and a single known site each in Guangxi province and on Hainan island (Ma & Wang 1986; Geissmann 1989; Groves & Wang Yingxiang 1990; Geissmann 1995; Bosco Pui Lok Chan et al. 2005; Geissmann 2007b), their distribution range extended as far north as the Yellow River in historical times (van Gulik 1967; Geissmann 1995; Geissmann et al. 2000). The identity of these gibbons is unclear (reviewed in Geissmann et al. 2000).

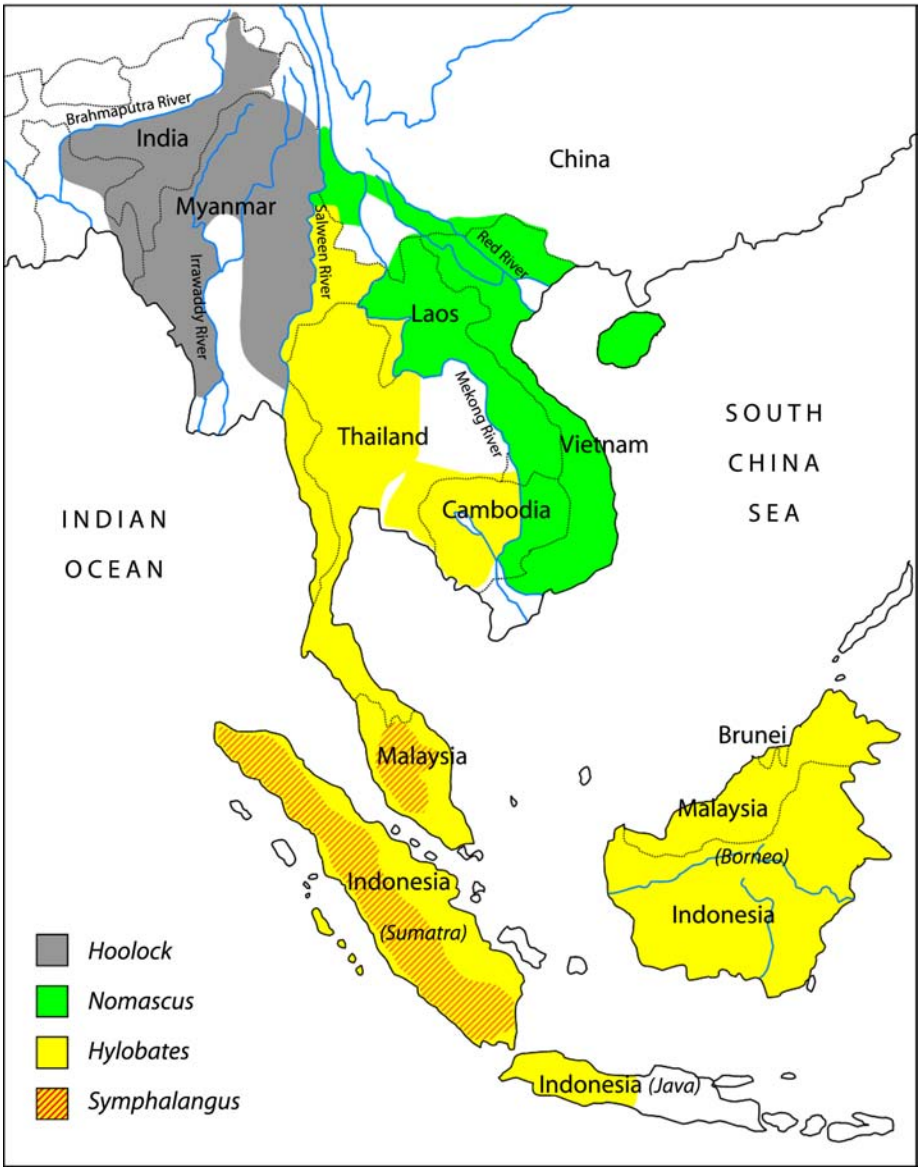


Figure 11. Geographical distribution of the four gibbon genera

After Geissmann (1995) and Van Ngoc Thinh et al. (2010b). Dotted lines indicate country borders and blue lines major rivers.

Until recently, there was much confusion about the distribution of *Nomascus* species, especially for the light-cheeked gibbons, but now acoustic and genetic investigations have enabled species boundaries to be elucidated in more detail (Geissmann et al. 2000; Konrad & Geissmann 2006; Ruppell 2009; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2010e; Van Ngoc Thinh et al. 2011). Accordingly, for most crested gibbon species, species boundaries - mainly in the form of larger rivers - are now known (Figure 12).

N. hainanus is restricted to Hainan Island, while *N. nasutus* is distributed east of the Red River and occurs in Vietnam and neighbouring China. *N. concolor* occurs in Vietnam, China and Laos. In Vietnam, the species is distributed between the Red and the Black Rivers and in China in central and western Yunnan Province. In western Yunnan province, *N. concolor* also occurs west of the Mekong River. This appears to be the only area where the genus *Nomascus* occurs west of the Mekong River (Ma & Wang 1986; Ma et al. 1988). Gibbons are apparently extinct in a large area in Yunnan between the Mekong and the Black River. It can be assumed that somewhere in this area a large contact zone between *N. concolor* and *N. leucogenys* must originally have existed (Geissmann et al. 2000). In Laos, an isolated population (*N. c. lu*) is restricted to Bokeo and Luang Namtha Provinces (Mootnick & Fan Pengfei 2011). The Mekong River represents its western border, on the other sides it is surrounded by populations of *N. leucogenys*, but the exact location of the inter-species boundary is unknown (Geissmann et al. 2000). *N. leucogenys* occurs from southern Yunnan to northern Laos and northern Vietnam. The southern limits of the species is the Kading River in Laos and in Vietnam most likely the Rao Nay River (Van Ngoc Thinh et al. 2010e; Van Ngoc Thinh et al. 2011). However, further studies are required to confirm the Rao Nay River as a species boundary. *N. siki* occurs in central Laos and central Vietnam, south of the range of *N. leucogenys*. In Vietnam, the species occurs south to approximately the Thach Han River (Van Ngoc Thinh et al. 2010e; Van Ngoc Thinh et al. 2011), while its southern limit in Laos remains unclear. The Banghiang River, however, might be wide enough to act as a species boundary. *N. annamensis* is distributed south of the range of *N. siki* and occurs in southern Laos, north-east Cambodia and central Vietnam. The species' range extends south to the Srepok River in Cambodia and the Ba River in Vietnam (Van Ngoc Thinh et al. 2010e; Van Ngoc Thinh et al. 2011). *N. gabriellae* is the southernmost crested gibbon species and occurs in south-east Cambodia and southern Vietnam. Its northern limits are the Srepok and Ba Rivers (Van Ngoc Thinh et al. 2010e; Van Ngoc Thinh et al. 2011).

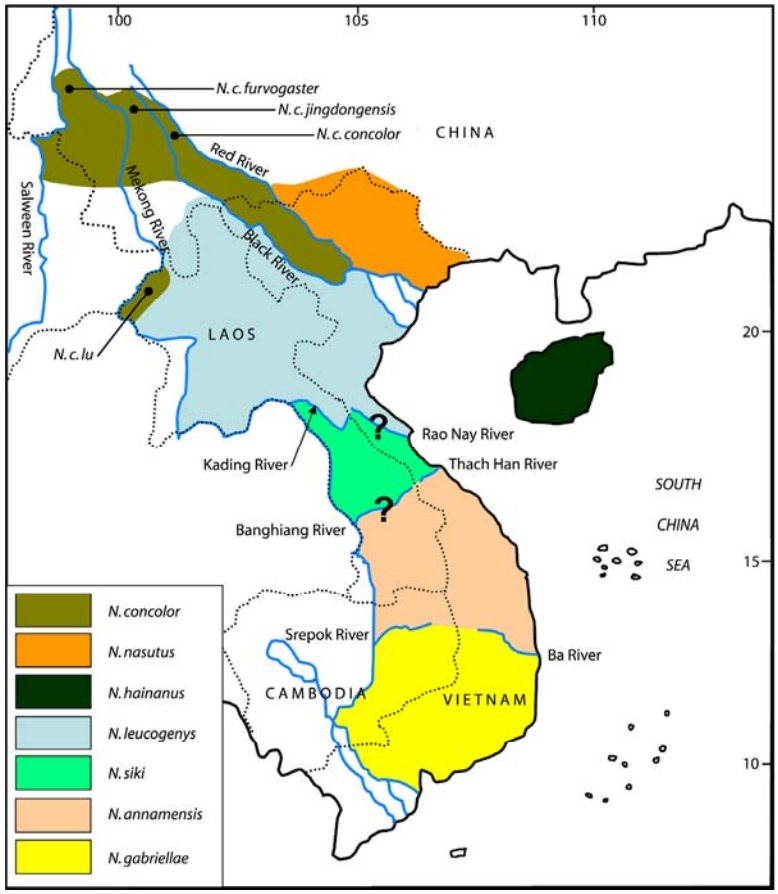


Figure 12. Distribution of crested gibbons

After Van Ngoc Thinh et al. (2010e). Dotted lines indicate country borders and blue lines major rivers. "?" indicates questionable taxon boundaries.

9.4 Characteristics of the Crested Gibbons in Vietnam

9.4.1 Eastern Black Gibbon *Nomascus nasutus*

Adult males and juveniles are almost completely black with a brownish tinge on the chest and frontal areas, and an only moderately developed crown crest. Adult females are pale yellow, yellow, orange or beige brown, exhibit a broad whitish face ring, and have a black cap that varies in size. Chest and sometimes the belly are adorned with a patch of varying size consisting of grey, brown or blackish hairs. The black crown is connected to the black facial area. It is narrow in the frontal area, becomes wide at the top of the head, and extends past the nape and across the shoulders where it then tapers toward the centre of the spine above or past the scapula. Description after Geissmann et al. (2000), Groves (2001), Mootnick (2006) and Mootnick and Fan Pengfei (2011).

Fully developed male vocalizations consist of only two of the three note types described for male crested gibbons (Geissmann 1993, 1995; Geissmann et al. 2000): staccato phrases and multi-modulated phrases; boom notes are absent (Figure 13). Staccato notes are short and consist of a rapid up-down sweep in frequency. The multi-modulated phrase is much more simple than in other crested gibbons. The first note usually differs from the other notes of the phrase and begins with a slow and moderate increase in frequency, followed by a more pronounced and long down-sweep in frequency. The following notes exhibit a different design and consist mainly of increasing frequency. The up-sweep is slow and moderate in the first part of the note, and short and pronounced in the second part. These notes sound like "*cao-vit*" or "*cao-vat*", which gave the gibbon its local name in Bac Kan Province (Geissmann, unpublished information). Adult males produce a special multi-modulated phrase, the "coda", during or immediately after the climax of the female great call. The coda phrase may include notes consisting of a frequency down-up sweep, which appear u-shaped in sonograms. Complete great call phrases of adult females consist of a series of 8-12 notes. All great call notes except the first 2-3 consist of very rapid vibrato sounds. These notes somewhat resemble the twitter-like vocalizations which follow at the end of the great call in other crested gibbons (Geissmann 1989, 1997; Geissmann et al. 2000; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2011). Great calls of *N. nasutus* (and *N. hainanus*) do not reach the high frequency levels of great calls of other crested gibbons: all fundamental frequencies are below 2.8 kHz, whereas in other crested gibbons, great call frequencies typically go up to above 3 kHz (Geissmann et al. 2000).

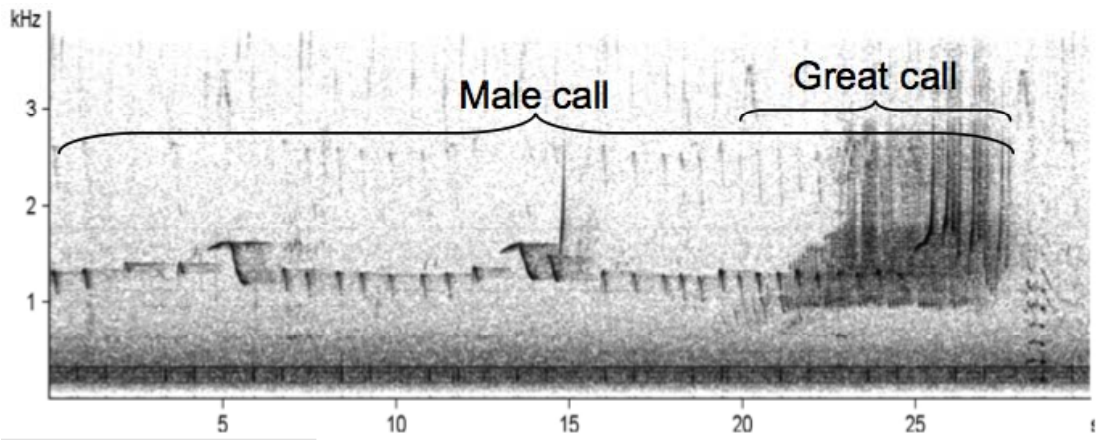


Figure 13. Sonogram showing call sequence of *Nomascus nasutus*

Several male phrases continued during great call and directly followed by male coda near the end of the great call. Adapted from Van Ngoc Thinh et al. (2011).

Genetically, *N. nasutus* is most closely related to *N. hainanus* (Roos et al. 2007; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010e). In the mitochondrial cytochrome b gene, *N. nasutus* differs from *N. hainanus* in 6.8%, and from the other crested gibbon species in 6.7-8.2% (Roos et al. 2007). *N. nasutus* separated from *N. hainanus* about 3.2 million years ago, and from the other crested gibbon species about 4.2 million years ago (Van Ngoc Thinh et al. 2010b).

9.4.2 Western Black Gibbon *Nomascus concolor*

Adult males and juveniles are completely black with a strongly developed crown crest. A few single white hairs may occur in the corner of the mouth. Adult females are pale yellow, yellow, orange or beige brown with a black cap and a large, often rhomboid area with black hairs on the ventral area. The amount of ventral black varies. In some females, the whole ventral fur may be black, strongly contrasting with the light back, at the other end of the range, the ventral fur may be merely interspersed with some black hairs. Description after Geissmann (1993, 1994, 1995), Geissmann et al. (2000), Groves (2001), Mootnick (2006) and Mootnick and Fan Pengfei (2011).

Fully developed male song vocalizations of *N. concolor* consist of all three different note types described for male crested gibbons (Geissmann 1993, 1995; Geissmann et al. 2000): single booms produced during inflation of the throat sac, staccato phrases, and multi-modulated phrases (Figure 14). The first note of the multi-modulated phrase starts with high frequency (>1 kHz) and is ascending, followed by notes with rapid down-up modulation (u-shaped in the sonogram). The female great call consists of 9-14 notes. The first one or two notes are of ascending frequency only, the others are down-up modulated (u-shaped), with the end frequency being higher than the starting frequency (Geissmann 1993, 1995; Geissmann et al. 2000; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2011).

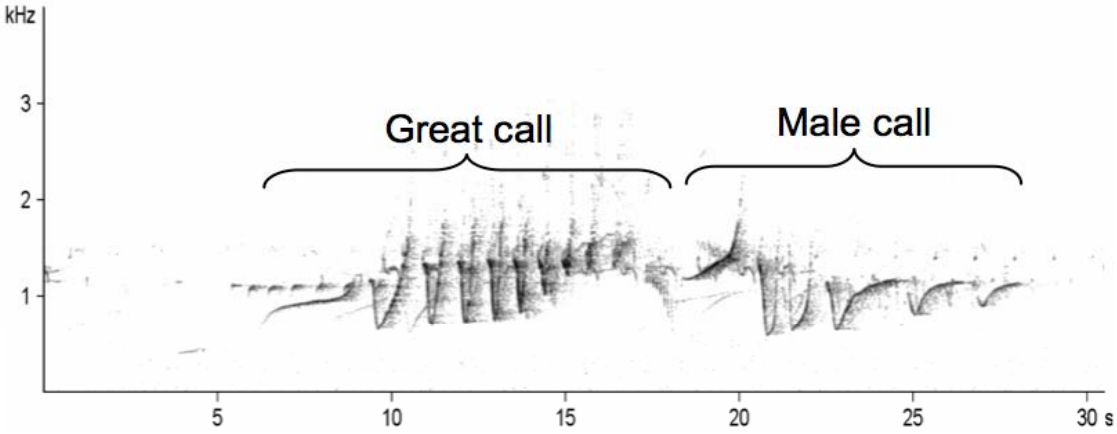


Figure 14. Sonogram showing call sequence of *Nomascus concolor*

Adapted from Van Ngoc Thinh et al. (2011).

Genetically, *N. concolor* is more closely related to the four light-cheeked crested gibbon species than to the other two all-black species *N. nasutus* and *N. hainanus* (Roos 2004; Takacs et al. 2005; Monda et al. 2007; Roos et al. 2007; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010e). In the mitochondrial cytochrome b gene, *N. concolor* differs from *N. nasutus* and *N. hainanus* in 6.8-8.2%, and from the light-cheeked crested gibbon species in 4.5-6.2% (Roos et al. 2007). *N. concolor* separated from *N. nasutus* and *N. hainanus* about 4.2 million years ago, and from the light-cheeked crested gibbon species about 2.8 million years ago (Van Ngoc Thinh et al. 2010b).

9.4.3 Northern White-cheeked Gibbon *Nomascus leucogenys*

Males and juveniles are black with a white cheek beard connecting under a black chin and extending up to the top of the ears. The beard can rarely be pale yellow in juveniles. The beard

does not look "brushed" outwards. The fur on the chest is black, and the crown crest is strongly developed. Adult females are pale yellow, yellow, apricot or orange yellow. The fur on the chest and belly is light, as the back, but often thinner. The face ring is usually white and distinctly lighter than the neck; it is often thin, but usually complete. The cheek fur does not stand out on the sides. Description after Geissmann (1993, 1994, 1995), Geissmann et al. (2000), Groves (2001), Mootnick (2006) and Mootnick and Fan Pengfei (2011).

Fully developed male song vocalizations of *N. leucogenys* consist of all three different note types described for male crested gibbons (Geissmann 1993, 1995; Geissmann et al. 2000): booms produced during inflation of throat sac, staccato phrases, and multi-modulated phrases (Figure 15). Booms are produced as single notes, as in other crested gibbons, but in some individuals, they can be produced in short series of up to four notes. The first note of the multi-modulated phrase has a long section of relatively stable frequency at the beginning with a rapid down-up sweep ("hook") at the end. Repeated changes of frequency modulation ("wou-ee-ou-ee-ou-ee") occur on the second and often on the third note. The female great call consists mainly of 8-30 (up to 39) notes, which normally start with a frequency of more than 0.6 kHz (Geissmann 1993, 1995; Geissmann et al. 2000; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2011).

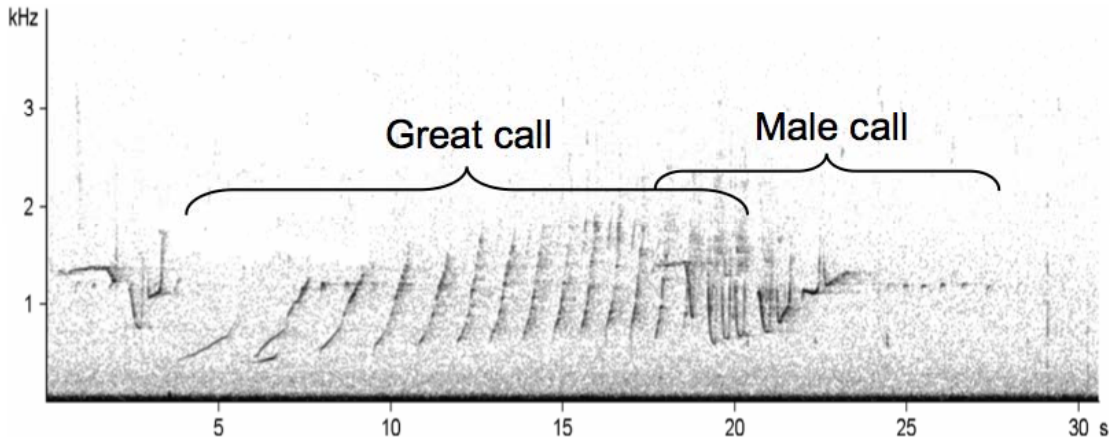


Figure 15. Sonogram showing call sequence of *Nomascus leucogenys*

Adapted from Van Ngoc Thinh et al. (2011).

Genetically, *N. leucogenys* is most closely related to *N. siki* (Roos 2004; Takacs et al. 2005; Monda et al. 2007; Roos et al. 2007; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e). In the mitochondrial cytochrome b gene, *N. leucogenys* differs from *N. siki* in 1.2-1.8%, and from the yellow-cheeked gibbons in 3.3-4.6% (Roos et al. 2007). *N. leucogenys* and *N. siki* separated about 0.5 million years ago, and both from the yellow-cheeked gibbons about 1.7 million years ago (Van Ngoc Thinh et al. 2010b). *N. leucogenys* carries a species-specific inversion on chromosome 7 (Carbone et al. 2009).

9.4.4 Southern White-cheeked Gibbon *Nomascus siki*

Males and juveniles are black with a white cheek beard. In contrast to *N. leucogenys*, the beard reaches only halfway up the ears, with a pointed upper end and extending to jaw angles and forming a bracket around the corners of the mouth (absent in *N. leucogenys*). The beard can rarely be pale yellow in juveniles. The beard is not "brushed" outwards (as in *N. gabriellae* and *N. annamensis*), but flatly towards the ears. The fur on the chest is black, and the crown crest is relatively well developed, but usually less high than in *N. leucogenys*. Adult females of *N. siki* look very similar to those of *N. leucogenys*, and no consistent fur colouration differences are known between them. Description after Geissmann (1993, 1994, 1995) (1993, 1994, 1995), Geissmann et al. (2000), Groves (2001), Mootnick (2006) and Mootnick and Fan Pengfei (2011).

Songs of *N. siki* closely resemble those of *N. leucogenys* (see above). Although the calls of both species can be told apart using multivariate analyses (Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2011), they sound very similar in the field, with no single characteristic being known that reliably separates their song (Figure 16). As a trend, *N. siki* males produce repeated changes of frequency modulations ("wou-ee-ou-ee-ou-ee") only in the third note of the multi-modulated phrase, whereas *N. leucogenys* males produce rapid up-and-down sweeps on the third note as well, at least after having gone through the initial stage of their song bout, and most regularly when replying to great calls. Also as a trend, great calls of *N. siki* tend to be shorter than those of *N. leucogenys* and consist of 8-18 notes in *N. siki* and about 15-30 (up to 39) notes in *N. leucogenys* (Geissmann 1995; Geissmann et al. 2000; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2011).

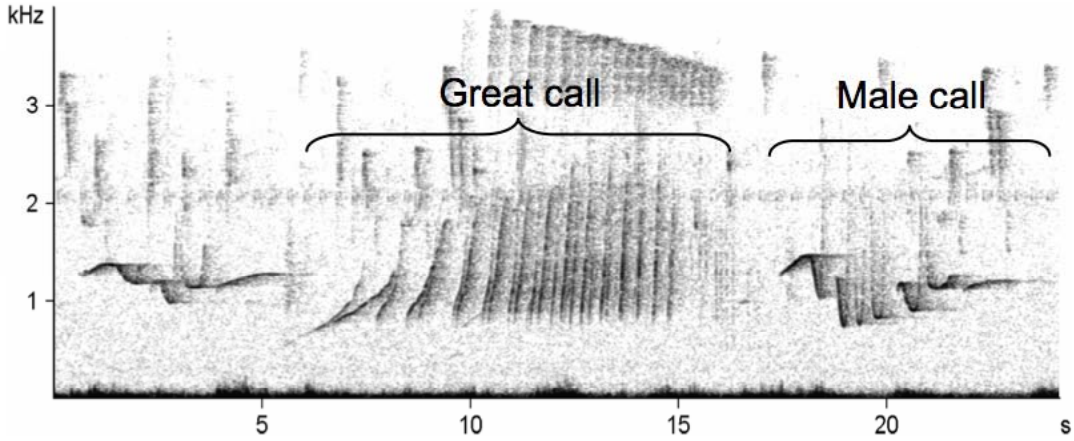


Figure 16. Sonogram showing call sequence of *Nomascus siki*

Adapted from Van Ngoc Thinh et al. (2011).

Genetically, *N. siki* is most closely related to *N. leucogenys* (Roos 2004; Takacs et al. 2005; Monda et al. 2007; Roos et al. 2007; Van Ngoc Thinh et al. 2010b; Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e). In the mitochondrial cytochrome b gene, *N. siki* differs from *N. leucogenys* in 1.2-1.8%, and from the yellow-cheeked gibbons in 3.3-4.6% (Roos et al. 2007). *N. siki* and *N. leucogenys* separated about 0.5 million years ago, and both from the yellow-cheeked gibbons about 1.7 million years ago (Van Ngoc Thinh et al. 2010b).

9.4.5 Northern Yellow-cheeked Gibbon *Nomascus annamensis*

Fur colouration characteristics of *N. annamensis* closely resemble those of *N. gabriellae* (see below), and no consistent fur colouration differences are known between the two species. It has been suggested that male cheek colouration might be darker in *N. annamensis* than in *N. gabriellae* (Van Ngoc Thinh et al. 2010c), but no statistically significant numbers of males of both species have been compared to confirm this. Moreover, it is unclear, to what degree the tone of male cheek colouration may be influenced by exposure to sunlight, humidity, sweat production and age, factors which are believed to play a role in the tone of the yellow body colouration in *Nomascus* females (Geissmann 1993; Mootnick 2006).

Fully developed male vocalizations consist of all three different note types described for male crested gibbons (Geissmann 1993, 1995; Geissmann et al. 2000): single booms produced during inflation of the throat sac, staccato phrases, and multi-modulated phrases (Figure 17), but booms occur only sometimes or may be so soft that they are not recorded. The staccato notes are uttered very softly and often at irregular intervals, as in *N. gabriellae*, whereas they are loud and produced in more rhythmic intervals in other crested gibbons (thus the name "staccato"). The first note of the multi-modulated phrase begins with a long section of descending frequency. Rapid changes of frequency modulation ("wou-ee-ou-ee-ou-ee") occur on the second note only, as in *N. gabriellae*. In *N. annamensis*, these repeated down-and-up sweeps in frequency are faster than in

N. leucogenys and *N. siki*, but less fast and less trill-like than in *N. gabriellae*. Female great calls consist of 6-15 notes, each beginning with a frequency of 0.6-0.7 kHz (Geissmann et al. 2000; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2011).

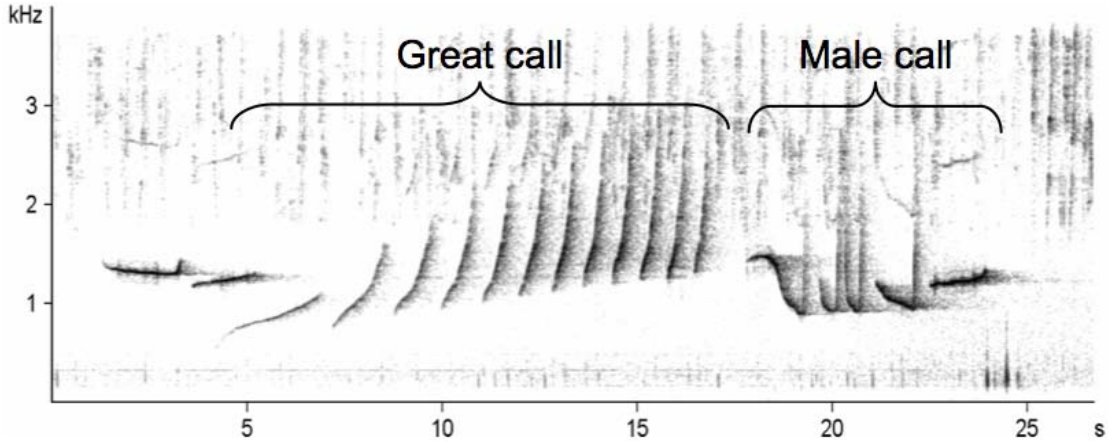


Figure 17. Sonogram showing call sequence of *Nomascus annamensis*

Adapted from Van Ngoc Thinh et al. (2011).

Genetically, *N. annamensis* is most closely related to *N. gabriellae* (Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e). In the mitochondrial cytochrome b gene, *N. annamensis* differs from *N. gabriellae* in 1.1-1.8%, and from the white-cheeked gibbons in 3.3-4.6% (Roos et al. 2007; Van Ngoc Thinh et al. 2010c). *N. annamensis* and *N. gabriellae* separated about 0.7 million years ago (Roos unpublished data), and both from the white-cheeked gibbons about 1.7 million years ago (Van Ngoc Thinh et al. 2010b).

9.4.6 Southern Yellow-cheeked Gibbon *Nomascus gabriellae*

Males and juveniles are black with a light cheek beard. The beard is pale yellow, apricot or orange, not white. Compared to *N. leucogenys* and *N. siki*, the cheek patches are much smaller, and the part above the mouth is not larger than the part below. The light fur of the cheek patches surrounds the corners of the mouth like a bracket as in *N. siki*. Unlike other crested gibbons, with the exception of *N. annamensis*, the beard stands out on the sides of the cheeks, as if "brushed" outwards, with the hairs spreading out from the corners of the mouth like a fan. The fur on the chest is not pure black, but has at least a trace of rusty brown. The crown crest is relatively well developed, but usually less high than in *N. leucogenys* and its top often looks more pointed than rounded, as compared to *N. leucogenys* and *N. siki*. Adult females are pale yellow, yellow, apricot or orange yellow. The fur on the chest and belly is light, as the back, but often thinner. The face ring is usually yellowish (rarely white), often not lighter in contrast to the neck and often incomplete. As in the males, the cheek fur stands out on the sides, as if "brushed" outwards, with the hairs spreading out from the corners of the mouth like a fan. A crown tuft is present in males, but absent in females. Description after Geissmann (1993, 1994, 1995), Geissmann et al. (2000), Groves (2001), Mootnick (2006), Mootnick and Fan Pengfei (2011) and Van Ngoc Thinh et al. (2010c).

Fully developed male vocalizations consist of only two of the three note types described for male crested gibbons (Geissmann 1993, 1995; Geissmann et al. 2000): staccato phrases and multi-modulated phrases; boom notes are absent (Figure 18). The staccato notes are uttered very softly and often at irregular intervals, whereas they are loud and produced in more rhythmic intervals in other crested gibbons (thus the name "staccato"). The first note of the multi-modulated phrase begins with a long section of descending frequency. Rapid changes of frequency modulation ("wou-ee-ou-ee-ou-ee") occur on the second note only. In *N. gabriellae*, these repeated down-and-up sweeps in frequency are extremely fast and resemble a trill, as compared to the slower

modulations in *N. leucogenys* and *N. siki*. Female great calls consist of 5-13 notes, but each note begins with ascending frequency, starting at a frequency of above 0.7 kHz (Geissmann 1993, 1995; Geissmann et al. 2000; Van Ngoc Thinh et al. 2010d; Van Ngoc Thinh et al. 2011).

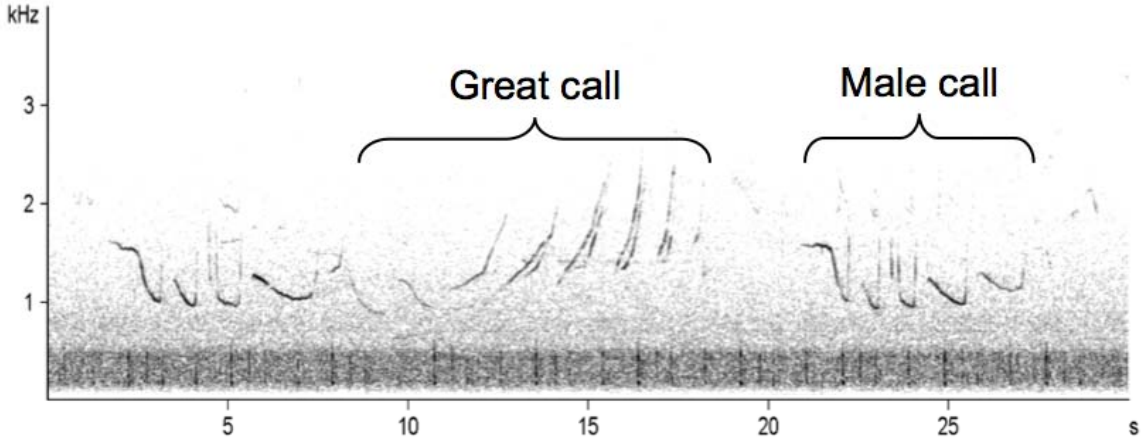


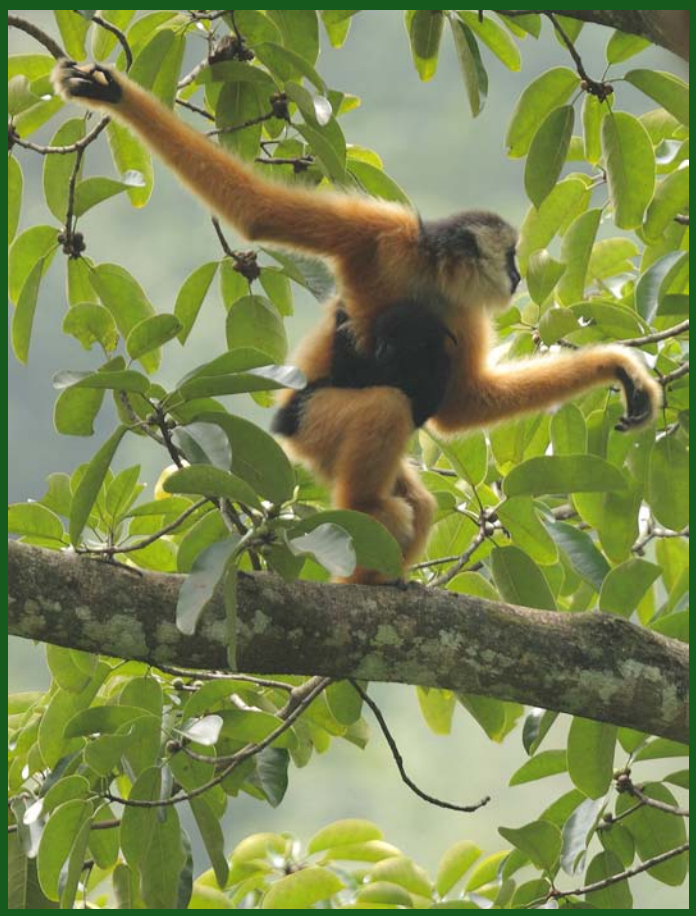
Figure 18. Sonogram showing call sequence of *Nomascus gabriellae*

Adapted from Van Ngoc Thinh et al. (2011).

Genetically, *N. gabriellae* is most closely related to *N. annamensis* (Van Ngoc Thinh et al. 2010c; Van Ngoc Thinh et al. 2010e). In the mitochondrial cytochrome b gene, *N. gabriellae* differs from *N. annamensis* in 1.1-1.8%, and from the white-cheeked gibbons in 3.3-4.6% (Roos et al. 2007; Van Ngoc Thinh et al. 2010c). *N. gabriellae* and *N. annamensis* separated about 0.7 million years ago (Roos unpublished data), and both separated from the white-cheeked gibbons about 1.7 million years ago (Van Ngoc Thinh et al. 2010b).

Chapter 10

Ecology & Behaviour of Crested Gibbons



Female *Nomascus nasutus* with infant
Photo: Huang Tao

10 Ecology and Behaviour of Crested Gibbons

10.1 Introduction

At the turn of the 21st century, the *Nomascus* genus was probably the least studied genera of the Hylobatidae. Very few of the seven species in the genus had been studied at that time, and most work had been conducted in China on *N. concolor* and over short periods of time. In the decade since the publication of the first Vietnam gibbon status review (Geissmann et al. 2000), however, considerable additional research has been conducted on members of the *Nomascus* genus. Longitudinal studies have now been completed on several taxa, and work is ongoing on others.

Despite the only recent rediscovery of *N. nasutus* in 2002 (La Quang Trung & Trinh Dinh Hoang 2004) there is a growing body of work on this taxon's ecology, including social structure (Fan Pengfei et al. 2010), diet (Nguyen Thi Hien 2007; Fan Pengfei et al. 2011) and ranging behaviour (Fan Pengfei et al. 2010), and it stands to become one of the best described species in the genus.

Nomascus concolor remains a focus of research, with a steady stream of published results coming out of China since the 1990s, including recent work on group structure (Fan Pengfei et al. 2006; Fan Pengfei & Jiang Xuelong 2010), diet (Fan Pengfei & Jiang Xuelong 2009; Fan Pengfei et al. 2009), ranging behaviour (Fan Pengfei & Jiang Xuelong 2008a), activity budgets (Fan Pengfei et al. 2008) and other aspects of the species ecology (Fan Pengfei et al. 2007; Fan Pengfei & Jiang Xuelong 2008b).

Nomascus leucogenys represents an ongoing research gap, with only a single study, which was completed in the 1980s (Hu et al. 1989). Published ecological work is still missing for *N. siki*. Some preliminary results on diet exist for *N. annamensis* (Traeholt et al. 2007; Phan Channa 2008); however, a habituated group of the species in Cambodia is the subject of ongoing research and promises to return additional information over coming years. *N. gabriellae* is the best studied species of the light-cheeked gibbons and has been the subject of one long-term study (Kenyon 2007) which has revealed significant detail about its ranging behaviour, group structure and diet.

While there are still many gaps in our knowledge, a picture of the *Nomascus* genus is slowly emerging, and there are some tantalizing suggestions that it differs in some ways from other gibbon genera. This chapter aims to summarise ecological information on each species of gibbon found in Vietnam.

10.2 Ecology of Crested Gibbons in Context

Gibbons have generally been characterized as monogamous in the literature since the first studies of Carpenter (1940), with families consisting of an adult male, adult female and up to three offspring (Bartlett 2007). As additional field data has been collected, however, it is becoming apparent that while it may be that paired monogamous groups are the norm, gibbons show significant variation in this respect. Extra-pair copulations and mate replacement have been noted in some species (Palombit 1994; Reichard 1995; Kenyon 2007) and instances of more than two adults in a single group make up 10% or more of all observation across the Family Hylobatidae (Fuentes 2000). *Nomascus* gibbons have been particularly important in redefining, or at least questioning, the previous paradigm with suggestions of social polygamy in *N. concolor* (Haimoff et al. 1986; Fan Pengfei et al. 2006; Fan Pengfei & Jiang Xuelong 2010), *N. nasutus* (Fan Pengfei et al. 2010) and *N. hainanus* (Liu Zhenhe et al. 1989; Jiang Zhou et al. 2005). Variability within the genus needs further assessment to determine the extent and frequency of this pattern.

Data on maturity in *Nomascus* gibbons is lacking, however in general gibbons may reach maturity as early as five years of age in captivity, although average age, especially in wild conditions, is likely to be closer to 7-8 years (Geissmann 1991), with both sexes subsequently dispersing from their parents' territory (Leighton 1987; Bartlett 2007). Studies of *Hylobates lar* provide the only

data for age of dispersal for gibbons where it was found to average 9 years 9 months (± 8.2 months) (Brockelman et al. 1998). However this was in a population likely at carrying capacity and figures may not necessarily be extrapolated validly to crested gibbons in any case. The gestation period in *N. leucogenys* is 200-212 days (Geissmann 1991) and it is likely that other *Nomascus* taxa are similar. A single young is born, with twinning being very rare. The interbirth interval is approximately 3 years based on data from other Hylobatid genera (summarised in Traeholt et al. 2005).

Nomascus species, like other gibbon species, are territorial, defending an area against other groups of the same species. The size of home ranges is likely determined by resource availability and group density, with average home range size across the family being around 40 hectares (Bartlett 2007). Data are lacking for most species of *Nomascus*, and for those where it exists data come from relatively few groups; however, it appears that more northerly distributed species in sub-tropical climes or higher altitudes may have larger home ranges (Liu Zhenhe et al. 1989; Bleisch & Chen 1991; Sheeran 1993; Fan Pengfei & Jiang Xuelong 2008a) than more southerly distributed species (Kenyon 2007) and above average figures for the family as a whole.

The diets of the Hylobatidae are generally dominated by fruits with lower consumption frequencies of flowers and leaves, and often a significant proportion of figs (Bartlett 2007). Feeding ecology data specific to *Nomascus* taxa is still severely limited; however, some additional studies have been conducted since the previous status review (Geissmann et al. 2000). *Nomascus concolor* remains the best studied taxon with several studies addressing its feeding ecology (Lan 1993; Sheeran 1993; Chen 1995; Fan Pengfei et al. 2009). There are now also preliminary data for *N. nasutus* (Geissmann et al. 2002; Nguyen Thi Hien 2007; Fan Pengfei et al. 2011), while *N. annamensis* (Traeholt et al. 2007; Phan Channa 2008) and *N. gabriellae* (Kenyon 2007) have been studied in limited detail. *Nomascus leucogenys* has only a single study conducted in the late 1980s (Hu et al. 1989) while *N. siki* remains unstudied to date. Despite the fact that most species have been studied to a certain extent (see Table 8), there remains considerable work to do.

Table 8. Dietary proportions for Vietnam's *Nomascus* taxa

Species	Fruit	*Ficus*	Flower	New leaf/ Shoots	Leaf	Insects/ Animals	Unknown/ Other	Reference
N. nasutus	62.79%	N/A	20.93%	16.28%	N/A	N/A	N/A	1
	86.60%				4.70%	0.50%	8.20%	2
	36.10%	21.90%	3.00%	14.30%	16.90%	7.00%	0.70%	3
N. concolor	25.50%	18.60%	9.10%		46.50%		0.30%	4
	24.00%	N/A	6.00%	N/A	54.00%	14.00%		5
	21.00%		7.00%	61.00%	11.00%			6
	44.00%				43.00%		13.00%	7
N. leucogenys	39.00%		5.00%	17.00%	36.00%	4.00%		8
N. siki	No Data Available							
N. annamensis	30.31%		12.17%	35.40%	22.12%			9
	54.04%		16.36%	27.55%	2.05%			10
N. gabriellae	43.04%	38.61%	8.86%	7.59%	1.90%			11

References: 1– Nguyen Thi Hien 2007; 2– Geissmann et al. 2002; 3– Fan Pengfei et al. 2011.; 4– Fan Pengfei et al. 2009; 5– Chen 1995 cited in Bartlett 2007; 6– Lan 1993; 7– Sheeran 1993; 8– Hu et al. 1989 cited in Geissmann et al. 2000; 9– Traeholt et al. 2007; 10– Phan Channa 2008; 11– Kenyon 2007
Note: Many studies measure feeding frequency in different ways (e.g. by feeding bout, by scan sample frequency, by volume etc.), sample sizes and length of study may be disparate between studies, studies use different definitions of food types, thus relative figures should be interpreted with caution and where possible original sources consulted.

An additional note concerning hunting and protein consumption in *Nomascus* seems appropriate at this stage based on the recent finding that *N. concolor* predates on vertebrates relatively frequently. The species was observed making 11 attacks on giant flying squirrel resulting in four successful predation events during one study (Fan Pengfei & Jiang Xuelong 2009). This is surprising given that this behaviour has not been recorded in gibbons previously, despite numerous study hours, mostly on the genus *Hylobates* (Bartlett 2007). Reports of predation on mammalian vertebrates has also been recently recorded for *N. annamensis*, with one successful predation event on a sub-adult variable squirrel (A. Briggs pers. comm.). Additionally, both species have also been recorded feeding on eggs and lizards (Traeholt et al. 2007; Phan Channa 2008; Fan Pengfei & Jiang Xuelong 2009).

10.3 Species Accounts

10.3.1 Eastern Black Gibbon *Nomascus nasutus*

Nomascus nasutus previously occurred across central northern Vietnam in montane and limestone forests (Dao Van Tien 1983; Geissmann et al. 2000) but now has a very limited distribution, occurring only in the limestone mountains of Trung Khanh District, Cao Bang Province and Bangliang Nature Reserve, Jingxi County in China. The habitat here is representative of tropical monsoon limestone forest with an altitudinal range of 500-930 m a.s.l. (Bosco Pui Lok Chan et al. 2008) the entire range of which appears to be utilised by the gibbon population (Geissmann et al. 2002)

Study into the ecology and behaviour of *N. nasutus* is at an early stage due to the species only being rediscovered in 2002 (La Quang Trung & Trinh Dinh Hoang 2004); however, preliminary data exist. The species social organization, like that of *N. concolor*, appears to have high frequencies of social polygyny with very large group sizes. One of us (BMR) assessed mean group size based on all observations of groups, excluding lone individuals and using lower estimates where group counts are uncertain, from published material (Geissmann et al. 2002; Vu Ngoc Thanh et al. 2005; Le Trong Dat 2007; Bosco Pui Lok Chan et al. 2008; Fan Pengfei et al. 2010). Mean group size in *N. nasutus* calculated from 32 observations was 5.91 individuals (95% CI 5.24 - 6.57). While many of these are doubtless double counts of the same 'groups', data was collected at different times over a seven year period and therefore capture the dynamics of gibbon group change in composition.

Considerably larger group sizes than in other gibbon taxa is a point of considerable interest from an ecological and conservation perspective. Two main hypotheses for these findings in the taxon present themselves. Firstly, a compression scenario with vastly reduced habitat size and/or quality in the Trung Khanh-Jingxi limestone forest area is altering normal group formation and/or dispersal. Opportunities to disperse may be limited for sub-adult animals at the site, which may result in larger group sizes, and possibly increased stress and higher mortality. That familial polygyny is occurring due to either lack of suitable habitat or mates for dispersing individuals, as has been suggested for *N. hainanus* on Hainan Island, China (Bleisch & Chen 1991), is a possibility. Should this be the case, the possibility of inbreeding depression and increased levels of competition and mortality may pose a long-term threat to the species and deserves research attention. Ongoing demographic monitoring needs to be conducted on focal groups to ensure that abnormal differential mortality is not skewing age structures and potentially putting the population at further extinction risk.

Alternatively, group size may be naturally larger in this taxon, with polygyny being an evolved and alternate adaptive strategy. It has been suggested as such for *N. concolor* (Fan Pengfei & Jiang Xuelong 2010) and groups with multiple females are also standard in *N. hainanus* (Liu Zhenhe et al. 1989; Jiang Zhou et al. 2005), although very few groups remain of this species. Of considerable interest is the observation that groups appear to be stable in composition over time in *N. nasutus* (Fan Pengfei et al. 2010), as they are in observed groups of *N. concolor* with multiple females (Fan Pengfei & Jiang Xuelong 2010), and in *N. concolor* at least inter-female aggression is minimal (Fan

Pengfei & Jiang Xuelong 2010). It may be that having multiple females in a group facilitates territorial and mate defence (Fan Pengfei & Jiang Xuelong 2010).

Initial observations on the diet of *N. nasutus* suggested this species is largely frugivorous (Geissmann et al. 2002; Nguyen Thi Hien 2007), exceeding average levels of fruit consumption among the Hylobatidae (Bartlett 2007). However the observations of Geissmann et al. (2002) came from only a period of 13 days in the month of August, and over 50% of feeding records were from a single fruiting tree species. Nguyen Thi Hien (2007) also noted that fruit consumption was high during this time of the year as was fruit availability. Longer term research on the species in China has shown that frugivory occurs at lower though still significant levels, with significant seasonality in diets (Fan Pengfei et al. 2011). How diet and ranging behaviour interact in the species in the small extent of degraded forest remaining for the taxon is not known. However, initial estimates of territory size from three groups from the Chinese part of the population returned values of 128, 130 and 133 ha (Fan Pengfei et al. 2010), which are large by Hylobatidae standards (Bartlett 2007).

10.3.2 Western Black Gibbon *Nomascus concolor*

Nomascus concolor lives in the high altitude, seasonal, subtropical areas of Yunnan Province, in areas of semi-humid broadleaf evergreen and mid-montane humid broad-leafed evergreen forests, including areas with low stature forest which is intermixed with pines (Haimoff et al. 1986; Bleisch & Chen 1991; Jiang Xuelong et al. 2006; Tian Changcheng et al. 2007; Fan Pengfei et al. 2009). In Nam Ha National Protected Area, Laos, they inhabit subtropical broadleaf evergreen forest (Johnson et al. 2005). In Vietnam, the species is found in the highlands in upper and lower primary evergreen montane forest (Dao Van Tien 1983; Long et al. 2001). The species is well adapted to high altitudes and cold temperatures, recorded up to around 2,900 m a.s.l. at Ailaoshan in Yunnan Province China (Bleisch & Chen 1991; Jiang Xuelong et al. 2006) and is found up to about 2,000 m a.s.l. in areas in Vietnam (Nguyen Xuan Dang & Lormee 1999; Long et al. 2000; Le Trong Dat & Le Minh Phong 2010).

Nomascus concolor was the first and is the best studied *Nomascus* taxon, and presented the first indication that polygyny might be a strategy used by the Hylobatidae. Haimoff's (1986) results from surveys in Yunnan Province showed large group sizes for gibbons, with an average of 7-8 individuals per group. Groups were found to be composed of a single male, 1-4 adult females and up to five or six offspring. Based on these observations, he suggested that gibbons here were polygynous, possibly facilitated by specialization for a folivorous diet, which indeed later research suggested they are adapted for. Bleisch and Chen (1991) and later Lan (1993) discounted the suggestion based on their surveys and long term ecological work, and while Sheeran (1993) found larger group sizes than typical for gibbons in her study groups, with 5.0-5.25 individuals per group, this was attributed to lack of dispersal options in a fragmented habitat with no evidence for polygyny found. However, more recently, extensive work on Wuliangshan has returned at least five polygynous groups and no monogamous groups often with more than one breeding female (Fan Pengfei et al. 2006; Fan Pengfei et al. 2008; Fan Pengfei & Jiang Xuelong 2010), while in Vietnam, groups with more than one female are commonly recorded (Le Trong Dat & Le Huu Oanh 2006; Le Trong Dat & Le Minh Phong 2010). As with *N. nasutus* (see above), whether this consistent finding represents a fundamental difference in mating strategy in *N. concolor* or a consistent lack of dispersal and/or mate options in fragmented and suppressed populations remains unknown.

Home range sizes for the species seem large. One field study, although conducted over a short period of time, estimated home ranges to be a minimum of 120 ha for one group, 70 ha for a second group and 40 ha for a third group in Yunnan, China (Bleisch & Chen 1991). Sheeran's (1993) estimates from Wuliangshan and Ailaoshan, China, were that the home range of her study groups exceeded 100 ha and possibly 200ha. More recently, one group of *N. concolor* was noted to have a home range size of 151 ha (Fan Pengfei & Jiang Xuelong 2008b). Day ranges in the same study averaged 1391 m, which is not abnormally large for the Hylobatidae (Bartlett 2007) but were highly variable and changed seasonally in relation to fruit abundance (Fan Pengfei & Jiang Xuelong 2008a). These large home ranges relative to other studied gibbon species (Bartlett 2007)

are probably linked to the high altitude areas that the species often inhabits. Animals may be forced to forage more widely throughout the year because of the relatively low quality and/or availability and distribution of resources (Sheeran 1993; Bartlett 2007; Fan Pengfei & Jiang Xuelong 2008a). This is reflected in the little dietary information for the species that is available, which shows high levels of folivory relative to frugivory, as summarized in Table 8.

Diet consists of low levels of fruit consumption and dominated by leaf buds and shoots, although fruit is apparently a preferred item (Lan 1993; Fan Pengfei et al. 2009). Even for studies showing relatively higher levels of fruit consumption for the species (Sheeran 1993; Fan Pengfei et al. 2009) levels of leaf consumption are high compared to other gibbon species (Chivers 1984; Bartlett 2007) and the species has been characterized as foli-frugivorous (Fan Pengfei et al. 2009). The highly seasonal environment in which much of the remaining global population lives, and resulting reliance on leaf for long periods of the year (Fan Pengfei et al. 2009), suggests that *N. concolor* endures an extreme of the Hylobatidae ecological niche.

Availability of food items apparently drives activity budgets in the species with average annual rates of resting (40.0%), feeding (35.1%), travelling (19.9%), singing (2.6%), playing (1.2%) and other (1.3%), being documented (Fan Pengfei et al. 2008). Activity budgets change seasonally, probably in relation to significant changes in fruit availability which demand energy conservation strategies at times of low fruit availability (Fan Pengfei et al. 2008).

10.3.3 Northern White-cheeked Gibbon *Nomascus leucogenys*

Nomascus leucogenys may prefer lowland evergreen forest, though are also found in areas of higher altitude in lower montane evergreen forest (Geissmann et al. 2000; Nguyen Manh Ha 2005) and in medium and high mixed coniferous and broadleaf evergreen forests in some locations (Le Trong Trai et al. 1999a). In Pu Mat National Park gibbons still occur in lowland evergreen forest, although at low numbers (Luu Tuong Bach & Rawson 2011) and they have now been largely extirpated from this habitat type in Vietnam being now restricted to higher altitude forests. For example, in Pu Huong and Pu Hoat Nature Reserves, the species was largely restricted to areas over 800 m due to lack of available habitat, with listening posts at over 1,000 m recording the species at both sites (Luu Tuong Bach & Rawson 2009b, 2010), while in China at one site they were found between 700 and 1,000 m a.s.l. (Hu et al. 1989).

Not much is known about the ecology and behaviour of *N. leucogenys*, as only one ecological study has been conducted on the species in Yunnan Province, China, which suggested the species has relatively low levels of fruit consumption, with high levels of leaf consumption (see Table 8) and marked seasonality in diet (Hu et al. 1989). No information on average group size or composition is available. Additional research is needed to determine the ecological and behavioural characteristics of the species.

10.3.4 Southern White-cheeked Gibbon *Nomascus siki*

Nomascus siki in Vietnam appears to have a preference for lowland tropical moist evergreen forest (Geissmann et al. 2000; Nguyen Manh Ha 2005). Geissmann et al. (2000) stated that the species is largely restricted to approximately 30-100m a.s.l., however, the species is recorded from 176-600 m a.s.l. in Phong Nha-Ke Bang National Park (Haus et al. 2009) and up to 1,900 m a.s.l. in Nakai-Nam Theun National Protected Area in Laos (Timmins & Evans 1996), suggesting considerable flexibility and ability to persist in montane evergreen forests. No studies have been conducted on the ecology or behaviour of this species.

10.3.5 Northern Yellow-cheeked Gibbon *Nomascus annamensis*

Nomascus annamensis inhabits broadleaf evergreen forests in south central Vietnam. The species apparently inhabits a wide range of altitudes, as low as 100 m a.s.l. in Ratanakiri Province, Cambodia (Rawson unpublished data) from 315-1,205 m a.s.l. in Quang Nam Province (Minh Hoang et al. 2005) and from 400-800 m a.s.l in Bach Ma National Park (Tallents et al. 2001b).

The recently described *N. annamensis* was part of several ecological studies, which are still ongoing. To date, limited information suggests that group size and composition is typical. In terms of diet, Traeholt et al. (2007) gave low figures for fruit consumption and high figures for leaves and shoots (see Table 8). However, frequencies come from the number of visits to trees, not a sampling regime, under which method one would expect figures to be skewed towards leaves. The findings of Phan Channa (2008), suggest more moderate levels of leaf consumption and a higher level of reliance on fruit. Both studies however detected a rather large reliance on flowers.

10.3.6 Southern Yellow-cheeked Gibbon *Nomascus gabriellae*

Nomascus gabriellae occurs in the wet evergreen, semi-evergreen and mixed deciduous forest of the Indochina lowlands (Geissmann et al. 2000). Undisturbed evergreen forest with a reasonably high canopy seems to be the most optimal habitat for the species (Nguyen Xuan Dang & Osborn 2004b; Traeholt et al. 2005; Kenyon 2007; Rawson et al. 2009). In Cat Tien National Park, gibbons are found in evergreen, semi-evergreen, mixed deciduous and even bamboo forest, although home range sizes are smallest in evergreen forest (Kenyon 2007). In a similar forest complex across the border in Cambodia, gibbons are found in fairly similar densities across evergreen, semi-evergreen and mixed deciduous forests, although patterns may be obscured by the mosaic nature of the forest (Rawson et al. 2009).

Kenyon (2007) found that gibbon group density was correlated with habitat quality, with disturbed areas and areas with few large trees of the Dipterocarpaceae having lower densities than less disturbed areas with higher densities of feeding trees. A relationship between distance from the park boundary of Cat Tien National Park and group density was also found, also suggesting a predisposition for southern yellow-cheeked gibbons to occur at lower densities in more degraded and disturbed habitats (Kenyon 2007). *Nomascus gabriellae* inhabits a wide altitudinal range, from 100 m a.s.l in Cat Tien National park (Eames & Robson 1993) to 904 m a.s.l. in Chu Yang Sin National Park (BirdLife International 2010) up to 2,287 m a.s.l. on the Da Lat plateau (Eames & Nguyen Cu 1994). Densities seem to reduce at higher altitudes however (Eames & Robson 1993). Home range in the species appears to be much smaller than those of the most northerly *Nomascus* gibbons. Kenyon found an average home range size in Cat Tien National Park of 41 hectares, although this was dependent on habitat with a range of 14.2-60.5 hectares (Kenyon 2007).

Nomascus gabriellae has only been the focus of one ecological study conducted in Cat Tien National Park, Vietnam (Kenyon 2007). Group size, based on 22 group observations, was 4.5 individuals with a range of 3-6 individuals (Kenyon 2007). All groups contained only a single adult male and a single adult female; however, based on paternity testing of 10 groups, one offspring was determined to have been sired by a lone male rather than the resident male suggesting that extra-pair copulations occur in the species (Kenyon 2007). Relatedness of individuals in neighbouring territories suggested that females are very philopatric, with short dispersal distances, whereas males may emigrate more widely (Kenyon 2007).

Dietary data from this same study (Kenyon 2007) suggest the species is a genuine frugivore (see Table 8), relying heavily on fruit and figs to the almost complete exclusion of leaves (Kenyon 2007). However, these frequencies are based on a small data set and come from feeding bouts rather than a sampling regime and so may change with additional research effort.

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Annex 1. Summary of Gibbon Records in Vietnam

The table below summarises all the site records presented in this report. Names in *italics* indicate sites for which there was no new information during the compilation of this status review. They are presented in a table at the end of each species chapter and here for completeness.

Table 9. Summary of gibbon records in Vietnam by site

Note: figures in brackets under the "Minimum number of groups" column are estimates for the whole population. "?" means the population size is unknown. See the individual site record for more details.

Site	Province	Area (ha)	Minimum number of groups	Post 2000			Before 2000			Nat. significance			Global significance			Population Status					
				Confirmed	Provisional	No Records	Confirmed	Provisional	No Records	>5%	<5%	Unknown	>5%	<5%	Unknown	Increasing	Stable	Declining	Prov. Extinct	Conf. Extinct	Unknown
Nomascus nasutus																					
Cao Vit Gibbon Conservation Area	Cao Bang	1,656	19	X					X	X			X			X					
Lung Ri	Cao Bang	>300			X				X		X			X					X		
Kim Hy NR	Bac Kan	15,416		X				X			X			X					X		
Than Sa-Phuong Hoang NR	Thai Nguyen	17,477				X		X			X			X					X		
Thanh Hen Lake	*Cao Bang*					X		X			X			X							X
Nomascus concolor																					
Hoang Lien-Van Ban NR	Lao Cai	25,669	2	X			X			X				X				X			
Mu Cang Chai SHCA	Yen Bai	20,293	14	X			X			X			X				X				
Muong La Watershed Protection Forest	Son La	3000 to 4000	6	X			X			X				X				X			
Hoang Lien NR and vicinity	*Lao Cai*					X		X			X			X							X
Pan village, Muong Do Commune, Phu Yen District	*Son La*					X		X			X			X							X
Tram Tau / Bac Yen / Phu Yen	*Yen Bai / Son La*					X		X			X			X							X
Xuan Son NR	*Phu Tho*					X		X			X			X							X
Nomascus leucogenys																					
Muong Nhe NR	Dien Bien	45,581	16	X				X		X					X						X
Sop Cop NR	Son La	18,709	2			X		X				X			X						X
Xuan Nha NR	Son La	16,317	?		X				X			X			X						X
Long Luong Commune, Moc Chau District	Son La		2	X					X		X			X							X
Pu Hu NR	Thanh Hoa	27,503			X			X			X			X							X
Xuan Lien NR	Thanh Hoa	27,668	7	X			X			X				X				X			
Pu Hoat NR	Nghe An	35,000	10	X			X			X				X				X			
Ben En NR	Thanh Hoa	15,800	1		X		X				X			X				X			
Pu Huong NR	Nghe An	50,075	7	X			X			X				X				X			
Pu Mat NP	Nghe An	91,113	22 (130)	X			X			X			X					X			
Huong Son Forest	Ha Tinh	50,000	4	X			X					X			X						X

Site	Province	Area (ha)	Minimum number of groups	Post 2000			Before 2000			Nat. significance			Global significance			Population Status					
				Confirmed	Provisional	No Records	Confirmed	Provisional	No Records	>5%	<5%	Unknown	>5%	<5%	Unknown	Increasing	Stable	Declining	Prov. Extinct	Conf. Extinct	Unknown
Vu Quang NR	Ha Tinh	55,029	10	X			X				X				X						X
Ke Go NR[1]	Ha Tinh	21,759	4	X			X				X			X				X			
Hang Kia - Pa Co NR	Hoa Binh	7,091			X				X		X			X					X		
Ngoc Son-Ngo Luong	Hoa Binh	19,254			X				X		X			X					X		
Pu Luong NR	Thanh Hoa	17,662				X		X			X			X						X	
Khe Net PNR[1]	Quang Binh	23,534		X				X			X			X					X		
Thach Tuong Commune	*Thanh Hoa*					X		X			X			X							X
Nomscus siki																					
Khe Ve PNR	Quang Binh	10,000	7	X					X			X			X						X
Giang Man PNR	Ha Tinh / Quang Binh	60,000	5	X					X			X			X						X
Phong Nha-Ke Bang NP	Quang Binh	85,754	50	X			X			X			X								X
Truong Son SFE	Quang Binh	40,156	10	X					X			X			X						X
Khe Giua SFE	Quang Binh	150,000	4	X					X			X			X						X
Bac Huong Hoa NR	Quang Tri	25,200	23	X					X	X					X						X
Nomascus annamensis																					
Dak Rong NR	Quang Tri	37,640	56	X			X			X				X							X
Phong Dien NR	Thua Thien Hue	30,262	26	X			X			X				X							X
A Luoi Watershed Protection Forest	Thua Thien Hue	29,838	8	X					X			X		X							X
Thua Thien Hue Saola NR	Thua Thien Hue	12,153	14	X					X	X				X							X
Quang Nam Saola NR	Quang Nam	11,732	?			X			X		X			X							X
Nam Dong Watershed Protection Forest	Thua Thien Hue	17,604	4	X					X		X			X							X
Bach Ma NP	Thua Thien Hue	37,487	8	X				X			X			X							X
Ba Na-Nui Chua NR	Da Nang	38,210	?	X				X				X		X							X
Que Son Proposed SHCA	Quang Nam	18,765	?	X					X			X			X						X
Song Thanh NR	Quang Nam	93,249	15	X					X	X					X			X			
Ngoc Linh PNR	Quang Nam	18,430	13	X					X	X				X							X
Ngoc Linh NR	Kon Tum	41,424	?	X			X				X			X							X
Kon Plong District	Kon Tum	65,077	4	X					X			X		X							X
Chu Mom Ray NP	Kon Tum	56,621	14	X				X		X				X							X
Kon Ka Kinh NP	Gia Lai	41,780	9 (42)	X			X			X				X				X			
Dakroong and Tam Lap SFEs	Gia Lai	14,250	8	X					X			X		X							X
Kon Cha Rang NR	Gia Lai	15,900	13 (20)	X			X			X				X				X			
Ba Nam Commune, Ba To District	Quang Ngai	10,000	3	X					X			X			X						X

[1] The species is not confirmed as *N. leucogenys* at this site. See the site record for more information

Site	Province	Area (ha)	Minimum number of groups	Post 2000			Before 2000			Nat. significance			Global significance			Population Status					
				Confirmed	Provisional	No Records	Confirmed	Provisional	No Records	>5%	<5%	Unknown	>5%	<5%	Unknown	Increasing	Stable	Declining	Prov. Extinct	Conf. Extinct	Unknown
Nomascus gabriellae																					
A Yun Pa PNR	Gia Lai	44,268			X		X					X			X						X
Yok Don NP	Dak Lak	115,545	2	X					X		X			X							X
Ea So NR	Dak Lak	22,000	?		X			X			X			X							X
Chu Yang Sin NP	Dak Lak	58,947	8	X					X			X			X			X			
Bi Dup-Nui Ba NP	Lam Dong	63,938	25	X					X			X			X			X			
Khanh Hoa SFE and Tram Huong Forestry Co.	Khanh Hoa	25,000	?	X					X			X		X							X
Hon Ba NR	Khanh Hoa	20,978	?	X					X			X		X							X
Phuoc Binh NP	Ninh Thuan	19,814	4	X					X			X		X							X
Ninh Son SFE	Ninh Thuan	30,332	6	X					X			X		X							X
Nam Nung NR	Dak Nong	10,499	11	X			X				X			X							X
Ta Dung NR	Dak Nong	18,893	6 (12)	X				X			X			X				X			
Quang Truc Commune, Dak Rlap District	Dak Nong	49,200	?	X			X					X			X						X
Bu Gia Map NP	Dak Nong	25,926	88 (124)	X					X	X			X					X			
Cat Tien NP	Lam Dong, Dong Nai, Binh Phuoc	73,878	149	X			X			X			X				X				
Loc Bac SFE	Lam Dong	34,851	?	X					X			X		X				X			
Dong Nai NR	Dong Nai	100,303	15	X					X			X		X							X
Nui Ong NR	Binh Thuan	25,468	?	X				X				X		X							X
Ea Sup / Ea H'leo District	*Dak Lak*					X	X					X		X							X
Ea Trang Commune, M'drak	*Dak Lak*					X	X					X		X							X
Krong No District	*Dak Nong*					X	X					X		X							X
Cu Jut District	*Dak Nong*					X	X					X		X							X

Annex 2. Threat Categories in the Vietnam Red Data Book 2007

This is an unofficial translation of part of the text in the Vietnam Red Data Book, where necessary or in case of lack of clarity please refer to the original in Vietnamese. The categories below closely follow IUCN Red List Categories and Criteria: Version 3.1 with some slight variations.

Levels of Threat of Extinction

The following three categories represent the high levels of threat of extinction in the wild within the Vietnam Red Data Book

Critically Endangered (CR) - A taxon is Critically Endangered when the best available evidence indicates it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN) - A taxon is Endangered when the best available evidence indicates it is not CR but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU) - A taxon is Vulnerable when the best available evidence indicates it is not CR or EN but is facing a high risk of extinction in the wild in a relatively near future.

Critically Endangered (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets one of the following criteria (A to E):

A) Reduction in population size based on any of the following forms:

1) An observed, estimated, inferred or suspected population size reduction of at least 80% over the last ten years or three generations (which ever is longer), based on one (can be determined) of the following:

a) direct observation

b) an index of abundance appropriate to the taxon

c) a decline in area of occupancy, extent of occurrence or quality of habitat

d) actual or potential levels of exploitation

e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2) An estimated, or suspected population size reduction of at least 80% within the next ten years or three generations (which ever is longer), based on one (can be determined) of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 100 km^2, or area of occupancy estimated to be less than 10 km^2, and estimates indicating at least one of two of following:

1) Severely fragmented or known to exist at only a single location.

2) Continuing decline, observed, projected, or inferred, in one of the following:

a) extent of occurrence

b) area of occupancy

c) area, extent or quality of habitat

d) number of locations or subpopulations

e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence

b) area of occupancy

c) number of locations or subpopulations

d) number of mature individuals

C) Population size estimated to number fewer than 250 mature individuals and one of following:

1) An estimated continuing decline of at least 25% over the last three years or the last generation (which ever is longer), or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of one of the following:

a) severely fragmented (i.e no subpopulation estimated to contain more than 50 mature individuals)

b) all individuals are only in one subpopulation

D) Population size estimated to number fewer than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within the next ten years or three generations (which ever is longer).

Endangered (EN)

A taxon is Endangered when it is not Critically Endangered but the best available evidence indicates that it meets one of the following criteria (A to E):

A) Reduction in population size based on any of the following forms:

1) An observed, estimated, inferred or suspected population size reduction of at least 50% over the last ten years or three generations (which ever is longer), based on one (can be determined) of the following:

a) direct observation

b) an index of abundance appropriate to the taxon

c) a decline in area of occupancy, extent of occurrence or quality of habitat

d) actual or potential levels of exploitation

e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2) An estimated, or suspected population size reduction of at least 50% within the next ten years or three generations, based on one of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 5,000 km^2, or area of occupancy estimated to be less than 500 km^2, and estimates indicating at least one of two of following:

1) Severely fragmented or known to exist at no more than five locations.

2) Continuing decline, observed, projected, or inferred, in one of the following:

a) extent of occurrence

b) area of occupancy

c) area, extent or quality of habitat

d) number of locations or subpopulations

e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence

b) area of occupancy

c) number of locations or subpopulations

d) number of mature individuals

C) Population size estimated to number fewer than 2,500 mature individuals and one of following:

1) An estimated continuing decline of at least 20% over the last five years or two generations (whichever is longer), or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of one of the following:

a) severely fragmented (i.e no subpopulation estimated to contain more than 250 mature individuals)

b) all individuals are only in one subpopulation

D) Population size estimated to number fewer than 250 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within the next 20 years or five generations (which ever is longer).

Vulnerable (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but the best available evidence indicates that it meets any of the following criteria (A to E):

A) Reduction in population size based on any of the following forms:

1) An observed, estimated, inferred or suspected population size reduction of at least 20% over the last ten years or three generations (which ever is longer), based on one (can be determined) of the following:

a) direct observation

b) an index of abundance appropriate to the taxon

c) a decline in area of occupancy, extent of occurrence or quality of habitat

d) actual or potential levels of exploitation

e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2) An estimated, or suspected population size reduction of at least 20% within the next ten years or three generations, based on one of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000 km^2, or area of occupancy estimated to be less than 2,000 km^2, and estimates indicating at least one of two of following:

1) Severely fragmented or known to exist at no more than ten locations.

2) Continuing decline, observed, projected, or inferred, in one of the following:

a) extent of occurrence

b) area of occupancy

c) area, extent or quality of habitat

d) number of locations or subpopulations

e) number of mature individuals

3) Extreme fluctuations in any of the following:

a) extent of occurrence

b) area of occupancy

c) number of locations or subpopulations

d) number of mature individuals

C) Population size estimated to number fewer than 10,000 mature individuals and one of following:

1) An estimated continuing decline of at least 10% over the last ten years or three generations (which ever is longer), or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of one of the following:

a) severely fragmented (i.e no subpopulation estimated to contain more than 1,000 mature individuals)

b) all individuals are only in one subpopulation

D) Population very small or restricted in the form of either of the following:

1) Population size estimated to number fewer than 1,000 mature individuals.

2) Population with a very restricted area of occupancy (typically less than 100 km^2) or number of locations (typically fewer than five)

So, this taxon will be prone to the effects of human activities; within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered, Endangered or even Extinct in a very short time period

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within the next 100 years.

The Conservation Status of Gibbons in Vietnam

Is the fate of gibbons in Vietnam indicative of general trends for biodiversity in the country as the nation struggles to reconcile the rapid economic development of its huge population with environmental protection? Vietnam is a very gibbon diverse as well as biologically diverse country. Gibbons are found from the most northern latitudes to some of the most southern provinces in Vietnam and from some of the highest altitudes to lowland forest. Vietnam's gibbons are all highly threatened and include some of the world's rarest primates. This report takes a detailed look at the status of each of Vietnam's six gibbon species and how they are fairing in the 21st century under the pressure of on-going hunting and habitat loss. Drawing from available litterature, it gives site by site accounts to form a picture of the conservation status of Vietnam's endangered gibbons in a national and regional context.

FAUNA & FLORA INTERNATIONAL
CONSERVATION INTERNATIONAL Vietnam
arcus FOUNDATION
Nowak-Sprague SE Asia Biodiversity Initiative
IUCN/SSC PRIMATE Specialist Group