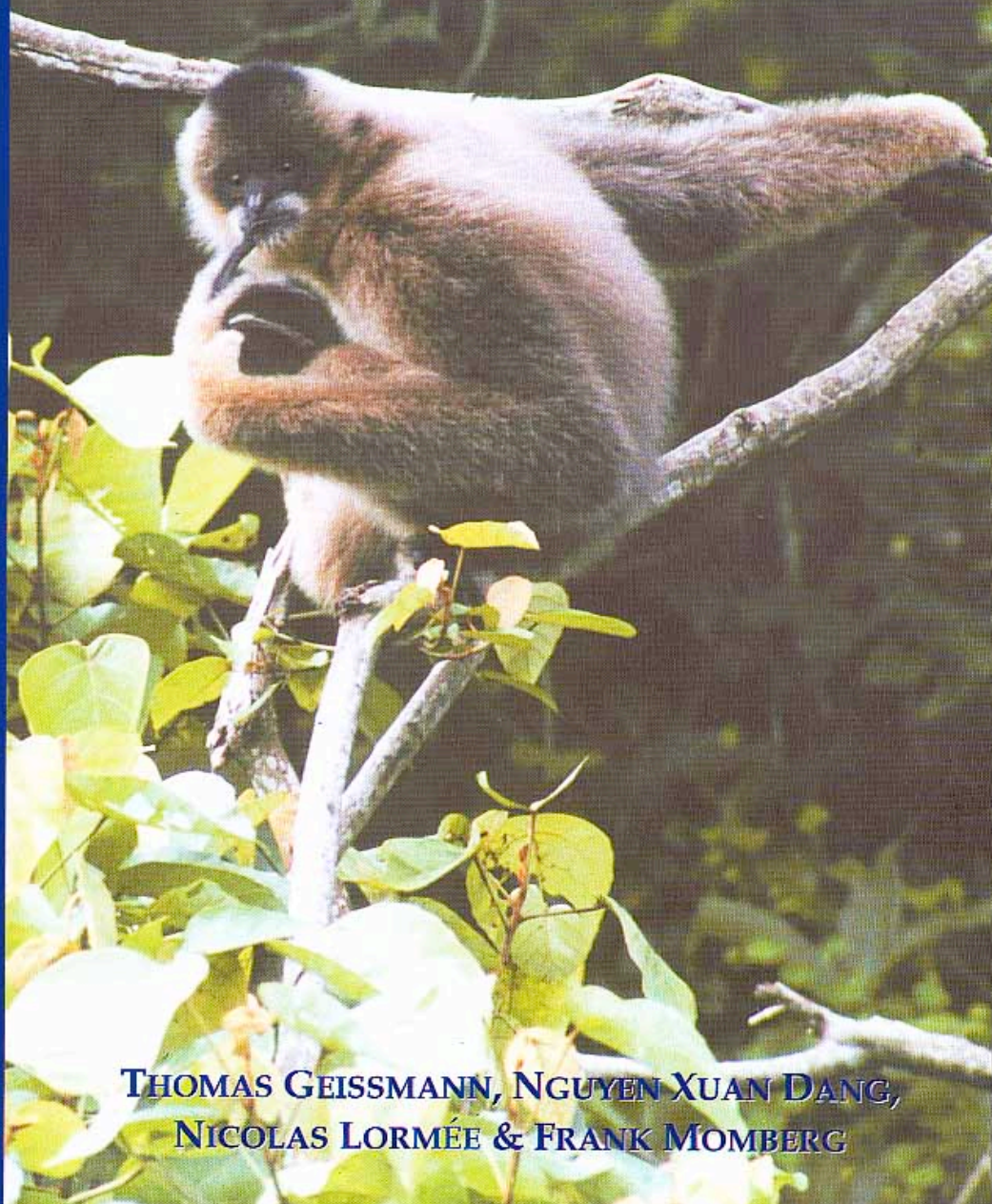


Việt Nam



VIETNAM PRIMATE CONSERVATION
STATUS REVIEW 2000
PART 1:

GIBBONS



THOMAS GEISSMANN, NGUYEN XUAN DANG,
NICOLAS LORMÉE & FRANK MOMBERG



VIETNAM PRIMATE CONSERVATION
STATUS REVIEW 2000
PART 1:

GIBBONS

THOMAS GEISSMANN, NGUYEN XUAN DANG,
NICOLAS LORMÉE & FRANK MOMBERG

FAUNA & FLORA INTERNATIONAL,
INDOCHINA PROGRAMME
HANOI, 2000

THE DESIGNATION OF GEOGRAPHICAL ENTITIES IN THIS DOCUMENT AND THE PRESENTATION OF THE MATERIAL DO NOT IMPLY ANY EXPRESSION ON THE PART OF THE AUTHOR OR FAUNA & FLORA INTERNATIONAL CONCERNING THE LEGAL STATUS OF ANY COUNTRY, TERRITORY OR AREA, OR ITS AUTHORITIES, OR CONCERNING THE DELINEATION OF ITS FRONTIERS AND BOUNDARIES.

THE OPINION OF THE INDIVIDUAL AUTHORS DOES NOT NECESSARILY REFLECT THE OPINION OF EITHER THE AUTHOR OR FAUNA & FLORA INTERNATIONAL.

THE AUTHORS AND FAUNA & FLORA INTERNATIONAL TAKE NO RESPONSIBILITY FOR ANY MISREPRESENTATION OF MATERIAL THAT MAY RESULT FROM THE TRANSLATION OF THIS DOCUMENT INTO ANY OTHER LANGUAGE.

PUBLISHED BY FAUNA & FLORA INTERNATIONAL INDOCHINA PROGRAMME OFFICE, IPO Box 78, 104B PHO HUE, HANOI, VIETNAM

COPYRIGHT
© 2000 FAUNA & FLORA INTERNATIONAL

REPRODUCTION OF ANY PART OF THIS PUBLICATION FOR EDUCATIONAL, CONSERVATION AND OTHER NON-PROFIT PURPOSES IS AUTHORISED WITHOUT PRIOR PERMISSION FROM THE COPYRIGHT HOLDER, PROVIDED THAT THE SOURCE IS FULLY ACKNOWLEDGED.

REPRODUCTION FOR RESALE OR OTHER COMMERCIAL PURPOSES IS PROHIBITED WITHOUT PRIOR WRITTEN PERMISSION FROM THE COPYRIGHT HOLDER.

CITATION:
T. GEISSMANN, NGUYEN XUAN DANG, N. LORMÉE & F. MOMBERG. VIETNAM PRIMATE CONSERVATION STATUS REVIEW 2000. PART 1: GIBBONS. FAUNA & FLORA INTERNATIONAL, INDOCHINA PROGRAMME, HANOI.

ISBN: 1-903703-03-4
PRODUCED BY: FAUNA & FLORA INTERNATIONAL, INDOCHINA PROGRAMME OFFICE

DESIGN BY: ARIF HASYIM
COVER: SUB-ADULT FEMALE SOUTHERN WHITE-CHEEKED CRESTED GIBBON, *Nomascus leucogenys siki* (PHOTO BY TILO NADLER)
BACK COVER: THE FOLLOWING GIBBONS ARE SHOWN (CLOCKWISE FROM TOP LEFT): MALE *Nomascus gabriellae*; MALE *N. concolor* (DIGITALLY RENDERED VERSION); FEMALE *N. concolor*; FEMALE *N. gabriellae*; FEMALE *N. leucogenys leucogenys* (IN CENTRE) (PHOTOS BY THOMAS GEISSMANN).

AVAILABLE FROM:
FAUNA & FLORA INTERNATIONAL
GREAT EASTERN HOUSE, TENSION ROAD,
CAMBRIDGE, CB1 2TT, UK
TEL: +44 (0) 1223 571000, FAX: +44 (0) 1223 461481
E-MAIL: INFO@FAUNA-FLORA.ORG, WEBSITE: WWW.FAUNA-FLORA.ORG

FAUNA & FLORA INTERNATIONAL
INDOCHINA PROGRAMME OFFICE
IPO Box 78, 104B PHO HUE
HANOI, VIETNAM
TEL: +84 (0)4 9432292 / 3, FAX: +84 (0)4 9432254
E-MAIL: FFI@FPT.VN

CONTENTS

ABBREVIATIONS	VI
IUCN CATEGORIES AND CRITERIA (HILTON-TAYLOR, 2000)	VII
ACKNOWLEDGEMENTS	IX
CONVENTIONS	X
1. INTRODUCTION	11
<i>Primates on the brink of extinction</i>	11
<i>Background</i>	12
<i>Gibbons in Vietnam</i>	12
<i>Previous gibbon surveys in Vietnam</i>	13
<i>Vietnam primate conservation status review</i>	14
<i>Methods</i>	14
2. GIBBONS (FAMILY: HYLOBATIDAE)	16
2.1 <i>An introduction to the gibbons</i>	16
2.2 <i>Splitting the gibbons</i>	17
2.3 <i>An introduction to the crested gibbons (genus Nomascus)</i>	19
3. GIBBON DISTRIBUTION	24
3.1 <i>Distribution of the genus Nomascus</i>	24
3.2 <i>Eastern black crested gibbon (Nomascus sp. cf. nasutus)</i>	26
<i>Distribution in China</i>	26
<i>Distribution in Vietnam</i>	27
3.3 <i>Western black crested gibbon (Nomascus concolor)</i>	28
<i>Distribution in China</i>	28
<i>Distribution in Laos</i>	28
<i>Distribution in Vietnam</i>	28
3.4 <i>Northern white-cheeked crested gibbon (Nomascus leucogenys leucogenys)</i>	29
<i>Distribution in China</i>	30
<i>Distribution in Laos</i>	31
<i>Distribution in Vietnam</i>	31
3.5 <i>Southern white-cheeked crested gibbon (Nomascus leucogenys siki)</i>	32
<i>Distribution in Laos</i>	32
<i>Distribution in Vietnam</i>	32
3.6 <i>Yellow-cheeked crested gibbon (Nomascus gabriellae)</i>	33
<i>Distribution in Cambodia</i>	33
<i>Distribution in Laos</i>	33
<i>Distribution in Vietnam</i>	33

4.	GIBBON ECOLOGY AND BEHAVIOUR	34
4.1	<i>Social organisation</i>	34
4.2	<i>Habitat</i>	37
4.3	<i>Diet</i>	38
4.4	<i>Songs</i>	39
5.	GIBBON SPECIES DESCRIPTIONS	44
5.1	<i>Eastern black crested gibbon (Nomascus sp. cf. nasutus)</i>	44
5.2	<i>Western black crested gibbon (Nomascus concolor)</i>	45
5.3	<i>White-cheeked crested gibbon (Nomascus leucogenys)</i>	47
5.4	<i>Yellow-cheeked crested gibbon (Nomascus gabriellae)</i>	48
5.5	<i>What goes on between siki and gabriellae?</i>	49
6.	CRESTED GIBBON RECORDS IN VIETNAM	52
6.1	<i>Eastern black crested gibbon (Nomascus sp. cf. nasutus)</i>	52
6.2	<i>Western black crested gibbon (Nomascus concolor)</i>	58
	Ho Nam Mu and Che Tao-Nam Pam	65
	<i>Importance for primate conservation</i>	67
	<i>Threats to biodiversity</i>	67
	<i>Conclusion</i>	68
6.3	<i>Northern white-cheeked crested gibbon (Nomascus leucogenys leucogenys)</i>	69
6.4	<i>Southern white-cheeked crested gibbon, Nomascus leucogenys siki</i>	76
	Pu Mat Nature Reserve	80
	Topography and forest quality	80
	Importance for primate conservation in Vietnam	80
	Conclusion	81
6.5	<i>White-cheeked crested gibbon (N. leucogenys siki) or Yellow-cheeked crested gibbon (N. gabriellae)?</i>	83
6.6	<i>Yellow-cheeked crested gibbon (Nomascus gabriellae)</i>	86
7.	GIBBON STATUS	93
7.1	<i>Eastern black crested gibbon (Nomascus sp. cf. nasutus)</i>	93
7.2	<i>Western black crested gibbon (Nomascus concolor)</i>	93
7.3	<i>Northern white-cheeked crested gibbon (Nomascus leucogenys leucogenys)</i>	94
7.4	<i>Southern white-cheeked crested gibbon (Nomascus leucogenys siki)</i>	95
7.5	<i>Yellow-cheeked crested gibbon (Nomascus gabriellae)</i>	96
8.	THREATS TO GIBBONS IN VIETNAM	98
8.1	<i>Hunting and wildlife trade</i>	98
8.2	<i>Habitat disturbance</i>	99
9.	RECOMMENDATIONS	102

9.1	<i>Hunting and wildlife trade</i>	102
9.2	<i>Population management</i>	103
9.3	<i>Habitat disturbance</i>	103
9.4	<i>Protected areas system review</i>	104
9.5	<i>Education and awareness raising</i>	105
9.6	<i>Research and field surveys</i>	105
9.7	<i>Species-specific recommendations</i>	105
9.7.1	Eastern black crested gibbon (<i>Nomascus</i> sp. cf. <i>nasutus</i>)	105
9.7.2	Western black crested gibbon (<i>Nomascus concolor</i>).....	106
9.7.3	Northern white-cheeked crested gibbon (<i>Nomascus leucogenys leucogenys</i>).....	106
9.7.4	Southern white-cheeked crested gibbon (<i>Nomascus leucogenys siki</i>).....	107
9.7.5	Yellow-cheeked crested gibbon (<i>Nomascus gabriellae</i>)	108
9.8	<i>General recommendations</i>	108

10. REFERENCES **110**

11. APPENDICES **123**

Appendix 1. Gibbon species in the protected area network of Vietnam.....	123
Appendix 2. Localities list	125

ABBREVIATIONS

Key to abbreviations for museum collections:

AMNH	American Museum of Natural History, New York
BM(NH)	British Museum (Natural History), London
FMNH	Field Museum of Natural History, Chicago
IEBR	Institute of Ecology and Biological Resources, Hanoi
IZCAS	Institute of Zoology, Chinese Academy of Sciences, Beijing
KIZ	Kunming Institute of Zoology, Kunming, China
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge
MNHN	Muséum National d'Histoire Naturelle, Paris
NMR	Naturhistoriska Riksmuseet, Stockholm
USNM	United States National Museum of Natural History, Washington, D.C.
XMFC	Xuan Mai Forestry College
ZMB	Zoologisches Museum der Humboldt-Universität, Berlin
ZMVNU	Zoological Museum, Vietnam National University, Hanoi
ZRC	Zoological Reference Collection, Department of Zoology, National University of Singapore

Key to other abbreviations used in this work:

BirdLife	BirdLife International Vietnam Programme
CPAWM	Centre for Protected Areas and Watershed Management of Department of Forestry, Ministry of Agriculture and Forestry (Laos)
EPRC	Endangered Primate Rescue Centre, Cuc Phuong National Park
FFI	Fauna and Flora International
FIPI	Forest Inventory and Planning Institute
FPD	Forest Protection Department
IEBR	Institute of Ecology and Biological Resources
WCN	World Conservation Union
MARD	Ministry of Agriculture and Rural Development
MoF	Ministry of Forestry
NBCA	National Biodiversity Conservation Area (Laos)
PCI	Primate Conservation Inc.
PNBCA	Proposed National Biodiversity Conservation Area (Laos)
SEE	Society for Environmental Exploration
SFNC	Social Forestry and Nature Conservation, Nghe An province
UNESCO	United Nations Education, Scientific and Cultural Organisation
Vietnam NCST	Vietnam National Centre for Natural Science and Technology
VRTC	Vietnam-Russian Tropical Centre
WCS	Wildlife Conservation Society
WWF	World Wide Fund for Nature

IUCN CATEGORIES AND CRITERIA (HILTON-TAYLOR, 2000)

1. Threatened species

Includes all the full species categorised at global level as either Critically Endangered (CR), Endangered (EN), or Vulnerable (VU).

Use any of the A-E criteria:	Critically Endangered	Endangered	Vulnerable
------------------------------	--------------------------	------------	------------

A. Declining population

Population decline rate in 10 years or 3 generations at least:	80%	50%	20%
---	-----	-----	-----

using either:

1. population reduction observed, estimated, inferred, or suspected in the past; or
2. population decline projected or suspected in the future based on:
 - a) direct observation
 - b) an index of abundance appropriate for the taxon
 - c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
 - d) actual or potential levels of exploitation
 - e) the effect of introduced taxa, hybridisation, pathogens, pollutants, competitors, or parasites

B. Small distribution and decline or fluctuation

Based on either extent of occurrence:	< 100 km ²	< 5,000 km ²	< 20,000 km ²
or area of occupancy:	< 10 km ²	< 500 km ²	< 2,000 km ²

and 2 of the following 3:

1. either severely fragmented (isolated sub-populations with a reduced probability of recolonisation, if once extinct) or known to exist at a number of locations.
2. continuing decline in any of the following:
 - a) extent of occurrence
 - b) area of occupancy
 - c) area, extent and/or quality of habitat
 - d) no. of locations or sub-populations
 - e) number of mature individuals
3. fluctuation in any of the following:
 - a) extent of occurrence
 - b) area of occupancy
 - c) no. of locations or sub-populations
 - d) no. of mature individuals

C. Small population size and decline

Number of mature individuals:	< 250	< 2,500	< 10,000
-------------------------------	-------	---------	----------

and the following 2:

1. rapid decline rate:	25% in 3 years or 1 generation	20% in 5 years or 2 generations	10% in 10 years or 3 generations
2. continuing decline (any rate) and either			
a) fragmented and all sub-populations:	≤ 50	≤ 250	≤ 1,000
or			
b) all individuals in one sub-population:	≤ 50	≤ 250	≤ 1,000

D. Very small and restricted

Either

1. number of mature individuals	< 50	< 250	< 1,000
---------------------------------	------	-------	---------

or

2. population is susceptible	area of occupancy < 100 km ² or number of locations < 5	(not applicable)	(not applicable)
------------------------------	---	------------------	------------------

E. Quantitative analysis

Indicating the probability of extinction in the wild to be at least:	50% in 10 years or 3 generations	20% in 20 years or 5 generations	10% in 100 years
--	-------------------------------------	-------------------------------------	------------------

2. Lower Risk: conservation dependant

Species for which sufficient data exist for an assessment to be made but which are not in a threatened category or extinct are Lower Risk. This has three sub-divisions. Of these, Lower Risk: conservation dependant (LR:cd) includes species that are the subject of a targeted conservation programme, the ending of which would result in the taxon moving into a category of threat within five years.

3. Lower Risk: near threatened

Taxa in this subcategory are “near threatened” (LR:nt) in the sense of being close to the threshold of the Vulnerable category.

4. Lower Risk: least concern

Taxa which do not qualify for conservation dependent or near threatened

5. Data Deficient

This category includes species where there is insufficient data to make an assessment of risk possible. Taxa in this category differ from those in the Not Evaluated category in that the question of data availability has been considered in the former but has not yet been considered in the latter.

ACKNOWLEDGEMENTS

Fauna and Flora International wishes to thank the Forest Protection Department, Ministry of Agriculture and Rural Development for their active support and encouragement.

This project was funded by the Walt Disney Foundation and the Canada Fund. We gratefully acknowledge the active support and encouragement of the Canadian Embassy.

The field surveys conducted by Fauna and Flora International for the purpose of this work were facilitated with the help and participation of the following institutions: Provincial Forest Protection Departments of Dak Lak, Bac Kan, Lao Cai, Phu Tho, Son La, Thai Nguyen and Tuyen Quang provinces, Forest Inventory and Planning Institute (FIPI), Hanoi University, the Institute of Ecology and Biological Resources (IEBR) and Xuan Mai Forestry College.

We would like to thank the following participants of FFI-Indochina Programme primate field surveys: Nguyen Xuan Dang (IEBR), Dong Thanh Hai (Xuan Mai Forestry College), Barney Long (FFI), Ngo Van Tri (FFI), Phung Van Khoa (Xuan Mai Forestry College) and Trinh Viet Cuong (IEBR).

We would like to express our gratitude to the following contributors for supplying information for this status review: Lynne R. Baker, Nicola Beharrel (Frontier Vietnam), William Bleisch, Ramesh Boonratana (*aka* Zimbo), Dao Yinglan, Do Tuoc (FIPI), Dong Thanh Hai (Xuan Mai Forestry College), Roland Eve (WWF-Vu Quang Conservation Project), Neil Furey (Frontier Vietnam), Bettina Grieser-Johns, Joanne Harding (Australian National University), Benjamin Hayes (WWF-Cat Tien Conservation Project), Le Trong Trai (Forest Inventory and Planning Institute), Li Zhaoyuan (University of Edinburgh), Barney Long (FFI-Indochina Programme), Yang Chang Man (Raffles Museum, Singapore), Bui Huu Manh (WWF-Cat Tien Conservation Project), Tilo Nadler (Frankfurt Zoological Society), Ngo Van Tri (FFI-Indochina Programme), Nguyen Truong Son (IEBR), Nong The Dien (Vice-director, Ba Be National Park), Thomas Osborn (Frontier Vietnam), Trinh Viet Cuong (IEBR), Pham Nhat (University of Hanoi), Gert Polet (WWF-Cat Tien Conservation Project), Jean-Marc Pons (Muséum d'Histoire Naturelle, Paris), Elizabeth Rogers (University of Edinburgh) and Andrew Tordoff (BirdLife International Vietnam Programme).

Several tape recordings of crested gibbons were kindly made available to Thomas Geissmann by Drs. Lan Daoying, Pete Davidson, Will Duckworth, Pham Nhat, Barney Long, Craig Robson, Rob Timmins and Prof. Dr. G. Tembrock. We are grateful to Robert Dallmann and Dr. David Chivers for reading and commenting on the manuscript. Thomas Geissmann gratefully acknowledges financial support during various field surveys from the IPPL (International Primate Protection League), Margot Marsh Biodiversity Fund, Messerli Foundation, and the Swiss National Foundation.

For proof reading various versions of this report we would like to thank Andrew Tordoff, Vern Weitzel, Barney Long, Lucy Tallents, Joe Heffernan, Paula Klossick, James Hardcastle, Sarah Miller and Richard Rastall.

Grateful thanks are also owed to the many local people who helped the survey teams in the field.

CONVENTIONS

The status and distribution of each species of gibbon is described in detail for the whole of Vietnam. In addition, to place the species in a regional context, a brief overview is given of distribution and status in other areas of Indochina. In this work, we consider Indochina to comprise the following regions: the Socialist Republic of Vietnam, the Lao People's Democratic Republic, the Kingdom of Cambodia, and southern parts of Yunnan and Guangxi provinces in the People's Republic of China.

For each species, a list of records in Vietnam is given. These lists are fairly extensive given that they include a number of unpublished scientific records.

The occurrence of the species at a given locality is considered as confirmed only if direct evidence (sighting, vocalisation, tracks) has been recorded since 1995 by a reliable collector. It is considered as provisional, if the species was recorded by indirect evidence (specimen, report by local people) collected after 1995. If no records more recent than 1995 could be found during our study, the status of the species at the considered locality is considered as unknown.

Specimens reported from provincial capitals are not taken into account in this work. Such localities are often the most important human settlement in the region, and therefore, it is not possible to accurately ascertain the exact origin of the specimen as it could have been collected from a number of areas in the province. Therefore, we consider that, if a specimen was reported from such a locality, its provenance cannot be determined with any certainty.

Forest types given in Appendix 2 follow the classification used in Wege *et al.* (1999). Seven types are considered in this work: evergreen, coniferous, semi-deciduous, deciduous, bamboo, mixed and limestone. Evergreen forest is itself divided into lowland and montane evergreen according to altitude, with areas below 700 m referred to as lowland, and above 700 m as montane.

"Special-use forest is referred to in the text, this describes only protected areas established by governmental decree. For instance, Na Hang Provincial Nature Reserve, which was established by Tuyen Quang People's Committee but not by governmental decree, is considered as a "proposed protected area" in this work.

Special-use forest size refers only to the core zone and excludes the buffer zone. Because boundaries are often revised following the original decree and sometimes not correctly established, a degree of uncertainty exists over the precise size of many protected areas. There is also a considerable amount of discrepancy between the area given at the time of the decree with the statistics calculated from protected area boundaries digitised by FIPI (see Wege *et al.*, 1999, p. 7).

1. INTRODUCTION

Primates on the brink of extinction

The Primate Conservation Status Review, Vietnam 2000 contains alarming findings for the fate of Vietnam's primates. At the beginning of the new millennium, among the many species that could be lost world-wide are mankind's closest relatives, the nonhuman primates. In Vietnam, many primates are either endangered or critically endangered. The Eastern black crested gibbon (*Nomascus* sp. cf. *nasutus*) is the world's most critically endangered primate species. Three of the four primate species that are endemic to Vietnam are critically endangered: golden-headed langur (*Trachypithecus poliocephalus*), Delacour's langur (*T. delacouri*), Tonkin snub-nosed Monkey (*Rhinopithecus avunculus*) whilst the grey-shanked douc langur (*Pygathrix nemaeus*) is data deficient and may well be critically endangered in reality. These four primates are also among the most endangered primates on earth. Without rigorous and immediate conservation interventions, these species are facing global extinction. Other primates, such as Western black-crested gibbons (*Nomascus concolor*), are also facing extinction in Vietnam.

Amazingly, despite globally increasing rates of deforestation and hunting, there has been no documented extinction of any primate species or sub-species on earth during the last millennium. It is a major challenge for the 21st century to save Vietnam's primates and its contribution to the world's natural heritage.

This conservation status review provides detailed recommendations for each species, ranging from research, protected area gazettement, anti-poaching patrols to conservation awareness. The most urgent conservation interventions are:

- The gazettement of protected areas for the Western black crested gibbon in Mu Cang Chai and Van Ban districts.
- The continuation of field surveys to find remnant populations of Eastern black crested gibbon in north-western Vietnam and southern China.
- The development of community-based law enforcement and conservation awareness programmes in priority areas for primate conservation.

Background

Vietnam extends about 1,600 km from north to south, along the eastern coast of Indochina from 23°N to 8°30'N. The country covers about 331,689 km². Altitude varies from sea level to 3,143 m at the summit of Mount Phan Si Pan in the extreme north-west of the country. Plains are principally found in the Mekong and Red River deltas, which are linked by a narrow band of coastal plain. The rest of the country comprises hills and high mountain ranges.

A geological feature of major interest is the limestone karst formations that are mainly found in the central and northern parts of the country. These areas support a high degree of endemism in the fauna and flora. Almost all of Vietnam's endemic and critically endangered primate species live either in limestone forests or montane forests, the exception being the grey-shanked douc langur.

In 1995, natural forest covered 8,769,000 ha, or 27.5% of the land area of Vietnam. Following the classification used by Wege *et al.* (1999), three forest types should be considered of particular importance for biodiversity. Evergreen forest, which is found in areas with a regular, high rainfall, is the main forest type in Vietnam, accounting for 64% of the total area of natural forest. Semi-deciduous and deciduous forests, which occur in lowland areas experiencing a distinct dry season, are largely restricted to central and southern parts of the country. In areas dominated by deciduous and semi-deciduous forests, leaf monkeys and gibbons are limited to evergreen forest patches along streams and on hills. A third forest type of interest is limestone forest, restricted to karst formations. Bamboo and coniferous forests, while natural, are essentially secondary in nature and their biodiversity value is lower than other natural forest types (Wege *et al.*, 1999).

8.6% of Vietnam's natural forest is now within the protected areas network. Special-use forests, including national parks, nature reserves, and cultural and historical sites cover 1,344,608 ha, of which only 57% are occupied by natural forests (Wege *et al.*, 1999).

Gibbons in Vietnam

Vietnam possesses the most diverse range of primates in mainland South-East Asia including four species of gibbon. The list of gibbon species and sub-species known to inhabit Vietnam with their local and global conservation status are given in Table 1.1.

Table 1.1. List of primate species and sub-species known to occur In Vietnam.

Common name	Latin name	Ministerial Decision No. 18/HDBT, 17 th Jan. 1992	1998 Vietnam Primate Workshop	IUCN conservation status (Hilton-Taylor, 2000)
Western black-crested gibbon	<i>Nomascus concolor</i>	group IB	Critically Endangered Listed as <i>Hylobates concolor concolor</i>	Endangered
Eastern black crested gibbon	<i>Nomascus</i> sp. cf. <i>nasutus</i>	None	Critically Endangered Listed as <i>Hylobates concolor hainanus</i>	Endangered
Northern white-cheeked crested gibbon	<i>Nomascus leucogenys leucogenys</i>	group IB	Endangered Listed as <i>Hylobates leucogenys leucogenys</i>	Endangered
Southern white-cheeked crested gibbon	<i>Nomascus leucogenys siki</i>	group IB	Endangered Listed as <i>Hylobates leucogenys siki</i>	Data Deficient
Yellow-cheeked crested gibbon	<i>Nomascus gabriellae</i>	group IB	Endangered Listed as <i>Hylobates gabriellae</i>	Vulnerable

Previous gibbon surveys in Vietnam

Despite this exceptional diversity and the international interest which it arouses, there is still very little scientific data available on the distribution and status of gibbons in the country. This can be explained by the long isolation of the country due to several decades of war and political ostracism. In recent years, a number of surveys have been conducted and our knowledge has considerably increased. However, at this time no comprehensive work has been published which compiles all of the data on this subject from the whole country. Consequently the information remains scattered.

This lack of knowledge about the status and distribution of gibbons in Vietnam poses a serious problem in terms of how to conduct a long-term conservation programme. The fact is that the recent surveys carried out in Vietnam reveal some alarming statistics. Gibbon conservation in Vietnam is now a critical concern as white-cheeked crested gibbon and Yellow-cheeked crested gibbon are regarded as endangered whilst both species of black crested gibbon are undoubtedly critically endangered in Vietnam.

Some primate surveys, however, have been conducted in Vietnam. In recent times, Ratajszczak *et al* (1990) presented preliminary data on the distribution and status of gibbons in northern Vietnam. Data from southern Vietnam was published by Eames and Robson (1993).

Vietnam primate conservation status review

The Vietnam Primate Conservation Status Review began implementation in July 1999, with the objective of collating a comprehensive data set for leaf monkeys and gibbons in Vietnam. The results are contained within two publications. This publication covers gibbons, while leaf monkeys are covered by a separate publication (see *Vietnam Primate Conservation Status Review 2000, Part II: Leaf Monkeys*).

Methods

Data on the status of gibbon species in Vietnam was collated from several sources:

- Scientific reports. Most available reports about gibbons, their habitats or their conservation status in Vietnam were analysed. Field survey records were considered reliable when the source of the information and the exact date and location were given. However, given the scarcity of information, all data detailing the source and its level of evidence were included in this work.
- Museum specimens. The origin of each museum specimen of Vietnamese gibbons was collated from the museum itself or from scientific literature. The exact location or the method of collection are often unknown and, therefore, these data should be considered as provisional. However, this type of data provides invaluable information regarding the historical distribution of given species, particularly in areas where the animals no longer occur.
- Personal communication. A significant quantity of information concerning primates is still unpublished in Vietnam. The authors collated data from numerous people working in the field, relating to opportunistic sightings or other provisional information regarding primates.
- Results of field surveys conducted by the authors other than for the FFI Primate Conservation Project.
- FFI primate field surveys. From October 1999 to November 2000, several primate field surveys were carried out in northern Vietnam. Because the objective was to collect data on species' status and distribution in remote areas, only a short time was spent at each locality and as large an area as possible was covered. Special attention was paid to Western black crested gibbon and Eastern black crested gibbon. The list of field surveys, with the fieldworkers involved and the species targeted, are given in the Table 1.2.

Table 1.2. Field surveys conducted by FFI for the Vietnam Primate Conservation Status Review.

Location of field survey	Date of survey	Participants	Species targeted
Yen Bai and Phu Tho provinces	17 October to 12 November 1999	Nguyen Xuan Dang (IEBR) and Nicolas Lormée (FFI)	Western black crested gibbon
Bac Kan, Thai Nguyen and Tuyen Quang provinces	17 October to 15 November 1999	Dang Ngoc Can (IEBR) and Nguyen Truong Son (IEBR)	Tonkin snub-nosed monkey
Son La province	25 October to 12 November 1999	Ngo Van Tri (FFI) and Barney Long (FFI)	Western black crested gibbon
Van Ban district, Lao Cai province	14 November to 28 November 1999	Dong Thanh Hai (FCV) and Nicolas Lormée (FFI)	Western black crested gibbon
Bac Kan province	7 January to 26 January 2000	Phung Van Khoa (FCV) and Nicolas Lormée (FFI)	Eastern black crested gibbon
Na Ri district, Bac Kan province	29 February to 17 March 2000	Ngo Van Tri (FR) and Nicolas Lormée (FFI)	Eastern black crested gibbon and François' langur
Mu Cang Chai district, Yen Bai province	25 September to 23 October 2000	Lucy Tallents (FFI), Le Trong Dat (FPD), La Quang Trung (FFI), Trinh Dinh Hoang (FFI), Barney Long (FFI) and Le Khac Quyet (FFI)	Western black crested gibbon
Van Ban district, Lao Cai province	5 November to 24 November 2000	Barney Long (FFI) and Le Khac Quyet (FFI)	Western black crested gibbon
Mu Cang Chai district, Yen Bai province	5 November to 3 December 2000	Lucy Tallents (FFI), Le Trong Dat (FPD), La Quang Trung (FFI), and Trinh Dinh Hoang (FFI)	Western black crested gibbon

2. GIBBONS (FAMILY: HYLOBATIDAE)

2.1 An introduction to the gibbons

The gibbons form the family *Hylobatidae*. They are often referred to as the "lesser apes". We find this term condescending and propose to use the term "small apes", instead. Gibbons form a relatively homogeneous group of species which are distributed throughout the tropical rain forests of South-East Asia (Chivers, 1977; Geissmann, 1995b; Groves, 1972; Marshall & Sugardjito, 1986). They are unusual among primates in several respects which can be summarised under three key complexes: locomotion, social structure, and communication.

Gibbons are strictly arboreal and mainly frugivorous (Chivers, 1984a; Leighton, 1987). Their arm-swinging form of locomotion (brachiation), unique suspensory behaviour and habitual erect posture represent extreme specialisations which evolved in connection with the animals' substrate and diet (Chivers, 1984b).

Gibbons live in monogamous, territorial family groups (Brockelman & Srikosamatara, 1984; Chivers, 1984b; Leighton, 1987). In the wild, single offspring are born at intervals of approximately 3 years. Offspring remain with their parental family group until attaining sexual maturity at about 8 years of age, at which time they usually leave the group in order to find a mate and a territory.

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

It is generally accepted that gibbons, the great apes and humans together form the monophyletic group Hominoidea comprising the apes and humans (Groves, 1989). Gibbons share a number of common derived (synapomorphous) 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, a relatively broad iliac blade (Os ilium) and a reduction of the ischial callosities (e.g. Fleagle, 1999).

It has also been widely accepted in recent years that the gibbons constitute the sister group to the combined great apes and humans (Figure 1) and show the most primitive characteristics within the Hominoidea (Fleagle, 1999). This view is supported by results from comparative studies of a wide array of morphological (Biegert, 1973; Remane, 1921; Sawalischin, 1911; Schultz, 1933, 1973; Wislocki, 1929, 1932), physiological (Hellekant *et al.*, 1990), cytogenetic (Wienberg & Stanyon, 1987) and molecular data (Bailey *et al.*, 1991; Darga *et al.*, 1984; Dene *et al.*, 1976; Felsenstein, 1987; Goldman *et al.*, 1987; Goodman *et al.*, 1990; Sarich & Cronin, 1976; Sibley & Ahlquist, 1984, 1987).



Fig. 1. Systematic position of the gibbons (Hylobatidae) within the primate order.

2.2 Splitting the gibbons

Although the monophyly of the gibbons (family Hylobatidae) is widely accepted, this is not the case for the taxonomy adopted within the family. In early studies on gibbon systematics, the Hylobatidae were grouped into two distinct genera including the siamang (*Symphalangus*) on one hand, and all the remaining gibbons (*Hylobates*) on the other (e.g. Napier & Napier; 1967; Schultz, 1933; Simonetta, 1957). This dichotomic view probably originated from the limitations of the available material. Siamangs and members of the *lar*-group of gibbons (*sensu* Geissmann, 1994, 1995b) have usually been the more readily available specimens to early scientists. Differences between these two groups are easily recognisable (siamangs are heavier and they have a much deeper voice, an external throat sac and webbing between toes 2 and 3). When gibbons of other groups were studied in more detail, it became clear, that more than two groups needed to be recognised, if any were recognised at all. In the then prevailing lumping-tradition, these groups were referred to as subgenera by Groves (1972) and most authors after him, except Lekagul and McNeely (1977), who recognised three genera (*Symphalangus*, *Nomascus*, and *Hylobates*).

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

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

There is considerably less agreement on the phylogenetic relationships among the four groups. Several authors suggest that among modern gibbons, the siamang (*Symphalangus*) was the first species to split off from the main stem (Bruce & Ayala, 1979; Creel & Preuschoft, 1976, 1984). Others disagree and see the crested gibbons (*Nomascus*) in that position (Groves, 1972; Haimoff, 1983; Haimoff *et al.*, 1982, 1984), whereas preliminary molecular data suggested that *Bunopithecus* may be the most basal branch (Zehr *et al.*, 1996). According to a fourth view, the siamang and the crested gibbons share a common ancestor not shared by other gibbons (Shafer, 1986; van Tuinen & Ledbetter, 1983, 1989). A survey of published phylogenetic trees of

2. Gibbons (Family Hylobatidae)

gibbons is presented in Geissmann (in press b). Apparently, the "relationships of the main divisions are very even, and any dichotomy is hard to elucidate" (Groves, 1989).

All four groups appear to have roughly the same age. Molecular data for the *Hylobates*-*Symphalangus* split suggest an age of about 8 million years. Based on analogy with other primates, this suggests a genus-level split, or "relative to the great apes, the gibbons have been grossly undersplit" (Goodman *et al.*, 1998, p. 596). Consequently, one of us (TG) proposes to recognise the four groups of gibbons as four distinct genera. The gibbon classification used in this study is summarised in Table 2.1.

Table 2.1. Main divisions of the genus *Hylobates* (after Geissmann, in press b).

Genus	Diploid number of chromosomes	Other division names	Species	
<i>Hylobates</i>	44	<i>Lar</i> group	<i>H. agilis</i> ¹	Agile gibbon
			<i>H. klossii</i>	Kloss's gibbon
			<i>H. lar</i>	White-handed gibbon
			<i>H. moloch</i>	Silvery gibbon
			<i>H. muelleri</i> ²	Müller's gibbon
			<i>H. pileatus</i>	Pileated gibbon
<i>Bunopithecus</i>	38		<i>B. hoolock</i>	Hoolock
<i>Nomascus</i>	52	<i>Concolor</i> group, crested gibbons	<i>N. concolor</i>	Western black crested gibbon
			<i>N. sp. cf. nasutus</i>	Eastern black crested gibbon
			<i>N. gabriellae</i>	Yellow-cheeked crested gibbon
			<i>N. leucogenys</i> ³	White-cheeked crested gibbon
<i>Symphalangus</i>	50		<i>S. syndactylus</i>	Siamang

¹ including *H. agilis albibarbis*
² including *H. muelleri abbotti* and *H. muelleri funereus*
³ including *N. leucogenys siki*

Only members of the crested gibbons (genus *Nomascus*) are distributed in Vietnam. The remainder of this article will, therefore, focus on crested gibbons. For the sake of completeness, we need to mention here that the pileated gibbon (*Hylobates pileatus*) has also been reported to occur in Vietnam, i.e. in Dao Phu Quoc, an island in the Gulf of Thailand. This record has been listed in numerous publications on Vietnamese primates (see Fooden, 1996, p. 867). Its original source goes back to Kloss (1929), who speculated that some pileated gibbons collected by Mouhot at an unspecified locality "on a small island near Cambodia" (Gray, 1861, p. 135) may have originated from Dao Phu Quoc. Because Mouhot (1864 cited in Brandon-Jones, 1995, p. 539, and in Fooden, 1996, p. 867) explicitly states that he was not on Dao Phu Quoc, Kloss's speculation is refuted.

2.3 An introduction to the crested gibbons (genus *Nomascus*)

2.3.1. General characteristics

Body size: Wild crested gibbons have an average body weight of 7-8 kg. This weight is similar to that of *Bunopithecus* (about 7 kg), larger than *Hylobates* (about 5 kg) and smaller than *Symphalangus* (about 11 kg) (Geissmann, 1993, 1998).

Cranial characteristics: Forehead high and rounded, with flattened supraorbital ridges ("as if the bony ring had been filed down"; Marshall & Sugardjito, 1986, p. 148). The facial profile is an almost straight line because the orbitae are not protruding.

Intermembral index high, above 135, as in *Symphalangus*; in *Bunopithecus* and *Hylobates*, intermembral indices are below 135 (Groves, 1972).

Small throat sac in males (possibly absent *N. gabriellae* and *N. sp. cf. nasutus*). The throat sac is visible only when inflated during certain song vocalisations (i.e. boom notes, see below).

Baculum (penis bone) very long (8.2-12.1 mm) and often with hook-like tip. The baculum is also long in *Symphalangus* (1 adult: 14.5 mm, Gerhardt, 1909), but shorter (6.4-8.0 mm) in *Bunopithecus* and much shorter in *Hylobates* (4.5-6.5 mm) (Groves, 1972, p. 34).

Diploid chromosome number: $2n=52$ (see Table 2.1).

Crown hair erect. In males, the crown hair is elongated and forms a crest (thus "crested gibbons"). Adult females usually have a black cap which is contrasting sharply with the surrounding lighter fur. The crown fur (including the cap) stands straight up, but is not elongated into a crest. In gibbons of other genera, no crest occurs, and in adult individuals, the crown fur lies flat (except in some individuals of *Hylobates lar*).

Strong sexual dichromatism in adult individuals: Males generally black (with or without light cheek patches). Females light yellow, orange yellow or light beige, usually with a blackish occipital patch, with or without dark ventral surface. A similar degree of sexual dichromatism is also found in the hoolock (*Bunopithecus hoolock*), and the capped gibbon (*Hylobates pileatus*). Some degree of sexual dichromatism also occurs in other gibbon species (such as *H. agilis* and *H. moloch*) but is much less pronounced there (Geissmann, 1994, 1995b).

Ontogenetic changes in fur colouration: infants are born with a light natal coat, somewhat similar in colouration to that of the adult female. During the first year of life (Delacour, 1934), at the age of about one year (Groves, 1972), or during the second year of life (Dittrich, 1979), the infants change colouration and assume a dark coat which is virtually identical to that of an adult male. At about the time of sexual maturity (at around 5-8 years of age), females change colouration a second time and adopt the light colouration typical of adult females (Delacour, 1934, 1942; Geissmann, 1993, p. 217f; Fischer, 1980, 1981; Pocock, 1905). A similar sequence of distinct fur colourations also occurs in the hoolock (*Bunopithecus hoolock*) (Geissmann, 1993, p. 217f; Groves, 1972; McCann, 1933; Peart, 1935). In the pileated gibbon (*H. pileatus*), the sequence is very much different (Geissmann, 1991, 1993, p. 217f; Groves, 1972),

2. Gibbons (Family Hylobatidae)

and in other gibbons, ontogenetic colour changes are absent or less spectacular, such as changes in the breadth of the face ring (e.g. Geissmann, 1993, p. 217f).

Fundamental frequency of song vocalisations: At least some notes have maximum frequencies above 2 kHz, in all other gibbons, maximum frequencies are below 2 kHz (Geissmann, 1993, 1995b). Other vocal characteristics of crested gibbons are described below.

Distribution: restricted to Indochina, including Vietnam, Laos, eastern Cambodia and south-western China (Yunnan province and Hainan island).

2.3.2. How many species?

The crested gibbons have traditionally been regarded as consisting of a single species, *Hylobates concolor*, containing 6 subspecies (e.g. Simonetta, 1957; Groves, 1972; Chivers, 1977; Marshall & Sugardjito, 1986; see Table 2.2, column 1). During the last 20 years, several reviews of crested gibbon taxonomy have been published (Fooden *et al.*, 1987; Geissmann, 1989, 1995b; Groves, 1984, 1993, in press; Groves & Wang, 1990; Ma & Wang, 1986; Ma *et al.*, 1988; Marshall & Sugardjito, 1986; Dao Van Tien, 1983). They will briefly be reassessed in this section.

Table 2.2. Various classifications of the crested gibbons. Double lines separate recognised species.

Traditional view	Recent studies:		
(e.g. Simonetta, 1957; Groves, 1972; Chivers, 1977; Marshall & Sugardjito, 1986)	Groves (1993)	Geissmann (1995b)	Geissmann, this study
Genus: <i>Hylobates</i>	Genus: <i>Hylobates</i>	Genus: <i>Hylobates</i>	Genus: <i>Nomascus</i>
<i>H. concolor</i> <i>concolor</i>	<i>H. concolor</i> <i>concolor</i> <i>furvogaster</i> <i>jingdongensis</i> <i>lu</i>	<i>H. concolor</i> <i>concolor</i> <i>jingdongensis</i> ? <i>lu</i> ?	<i>N. concolor</i> <i>concolor</i> <i>furvogaster</i> ? <i>jingdongensis</i> ? <i>lu</i> ?
<i>lu</i>			
<i>hainanus</i>	<i>hainanus</i>	<i>cf. nasutus</i> <i>hainanus</i> new ssp.	<i>N. sp. cf. nasutus</i> <i>cf. nasutus</i> <i>hainanus</i> new ssp.
<i>leucogenys</i>	<i>H. leucogenys</i> <i>leucogenys</i>	<i>H. leucogenys</i> <i>leucogenys</i>	<i>N. leucogenys</i> <i>leucogenys</i>
<i>siki</i>	<i>H. gabriellae</i> <i>siki</i>	<i>siki</i>	<i>siki</i>
<i>gabriellae</i>	<i>gabriellae</i>	<i>H. gabriellae</i>	<i>N. gabriellae</i>

Recognition of all light-cheeked gibbons (*N. leucogenys*) as a separate species from the black crested gibbons (*N. concolor*) was proposed mainly because of anatomical differences between the two taxa – especially in the size of the baculum (Dao Van Tien, 1983; Ma & Wang, 1986). In addition, evidence from museum specimens appeared to suggest that areas of sympatry between the forms exist both in China and in Vietnam, without occurrence of hybrids (Dao Van Tien, 1983; Ma & Wang, 1986, 1988). One of us (TG) examined all known wild shot museum specimens of crested

gibbons, however, and found no evidence for sympatry between light-cheeked and black crested gibbons. There were no reliably identified *N. leucogenys* from east of the Black River in China, and no *N. concolor* from west of the Black River in Vietnam, which would have supported the existence of areas of sympatry as proposed by Dao Van Tien (1983) and Ma and Wang (1986). A possible wild-born hybrid between these two species has been described by Geissmann (1995a), but cannot be regarded as reliable evidence. Therefore, these areas of sympatry must be regarded as doubtful and are not shown in the distribution map (see below: Figure 3), in contrast to a previous publication (Geissmann, 1995b).

A subsequently suggested species-level differentiation between *N. leucogenys* and *N. gabriellae* was also based on differences in the penis bone (Groves, 1993; Groves & Wang, 1990); however, only one such bone had been studied of *N. gabriellae* at that time. Geissmann and Lim (1994) later demonstrated that there was a considerable variability in baculum size and form in adult *N. gabriellae*, suggesting that the importance of bacula for *Nomascus* systematics may need to be re-evaluated.

A further form, *siki*, whose distribution area is situated between that of *N. gabriellae* and *N. leucogenys*, has previously been identified as a subspecies of *N. gabriellae* by Groves (Groves, 1993; Groves & Wang, 1990; see Table 2.2, column 2), because the penis bone of *siki* (MNHN CG1971 No.81) appears to resemble that of *N. gabriellae* (Groves, 1972). Unfortunately, this particular baculum is not suitable to determine the affinities of *siki*, because it is (1) incomplete and (2) not of *siki* but of *N. leucogenys* (Geissmann, 1995b).

More informative, at present, is the observation that the song of *siki* resembles that of *N. leucogenys* more than that of any other form of crested gibbon including *N. gabriellae* (Geissmann unpubl. data). Likewise, mitochondrial DNA sequences suggest that *siki* is more closely related to *leucogenys* than to *gabriellae* (Garza & Woodruff, 1992, 1994; Zhang, 1997). As additional evidence for a close relationship between *N. l. leucogenys* and *N. l. siki*, it should also be noted that the females of both forms are so similar in fur colouration that no distinctive features are known, at present, whereas both differ from females of *N. gabriellae* (Geissmann, 1995b; see also below). As a result, *siki* was recognised as a subspecies of *N. leucogenys* (Geissmann, 1994, 1995b; see Table 2.2, column 3).

Recently, Groves (in press) and Zhang (1997) proposed to recognise *siki* as a full species, although both authors were aware of the close affinities between *leucogenys* and *siki*. This solution is not supported by the evidence mentioned above and is not followed here.

The previously published data supporting the recognition of several species of crested gibbons instead of only one appear to consist mainly of two sources of information: differences in baculum size and areas of sympatry without hybridisation. Upon my re-examination, both sources appeared to be either doubtful (sympatry) or not reliably documented by reasonable sample sizes (bacula).

We propose to consider vocal evidence in order to reassess species distinctions among crested gibbons. In a previous study, Geissmann (in press b) compared three different data sets of about equal size in order to assess their relevance for a reconstruction of gibbon phylogeny using cladistic methods (1: fur colouration; 2: primarily morphological and anatomical data, 3: vocal data). A cladistic analysis of each set demonstrated that vocal data produced the most reliable phylogeny of the data sets under study.

2. Gibbons (Family Hylobatidae)

Studies on large samples demonstrate that all three forms (*concolor*, *leucogenys* and *gabriellae*) differ markedly in their song (Geissmann, 1993, 1995b, and unpublished data). These differences are of a similar degree to those found among species of the *lar* group (genus *Hylobates*). No readily recognisable differences have been documented, so far, to exist among different subspecies of the *lar* group. As a result, we propose to recognise species status for *Nomascus concolor*, *N. leucogenys* and *N. gabriellae*.

In addition, vocalisations of one captive female from north-eastern Vietnam as well as songs of crested gibbons from the island of Hainan differed so radically from those of all other crested gibbons as to suggest the existence of a previously unrecognised fourth taxon at the species level. The name *Hylobates nasutus* has been proposed by Kunckel d'Herculais (1884) for a juvenile captive female reportedly originating from Along (=Ha Long) Bay in north-eastern Vietnam. The name has precedence over *Hylobates hainanus*, which was proposed by Thomas (1892) for gibbons from Hainan island. The reliability of the locality information provided by Kunckel d'Herculais (1884) as well as the taxonomic problems involved with this name have been described in Geissmann (1989). These problems will be evaluated and hopefully resolved in a future study. Until then, the fourth species is provisionally recognised here as the Eastern black crested gibbon, *N. sp. cf. nasutus* (see Geissmann, 1996, 1997).

2.3.3. Classification and phylogeny

The classification of the genus *Nomascus* used in this paper is summarised in Table 2.3. This table also lists the distribution areas and common names for each subspecies.

Because the fossil history of gibbons is virtually unknown, gibbon evolution can only be reconstructed from a comparative analysis of evolutionarily informative characteristics of modern gibbons and, to some degree, of related primate taxa that can be used as out-group. A recent study compared three different data sets of about equal size in order to assess their relevance for a reconstruction of gibbon phylogeny using cladistic methods (Geissmann, in press b). Set 1 used characteristics of fur colouration, set 2 consisted primarily of morphological and anatomical data, and set 3 consisted of vocal data. The tempo of evolutionary change, however, appears to differ among the data sets, similar to DNA sequences derived from different parts of the genome. Most data from set one appear to have changed considerably more than most of those from set three, whereas set two yields an intermediate position. As a result, each set appears to be suited to the analysis of different levels of resolution within the hylobatid radiation, but it is vocal data that produce the most reliable phylogeny of the data sets under study. Figure 2 presents a preliminary phylogenetic tree of all gibbon species, including the four species of crested gibbons, based on vocal data (from Geissmann, in press b). Although the relevant bootstrap values are very low, this tree appears to provide first support to Groves' (1993) hypothesis, that within *Nomascus*, black crested gibbons may be more basal than the light-cheeked species.

Table 2.3. The crested gibbon classification proposed in this study. Distribution information and common names are indicated for each taxon. Taxa and populations are ranked at three levels of taxonomic confidence (fourth column).

Taxon	Distribution	Common Name	Taxonomic Confidence ¹
<i>N. concolor concolor</i>	C. Yunnan (China), N. Vietnam, between Black and Red River	Tonkin black crested gibbon	(1)
<i>N. concolor furvogaster</i> ²	W. Yunnan (China), between Salween and Mekong River	West Yunnan black crested gibbon	(2)
<i>N. concolor jingdongensis</i> ²	C. Yunnan (China), between Mekong and Black River	Central Yunnan black crested gibbon	(2)
<i>N. concolor lu</i> ²	Bokeo province (NW. Laos)	Laotian black crested gibbon	(2)
<i>N. sp. cf. nasutus nasutus</i> ³	NE. Vietnam east of the Red River	Eastern black crested gibbon	(3)
<i>N. sp. cf. nasutus new ssp.</i> ⁴	NE. Vietnam east of the Red River, "hinterland of Hon Gai"		(3)
<i>N. sp. cf. nasutus hainanus</i>	Hainan Island (China)	Hainan black crested gibbon	(1)
<i>N. leucogenys leucogenys</i>	S. Yunnan (China), N. Laos, NW. Vietnam	Northern white-cheeked crested gibbon	(1)
<i>N. leucogenys siki</i>	S. Laos, C. Vietnam	Southern white-cheeked crested gibbon	(1)
<i>N. gabriellae</i>	S. Laos, S. Vietnam, E. Cambodia	Yellow-cheeked crested gibbon	(1)

- 1 (1) Recognised taxon.
 (2) Disputed taxon.
 (3) Credible evidence that separate taxonomic recognition is warranted, but no not named yet or taxonomic issues pending.
 2 Very similar to, and possibly synonymous with, *N. c. concolor*.
 3 See Geissmann (1995b, 1997).
 4 Known from a single specimen (Geissmann, 1989).

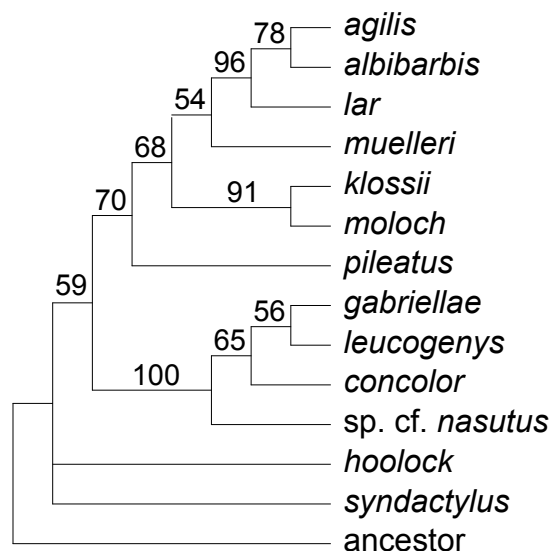


Fig. 2. Maximum parsimony tree (bootstrap 50% majority-rule consensus, 100 replications) based on vocal data (from Geissmann, in press b).

3. GIBBON DISTRIBUTION

3.1 Distribution of the genus *Nomascus*

A distribution map of all species of crested gibbons (genus *Nomascus*) is shown in Figure 3. In order to keep this map simple, the distribution areas are depicted as large continuous areas, which they probably were originally. Mainly as a result of habitat destruction, present distribution areas are considerably more fragmented than indicated in this figure, often consisting of isolated (and sometimes very small) patches of more or less virginal forest. A more accurate idea of the remaining areas of tropical forest in Asia is provided in Collins *et al.* (1991).

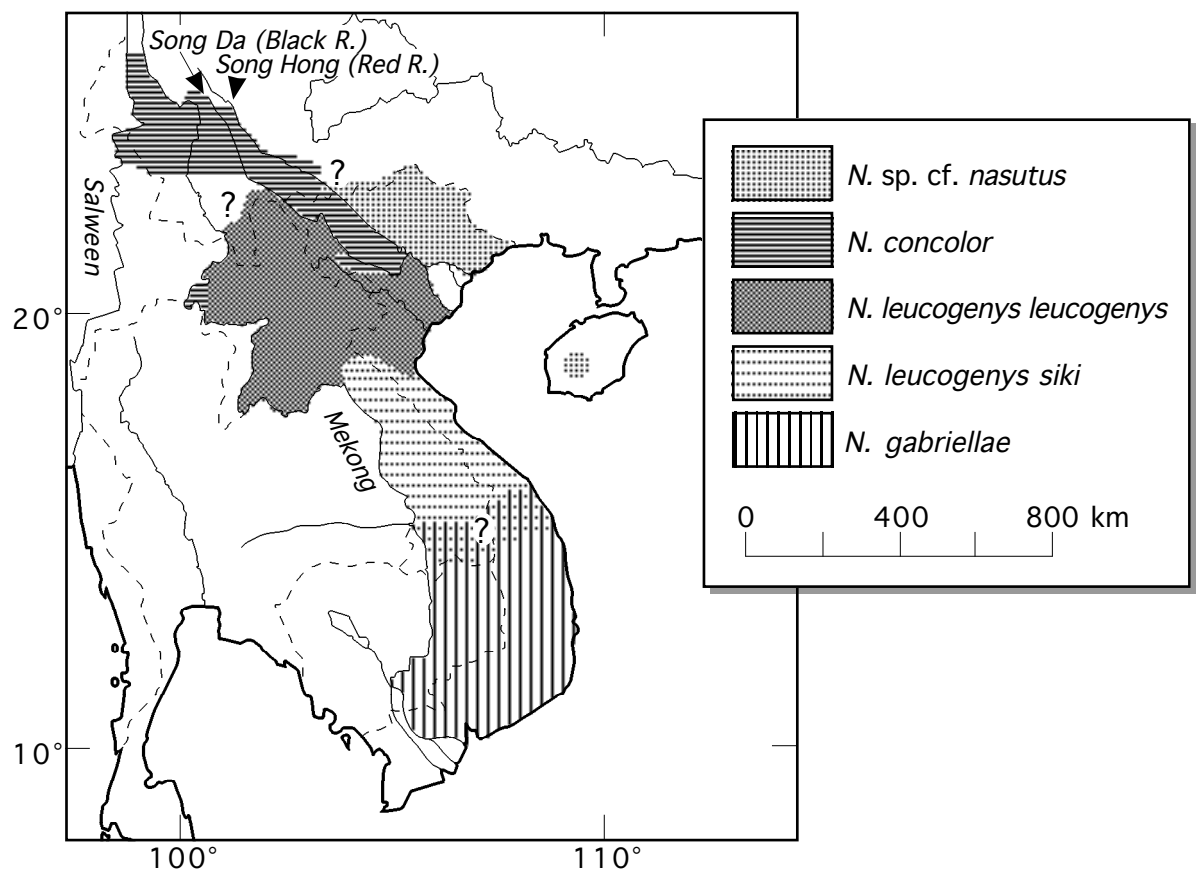


Fig. 3. Distribution of the species of the genus *Nomascus* (after Geissmann, 1995b, supplemented). Question marks refer to, from north to south, (1.) the unknown survival (and identity) of Chinese gibbons east of the red river in Yunnan province; (2.) a large apparent gap in the distribution area of gibbons in Yunnan province; and (3.) the unknown identity of gibbons in a large area between the distribution areas of *N. leucogenys* and *N. gabriellae*, respectively.

Crested gibbons are restricted to Indochina and southern China. The Mekong River represents the western border of their distribution area 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 able to cross the Mekong River. A small area of sympatry apparently exists (or existed) between this species and *Hylobates lar* in Dascue Shan Reserve in south-western Yunnan (Haimoff *et al.*, 1987; Lan & Guo, 1995; Ma & Wang, 1986; Zhang *et al.*, 1992) (see also Figure 3).

Delacour (1934), who kept several crested gibbons in France, reported them to be very hydrophobic. If they fell into the water, they would immediately swim to the nearest shore. They would never enter the water voluntarily and could be kept on small islands planted with some large trees which they never left, although the body of water around the islands was only 3 m wide. The reluctance to enter water is common to all gibbon species and at least partly explains why the common border between distributional ranges of neighbouring gibbon species are often formed by major rivers (Marshall & Sugardjito, 1986).

Although water appears to constitute an impassable barrier for most individuals if there are no trees available which can be used as bridge, individual gibbons may become habituated to water. The Saigon Zoo had, for several years, a male *N. gabriellae* who would walk knee-deep into the water surrounding his island, in order to splash water at the visitors.

While Chinese gibbons today are restricted to southern Yunnan and Hainan (Fooden *et al.*, 1987; Geissmann, 1989, 1995b; Groves & Wang, 1990; Ma & Wang, 1986), their distributional range extended as far north as the Yellow River in historical times (Gao *et al.*, 1981; van Gulik, 1967; Zhang *et al.*, 1992), as shown in Figure 4. The identity of these gibbons is unclear. Although the more southern populations were, in all probability, members of the *concolor* group, Pleistocene fossils (mainly confined to individual teeth) from the more northern part of this now gibbon-less area have been referred to as both *Nomascus* and *Bunopithecus* (Groves, 1972; Gu, 1989; Marshall & Sugardjito, 1986). Several old Chinese paintings of gibbons are reproduced in Van Gulik (1967). At least the most naturalistic of these paintings strikingly resembles *Bunopithecus hoolock*. It was painted by I Yuan-Chi (ca. 1000-1064 AD), who reportedly had wandered all over south Hubei and north Hunan provinces in order to observe wild gibbons. During the last 1,000 years, hunting and deforestation have probably heavily contributed to the extirpation of gibbons from the largest part of their former range in China.

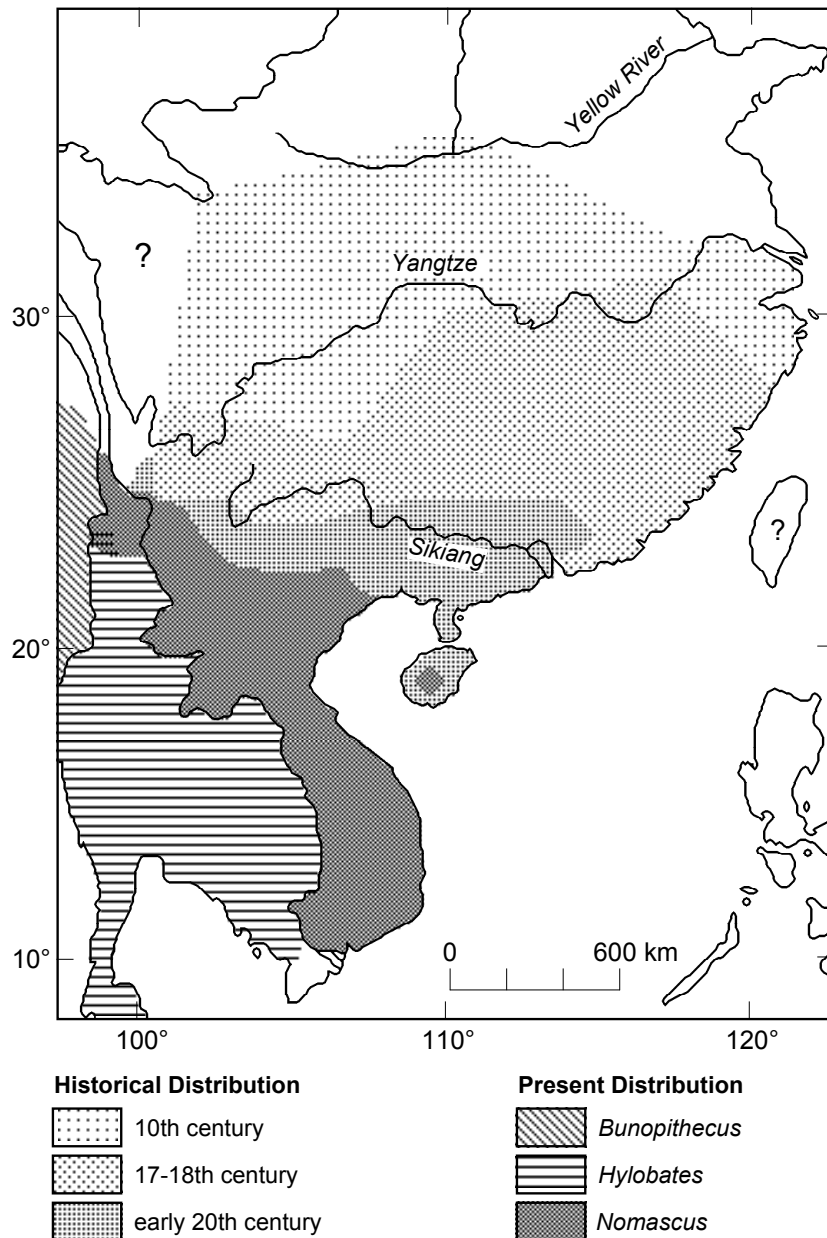


Fig. 4. Historical and present distribution of gibbons in China and adjacent regions (after Geissmann, 1995b).

3.2 Eastern black crested gibbon (*Nomascus* sp. cf. *nasutus*)

Distribution in China

Until the 1940s, gibbons were still found in some localities in northern Guangdong province and in south-western Guangxi province, where they are believed to have become extinct during the 1950s (Fooden *et al.*, 1987; Tan, 1985; Zhang *et al.*, 1992), although Wu (1993) reports that a female pelt "was collected from local people in Longgang Nature Reserve [Guangxi province] in recent years". These gibbons were in all probability Eastern black crested gibbons.

Gibbons occurring east of the Red River were also reported from southern Yunnan province (Mt. Dawei, Hekou-Pingbian county, and Guangting, Jianshui county) by Ma and Wang (1986), but it is unknown whether gibbons still occur there. These gibbons may, however, be *N. concolor*, not *N. sp. cf. nasutus*. An incomplete but apparently adult female skin collected in Jianshui county in 1965 (KIZ 003151; without skull) exhibits a large and sharply demarcated black ventral area, like *N. concolor*. If the locality of the specimen is correct, this would suggest that Western black crested gibbons were able to cross the upper Red River in Yunnan province and are distributed on the east bank as well, whereas only females with light ventral colouration have been collected from the Vietnamese localities east of the Red River.

Currently, the only reliably located remaining Chinese population of the species appears to be restricted to the Bawangling Nature Reserve on Hainan Island (Zhang, 1992a, b; Zhang & Sheeran, 1994). The population on Hainan fell from an estimated 2,000 animals in the 1950s to 3 groups with a total of less than 20 individuals in 1993 (Geissmann, unpublished observations).

Distribution in Vietnam

In Vietnam, Eastern black crested gibbons were only recorded east of the Red River. Dao Van Tien (1983) also lists one locality from the west bank (Chi Ne, Hoa Binh province, about 60 km west of the Red River), based on a museum specimen (ZMVNU 150, with skull). Later, however, he identified the same specimen as *N. leucogenys* (Dao Van Tien, 1985). The specimen is an adult female with light ventral area, collected in 1961. An additional skull (ZMVNU 158) was collected at the same locality in 1960. Because no male skin is available, it is difficult to identify the species (Fooden, 1996), and, unfortunately, gibbons are now extirpated from this area. We consider it unlikely that gibbons from east of the Red River were able to cross the River at this latitude (i.e. south of Hanoi). Here, the Red River is a mighty river, fanning into a broad delta area which is reportedly not populated by gibbons (Fischer, 1965). According to T. Nadler (pers. comm. 2000, who conducted interviews in the area, in all probability, animals from Chi Ne are *N. leucogenys*.

An idea of the dimensions of the distribution area is provided by reliably identified museum skins from three localities (Tam Dao, Vinh Phuc; Na Ri, Bac Kan; and Trung Khanh, Cao Bang). Unfortunately, very few surveys were conducted in Ha Giang, Cao Bang, Lang Son and Quang Ninh provinces, which are situated within the suggested historical range of this species. Smaller sectors of several other provinces also overlap with the distribution area. Felix (1985) reported having seen a family group of gibbons in Yen Bai province near the Thac Ba lake. No description of the animals is provided. Because the lake is situated east of the Red River, the gibbons seen by Felix probably were Eastern black crested gibbons. No recent evidence for the continued occurrence of gibbons is available for this province.

Museum specimens of two other localities from within the suggested range of the Eastern black crested gibbon are available, but the localities are less reliable. They include a gibbon skin (and skeleton, ZMB 70036) with a unique phenotype from the "hinterland" of Hon Gai (Quang Ninh province), and two skulls from Van Hai (Ha Long Bay). The Hon Gai specimen is discussed in Geissmann (1989) and below (see section 6.1.).

Van Hai, on the other hand, is problematic, because it could refer to several localities. Today, it is the name of a small island near Cat Ba island with an area of less than 5 km² (Fooden, pers. comm.). It is unlikely that this island was large enough to bear a

3. Gibbon Distribution

self-sustaining gibbon population. Van Hai is also an old name for Cat Ba island itself, as well as the name of a village on Cat Ba. This island has an endemic leaf monkey taxon (*Trachypithecus poliocephalus*) and probably would be large enough to carry a gibbon population. Interviews carried out with elderly local people on Cat Ba (Geissmann, unpublished data) did not reveal any evidence that gibbons ever lived on the island, whereas the skulls from Van Hai (ZMVNU 159 and 160) were collected in December 1961. As a result, the origin of the Van Hai skulls remains unclear.

3.3 Western black crested gibbon (*Nomascus concolor*)

Distribution in China

Nomascus concolor is distributed in central and western Yunnan province. In western Yunnan province, this species also occurs west of the Mekong river and has been described as *N. c. furvogaster* (Ma & Wang, 1986; Ma *et al.*, 1988). 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 south of the Wuliang Mountains (see question mark in Figure 3). It can be assumed that somewhere in this area a large contact zone between *N. concolor* to the north and *N. leucogenys* to the south must originally have existed.

Distribution in Laos

Until 1998, the isolated Laotian population of *N. concolor* was known from only six museum specimens collected in January 1939 by Delacour, Greenway and Edmond-Blanc in Ban Nam Khueng (Delacour, 1951) (preserved at AMNH, BM(NH), MCZ, MNHN), and one specimen collected by Robert E. Elbel in February 1953 at Khao Tham Phra (USNM 296921). Both localities are situated near the Mekong River in Bokeo province (north-western Laos). In early 1998, some animals were videotaped by Peter Livermore in Nam Kan PNBCA. A survey by one of us (TG) in March 1999 revealed that these gibbons can be identified as *N. concolor* and that at least 9 gibbon groups are living in the Nam Kan valley in an area of about 20 km². This survey area represents only a small part of the whole protected area, whose exact size could not be established during the survey (Geissmann, unpublished data). The distribution area of this isolated population is restricted to Bokeo province. 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.

Groves (1972) suggested that a single race of black crested gibbons was once spread all over northern Indochina, but has been replaced recently by white-cheeked crested gibbons (*N. leucogenys*). The expansion of the distribution area of *N. leucogenys* may have cut the Bokeo population off from the remainder of the *N. concolor* populations in northern Vietnam and Yunnan province.

Distribution in Vietnam

In Vietnam, *N. concolor* mostly occurs between the Red and the Black Rivers. Most museum specimens (including the type) were collected in Sa Pa (= Chapa), Lao Cai province, specimens preserved at BM(NH), FMNH, MCZ, NRM). Only skulls are available from Thuong Bang La (Yen Bai province, IEBR 185 and 193). Reliably

identified specimens were also collected in one locality west of the Black River at Long Sap (Moc Chau district, Son La province, IEBR 364/185, 365/186, and unnumbered infant). However, it seems odd to find *N. concolor* west of the Black River in just one locality, whereas only *N. leucogenys* appears to occur in other localities west of the Black River.

In addition, Dao Van Tien (1983) identified museum specimens from two other localities west of the Black River as *N. concolor*: Muong Lay (Lai Chau province) and Hoi Xuan (Thanh Hoa province). Dao Van Tien (1983) also identified both the Muong Lay and the Hoi Xuan/Bai Thuong localities as areas of overlap between the two species *N. concolor* and *N. leucogenys*.

A re-examination of the available museum material by one of us (TG) did not provide evidence for the coexistence of two species at any of these localities, as shown below.

There are four gibbon specimens at IEBR which are labelled "Lai Chau" (skins: IEBR D2, K53, and two unnumbered skins). As mentioned in Dao Van Tien (1985, p. 148), at least one of the skins was collected at Muong Lay (some kilometres south of Lai Chau), another one at Tuan Giao. According to Fooden (1996), the skins IEBR D2 and K22 are both from Muong Lay. Of these specimens, only two skins (IEBR K53 and one of the unnumbered skins) exhibited characteristics suitable for a species identification, and both were black phase *N. leucogenys*, with fragments of the white beards preserved. Three additional skins from Lai Chau (FMNH 31761 and 31768, and MNHN CG1892 No. 1530) also look like *N. leucogenys* and clearly are not *N. concolor*.

Dao Van Tien (1985, p. 197) mentions two skins (IEBR 541/23 and 542/24) from Hoi Xuan, but only a skull (IEBR 23) belonging to one of the skins was seen during this study, whereas the skins were not found in the collection (Geissmann, visits to IEBR in 1993 and 1998). Dao Van Tien (1983) identified the skull as *concolor*, but two years later, the same author listed it as *N. leucogenys* (Dao Van Tien, 1985, p. 197). He also explicitly stated that the male skin had white cheeks and that the female had a light ventral area (Dao Van Tien, 1985, p. 197).

Of all specimens seen from Hoi Xuan during this study (1 skull IEBR 23, 1 adult female skin FMNH 39151) and from Bai Thuong (Thanh Hoa province, ZMVNU 156, 1 subadult/young adult female skin), the skull does not provide reliable features for species identification. The two skins, however, look like *N. leucogenys* and clearly are not *N. concolor* (see also Fooden, 1996; Geissmann, 1989).

The available evidence does not suggest that gibbons other than *N. leucogenys* occur at these localities.

3.4 Northern white-cheeked crested gibbon (*Nomascus leucogenys leucogenys*)

Nomascus leucogenys leucogenys occurs from southern Yunnan to northern Laos and northern Vietnam. However, the southern limit of its range where it is replaced by the subspecies *N. leucogenys siki* is unknown. Criteria for reliably distinguishing between adult females of *leucogenys* and *siki* are unknown. Size and shape of the white cheek patches of black phase individuals (adult males and juveniles) are the diagnostic criteria (see below: section 6.3). Recognition of these characteristics is difficult in the

3. Gibbon Distribution

forest. Songs may contain additional distinctive features, but only few reliably identified individuals *N. l. siki* have been tape-recorded, so far. In addition, tape-recordings are not systematically being carried out during most surveys. It is also probable that individuals with intermediate characteristics occur in the common border area between the two sub-species.

Distribution in China

The distribution area of *N. leucogenys leucogenys* in China is restricted to the extreme south of Yunnan province, where it occurs in the south-eastern corner of Xishuangbanna Autonomous Prefecture (Mengla county) close to the Laotian border (Fooden *et al.*, 1987). The species' distribution area apparently also extended eastwards to Jiangcheng county and even to Luchun county, east of the Black River (Ma & Wang, 1986). In the latter locality (in the area of Mt. Huanglian), Ma and Wang (1986) also reported sympatry of *N. leucogenys* and *N. concolor*. A survey of museum collections (Geissmann, unpublished data) did not reveal any reliably identifiable specimens of *N. leucogenys* from Luchun county. The only specimen was an infant skin (KIZ 003145), which does not provide reliable features for species identification and cannot be used to support the report of sympatry in Luchun county. Furthermore, Lan Daoying (in prep.) suggests that the two species may be separated by ecological niche and observed that the habitat on Huliangshan is similar to other locations where *N. concolor* is found. Therefore the author concluded that if there is only one gibbon species in this area, it should be black gibbon, rather than white-cheeked gibbon.

More surprising, however, was the discovery of a previously uninventorised adult female skin from Mongla (Jingpin county, IZCAS 00083), i.e. from even further to the east of the Black River than the reported area of sympatry and very close to the Red River (Geissmann, unpublished data). This specimen was collected at an altitude of 800 m and has a light ventral area and clearly is not *N. concolor*. If this specimen is *N. leucogenys* and the locality record is correct, the former area of sympatry between *N. leucogenys* and *N. concolor* would have had immense dimensions. It would appear slightly more plausible to assume that this female is *N. sp. cf. nasutus* on the wrong side of the Red River. In any case, this specimen should be considered with caution.

Also surprising was the discovery of another un-inventoried skin collected in 1958 in Mengla county (IZCAS 010). This adult sized female exhibits a dark ventral area and clearly looks like *N. concolor*, although the locality is in the middle of the *N. leucogenys* area. Unfortunately, no skull is available which could be used to verify that this female is adult. The body weight information on the tag is only partly legible but begins with 5'44... This probably means that the female had a body weight of about 5.4 kg, which is very light for adult females of either *N. concolor* or *N. leucogenys* (average: 7.62±1.27 kg and 7.32±0.57 kg, respectively; Geissmann, 1993). The light weight suggests that the specimen was not adult, and, thus, probably represents a subadult *N. leucogenys* exhibiting a transitory coat. This example documents the fact that gibbon populations represented by a single museum specimen may be misidentified. Without large sample of other reliably identified museum specimens of *N. leucogenys* from Mengla county, this individual specimen would probably have been regarded as evidence that the area is inhabited by *N. concolor*.

Distribution in Laos

In Laos, *N. leucogenys leucogenys* is distributed over much of the country's northern half, but limited to the west by the Mekong River. Kloss (1929) reported that the species was also collected east of the Mekong at Muang Pak-Lay and restricted the type locality to that area. Fooden (1987) demonstrated, however, that the specimens Kloss was referring to were not collected at Muang Pak-Lay, but at Muang Khi, west of the Mekong. As mentioned above, the southern limit of the range of *N. leucogenys leucogenys*, where it is replaced by the subspecies *N. leucogenys siki* is unknown. We speculate that the Nyiap and Chian Rivers (Bolikhamsai province and Saisombun Special Zone) may be acting as a barrier between the two taxa.

Distribution in Vietnam

In Vietnam, *N. l. leucogenys* occurs in the north-western part of the country and to the west of the Black River (as discussed above, the species may also occur east of the Black River in Yunnan province, China).

The evidence (or lack of such) for the proposed sympatry (Dao Van Tien, 1983) of *N. concolor* and *N. leucogenys* in Vietnam has been discussed above (see section 6.3).

As in Laos, the boundary where *N. l. leucogenys* is replaced by *N. l. siki* could not be accurately determined in previous studies (Dao Van Tien, 1983; Fooden, 1996; Groves, 1972).

Dao Van Tien (1983) identifies Bai Thuong (Thanh Hoa) as the southernmost locality for *N. l. leucogenys*, and Nghia Dung/Tan Ki and Quy Chau (Nghe An province), both north of the Ca River, as the northernmost localities for *N. l. siki*. Accordingly, the border area between *N. l. leucogenys* and *N. l. siki* should be situated somewhere between the Ma and Ca Rivers.

A re-examination of the available museum specimens (Geissmann, unpublished data) provides a different picture.

Two of the skins from Nghia Dung (Nghe An) are in the black phase (IEBR 563, IEBR 736). Although the cheek areas are incompletely preserved, the upper half appears to consist of relatively long white hairs in both. Only one corner of the mouth is preserved in each. Both specimens do not show the white bracket-like hair patch typical of *N. l. siki* (see below, section 5.3). These gibbons have variously been identified as *N. l. siki* by Dao Van Tien (1983, 1985), and as *N. l. leucogenys* by Fooden (1996). In spite of the poor preservation of the specimens, our examination suggests that they are probably *N. l. leucogenys*.

If the reassessment is correct, the distribution area of *N. l. leucogenys* would extend as far south as the Ca River (Nghe An province), in contrast to the interpretation proposed by Dao Van Tien (1983), and Nghia Dung could be regarded as the most southern record of *N. leucogenys leucogenys*.

Dao Van Tien (1983) identifies Chau Binh, Quy Chau (Nghe An) as the northernmost locality of *N. l. siki*, but two years later lists the same museum specimens as *N. l. leucogenys* (Dao Van Tien, 1985, p. 217). Fooden (1996) lists them as *N. l. siki*, although he considers specimens from the more southern localities of Nghia Dan (adult female skin, BM(NH) 1928.7.1.1) and Nghia Dung (see above) being *N. l. leucogenys*. If the Ca River is the common distribution border between the two

subspecies, as we propose, then gibbons from Quy Chau should certainly be *N. l. leucogenys*. Only two of the three skins from Chau Binh, Quy Chau (Nghe An) are in the diagnostic black phase (IEBR 503 and 696). In both, the head or the relevant cheek areas are missing, precluding a reliable subspecies identification. Our interpretation receives some support, from two animals at Hanoi Zoo, which reportedly came from Quy Chau district (19°39' / 105°02'E) and which were identified as *N. l. leucogenys* by Ratajszczak *et al.* (1990).

The northernmost occurrence of *N. l. siki*, on the other hand, may be represented by a dark infant from the "Chaîne Annamitique de la Province de Vinh" (Nghe An, BM(NH) 1928.10.2.1). Although the town of Vinh is situated north of the Ca River, the Annamite Mountains are located to the west of Vinh and cannot be reached without crossing the Ca River. As a result, we suggest that the lower Ca River may be the common boundary between the two subspecies of *N. leucogenys*. This interpretation is also supported by the carcass of a gibbon which reportedly had been shot in Anh Son district, close to the Laotian border (Ratajszczak *et al.*, 1990). This locality is also south of the Ca River and probably not very far from the locality of the specimen mentioned above (BM(NH) 1928.10.2.1). The carcass was examined and identified as *N. l. siki* by Ratajszczak *et al.* (1990).

3.5 Southern white-cheeked crested gibbon (*Nomascus leucogenys siki*)

Southern white-cheeked crested gibbons inhabit northern central Vietnam and central Laos, again with the Mekong River being the western range boundary.

Distribution in Laos

The northern limit of the distribution area of *N. l. siki* in Laos is unknown, but may be coincide with the Chian and Nyiap Rivers (Bolikhamsai province and Saisombun Special Zone), as speculated above. The southern limit is even more problematic. For instance, museum specimens from the Bolavens Plateau look like *N. gabriellae*, but the songs are clearly different (Geissmann, 1995b). A more detailed discussion of the available evidence is presented below (see section 6.5).

Distribution in Vietnam

As demonstrated above, the lower Ca River (Nghe An province) may be the northern limit of the distribution area of *N. l. siki* in Vietnam. In the south, *N. l. siki* is replaced by *N. gabriellae*, but the southern range limits of *N. l. siki* are unknown. The data (vocal data and fur colouration) collected in a large area between the range of typical *N. l. siki* and typical *N. gabriellae* (both in Laos and Vietnam) provide conflicting evidence and suggest a more complex situation than a simple river boundary or a small hybrid zone, as discussed in more detail below (see section 6.5).

Evidence for this large zone between typical *N. l. siki* and typical *N. gabriellae* is available from as far north as Bach Ma National Park (south of Hue, Thua Tien-Hue province), but how far the zone actually extends to the north is unknown. A pet gibbon which was kept at Hue (Thua Thien-Hue province) looks like *N. l. siki* (Delacour, 1951, MNHN CG1939 No. 2148), and a specimen collected at Thua Luu (south of Hue) also looks like *N. l. siki* (BM(NH) ZD.1933.4.1.6[a]). Some museum specimens

from Bach Ma, only a little to the south of Thua Luu, look like *N. gabriellae* (NRM 8747, and at least one specimen collected by FIPI, not seen, cf. Eames & Robson, 1993, Robson, 1990). Gibbon songs tape-recorded at Bach Ma, however, clearly do not sound like *N. gabriellae* and resemble those of *N. l. siki* (Geissmann, unpublished data). Prof. Pham Nhat (pers. comm. to TG) reported having seen 2 wild gibbons in Bach Ma which looked like *N. l. siki*.

3.6 Yellow-cheeked crested gibbon (*Nomascus gabriellae*)

Nomascus gabriellae occurs in southern Laos and Vietnam and in north-eastern Cambodia.

Distribution in Cambodia

The Yellow-cheeked crested gibbon inhabits the north-eastern part of the country situated on the east side of the Mekong River. Little is known about the crested gibbons in this country (see Long & Swan, 2000). The species has been reported to occur in eastern Mondulakiri province (Desai & Vuthy, 1996), in the Samling logging concession in southern Mondulakiri province, and in the Snoul Wildlife Sanctuary, Kratie province (Walston *et al.*, in press).

Distribution in Laos

Gibbons looking like *Nomascus gabriellae* occur as far north as Thateng and the Bolavens Plateau. Gibbons songs tape-recorded in Laos, however, provide a completely different picture. Even the southernmost gibbons recorded in Laos (Xe Pian, Chamapsak province) produced songs which differed from typical *N. gabriellae*, and the crested gibbons from southern Laos appear to belong to the large area between the range of typical *N. leucogenys siki* and typical *N. gabriellae* already mentioned under *N. l. siki* (and discussed below: section 6.5).

Distribution in Vietnam

As pointed out above, the identification of the northern limit of the distribution area of *N. gabriellae* is currently not possible, although all museum specimens collected from south of Danang appear to correspond to the *N. gabriellae* phenotype. One exception was a mounted specimen of an adult male from Kon Cha Rang (Gia Lai province, IEBR MA1598, collected by T. M. Hoat, 20/12/1978), which looked like *N. leucogenys leucogenys* and clearly was neither *siki* nor *gabriellae*. The occurrence of a Northern white-cheeked crested gibbon so far outside its known range is very unlikely. We suspect that this gibbon may have been a pet bought at the locality indicated on the label but originating from northern Vietnam.

Unfortunately, virtually no tape-recorded gibbon songs are available from anywhere between Bach Ma (Thua Thien-Hue province) and Nam Cat Tien (Dong Nai province). Such recordings could help to locate the northernmost area where the song typical of *N. gabriellae* occurs. At the present state of knowledge, this northern limit could be anywhere in the Quang Nam, Kon Tum, Gia Lai, Binh Dinh and Phu Yen or even Dak Lak provinces.

4. GIBBON ECOLOGY AND BEHAVIOUR

Our knowledge in this domain is very poor. Very few field studies have been carried out on the behavioural ecology of crested gibbons. Most of them focus on *N. concolor* in Yunnan province (China). Only a little data was collected on *N. sp. cf. nasutus hainanus* on Hainan Island and on *N. leucogenys* in Yunnan province. Only anecdotal field observations are available for crested gibbons in Laos, Vietnam and Cambodia. As a result, the southern populations of the genus remain virtually unstudied.

The data currently available suggest that the behaviour and ecology of the crested gibbons are largely similar to the other gibbons, with few possible exceptions.

4.1 Social organisation

Crested gibbons, as with all other members of the *Hylobatidae*, appear to be dominantly monogamous. A gibbon group typically includes an adult pair and their immature offspring. The average group size in non-crested gibbons ranges from 3 to 5 individuals (Leighton, 1987). Several reports mention larger group sizes for crested gibbons (Table 4.1). These large numbers should be regarded with caution. Some of them are based on short term studies, during which groups were not repeatedly sighted. It is possible that some large groups may actually be two groups meeting at a common boundary. During such border conflicts, gibbons may be particularly vocal and more easily detected than solitary groups. Nevertheless, it cannot be ruled out that the average group size in some crested gibbon populations may be higher than those reported for other gibbon genera.

Cohesion among family members appears to be high. According to the local hunters, adult males do not flee when the female is shot, but stay around trying to protect her. If Vietnamese hunters meet a gibbon group, they shoot at the adult female first in the hope that her mate will stay in the vicinity and can also be shot. If the information is reliable, the protective behaviour of adult males makes crested gibbons very vulnerable, because whole groups can be killed relatively easily.

Some authors have claimed that *N. concolor* is polygynous and exhibits a tendency of containing more than one adult female per group (Dao Van Tien, 1983; Haimoff *et al.*, 1986, 1987). Delacour (1933) appears to have been the first author to report that Indochinese gibbons "live in small parties, probably families, of five to ten; there are usually two or three adult buff-coloured females, and from four to six black individuals of different ages". The same author pointed out that, based on his occasional observations, it was not possible to identify whether the larger groups he observed were actually single family groups or encounters of several neighbouring groups (Delacour, 1934). Polygyny would be a very unusual social organisation among the *Hylobatidae*. The evidence for polygyny, however, appears to be based on very little direct observation. A polygynous social organisation of crested gibbons was questioned by several authors and does not appear to be supported by recent surveys, which recorded mainly pairs (Bleisch & Chen, 1991; Hu *et al.*, 1989; Lan *et al.*, 1990; Sheeran & Poirier, 1990; Sheeran *et al.*, 1998).

Table 4.1. Crested gibbon group size and ranging.

Study Site	Altitude of gibbon habitat (m)	Average group size, min.-max. (nr. of groups)	Density: Groups / km ²	Home range (ha)	Day range (m)	Source
<i>N. leucogenys</i>						
Various sites, Mt. Wuliang, Yunnan province, China	2,400-3,100	6.6, 3-10 (7)	0.82			Haimoff <i>et al.</i> , 1986, 1987
Several localities, Yunnan province, China	500-2,700	3.0, 1-5 (14)				Lan, 1989a, 1989b
Ailao Mt., Yunnan province, China	2,460-2,640	4 (1)		87	1,306	Chen, 1995, cited in Sheeran <i>et al.</i> , 1998
Xiaobahe, Mt. Wuliang, Yunnan prov., China	2,000-2,700		0.62	44-49	795, 600-1,100	Lan, 1989a, 1989b
Xiaobahe, Mt. Wuliang, and Ailao Mt., Yunnan province, China	1,900-2,900	2.9, 1-5 (8) [minimum estimates]		77, 40-120 [minimum estimates]		Bleisch & Chen, 1991
Xiaobahe, Mt. Wuliang, Yunnan prov., China	2,400-2,700	5 or 5.25, 4-6 (4)	0.52			Sheeran, 1993
Xiaobahe, Mt. Wuliang, Yunnan prov., China	2,400-2,700	4.3, 3-6 (?)		100-200		Jiang <i>et al.</i> , 1994
Xiaobahe, Mt. Wuliang, Yunnan prov., China	2,400-2,700	5.5, 4-8 (6)	0.43	100-200		Sheeran <i>et al.</i> , 1998
<i>N. leucogenys</i>						
Bawangling Nature Reserve, Hainan, China	800-1,200	4-8				Xu <i>et al.</i> , 1983
Bawangling Nature Reserve, Hainan, China	800-1,200	5.5, 4-7 (4)				Liu <i>et al.</i> , 1987
Bawangling Nature Reserve, Hainan, China	800-1,200	5.25, 4-7 (4)		363, 200-500		Liu <i>et al.</i> , 1989
Bawangling Nature Reserve, Hainan, China	800-1,200			100-200		Liu & Tan, 1990
Bawangling Nature Reserve, Hainan, China	800-1,200		0.50-0.57			Zhang <i>et al.</i> , 1995
<i>N. leucogenys</i>						
Mengla Nature Reserve, Xishuangbanna, Yunnan prov., China	700-1,000	3.78, 3-5 (9)			1305, 748-2,158	Hu <i>et al.</i> , 1989

The largest adult female proportions were reported for *N. concolor* groups in Yunnan province by Haimoff *et al.* (1986, 1987), who counted an average of 2.1 adult females per group, including one group with four adult females. Bleisch and Chen (1991) suggested that immature females singing with their mother may have been counted as adults. As mentioned in Geissmann (1993), however, the vocal deception goes even further: Not only songs of immature females but songs of immature individuals of either sex resemble the adult female song. In the song bouts of adult crested gibbons (as described below, see section 5.4), great calls are female-specific phrases. Immature crested gibbons, however, usually participate in the duet songs of their parents and produce great call-like phrases only. As a result, if early scientists used vocal data in order to assess the composition of gibbon groups, they may easily have reached the conclusion that several females were present in most groups. Gibbon group composition should preferably be determined by repeated counts of the group during direct visual observations. It should be noted, however, that Haimoff *et al.* (1986, 1987) explicitly stated that their data were based on direct sightings.

In any case, subsequent field surveys reported smaller groups (Table 4.1), usually with only one adult female. It should be kept in mind, however, that at least two groups with more than one yellow (and thus presumably adult) female have been sighted in more recent studies (e.g. Lan & Sheeran, 1995; Liu *et al.*, 1989; Sheeran *et al.*, 1998). A re-analysis of all dated sightings of one of these groups on Hainan island (Liu Zhenhe, Jiang Haisheng and others, pers. comm. to TG) revealed that the "second" female had been a member of the group while it was still in its black juvenile coat and that the female had repeatedly been observed while she was in the transitory coat. Because she changed her colour from black to yellow while she was a member of the group, this suggests that she was an offspring of the group and not a second female which secondarily joined the group. Although this finding does not exclude polygyny, this interpretation becomes less likely if the second female is a daughter of the breeding pair.

The second multi-female group was observed in the Wuliang Mountains. This isolated group increased in size from 4 individuals (1990) to 8 (1997). By 1997, it included two breeding females, perhaps because there were no dispersal options and few suitable mates (Sheeran *et al.*, 1998).

The question as to whether polygyny is the standard social organisation in some or even all crested gibbons is still unresolved. There are just too many variables which influence the available reports. One of them is female colouration. We do not know how old females are, on average, when they change from black to yellow fur colouration. One of us (TG) saw some very small captive females which were considered juveniles, not subadults, and which changed their colouration, nevertheless, before reaching adult size. There may be considerable variation in the timing of this change (Geissmann, 1993). If field workers identify all yellow females as adult, their data may not be comparable with field data on the genera *Hylobates* and *Symphalangus*. In the latter genera, maturing females exhibit little or no change in their fur colouration. In the field, the age of these females is usually estimated based on their body size or on facial physiognomy.

But even if an unequivocally polygynous wild group of crested gibbons is discovered, what would be its significance? It would show that polygyny is an option for gibbons, albeit rarely realised. It would not, however, make a species polygynous. It would not even prove that the social organisation in crested gibbons is different from that of other gibbons, or whether polygyny occurs more often in crested gibbons. In other gibbon genera, groups with more than one adult female are occasionally encountered

as well (e.g. Srikosamatara & Brockelman, 1987), although the prevalence of a monogamous social structure has been well documented in numerous field studies of several gibbon species (Leighton, 1987).

These observations are well supplemented by captive studies. Most zoos initially had to learn the hard way that it is very difficult to keep more than one adult gibbon of the same sex in one cage (e.g. Benchley, 1942; Ibscher, 1964), although it is occasionally possible to create a zoo group with more than one adult male or female. The same appears to apply to crested gibbons. Early zoo reports document that crested gibbons are preferentially kept in monogamous groups. Delacour was probably the first European to release crested gibbons in a European park. After some time, he had to sell one old pair because the female killed two younger females and even attacked younger males which were released later (Delacour, 1933; Edmond-Blanc, 1932). Yet, zoos occasionally succeed in creating larger groups (Geissmann, own observations). A captive group of hybrid crested gibbons at the La Flèche Zoo (France) successfully bred although it included 2 adult males (brothers, both older than 10 years). Only one of the brothers mated and reproduced with the female. Another group at the Bangkok Zoo included one adult male (*N. leucogenys*) and three non-related adult females. One of them was *N. gabriellae*. The other two were *N. leucogenys*, but one was very old and clearly exhibited a subdominant behaviour towards the other females.

4.2 Habitat

Crested gibbons are found in a variety of forest habitats, depending on latitude and possibly species-specific preferences or adaptations. Crested gibbons appear, however, to prefer primary and mature secondary forests and are mostly absent from disturbed forests.

Western black crested gibbons (*N. concolor*) in northern Vietnam live in cool and damp subtropical, evergreen and semi-evergreen forests at elevations of 1,600-2,000 m (Dao Van Tien, 1983). In Yunnan province, the species lives in northern moist broad-leaved evergreen forest at elevations of 1,900-2,600 m, where night temperatures may occasionally drop down to -4°C (Wuliang Mountains) or to -5°C (Ailao Mountains) (e.g. Bleisch & Jiang, 2000). In the Ailao Mountains, the species may occur up to an elevation of 2,900 m (Bleisch & Chen, 1991).

Eastern black crested gibbons (*N. sp. cf. nasutus*) in Vietnam live in the midland of the northern region, in the lower montane and limestone forests, in a wet tropical monsoon climate at elevations of 50-900 m (Dao Van Tien, 1983). On Hainan, the species is currently restricted to a single forest area (Bawangling Nature Reserve) at elevations of 200-1,560 m. In this area, the gibbons live only in the middle part of the mountain ranges at altitudes of 800-1,200 m and inhabit the tropical valley rain forest and mountain rain forest, but avoid the secondary forest or the high peak dwarf forest (Liu & Tan, 1990; Liu et al., 1989).

Northern white-cheeked crested gibbons (*N. leucogenys leucogenys*) live in the lowland of north-eastern Vietnam and northern Laos in a subtropical climate with a short and not very cold winter without frost, at elevations of 200-600 m (Dao Van Tien, 1983). Southern white-cheeked gibbons (*N. leucogenys siki*) live in the lowlands at elevations of 30-100 m, in a typical wet tropical climate, with no influence of the N.E. monsoon and no conspicuous dry season (Dao Van Tien, 1983).

Yellow-cheeked crested gibbons (*N. gabriellae*) live in a wet tropical climate of the southern Indochina lowlands (Dao Van Tien, 1983). When surveying the Da Lat Plateau (Lam Dong province, Vietnam), Eames and Robson (1993) observed that the species was very scarce between 1,500 and 2,000 m. The authors proposed that this altitude could be a sub-optimal habitat for this species.

4.3 Diet

Crested gibbons are diurnal and arboreal, going down on the ground very rarely. One early western traveller described that on the road between Djiring (Di Linh) and Buon Ma Thuot (southern Vietnam), "a troop of gibbons dropped from the trees into our path, awaiting our oncoming in petrified astonishment. At the last moment, when the chauffeur was already braking hard, they departed with fine acrobatic flourishes" (Lewis, 1951, p. 70). Interviews with local people in Xiaobanmaxueshan (Genma county, Yunnan province) suggested that *N. concolor* occasionally eats young bamboo shoots, berries and herbage from the ground (Yang & Xu, 1990).

Gibbons are mainly frugivorous (e.g. Leighton, 1987). This also appears to apply to Vietnamese crested gibbons. Dao Van Tien (1985) studied the content of the stomach of two *N. concolor*, three *N. leucogenys leucogenys* and one *N. l. siki*. He found 90-100% fruits, associated with some leaves and insects. The stomach content of *N. sp. cf. nasutus* on Hainan also appears to consist mainly of fruits (Xu *et al.*, 1983). These data cannot be directly compared to field observations, which usually measure the time spent eating various food items.

Short field studies on Chinese *N. concolor* and *N. leucogenys* report a lower intake of fruits and flowers for crested gibbons (Table 4.2) as compared to most other gibbon species except siamangs (e.g. as reviewed by Leighton, 1987), suggesting that crested gibbons may be less frugivorous. At least during the dry season, the most commonly eaten food items are leaf buds and shoots (61%; Lan, 1989a, 1989b, 1993).

During the rainy season (May-October), many fruits are available to *N. leucogenys* in Xishuangbanna (southern Yunnan, see Table 4.2). During this time, gibbons travel less, whereas in the dry season (November-April), the gibbons eat more leaves and travel for longer distances (Hu *et al.*, 1989). Similarly, *N. concolor* on Mt. Wuliang (central Yunnan) eat more fruit in the rainy season. During the dry season, on the other hand, they eat a higher percentage of leaves and spend more time foraging (Sheeran, 1993, 1995).

Table 4.2. Crested gibbon mean dietary proportions. The data lines for Xiaobahe do not distinguish between 'fruit' and 'flowers'. The value provided is actually from pooling these two dietary categories. Similarly, the same data lines also do not distinguish between 'leaves' and 'leaf buds/shoots' and present pooled values of those two categories instead.

Study Site	Dietary proportions (mean and range)						Source
	Fruit	Flowers	Leaves	Leaf buds/ shoots	Insects	Unknown	
<i>N. concolor</i>							
Ailao Mt., Yunnan province, China			54				Chen, 1995, cited in Sheeran <i>et al.</i> , 1998
Xiaobahe, Mt. Wuliang, Yunnan province, China	21	7	11	61	0	NA	Lan, 1989a, 1989b, 1993
Xiaobahe, Mt. Wuliang, Yunnan province, China		44		43	NA	13	Sheeran, 1993
Xiaobahe, Mt. Wuliang, Yunnan province, China	49.5		39.5		NA	11	Sheeran, 1995
<i>N. leucogenys</i>							
Mengla Nature Reserve, Xishuangbanna, Yunnan province, China	39	5	36	17	4	NA	Hu <i>et al.</i> , 1989

4.4 Songs

Gibbon song bouts are long, loud and relatively stereotyped. They are typically produced in the early morning and include sex and species specific characteristics (Geissmann, 1993, 1995b, 2000, in press a; Haimoff, 1984a; Marshall & Sugardjito, 1986). Gibbon songs are believed to serve a variety of functions, including defence of resources (e.g. territory, mate), mate attraction, strengthening of pair bonds and advertisement of pair bonds, and different functions may be exploited by either sex and by different gibbon species (e.g. Cowlshaw, 1992, 1996; Geissmann, 1999; Geissmann & Orgeldinger, 2000; Mitani, 1990; Raemaekers & Raemaekers, 1985).

Song bouts by mated pairs of the genus *Nomascus* typically are duet song bouts (as in *Bunopithecus* and *Symphalangus*). In contrast, mated pairs in all species of the genus *Hylobates* are known to produce male solo song bouts *and* duet song bouts (or male solo song bouts and female solo song bouts) (Geissmann, 1993, in press a). In crested gibbons, solo songs appear to be produced by non-mated individuals only, and are heard more frequently from males than from females (Geissmann, unpublished data).

As in most gibbon species, the song repertoire of adult crested gibbons is sexually dimorphic (Deputte, 1982; Geissmann, 1993, in press a; Goustard, 1984; Schilling, 1984). Whereas at least some notes of the song repertoire are produced by adult individuals of either sex in other gibbon species, the sexual dimorphism in the song repertoire in crested gibbons is complete. As a rule, adult crested gibbons produce sex-

4. Gibbon Ecology and Behaviour

specific song notes only, and exceptions are very rare (Geissmann own observation; Schilling, 1984). The majority of crested gibbon songs are started immediately after dawn (Geissmann own observation in north-western Laos, Yunnan province and Hainan, China). Songs may occur, at decreasing probability, later in the morning and are less common in the afternoon.

In all species of crested gibbons, songs usually have a duration of 10-13 minutes (Geissmann, own observation; Jiang & Wang, 1997; Lan, 1993; Sheeran, 1993; Sheeran *et al.*, 1988). In the Wuliang Mountains (Yunnan province, China), median song bout duration exhibited seasonal fluctuations, with longer song bouts (12.40 min) in the wet season and shorter song bouts (10.84 min) in the dry season (Sheeran, 1993; Sheeran *et al.*, 1988). In addition, gibbons in this area were singing more regularly during the wet season than during the dry season (i.e. on 63% vs. 51% of sampled days). The gibbons may have spent more energy on searching food and less energy on singing when the abundance of figs and other fruit dropped during the dry season (Sheeran *et al.*, 1988).

Because of the importance of vocal data for gibbon systematics, some structural and organisational features of song bouts are briefly described below. This will allow readers who are not familiar with gibbon songs to understand the species-specific song characteristics which are presented below (see section 6).

Adult females produce great call phrases only (Figure 5a), although many great calls may be aborted before completion. Each phrase begins with long notes of increasing frequency (*fa* notes). During each phrase, note durations and interval durations are continuously shortened and maximum frequencies are raised ("acceleration-type climax" after Geissmann, 1995b). In most crested gibbons, the accelerando-part of the great call consists of short barks (*fb*) which tail off into a twitter (*fc*) after the climax. Only in the Eastern black crested gibbon are vibrato-like notes produced instead of the *fb* and *fc* notes (see section 5.1).

Fully developed male song vocalisations typically consist of three different types of notes (*ma*, *mb*, *mc*) (Figure 5b). Boom notes (*ma*) are produced during inflation of the throat sac. Most males produce single booms only, but some individuals regularly utter several booms in a row. Booms are the deepest notes in the male repertoire (basal frequency below 0.8 kHz), and they are lacking in some species of crested gibbon (see section 5.1 and 5.4). Short "*aa*" notes (*mb*) are uttered in brief staccato-like phrases. The most prominent male song contributions, however, are the multi-modulated phrases (*mc*; termed multi-modulated figure by Haimoff, 1984b). They consist of a series of highly frequency modulated notes. Adult males also produce a multi-modulated phrase ("coda") at or immediately after the climax of the female great call phrase (Figure 5a). During a fully developed and undisturbed male song, the singer continues to cycle through the three types of vocalisations: boom, staccato phrase, multi-modulated phrase, and so on in this order.

Male phrases uttered at the beginning of a song bout consist of long, hardly modulated precursors of the multi-modulated phrases. Only gradually, the phrases become more modulated, and booms and staccato phrases are added to the song. The gradual building-up of male phrases – until fully developed phrases are attained – occurs in all crested gibbons and also in other gibbon species (T. Geissmann, own observation). In crested gibbons, it has been described in more detail for *N. leucogenys* (Deputte, 1982; Goustard, 1984; Schilling, 1984), *N. gabriellae* (Goustard, 1976) and for *N. concolor* (Haimoff, 1984b: mistakenly identified as "Hainan black gibbon").

In immature crested gibbons, the situation is different. Their song contributions consist of short, great call-like phrases (Figure 5c), which are produced in synchrony with the great calls of their mother (or with those of other gibbons nearby). This was heard in several immature males and females of *N. leucogenys* and *N. gabriellae* (own observation), and probably occurs in all species of crested gibbons (*Nomascus*). One of us (TG) also observed immature males producing great call phrases in several species of the *lar* group (*Hylobates* spp.) and in the siamang (*Symphalangus syndactylus*), but it may be more common or more conspicuous in crested gibbons.

The great calls of maturing females become gradually more similar to those of adult females (Merker & Cox, 1999). Males of these species, however, change from female to male repertoire at some time during their development. This event may be related to attainment of sexual maturity (Geissmann, 1993, p. 51f), but there is not much reliable information on the age at which males begin to switch their repertoire or how long this process takes (Geissmann, 1993).

Representative sonagrams of male phrases and great call sequences of all crested gibbon species are provided below (see section 5). These vocalisations have been recorded from captive and wild specimens by the present author. Species specific song characteristics appear to be largely inherited (Brockelman & Schilling, 1984; Geissmann, 1984, 1993, 2000; Tenaza, 1985; Marshall & Sugardjito, 1986), and gibbon song bouts in the wild are virtually identical to those recorded from captive gibbons (T. Geissmann, own observations).

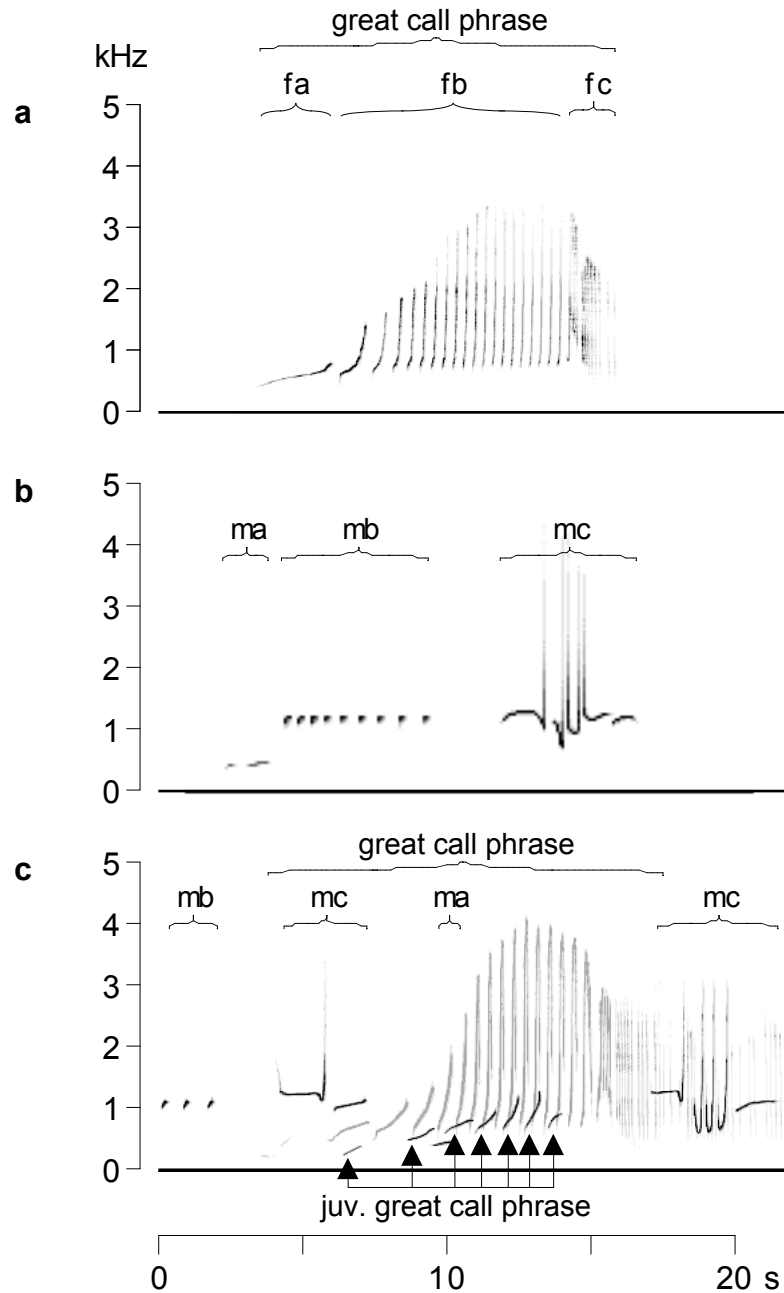


Fig. 5. Sonograms (fundamental frequencies only) showing sexual dimorphism in typical song phrases of the Northern white-cheeked crested gibbon (*Nomascus leucogenys leucogenys*): a. great call phrase of an adult female (Eberswalde Zoo, Germany, 11 July 1988). The great call begins with *uuu* notes (*fa*), followed by barking notes (*fb*), and ends with twitter notes (*fc*); b. phrases of an adult male (Ménagerie du Jardin des Plantes, Paris, 17 May 1988). This sequence begins with booms (*ma*), followed by staccato notes (*mb*) and ends with a multi-modulated phrase (*mc*); c. trio song of an adult pair and their juvenile son (Hannover Zoo, Germany, April 1999, juvenile born on 23 Dec. 1995). The female sings a great call into the phrases of her mate, who pauses his song after a boom note (*ma*), and adds a multi-modulated phrase (*mc*) to the end of the female's great call. During her great call, the female is accompanied with a short, great call-like phrase by her juvenile son. In order to facilitate "reading" of this sonagram, the female contributions are artificially lightened and the juvenile phrase is darkened.

5. GIBBON SPECIES DESCRIPTIONS

5.1 Eastern black crested gibbon (*Nomascus* sp. cf. *nasutus*)

Adult males are almost completely black. A brownish tinge may occur on the chest and frontal areas (only seen in males of the mainland population). Adult females (both from the mainland and from Hainan) are pale yellow, yellow, orange or beige brown and have a black cap. Only one specimen from Hainan was of light grey brown colour with only a trace of the cap (BM(NH) 1907.12.1.1, see also Pocock, 1905). The fur on the chest and belly is as light as the back, but often thinner.

Only one female (ZMB 70036) had dark brown fur on the chest. This gibbon lived the Berlin Tierpark for many years and differed from other crested gibbons in several characteristics of its fur colouration, as described in Geissmann (1989). The black cap of this female is very big and broad, reaching down between the shoulder blades on the back. The cap is also in direct contact with the dark facial area (in other crested gibbons, there is usually at least a trace of light fur separating the cap from the face). This female has no denticle of light fur reaching from the cheeks towards the nose, whereas this characteristic appears to occur in all other crested gibbons. In addition, this female has a naked glabella. This characteristic was clearly visible in the living animal. It was also observed in some museum specimens from Hainan and north-eastern Vietnam, but its significance is unclear, because the circumfacial area is often poorly preserved in museum specimens and little hairless spots may also occur as artefacts.

Fully developed male vocalisations consist of staccato phrases and multi-modulated phrases. Booms produced during inflation of throat sac appear to be absent. The multi-modulated figure is much more simple than in other crested gibbons: All notes are of ascending frequency only; no rapid down-and-up sweeps in frequency modulation occur (in contrast to all other crested gibbons) (Figure 6a).

Complete great call phrases of adult females consist of a series of 5-10 notes. All great call notes except the first two consist of very rapid vibrato sounds. These notes somewhat resemble the twitter-like vocalisations which follow at the end of the great call in other crested gibbons. The vibrato-like quality of the great call of this species has already been mentioned in the song description of a female from Hainan by Pocock (1905). All fundamental frequencies are below 2.5 kHz, whereas in other crested gibbons, great call frequencies typically go up to above 3 kHz. Adult males produce a multi-modulated phrase ("coda") at or immediately after the climax of the great call (Figure 6b).

The songs of *N. sp. cf. nasutus* are known only from Hainan (three groups) and from the solitary female from the Berlin Tierpark (the latter producing great calls which are largely identical to those from Hainan). No tape-recordings are available from a reliably known locality from the mainland where the species is critically endangered.

Presumably, three different subspecies should be recognised, which differ from each other in fur colouration: One on Hainan and two on the mainland east of the Red River. One of the mainland subspecies is very similar to the island form and is represented in several museum specimens in Vietnamese collections. The other is much more distinct in colouration but, so far, is known only from the single specimen

from the Berlin Tierpark (Geissmann, 1989). This female was reported to originate from the "hinterland" of Hon Gai (north-eastern Vietnam) and was shipped to the Berlin Tierpark in 1962 (Fischer 1965, 1980). The place of origin is neither very accurate nor very reliable. The female must have originated from the mainland, probably north-eastern Vietnam. Hon Gai, however, is a very industrial city and may just be the place where the female was bought in the animal market. In all probability, the area around Hon Gai was already deforested in 1962.

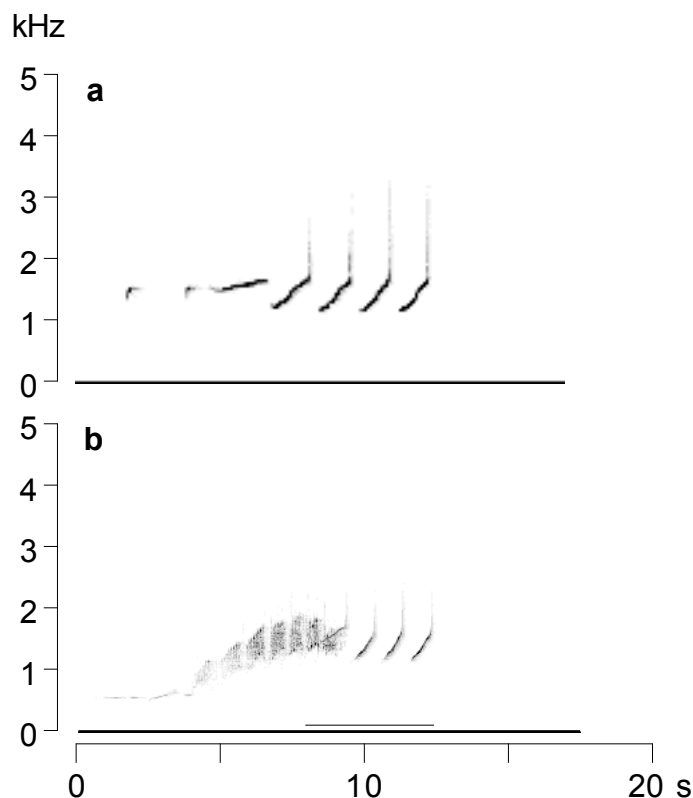


Fig. 6. Sonograms of song phrases of *N. sp. cf. nasutus*: a. male short phrases (Bawangling Nature Reserve, Hainan, China, 21 Oct. 1993); b. great call sequence consisting of female great call with male contribution (underlined) (Bawangling Nature Reserve, Hainan).

5.2 Western black crested gibbon (*Nomascus concolor*)

Adult males are completely black. A few single white hairs may occur in the corner of the mouth.

Adult females are pale yellow, yellow, orange or beige brown. Adult females have a black cap and a large, often rhomboid area with black hairs on the ventral area. The amount of ventral black varies. 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.

A geographically isolated population of black crested gibbons from Bokeo province (north-western Laos) has been described as a separate subspecies, *N. c. lu* (Delacour, 1951). In addition, Ma and Wang (1986) described the subspecies *N. concolor fuvogaster* and *N. c. jingdongensis* from western and central Yunnan province

5. Gibbon Species Descriptions

(China), respectively. Having examined all known museum specimens of these three forms, one of us (TG) failed to find consistent differences between any of these taxa and *N. concolor concolor*. Darker fur colouration which was originally considered to be distinctive for females of *lu* and *furvogaster* turned out to be based on inclusion of subadult females which have not completely finished their colour change. Fully adult females do not exhibit these characteristics. Males of *N. c. lu* have also been reported to exhibit a silvery-black line between eye and ear (Delacour, 1951). This characteristic does not occur in all specimens of *N. c. lu*, and, moreover, also occurs in other crested gibbons. This characteristic does not appear to be of diagnostic value for identification of this taxon (Geissmann, 1989). As a result, each *N. c. lu*, *N. c. furvogaster* and *N. c. jingdongensis* may be synonymous with *N. c. concolor*.

Fully developed male song vocalisations of *N. concolor* consist of all three different types of notes described above: single booms produced during inflation of throat sac, staccato phrases, and multi-modulated phrases. The first note of the multi-modulated phrase is of ascending frequency only; rapid changes of frequency modulation occur on the second and sometimes on the third note of the phrase (Figure 7a).

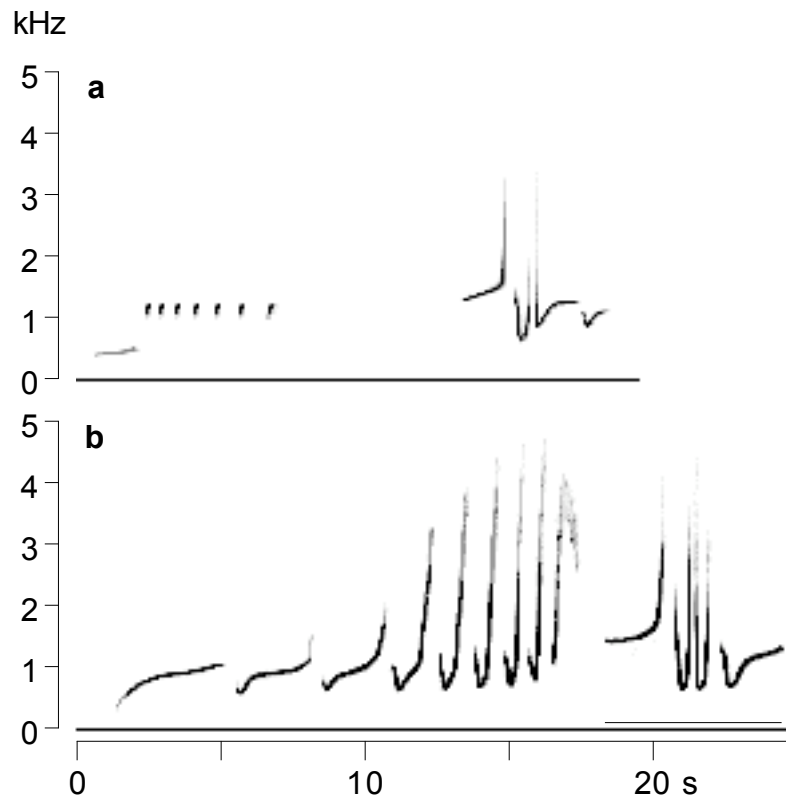


Fig. 7. Sonograms of song phrases of *N. concolor*: a. male short phrases (Gejiu Zoo, China, 2 Aug. 1990); b. great call sequence consisting of female great call with male contribution (underlined) (Xujiaba, Ailao Mountains, China, 1 Aug. 1990).

Complete great call phrases of adult females consist of a series of 5-10 notes. Great call notes during the climax begin with descending frequency before increasing (unlike those of other crested gibbons). Climax notes have twitter-like endings (very rapid frequency fluctuations). Purely twitter-like vocalisations follow at the end of the great call. Adult males produce a multi-modulated phrase ("coda") at or immediately after the climax of the great call (Figure 7b).

5.3 White-cheeked crested gibbon (*Nomascus leucogenys*)

Males are black with a white cheek beard. The beard is rarely pale yellow (seen in some juvenile animals). The beard is not "brushed" outwards (as compared to *N. gabriellae*). The fur on chest is black (as compared to *N. gabriellae*). In the subspecies *N. l. siki*, the cheek patches are reduced in size, but (unlike *N. gabriellae*) the part above the mouth is still larger than the part below. Also in *N. l. siki*, the light fur of the cheek patches surrounds the corners of the mouth like a bracket (this is not seen in *N. l. leucogenys*, but also occurs in *N. gabriellae*).

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 (as compared to *N. gabriellae*). No consistent fur colouration differences are known between adult females of *N. l. leucogenys* and *N. l. siki*.

Fully developed male vocalisations consist of same three different types of notes, uttered in the same succession as in *N. concolor*: booms produced during inflation of throat sac, staccato phrases, and multi-modulated phrases. Booms may in some individuals be produced in short series of up to four notes (rare). The first note of the multi-modulated figure has a long section of relatively stable frequency at the beginning with a rapid down-up-sweep ("hook") at the end. Rapid and repeated changes of frequency modulation occur on the second and often on the third note (Figure 8a).

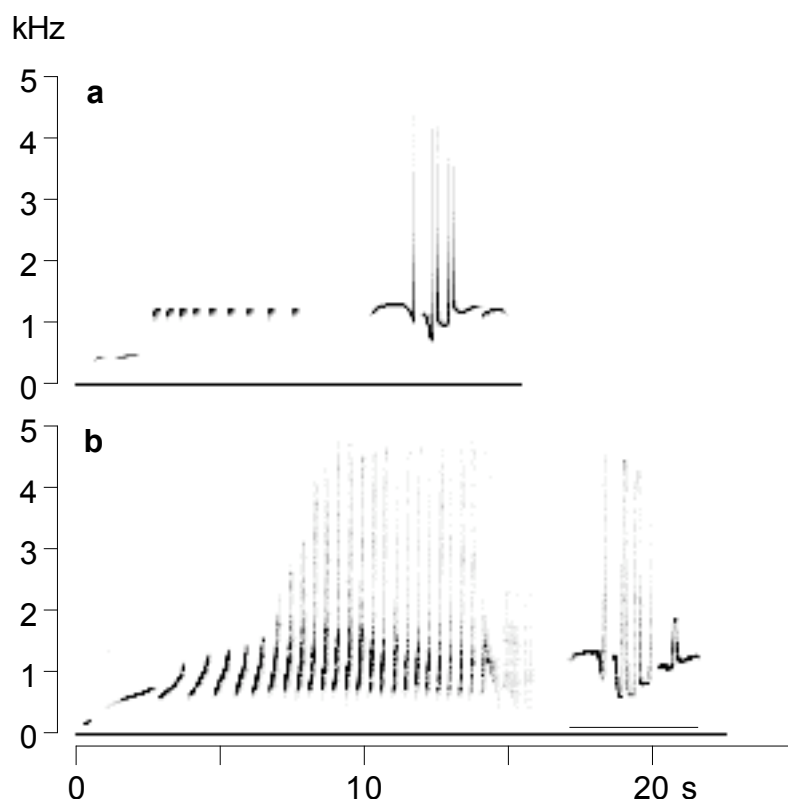


Fig. 8. Sonograms of song phrases of *N. leucogenys leucogenys*: a. male short phrases (Paris, Ménagerie, France, 17 May 1988); b. great call sequence consisting of female great call with male contribution (underlined) (Paris, Ménagerie, France, 17 May 1988).

Complete great call phrases of adult females are similar to those of *N. concolor*, but usually faster and with more notes; usually 8-18 in *N. l. siki*, about 15-30 (up to 39) in *N. l. leucogenys*. Notes begin with ascending frequency. Adult males produce a multi-modulated phrase ("coda") at or immediately after the climax of the great call (Figure 8b).

Based on the tape-recorded song material available at present, no characteristics which reliably differentiate between *siki* and *leucogenys* were found, only some trends of unknown significance (Geissmann, unpublished data). As mentioned above, great calls of *siki* tend to be shorter than those of *leucogenys*. Some, but not all, *siki* males produce repeated changes of frequency modulations only in the third note of the multi-modulated phrase, even during long song bouts and even after the great call of their mates. As a rule, *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.

5.4 Yellow-cheeked crested gibbon (*Nomascus gabriellae*)

Males are black with a light cheek beard. The beard is pale yellow, apricot or orange, not pure white. Compared to *N. leucogenys*, 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. l. siki*). Unlike other crested gibbons, 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 (as compared to *N. leucogenys*).

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. This characteristic was not observed to occur in *N. leucogenys* and (apart from vocalisations) appears to be the most reliable external difference between females of *N. gabriellae* and females of other crested gibbons.

Fully developed male vocalisations consist of a series of staccato phrases and multi-modulated phrases. Booms produced during inflation of the throat sac appear to be absent. 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 figure begins with a long section of descending frequency. Rapid changes of frequency modulation occur on the second note only (Figure 9a); in other crested gibbons, they may also occur on the third note. In *N. gabriellae*, these repeated down-and-up sweeps in frequency are extremely fast and resemble a trill; in all other crested gibbons, these frequency modulations are much slower.

Female great calls are similar to those of *N. concolor* and usually consist of about 5-13 notes, but each note begins with ascending frequency. Notes appear to begin at higher frequency than both *N. concolor* and *N. l. leucogenys* (although this remains to be quantified). Adult males produce a multi-modulated phrase ("coda") at or immediately after the climax of the great call (Figure 9b).

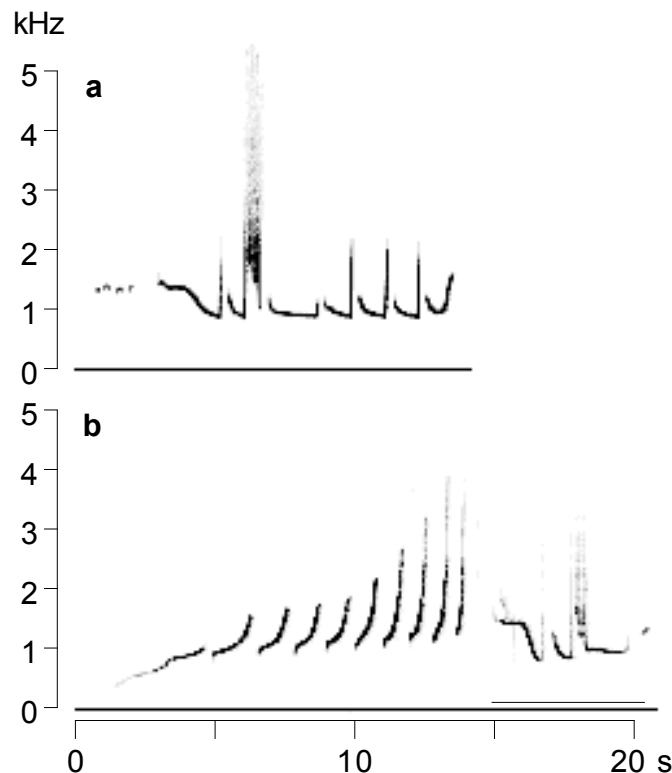


Fig. 9. Sonograms of song phrases of *N. gabriellae*: a. male short phrases (La Flèche Zoo, France, 29 May 1988); b. great call sequence consisting of female great call with male contribution (underlined) (Mulhouse Zoo, France, 13 Sept. 1988).

5.5 What goes on between *siki* and *gabriellae*?

Observations on captive gibbons

One male of the five adult and unrelated captive *siki* males of this study produced a slow frequency decrease on the first note, resembling *N. gabriellae* in this respect, but otherwise conformed with the songs of other *siki* (and *leucogenys*) males. Because of the small size of the *siki* sample, the relevance of this observation is difficult to evaluate. Are there two different song types and, thus, two populations of *N. leucogenys siki*, or is the second song type evidence for intergradation between *siki* and *gabriellae*, even though the karyotype of this individual was typical of *siki* (the same individual was used for the karyotype shown in Figure 2 of Couturier & Lernould, 1991)?

A few wild caught zoo specimens were identified as natural hybrids between *N. gabriellae* and *N. leucogenys*, based on their karyotype (Lernould, pers. comm.). The very short song fragment which is available from one of them (a male) sounds more like *N. gabriellae*, and the animal clearly looks like *N. gabriellae*.

Several other wild caught crested gibbons, which also look exactly like *N. gabriellae*, had a karyotype corresponding to that described for *N. leucogenys siki* (Lernould, pers. comm.). Tape-recordings which are available of two of these animals (females) both correspond to this species' phenotype (i.e. *N. gabriellae* great calls).

5. Gibbon Species Descriptions

Three infant/juvenile crested gibbons which had been confiscated at Hong Kong arrived at the Mulhouse Zoo in 1993 and were initially kept together in one cage. All three were easily identified as *N. gabriellae* based on their fur colouration. After learning that one of them had a *siki* karyotype, one of us (TG) carefully examined them in order to find out whether it was possible to identify the "outlier" without knowing which one it was. The experiment failed. The gibbon which looked least like *gabriellae* (because the cheeks were almost white) turned out to be a "true" *N. gabriellae*, while the animal with the most distinct *gabriellae* features turned out to have the *siki* karyotype.

Interestingly, no zoo animals have been discovered so far, which combine a *siki* phenotype with either a *gabriellae* song or a *gabriellae* karyotype, or a *siki* song with either a *gabriellae* phenotype or a *gabriellae* karyotype. Wild caught gibbons which look like *gabriellae* appear to sing like *gabriellae*, but the current sample size is too small to draw reliable conclusions.

Captive bred F1 hybrids (one female, two males) between *N. gabriellae* and *N. leucogenys siki* more resemble the *gabriellae* phenotype: They exhibit cheek patches which are brushed out like fans lateral to the corners of the mouth. The cheek patches of the males are yellow, not white. Unlike typical *N. gabriellae*, however, both males had a black chest (no brown). The male hybrids produce a mixture of elements in their song bouts, including a long down sweep on the first note of the multi-modulated phrases (like *N. gabriellae*), more than two up-down frequency jumps on the second note (like *N. gabriellae*), up-down frequency jumps also occurring on the third note (like *N. leucogenys*), the presence of boom notes (like *N. leucogenys*), and staccato phrases are uttered very softly (like *N. gabriellae*).

Field data

A contact zone of unknown extent, possibly with some hybridisation, may occur between the respective distribution areas of *N. gabriellae* and *N. leucogenys siki* in southern Vietnam and Laos (see Figure 3), but not much data from that zone is available. According to Delacour (1951) and Groves (1972, in press), intergrades between *gabriellae* and *siki* occur in Saravane and Savannaket (Laos). During the present study, only two specimens from Savannaket were located (BM(NH) 1926.10.4.3 and 1933.4.1.6), and only the latter specimen is in the diagnostic black coat. It looks like *siki*, but with slightly yellowish cheek patches. Because this is a juvenile specimen, the importance of a slight yellowish tinge in the cheek patches is difficult to assess. It may regularly occur in juvenile *N. leucogenys* and may not necessarily identify an intergrade. One of us (TG) observed this feature in several reliably identified juvenile captive *N. l. leucogenys*, who differed in this characteristic from their father (observations at Hannover Zoo, Germany, Bronx Zoo, N.Y., and Washington Zoo, DC, U.S.A.).

Gibbon songs from southernmost Laos (Xe Pian and Xe Kaman Dam site NE of Xe Pian) differ from either *siki* or *gabriellae*, and may represent intermediates between the two taxa. Gibbon song excerpts from the Bolavens Plateau (Dong Hua Sao, southern Laos, NE of Xe Pian) and especially from Bach Ma (central Vietnam) sound somewhat more like *siki*. Museum specimens from the Bolavens Plateau (e.g. AMNH), however, clearly look like *gabriellae*. At least one specimen from the vicinity of Bach Ma (Thua Luu, S. of Hue) looks like *siki* and actually is the holotype of *Hylobates concolor siki* (BM(NH) ZD.1933.4.1.6[a]), whereas another specimen from the same locality clearly is of the *gabriellae* phenotype (NRM 8747). The

occurrence of two different phenotypes at the type locality appears to make the type specimen a less than ideal choice, especially if it should turn out that the name "*siki*" describes a hybrid.

What does it all mean?

The easiest interpretation of these preliminary data on the "gibbons between *siki* and *gabriellae*" probably is to postulate a broad intergrade zone in which one species gradually replaces the other. The possibility should not be ruled out, however, that previously unrecognised taxa may occur in this large area. This second interpretation would be supported if it could be demonstrated that (1) songs of several individuals in a particular area follow the same pattern, and that (2) songs do not exhibit a clinal change from the typical *gabriellae* to the typical *siki* pattern as one moves from the *gabriellae* area in the south to the *siki* area in the north, but that the cline is interrupted over larger areas in which song patterns remain stable.

6. CRESTED GIBBON RECORDS IN VIETNAM

6.1 Eastern black crested gibbon (*Nomascus* sp. cf. *nasutus*)

The localities discussed in this section are mapped on Plate 1.

Than Xa Forest, Vo Nhai district (THAI NGUYEN)

Special-use forest: None

Gibbon status: Provisional occurrence, last report in 1997 (Geissmann & Vu Ngoc Thanh, in press)

(see Appendix 2, Locality 2)

This locality was first reported by Le Xuan Canh and Pham Nhat (1997) based on interviews. In order to confirm this information, a survey was carried out by Geissmann and Vu Ngoc Thanh in March, 1998 (Geissmann & Vu Ngoc Thanh, in press). They obtained only one first hand report of a sighting by a local hunter in 1997. No gibbons were sighted or heard during the survey. One interviewee partner suggested that gibbons no longer occur in this forest. It is possible, however, that a few individuals remain.

Kim Hy Forest, Na Ri and Bach Thong districts (BAC KAN)

Special-use forest: None

Gibbon status: Provisional occurrence, last report in 2000 (Ngo Van Tri & Lormée, 2000)

(see Kim Hy forest data sheet, in: *Vietnam Primate Conservation Status Review 2000, Part II: Leaf Monkeys*)

A first record from this area was given by Dao Van Tien (1983), who mentioned two gibbon skins which were collected in the district (ZMVNU 154 and 155). These specimens were not found in the ZMVNU collection during two visits by one of us (TG) in 1993 and 1998. Dao Van Tien gave the coordinates as 22°02'N / 106°03'E. We suppose that these animals were collected in Kim Hy commune in 1966, based on an interview with an old hunter who remembered having shot two individuals for Dao Van Tien when he visited the commune (Geissmann, unpublished data).

Le Xuan Canh and Pham Nhat (1997) reported that all-black crested gibbons still occurred in the forest near Kim Hy commune in 1993. A short survey was conducted in this forest in March 1998 with the special objective of finding the gibbons (Geissmann & Vu Ngoc Thanh, in press). Although most of the interviewed people recognised gibbons, descriptions were not always reliable. Geissmann and Vu Ngoc Thanh obtained three first hand records of sightings in 1997 and 1998, but no gibbons were sighted or heard during 7 days in the forest. After the survey, the authors were also told by the head of Kim Hy forest protection station that a hunter from An Tinh commune had shot a gibbon only one day prior to the survey. However, due to lack of time, it was impossible to visit An Tinh.

Tordoff *et al.* (2000c) visited Kim Hy commune for two days in November 1999. They could not collect any first-hand information more recent than 10 years ago. They were also told that a hunter from An Tinh hamlet had hunted a gibbon. However, the date given was October 1999.

FFI carried out a short field survey of 10 days in January 2000 followed by three weeks of field work in this area in March 2000. Every hamlet surrounding the forest was visited, and a representative number of interviews with hunters were conducted in each hamlet. Due to bad weather conditions, only a total of eight days were spent surveying the limestone forest.

According to informants, wildlife has been pushed far to the south as a result of disturbance by gold mining activities and intensive hunting. Of twelve interviewed hunters, only one correctly described the song and the fur colouration of female gibbons. One hunter claimed that he shot a female in 1999, but after testing his description of the gibbon, this information was classified as unreliable. In the gold-mining hamlet of Nam Djai, about two-hours walk from Kim Hy, nobody knew of gibbons remaining in the surrounding forested area, although some hunters were able to describe the species correctly.

FFI teams (Phung Van Khoa & Lormée) carried out at least 15 interviews with local hunters in An Tinh commune and surrounding hamlets in January 2000, and Ngo Van Tri and Lormée conducted 6 days of field surveys in this forest section in March 2000. Nobody knew of a gibbon that was shot recently by any hunter from the commune. No hunter interviewed had seen or heard gibbons during the last five years, whereas François's langur (*Trachypitecus francoisi*), although considered rare, were sighted, heard and hunted. While the field survey was able to confirm the presence of leaf monkeys (scats in a sleeping cave), no evidence of gibbons was found, despite transect walks using playbacks of gibbons (*N. leucogenys*) recorded at the EPRC.

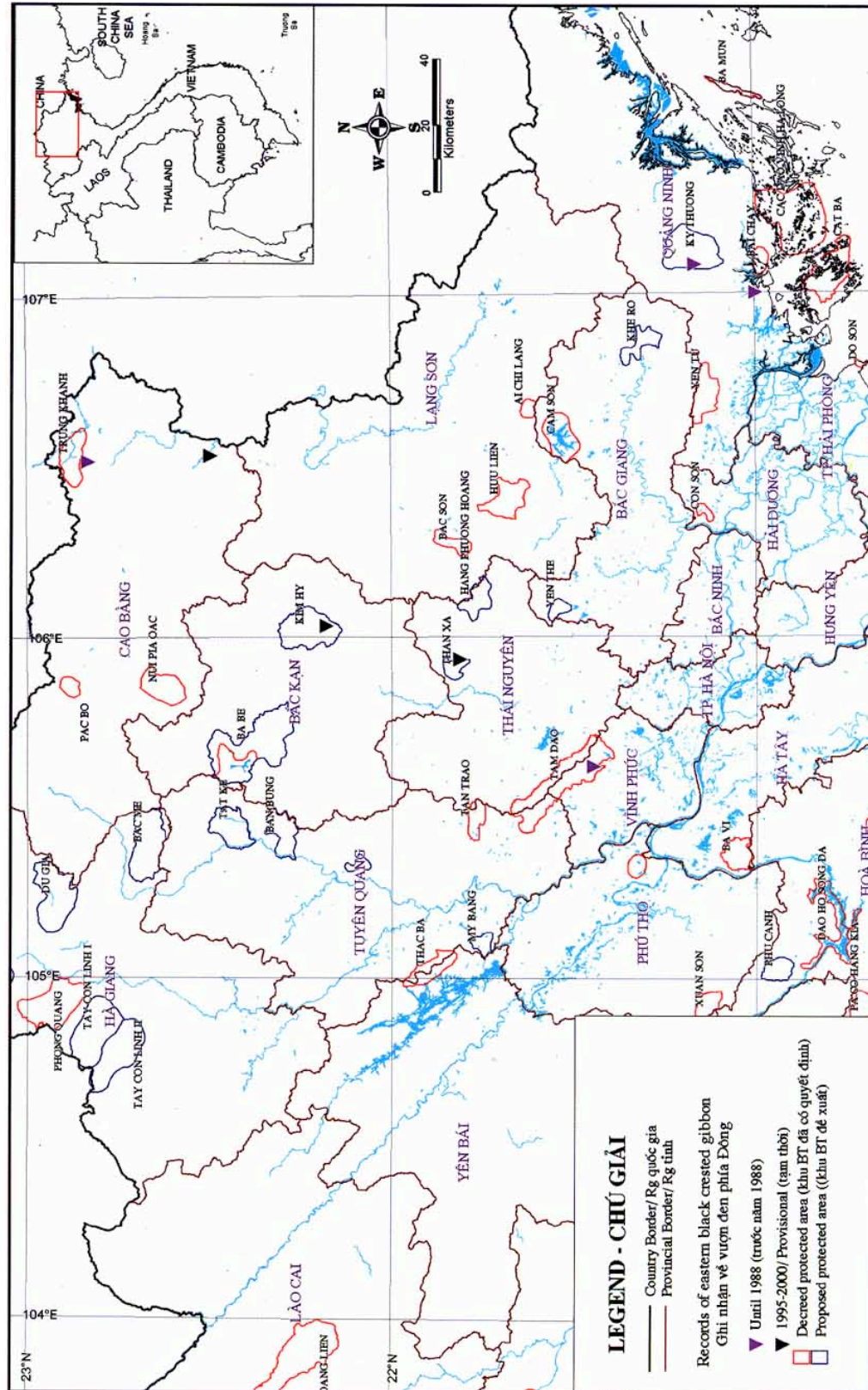
In Cao Son commune, logging and hunting are much more intensive than elsewhere in Na Ri district. Although most of the people were able to describe gibbons, everybody suggested that gibbons no longer occur in the commune's forests.

The only information that appears to support the continued presence of gibbons in the forest of Kim Hy was collected in the hamlets of Coc Keng and Coc Xa (Con Minh commune). The illegal logging impact is relatively low in this area, but, as in all localities visited, gun shots were heard regularly. Two hunters claimed to have heard gibbon songs during the previous year (1999) and were able to provide a good description of the gibbons and their song. According to them, it is possible to hear the gibbons only very rarely, on very sunny mornings between April and July. One hunter of Coc Keng suggested that only three to four animals remain in the forests of Kim Hy, in a valley (locally called "monkey valley" = Thung Khi) situated three-hours walk from Coc Keng hamlet, between Kim Hy and An Tinh communes.

Much of the contradictory information obtained from various interviewees can be attributed to their confusion of Eastern black crested gibbon with François's langur.

Every reliable description reveals that the adult female fur colouration is yellow without black on the ventral area, like museum specimens from north-eastern Vietnam (Geissmann, unpublished data). No information was collected which could provide insight into the distribution area of gibbons represented by the single female from the Berlin Tierpark whose reported provenance was the "hinterland of Hon Gai" (Geissmann, 1989).


 SOUTH CHINA SEA
 Tsung
 55



Thang Hen Forest, Tra Linh district (CAO BANG)**Special-use forest:** None**Gibbon status:** Provisional occurrence, last report in 1999 (Tordoff *et al.*, 2000c)
(see Appendix 2, Locality 1)

A recent short visit by a BirdLife and FIPI team reported the presence of all-black crested gibbons in this area, based on a few interviews. One local hunter claimed that he saw four individuals in May or June 1999 (Tordoff *et al.*, 2000c). However, the report concludes that, considering the limited size of the forest (less than 1,000 ha), continuous forest degradation by logging and fuelwood extraction, and high hunting pressure and agricultural encroachment, this remnant population, if it still exists, has no chance of survival.

Locations where Eastern black crested gibbon was previously recorded and is now believed to be extinct**Quang Ninh province (Ha Long area, Ky Thuong proposed nature reserve)**

Ha Long ("Along Bay") is the reported locality of the first description of "*Hylobates nasutus*" by Kunckel d'Herculais (1884), based on a juvenile male collected by Dr Harmand. The type specimen apparently no longer exists.

Two adult gibbon skulls (ZMVNU 160 and 161) were reportedly collected on Van Hai Island in December 1961 by Thanh, Khoi and Cong (Dao Van Tien, 1983). Van Hai is a small island in the Ha Long Bay area. It is considered a questionable locality record, as discussed above (see section 3.2). A infant female (ZMB 70036), caught in September 1962, reportedly came from the "hinterland" of Hong Gai, Ha Long commune (Fischer, 1980). Because this specimen was bought in Hanoi, its provenance cannot be reliably established. For many years, this female (named "Patzi", Fischer, 1965, 1980, 1981) was kept in the Berlin Tierpark (Germany), where she died in 1986 (Geissmann, 1989).

The investment plan for Ky Thuong proposed Nature Reserve (Hoanh Bo district) prepared by FIPI (Anon., 1993b) listed gibbons as 'rare'. The occurrence of gibbons could not be confirmed during a recent field survey by BirdLife and FIPI in November 1999 (Tordoff *et al.*, 2000c). No local interviewee reliably confirmed a historic or current occurrence of gibbons in this area.

With the industrial development of the Hai Phong area and Quang Ninh coastal zone, almost all coastal and island forests were destroyed after the Vietnam War. The only significant forest remains on Cat Ba island and in Ky Thuong, where no gibbons are known to occur. It appears that gibbons are extinct in the area of Ha Long and Hai Phong.

Tam Dao National Park (VINH PHUC, THAI NGUYEN and TUYEN QUANG)

One gibbon skin and one skull (ZMVNU 149 and 157) were collected in Tam Dao in January 1961. Fischer (1965) reported hearing several gibbon groups in Tam Dao. Tam Dao National Park is a famous tourist destination and the forest has been the subject of many scientific surveys. There are no further records of gibbons from this place and they can be regarded as extinct there (Pham Nhat *et al.*, 1998).

Trung Khanh Nature Reserve, Trung Khanh district (CAO BANG)

Several gibbons (IEBR 48, 50 and 51) were collected in Kham Thanh hamlet in June 1965 (Dao Van Tien, 1985). In 1986, Trung Khanh was decreed a nature reserve, but the boundaries of the reserve were never demarcated. During a short field survey, a BirdLife and FIPI team found that the natural habitat in Trung Khanh was already significantly degraded by forest clearance and subjected to heavy hunting. According to the survey results, the only remaining significant natural vegetation is situated in the south of Chi Vien and Dam Thuy communes. This remaining forest covers only 846 ha. It is fragmented into four patches and appears too small to support a viable population of gibbons or other larger mammals. Based on interviews with local people, gibbons no longer occur in the area (Tordoff *et al.*, 2000c).

Locations where Eastern black crested gibbon was reported by local people to be extinct (previously unrecorded in scientific literature)

Ba Be National Park, Ba Be district (BAC KAN) ca. 22°25'N / 105°35'E

(see Appendix 2, Locality 3)

An individual gibbon was reported to have been observed by a Frontier team near the lake shore of Ba Be in 1994 (Kemp *et al.*, 1994). However, the species was not reported during the FIPI/IEBR survey in 1990, neither is it mentioned in the second Frontier survey in 1996 (Hill *et al.*, 1996a). As a result of primate surveys in northern Vietnam, Ratajszczak *et al.* (1990) concluded that the species certainly does not occur in the area. According to Nong The Dien (pers. comm. 2000), Vice-director of the national park, the last sighting of a gibbon in the Ba Be area was made before 1982, in the region of Dong Puong.

Huu Lien Nature Reserve (LANG SON) ca. 21°35'N / 106°25'E

Gibbons were recorded on the basis of interviews during a survey conducted by IEHR in 1999. Frontier also recorded the same information in May 2000. However, given the high levels of forest disturbance and human pressure in the area, it is doubtful whether Huu Lien still supports a significant population of gibbons (T. Osborn, pers. comm. 2000).

Cho Don district (BAC KAN) ca. 22°10'N / 105°36'E

No records were reported during the last 10 years (Phung Van Khoa & Lormée, 2000, interviews conducted in 1999).

Nui Pia Oac Nature Reserve, Nguyen Binh district (CAO BANG) ca. 22°35'N / 105°53'E

A rapid field survey of this locality was carried out in November 1999 by a BirdLife and FIPI team, but did not record the presence of Eastern black crested gibbons. Although this area was likely to be in the historical range of this species, it can be safely assumed that the species is now extinct in this area (Tordoff *et al.*, 2000c).

Nui Con Voi, Van Yen district (YEN BAI) ca. 22°04'N / 104°30'E

There was no evidence of gibbons during the last ten years. (Nguyen Xuan Dang & Lormée, 1999, interviews conducted in 1999).

Discussed records

Tay Con Linh I proposed nature reserve (HA GIANG) ca. 22°50'N / 104°45'E

Gibbons are reported in the investment plan for Tay Con Linh I proposed nature reserve, Ha Giang province (Anon., 1994b). However, no references are given.

6.2 Western black crested gibbon (*Nomascus concolor*)

The localities discussed in this section are mapped on Plate 2.

Hoang Lien Nature Reserve and vicinity, Sa Pa and Than Uyen districts (LAO CAI)

Special-use forest: In part nature reserve

Gibbon status: Provisional occurrence, last report in 1997 (Tordoff *et al.*, 1999)
(see Appendix 2, Locality 3)

In the period from November 1929 to February 1930, eight gibbons were collected by Delacour and Lowe from the vicinity of Sa Pa (Osgood, 1932, only six of them could be located for this study and are preserved at BM(NH) and FMNH). Six additional specimens were collected at Sa Pa between December 1938 and February 1939 by Björkegren (preserved at MCZ and NRM).

Nomascus concolor was recorded based on interviews during a survey carried out by a Frontier team between April and June 1994, but no further details were given (Ghazoul & Le Mong Chan, 1994).

The continued occurrence of *N. concolor* in this area was supported by several interviews carried out by a Frontier-Vietnam team between October 1997 and September 1998. In addition, this team observed one male skin in a hunter's house in Seo Mi Ti village, Ta Van commune. Despite one year of surveys, the Frontier-Vietnam survey teams did not see or hear any gibbons. Interviews with hunters suggest that gibbons are very rare, occurring only in the remotest parts of the reserve, and that they may be more common in the south-western side of the Hoang Lien mountain range in Than Uyen district, which is no longer included in the protected area. According to this report, it is unlikely that Hoang Lien Nature Reserve supports a viable population of gibbons (Tordoff *et al.*, 1999).

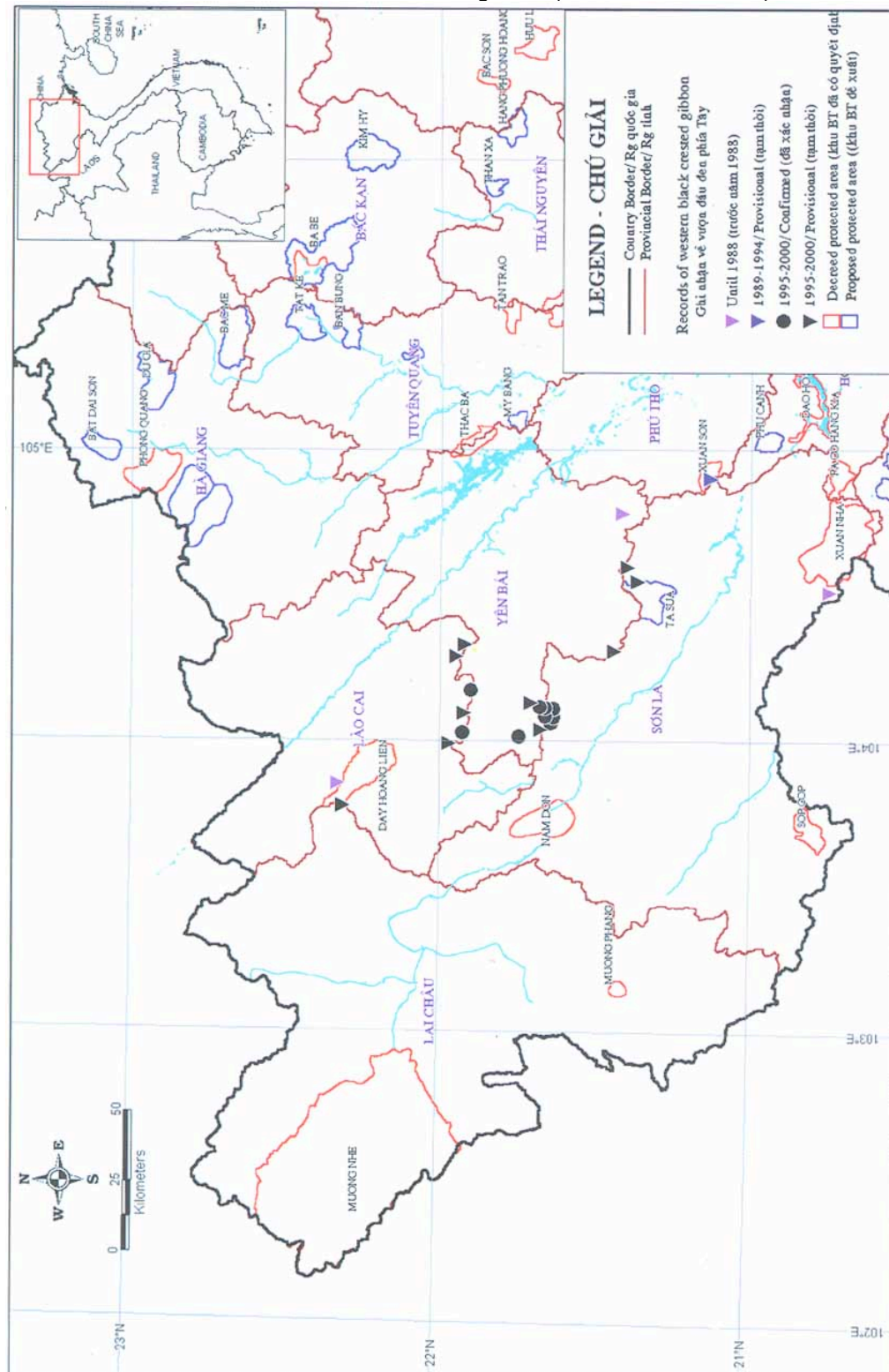
A reserve extension to include the continuous forest to the south (in Van Ban district) and south-west (Than Uyen district) may protect a larger population of gibbons than the current shape of the protected area, more than 50% of which comprises agricultural land, grassland and scrub. Additional surveys are necessary to assess the status of gibbons in the Hoang Lien mountain range.

Long Sap, Moc Chau district (SON LA)

Special-use forest: None

Gibbon status: Unknown, last report in 1963 (museum specimen)

Three gibbons (mounted specimens IEBR 364/185, 365/186 and unnumbered infant) were collected at this locality in November 1963 (Dao Van Tien, 1983, 1985). This is the only reliably confirmed Vietnamese locality of *N. concolor* west of the Black River. However, it seems odd to find this species west of the Black River in just one locality, whereas only *N. leucogenys* appears to occur in other localities west of the Black River. There has been no further information on gibbons from this area.

Plate 2. Distribution of Western black crested gibbon (*Nomascus concolor*) in Vietnam.

6. Crested Gibbon Records in Vietnam

Xuan Son Nature Reserve, Thanh Son district (PHU THO)

Special-use forest: Nature Reserve

Gibbon status: Provisional occurrence, last report in 1999 (Nguyen Xuan Dang & Lormée, 1999)

(see Appendix 2, Locality 4)

Nomascus concolor was reported to occur in the nature reserve during a feasibility study conducted by FIPI and Vinh Phuc FPD (Anon., 1990). In 1998, gibbons were also recorded in a locality near Nui Cam during a survey by scientists from FIPI and Hanoi University (Anon., 1998c). However, this report is very doubtful, reporting gibbon calls at night: "local people confirmed its existence. On 25 May 1998, at 2 a.m. while spending a night in Xom Du Forest Protection Station, we heard the howling of gibbons at a distance of 3-3.5 km to the northwest".

In October 1999, the FFI-Indochina Programme conducted a short field survey of 10 days in this area. The interviewed people reported that they had not heard or seen gibbons for about five to six years. Nevertheless, it was suggested that some individuals might survive in forest sections close to Son La and Hoa Binh provinces (Nguyen Xuan Dang & Lormée, 1999).

Border between Tram Tau district (YEN BAI) and Bac Yen and Phu Yen districts (SON LA)

Special-use forest: None

Gibbon status: Provisional occurrence, last report in 1999 (Ngo Van Tri & Long, 1999, Nguyen Xuan Dang & Lormée, 1999)

This border area is formed by a high mountain range with an altitude of up to 2,000 m. Despite the steep relief of the area, forest only remains above 1,500 m.

No information was available on gibbons in this area prior to two surveys conducted by FFI-Indochina Programme in Son La and Yen Bai provinces. Interview data obtained in October and November 1999 by FFI teams suggest that gibbons may still occur in the area. Due to time restrictions, the forest was not surveyed. Interview data obtained in Ta Sua proposed nature reserve suggest that two groups still live in the forest close to Sang hamlet, where one hunter saw two animals in November 1999. Further evidence was provided by two female skins and one forearm bone examined in a hunter's house in Hang Dong A hamlet, Ta Sua area. These specimens were reportedly collected ten years ago (Ngo Van Tri & Long, 1999).

In Phu Yen district, local informants from Soui To commune estimated that one or two gibbon groups were living near the To River and regularly visited the Ta Sua area. The local chairman reported having heard gibbon songs recently on sunny days (Ngo Van Tri & Long, 1999).

In Tram Tau district, the most recent first-hand report on gibbon dates from four or five years ago. Access to this forest is difficult, and it is possible that a few gibbons still occur in the remotest parts of the forest (Nguyen Xuan Dang & Lormée, 1999).

Che Tao – Nam Pam Forest, Mu Cang Chai and Muong La districts (YEN BAI and SON LA)

Special-use forest: None

Gibbon status: Occurrence confirmed, last evidence in 2000 (Long *et al.*, 2000b) (see Ho Nam Mu and Che Tao-Nam Pam area data sheet, p. 65)

A short visit by Baker (1999b) recorded the occurrence of gibbons based on two interviews conducted in Nam Pam commune in May 1999.

The follow-up surveys conducted by FFI-Indochina Programme in October and November, 1999 (Ngo Van Tri & Long, 1999; Nguyen Xuan Dang & Lormée, 1999) both confirmed the presence of Western black crested gibbons in this area. Hunted specimens were examined in several places during the surveys (these included four skins, aged of four years, seen in one family home in Na Hang village, Che Tao commune, and one male skin shot in August 1999 which was found in Ban Pien village, Nam Pam commune). Furthermore most local people interviewed were able to provide reliable descriptions of gibbons.

On the morning of 24 October 1999, the survey team recorded the songs of three gibbon pairs in Nang Lu forest, south-east of the area. At 08:12 a.m., one group located at a distance of about 500 m to the west of the camp site started to call for about 3 minutes. After 40 minutes of silence, two other groups began to sing simultaneously at 08:50 a.m., at a distance of about 1,000 m to the south and 2,000 m to the east, respectively. This was the first scientifically confirmed direct evidence of living *N. concolor* in Vietnam for about 30 years.

On the basis of this information it was estimated that there may be between 20-30 individuals in this area (Nguyen Xuan Dang & Lormée, 1999). Although this is a small population, given the number of Western black crested gibbons found in Yunnan province, China, it was a nationally significant discovery. Therefore, both Nguyen Xuan Dang and Lormée (1999) and Ngo Van Tri and Long (1999) recommended that the area be considered immediately for protection and that more extensive surveys should be carried out particularly in those areas of forest where the status could not be confirmed.

More intensive surveys in Che Tao commune, conducted by FFI-Indochina Programme in October/November 2000 have confirmed the presence of a minimum of 25 groups. The minimum population size, based on sightings and vocalisations, is 58 individuals (Long *et al.*, 2000b). The true population size is likely to be higher, as the auditory surveys do not detect juveniles or infants. Interview data suggests that at least a further six groups exist in currently unsurveyed areas. The highest population density was found in Nang Lu and Ta Sua forests to the south-east, which is the area in which Nguyen Xuan Dang and Lormée (1999) first confirmed this species in Che Tao.

These most recent surveys confirm that Che Tao possesses the largest remaining population of Western black crested gibbons in Vietnam. The report highlights the necessity of a complete cessation of hunting and control of swidden agriculture. The need for further surveys of forested areas not covered in this report, as well as the confirmation of the size and location of gibbon groups are also required as base-line data for long-term protective measures.

6. Crested Gibbon Records in Vietnam

Pan Village, Muong Do commune, Phu Yen district (SON LA)

Special-use forest: None

Gibbon status: Provisional occurrence, last report in 1999 (Ngo Van Tri & Long, 1999)

In this area, the forest is restricted to a patch covering the To mountain. There are several settlements in the area, principally inhabited by members of the Muong ethnic group.

This area has never been mentioned as a gibbon locality prior to the survey carried out by FFI in November 1999. Based on interviews, it appears that some gibbons still occur there. One animal may have been shot in April 1999. If some gibbons still occur in the area, they are likely to be extirpated within a few years (Ngo Van Tri & Long, 1999).

Ho Nam Mu Forest, Van Ban district (LAO CAI)

Special-use forest: None

Gibbon status: Provisional occurrence. Last report in 2000 (Long *et al.*, 2000a)
(see Ho Nam Mu and Che Tao-Nam Pam area data sheet, p. 64)

The FFI field survey in November 1999 appears to have been the first in this area. This is surprising, because the forest area is quite large for northern Vietnam and appears to be continuous. Every interviewee in the adjacent villages was able to describe black crested gibbons. Due to the lack of time and the difficult access of the area, only three days were spent in the forest. No gibbons were heard or sighted. Remains of two hunted specimens were examined: one skin of a black gibbon made to a hunting bag in Nam Xe commune (shot in June 1998) and a partial skin of another black gibbon in Nam Xay commune (shot in 1996). According to the interviews, about seven groups still live in the area.

A follow-up survey was conducted by FFI-Indochina in November 2000 in Phu Nam Lap Pieng forest in Nam Xay commune (Long *et al.*, 2000a). A single group was heard in the continuous forest adjacent to the Nam Xe commune where 5-7 groups were reported on the basis of interviews conducted in 1999 (Dang Thanh Hai & Lormée, 1999). Interview data in 2000 suggested this to be only one group of gibbons occurring in the west of Nam Xay commune. The group consisted of an adult male, and adult female and a third, black individual. A further group, made up of an adult male, and adult female and a 'yellow' juvenile was seen in Da Cho Che forest in the east of the commune. A single male was also reported to occur in La Cai forest, between the two confirmed groups.

The forests of Nam Xe and Nam Xay communes may contain up to 9 groups of gibbons. Although this may be an over-estimate, the forest is large and more intact than the forest in Che Tao. The area holds the second highest population of Western black crested gibbon in Vietnam and should therefore be treated as an area of national significance for this species. However, there is intense hunting pressure (more so than in Che Tao) and on-the-ground conservation measures need to be established immediately in order to protect this significant population. If such measures are implemented, the population stands a good chance of long-term survival owing to the size of continuous forest.

Liem Phu Forest, Van Ban district (LAO CAI)**Special-use forest:** None**Gibbon status:** Provisional occurrence, last report in 1999 (Dong Thanh Hai & Lormée, 1999)

The only record of this location was obtained during a short survey by the FFI-Indochina Programme in November 1999. The forest appears to be quite intact and difficult to access. Despite this, every local informant in Lam Sinh hamlet reported that only two gibbon groups were present in the area (Dong Thanh Hai & Lormée, 1999).

One of these groups was said to live near Lung Cung hamlet. A female skin, from this locality, used as hunting bag, was collected in Van Ban town (hunted in 1997). This specimen, although incomplete, shows a distinctively dark underside and obviously is *N. concolor*. One day of walking is necessary in order to reach this forest. Because of the lack of time, the forest was not surveyed.

The second group was reported to live in the forest above Lam Sinh hamlet. Two days were spent surveying this forest. Although access is difficult, the habitat is highly disturbed and gunshots were repeatedly heard during the survey. It is doubtful that a significant gibbon population exists in this part of the forest.

Locations where Western black crested gibbon was previously recorded and is now believed to be extinct**Muong Lay and Tuan Giao district (LAI CHAU)****Special-use forest:** None**Gibbon status:** Unknown, last report in 1963 (museum specimen)

Although IEBR museum specimen from Muong Lai were listed as Western Black crested gibbons by Dao Van Tien (1983), all identifiable specimen studied by one of us (Geissmann) were Northern white-cheeked crested gibbons (*N. leucogenys*) (see section 3.3). There is no evidence that *N. concolor* ever occurred in this area. There are no further records on gibbons from this locality.

Thuong Bang La, Van Chan district (YEN BAI)

Two gibbon specimens (skulls, IEBR 185 and 193) were collected at this locality in October 1963 (Dao Van Tien, 1985, p. 184). During a brief visit to Van Chan City in October 1999, the FFI team could not collect any information on crested gibbons. Most of the forest has been destroyed or is heavily degraded. The remaining forest area does not appear large enough to support a gibbon population. It is highly probable that gibbons have been extirpated from this locality.

Locations where Western black gibbon was reported by local people to be extinct (previously unrecorded in scientific literature)**Phong Du Thuong commune, Van Yen district (YEN BAI) 21°50'N / 104°20'E**

There is no evidence of gibbons in the area for more than 10 years (Nguyen Xuan Dang & Lormée, 1999, interviews conducted in 1999).

6. Crested Gibbon Records in Vietnam

Xuan Tam commune, Van Yen district (YEN BAI) 21°53'N / 104°28'E

There is no evidence of gibbons in the area for more than 10 years (Nguyen Xuan Dang & Lormée, 1999, interviews conducted in 1999).

Hong Ca and Kien Thanh communes, Tran Yen district (YEN BAI) ca. 21°34'N / 104°42'E

There is no evidence of gibbon in the area for more than 10 years (Nguyen Xuan Dang & Lormée, 1999, interviews conducted in 1999).

Cau Pha forest, Mu Cang Chai district (YEN BAI) ca. 21°40'N / 104°45'E

There is no evidence of gibbon in the area for more than 10 years. (Nguyen Xuan Dang & Lormée, 1999, interviews conducted in 1999).

Nam Don commune, Muong La district (SON LA) 20°34'N / 103°50'E

The last reported record was in 1992-1993. The described species was Western black crested gibbon (Ngo Van Tri & Long, 1999, interviews conducted in 1999).

Chieng Muong commune, Muong La district (SON LA) 21°50'N / 104°11'E

The last reported record was in 1992-1993. The described species was Western black crested gibbon (Ngo Van Tri & Long, 1999, interviews conducted in 1999).

Muong Thai commune, Phu Yen district (SON LA) 21°21'N / 104°40'E

The last reported record was in 1992 (Ngo Van Tri & Long, 1999, interviews conducted in 1999).

Trung Son commune, Yen Lap district (PHU THO) 21°20'N / 104°59'E

Gibbons were not seen or heard for more than 10 years (Nguyen Xuan Dang and Lormée, 1999, interviews conducted in 1999).

Ho Nam Mu and Che Tao-Nam Pam

Ho Nam Mu and Che Tao-Nam Pam (Plate 3) are situated in the south of the Hoang Lien mountain range, to the south of Sa Pa and Than Uyen districts. The two forests blocks are separated by a large area of grassland, agricultural land and habitation.

Location, Topography and forest quality

Ho Nam Mu area

The Ho Nam Mu area constitutes the north-western slope of a mountain marking the boundary between Van Ban and Mu Cang Chai districts. The area is mainly situated in the territory of Nam Xe commune. A small part also extends into the territory of Nam Xay commune, although a small part extends into Nam Xe commune. The co-ordinates are approximately 22°01'N latitude, and 103°58'E longitude. There are about 600 inhabitants in Nam Xe commune, belonging to the Tay and Dao ethnic groups.

The land is very uneven, with altitudes often in excess of 1,000 m. The area is difficult to access and as a result, the primary forest has remained intact. It is one of the largest forest blocks north of Hanoi, comprising about 10,000 ha. According to data from satellite images, most of this is rich evergreen forest.

However, prior to the survey conducted by the FFI-Indochina Programme, the area had not been studied by scientists. Only a short time was spent in the area during 1999, only allowing the collection of very general information. Details on biodiversity, natural resource use and the socio-economic situation were collected by Lang *et al.* (2000a).

Che Tao-Nam Pam area

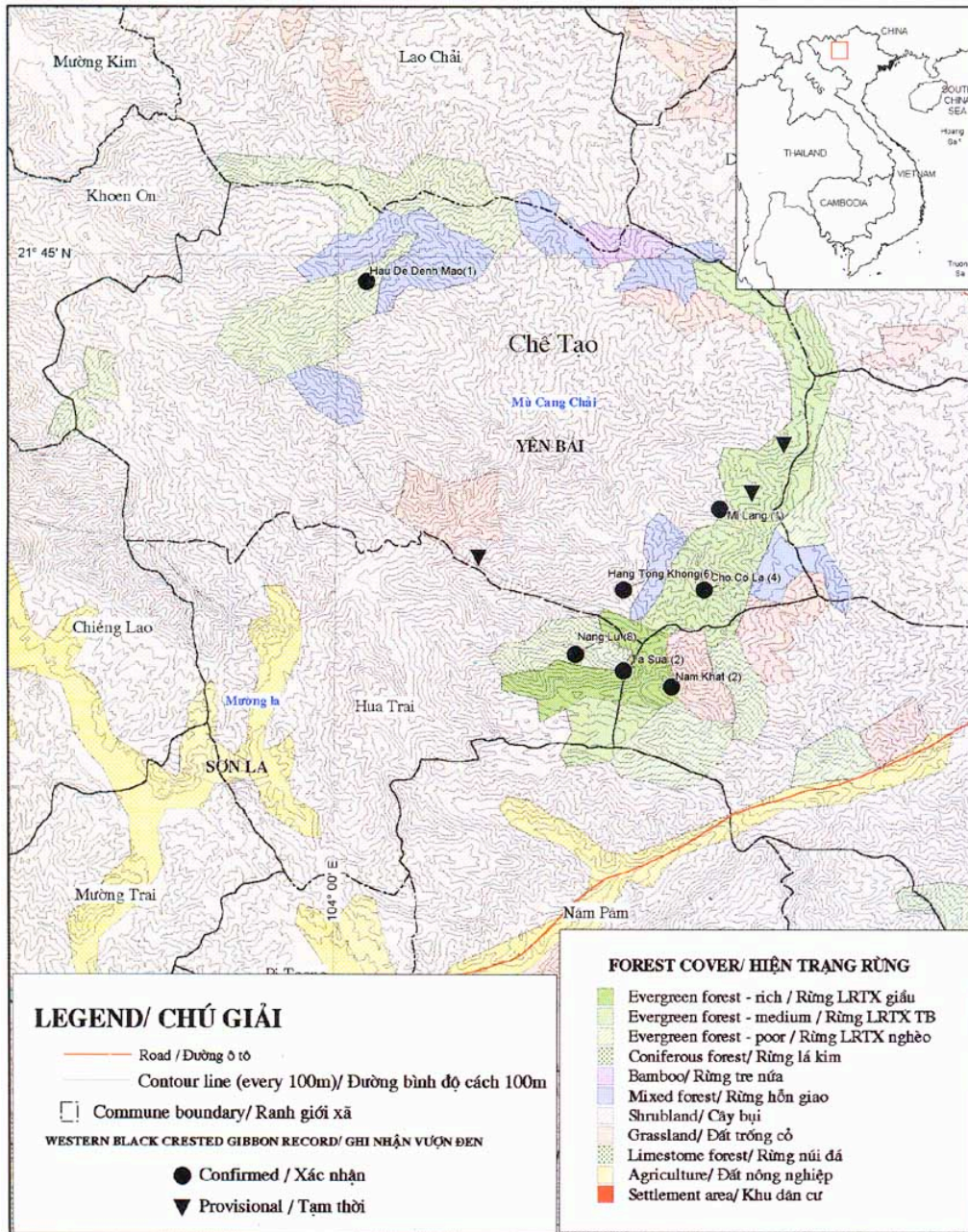
Che Tao-Nam Pam forest is located on a mountain ridge, over 2,000 m in elevation, which surrounds a basin cut by steep and narrow stream valleys. Che Tao village is located at 21°43'N latitude and 104°03'E longitude. There are about 1,000 inhabitants in Che Tao commune, all of them belonging to the H'mong ethnic group.

Up to 1,500 m, the natural forest has been replaced by scrub and grassland, thus the remaining forest forms a narrow strip 1 to 5 km wide and about 25 km long. Remnants of forest are also found on the steep slopes beside streams. The total forested area does not exceed 5,000 ha. The most important part is close to Na Hang hamlet, and is continuous with Pieng hamlet (Nam Pam commune, Muong La district, Son La province).

Ho Nam Mu and Che Tao-Nam Pam forests form a watershed for the area, yet are not included in any future protection programme in Vietnam, although feasibility studies for protected area status are being prepared by FFI-Indochina Programme.

6. Crested Gibbon Records in Vietnam

Plate 3. Distribution of Western black crested gibbon (*Nomascus concolor*) and forest cover in Che Tao forest.



Importance for primate conservation

The area is extremely important for primate conservation in Vietnam, because it contains one of the last significant populations of Western black crested gibbons (*Nomascus concolor*) in Vietnam. Recent surveys carried out by the FFI-Indochina Programme in the three districts identified populations of this globally “Endangered” species in both of the forest areas: Ho Nam Mu area (Van Ban district) and Che Tao-Nam Pam area (Mu Cang Chai and Muong La districts) (Long *et al.*, 2000a & b).

In Che Tao-Nam Pam, black crested gibbons are reportedly easily seen and heard throughout the forest. Surveys have confirmed 25 groups, and, according to local people, there may be as many as 31 groups. With regard to the relatively small size of the forest block, the area contains one of the highest densities of this species in Vietnam. Furthermore, songs were first heard by an FFI team on 24 October 1999, which constituted the only confirmed record of the species in Vietnam for thirty years; this was further supported by the sightings and vocalisations recorded by FFI surveys in October/November 2000 (Long *et al.*, 2000b).

Ho Nam Mu also possesses a remnant population of Western black crested gibbons. The species was often described and remains were discovered in villages surrounding the forest. Local people reported that five to seven groups may inhabit the far western part of this area, totalling about 30 individuals. An additional group was confirmed during surveys in 2000, and an individual male was also recorded during interviews (Long *et al.*, 2000a).

Threats to biodiversity

Hunting is the main threat to the survival of the Western black crested gibbon in these two areas, as shown by the number of remains found in the villages during the three FFI surveys.

In Ho Nam Mu forest, most Dao and Tay people now farm permanent fields. Shifting cultivation is not widespread.

In contrast, the mountainous areas of Che Tao have been almost completely deforested by forest burning during swidden agriculture. Agricultural encroachment may be a serious threat for the stability of the gibbon population in this area. Most of the areas below an altitude of 1,500 m have been cleared. The western part of the forest block, although linked to the rest of the forested land by a ridge above 2,000 m, is now isolated and very fragmented.

One particular development, which has been highlighted in the most recent survey of Che Tao, is the construction of a road between Che Tao commune and Mung Chang Chai town. Not only will this aid the trade in wildlife, but the physical barrier will effectively split the population in two, exacerbating what is already a considerable threat to the gibbons in this area due to the effects of swidden agriculture. Any splitting of the population will increase the risks of a reduced gene pool due to little contact between groups. The repercussions of this may be a rising incidence of infertility and an increased vulnerability to disease.

6. Crested Gibbon Records in Vietnam

With regard to the current status of *N. concolor*, a comprehensive assessment of the status of this species, and a feasibility study to establish a protected area in Ho Nam Mu and Che Tao-Nam Pam is being undertaken by FFI-Indochina Programme. Further surveys are required to assess the forest quality and status of primates over the whole of Van Ban district.

Conclusion

Ho Nam Mu and Che Tao-Nam Pam areas should be regarded as priority sites for primate conservation for the following reasons:

- These areas support possibly the last significant populations of Western black crested gibbon in Vietnam.
- Ho Nam Mu is one of the largest undisturbed forest blocks north of Hanoi, and is able to support a large population of primates. A forest of similar size and quality can be found north of Ho Nam Mu, near Sa Pa district. However, the two forests are separated by a valley, with a road, settlements and rice fields.

Very little data is currently available on the ecology and behaviour of Western black crested gibbon. With regard to the high density of this species in Che Tao-Nam Pam forest, the area may be a good site for a long term study of the species.

6.3 Northern white-cheeked crested gibbon (*Nomascus leucogenys leucogenys*)

The localities discussed in this section are mapped on Plate 4.

Muong Lay and Lai Chau districts (LAI CHAU)

Special use forest: None

Gibbon status: unknown, last report in 1963 (museum specimen)

Information on gibbons in this area is only available from museum specimens. In 1892, Prince Henri d'Orléans collected a mutilated adult female skin (MNHN CG1892 No.1530) in Lai Chau (Pousargues, 1896). In April 1929, R.W. Hendee collected two additional skins (FMNH 31761 and 31768) at the same locality.

One juvenile male gibbon (FMNH 31771) was collected in Muong Mon (=Muong Moun) by R. E. Wheeler in March 1929. There are no further records on gibbons from this locality.

Four gibbon specimens at IEBR are also labeled "Lai Chau" (skins: IEBR D2, K53, and two unnumbered skins). As mentioned in Dao Van Tien (1985, p. 148), at least one of the skins was collected at Muong Lay (some kilometres south of Lai Chau), another one at nearby Tuan Giao. According to Fooden (1996), the skins IEBR D2 and K22 are both from Muong Lay. All skins were collected in April 1963.

No further records have been published from this area. For a discussion of the identification of these gibbons, see section 4.3.

Muong Toi, Dien Bien district (LAI CHAU)

Special use forest: None

Gibbon status: Unknown, last report in 1977 (museum specimen)

One infant gibbon skull (IEBR 1546/360,720) was collected in this locality in June 1977. There are no further records on gibbons from this locality.

Muong Nhe Nature Reserve and vicinity, Muong Te and Muong Lay districts (LAI CHAU)

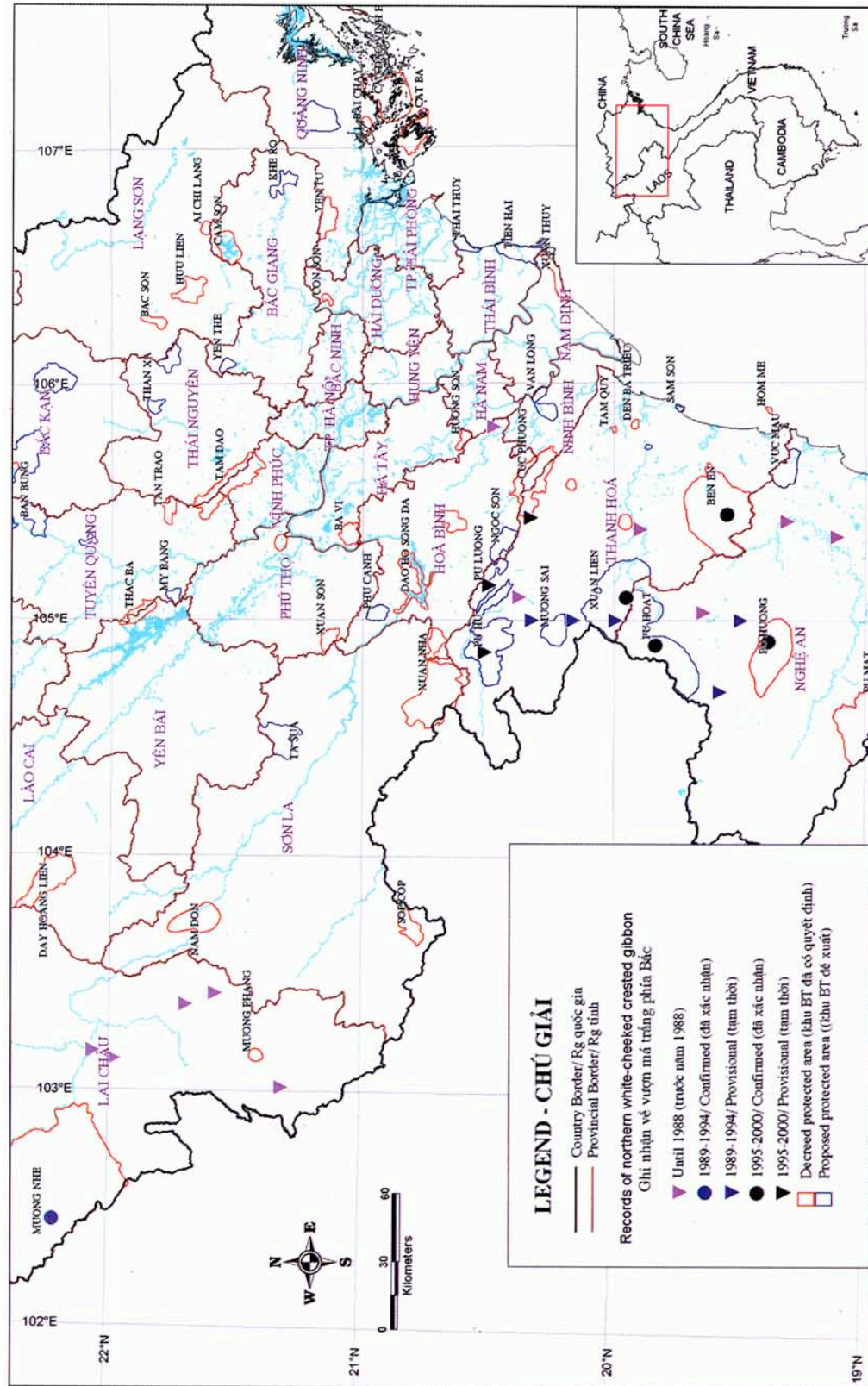
Special use forest: Nature reserve

Gibbon status: Unknown, last report in 1991 (Cox *et al.*, 1992)
(see Appendix 2, Locality 5)

One month of surveys were carried out by WWF between November and December 1991 for a management feasibility study (Cox *et al.*, 1992). White-cheeked gibbons were observed, but the animals appeared to be restricted to the remotest parts of the reserve. Between January and March 1997, Frontier-Vietnam visited the southern part of Muong Nhe (Hill *et al.*, 1997). No gibbons are mentioned among the mammals recorded during their survey. They did, however, observe gibbon skins for sale in Si Pha Phin and Dien Bien markets.

6. Crested Gibbon Records in Vietnam

Plate 4. Distribution of Northern white-cheeked crested gibbon (*Nomascus leucogenys leucogenys*) in Vietnam.



Quan Hoa district (THANH HOA)**Special use forest:** None**Gibbon status:** Unknown, last report in 1989 (Ratajszczak *et al.*, 1990)

In 1989, during a primate survey conducted in northern Vietnam by WWF/IUCN, skins of Northern white-cheeked crested gibbons recently collected from this district were seen (Ratajszczak *et al.*, 1990).

Pu Hu proposed nature reserve, Quan Hoa and Muong Lat districts (THANH HOA)**Special use forest:** None**Gibbon status:** Provisional occurrence, last report in 1998 (Anon., 1998b)

A captive animal was observed and photographed during the survey conducted for the investment plan of Pu Hu proposed nature reserve (Anon., 1998b)

Pu Luong proposed nature reserve, Quan Hoa and Ba Thuoc districts (THANH HOA)**Special use forest:** None**Gibbon status:** Provisional occurrence, last report in 1999 (Baker, 1999b) (see Appendix 2, Locality 7)

In January 1930, an adult female (FMNH, 39151) was collected in Hoi Xuan by Delacour and Lowe. This specimen was described as *concolor* by Osgood (1932). However, Geissmann (1989) observed a facial white brow-band, and after comparing it to several other museum specimens and considering its geographical origin, he regarded it as *N. leucogenys*. The area is also recorded by Dao (1983, 1985) on the basis of a subadult female skull and of a male (IEBR 541/23 and 542/24) collected in March 1964 by Ha Van Than in Dun Nam near Hoi Xuan. The identification of these specimens is also confused. In 1983, Dao identified the skull as *concolor*. But two years later, the same author called it *leucogenys* (see Fooden, 1996).

The last sightings of gibbons given by local villagers vary. In Hoi Xuan, Thanh Xuan and Phu Le communes, the last sightings of this gibbon species are reported from between 1979 to as recent as 1999. In Nam Ba hamlet, Lung Cao commune, the species was not seen or heard since 1996 or 1997. However, in Thanh Cong, Ho and Lang Hang hamlets (same commune), gibbons were not seen since at least 1989. The local informants from the other localities around the proposed nature reserve (Phu Nghiem, Phu Xuan, Co Lung and Thanh Son) report that they had not seen or heard any gibbons for more than 10 years (Baker, 1999b).

Although some informants consider that White-cheeked gibbons still occur in the proposed nature reserve, the dates given for the most recent sightings are very divergent. If the species still inhabits this area, it must be very few in number.

Xuan Lien Nature Reserve, Thuong Xuan district (THANH HOA)**Special-use forest:** Nature Reserve**Gibbon status:** Occurrence confirmed, last report in 1999 (Le Trong Trai, 1999a) (see Appendix 2, Locality 6)

In June 1960, a young adult female gibbon (ZMVNU 156) was collected in Bai Thuong. Dao Van Tien (1983) also mentioned two additional skins from the same

6. Crested Gibbon Records in Vietnam

locality. The latter were not found during this study, but the submission date of Dao Van Tien's paper suggests that they were collected not later than 1982.

In 1989, during a primate survey conducted in northern Vietnam by WWF/IUCN, skins of White-cheeked crested gibbon recently collected from this district were seen by Ratajszczak *et al.* (1990). These authors suggest that gibbons may still occur near the Laotian border.

This forest is included in Xuan Lien Nature Reserve (total area 18,522 ha), which was surveyed by a team from BirdLife and FIPI in October-November 1998 (Le Trong Trai, 1999a). The survey team heard one gibbon song from one group (unknown number of individuals) at the Hon Lech stream (Ken River area). According to Le Trong Trai (1999a), the forest is heavily disturbed. Primary forest only remains above an altitude of 700 m and is fragmented into large patches.

Ngoc Lac district (THANH HOA)

Special-use forest: None

Gibbon status: Unknown, last report in the 1989 (Ratajszczak *et al.*, 1990)

In 1989, during a primate survey conducted in northern Vietnam by WWF/IUCN, skins of White-cheeked crested gibbon recently collected from this district were seen (Ratajszczak *et al.*, 1990). These authors suggest that gibbons may still occur near the Laotian border.

Thach Tuong commune, Thach Thanh district (THANH HOA)

Special-use forest: None (community forest protection contracts)

Gibbon status: Provisional occurrence, last report 1998 (Baker, 1999b)

A local hunter reported having seen gibbons near Tuong 3 hamlet, Thach Tuong commune, in 1998. Due to a local legend describing the dangers of touching gibbon urine, gibbons might be hunted less heavily in this forest as compared to other areas in Vietnam (Baker, 1999b). In order to confirm the presence of gibbons, further surveys are highly recommended. The forest extends to the westernmost tip of Cuc Phuong National Park. In Cuc Phuong, gibbons are extinct, but interviews with local people revealed that gibbons were still present there one generation ago (T. Nadler, pers. comm., and Geissmann, interviews conducted in 1993).

Ben En National Park, Nhu Xuan and Nhu Thanh districts (THANH HOA)

Special-use forest: National park

Gibbon status: Occurrence confirmed, last report in 1998 (Tordoff *et al.*, 2000a) (see Appendix 2, Locality 8)

On several occasions between July and September 1997, a Frontier-Vietnam survey team observed a single group of White-cheeked crested gibbons, numbering about eight animals. On two occasions, they heard male song. In addition, a captive gibbon was kept in the park headquarters (Tordoff *et al.*, 1997). Between October and December 1998, gibbon song was heard at the same location that the gibbons were observed at in 1997 (Tordoff *et al.*, 2000a). Because the population of gibbons in the national park is low, it is highly susceptible to hunting (Tordoff *et al.*, 2000a). However, forest areas to the west of the national park, in the area of the Chang river, may support larger populations of gibbons (A. Tordoff, pers. comm. 2000).

Pu Hoat proposed nature reserve, Que Phong district (NGHE AN)**Special-use forest:** None**Gibbon status:** Occurrence confirmed, last report in 1997 (Le Trong Trai, pers. comm. 2000) (see Appendix 2, Locality 9)

Gibbon vocalisations were heard occasionally during a FIPI survey in the proposed nature reserve in July 1997 (Le Trong Trai, pers. comm. 2000).

Pu Huong Nature Reserve, Que Phong, Quy Chau, Quy Hop, Con Cuong and Tuong Duong districts (NGHE AN)**Special-use forest:** Nature reserve**Gibbon status:** Occurrence confirmed, last report in 1995 (Kemp & Dilger, 1996) (see Appendix 2, Locality 10)

Between April and June 1995, Pu Huong was surveyed by Frontier-Vietnam (Kemp & Dilger, 1996). They reported having heard gibbon songs in Quy Chau district.

Quy Chau district (NGHE AN)**Special-use forest:** None**Gibbon status:** Unknown, last report in 1989 (Ratajszczak *et al.*, 1990)

In November 1964, Lo Van Thien and Lo Van To collected 3 gibbons (IEBR 670/110/695, 671/111/696, and 679/119/503) in the Chau Binh locality (Dao Van Tien, 1985).

According to Ratajszczak *et al.* (1990), two captive *N. leucogenys* at the Ha Noi Zoo were caught in the Quy Chau district in 1989.

Nghia Dan district (NGHE AN)**Special-use forest:** None**Gibbon status:** Unknown, last report in 1928 (museum specimen)

In February 1928, Delacour and Lowe collected an adult female gibbon (BM(NH) 1928.7.1.1) in Nghia-Hung, Phu-Qui (Thomas, 1929; Jenkins, 1990). The locality recorded by the collector corresponds to Nghia Dan (Fooden, 1996; U.S. Board on Geographic Names, 1986). There are no further records of gibbons from this locality.

Nghia Dung, Tan Ky district (NGHE AN)**Special-use forest:** None**Gibbon status:** Unknown, last report in 1964 (museum specimen)

In December 1964, Lo Van Hong and Ngan Van Thuan collected four gibbons at this locality (IEBR 703/143/528, 736/180, 737/179/564 and 738/178/563) (Dao Van Tien, 1983, 1985, p. 217; where inventory numbers differ, ours were taken from the specimen tags). This is the most southern record of Northern white-cheeked crested gibbon. There are no further records of gibbons from this locality.

Locations where Northern white-cheeked crested gibbons was reported by local people to be extinct (previously unrecorded in scientific literature)

Nui Tuong limestone area, Ba Thuoc district (THANH HOA) ca. 20°22'N / 105°20'E

The species was not confirmed in this area as no local people could describe it (Baker, 1999b). Based on local interviews, it is estimated gibbons may have become extinct 10 years ago in this locality (Ngo Van Tri, 1999a).

Cam Quy commune, Cam Thuy district (THANH HOA) 20°17'N / 105°28'E

The species has not been seen or heard for many years (Baker, 1999b; interviews conducted in 1999).

Ban Phang (21°16.90'N / 104°04.22'E) and Ban Dan (21°19.66'N / 104°02.11'E) hamlets, Muong Bang commune, Mai Son district (SON LA)

Gibbons were reported as probably extinct in Ban Dan hamlet and to have not been seen or heard for 10 years in Ban Phang hamlet. The species described should be White-cheeked crested gibbon (L. R. Baker, pers. comm. 2000, interviews conducted in 1999).

Na Ot commune, Mai Son district (SON LA) 21°03'N / 103°59'E

The species was described but the reports were very vague (L. R. Baker, pers. comm. 2000, interviews conducted in 1999).

Phieng Pan commune, Mai Son district (SON LA) 21°04'N / 104°04'E

No gibbons were seen or heard for 10 years (L. R. Baker, pers. comm. 2000, interviews conducted in 1999).

Ban Puon hamlet, Chieng Mai commune, Mai Son district (SON LA) 21°11.41'N / 104°01.70'E

No gibbons were seen or heard for at least 20 years. The species described was White-cheeked crested gibbon (L. R. Baker, pers. comm. 2000, interviews conducted in 1999).

Ban Tam (21°07.13'N / 104°03.51'E) and Tu Buon (21°09.60'N / 104°00.13'E) hamlets, Chieng Ve commune, Mai Son district (SON LA)

The last gibbon sightings were reported to have been 10 to 20 years ago. The species described was White-cheeked crested gibbon (L. R. Baker, pers. comm. 2000, interviews conducted in 1999).

Pieng Luong hamlet, Phong Lai commune, Thuan Chau district (SON LA) 21°36.30'N / 103°35.00'E

No gibbons were seen or heard for 10 years. The species described was White-cheeked crested gibbon (L. R. Baker, pers. comm. 2000, interviews conducted in 1999).

**Chieng Set hamlet, Chieng Den commune, Thuan Chau district (SON LA)
21°23.43'N / 103°49.77'E**

The last gibbon sighting was reported to have been two to three years ago. It is likely that gibbons are now extinct in the area. The species described was White-cheeked crested gibbon (L. R. Baker, pers. comm. 2000, interviews conducted in 1999).

Cuc Phuong National Park (HOA BINH, NINH BINH and THANH HOA) ca. 20°00'N / 105°35'E

On the basis of interviews conducted in 1993 (Geissmann), the species can be considered extinct in Cuc Phuong National Park.

Discussed records**Pa Co-Hang Kia Nature Reserve, Mai Chau district (HOA BINH) ca. 20°42'N / 104°55'E**

Gibbons are reported in the feasibility study for Pa Co-Hang Kia Nature Reserve (Anon., 1993a). However, as no reference is given, this record cannot be considered reliable. The reserve supports a small area of forest, which is heavily disturbed and highly fragmented, and, therefore, is unlikely to support a population of gibbons (A. Tordoff, pers. comm. 2000).

Xuan Nha Nature Reserve (SON LA) ca. 20°45' / 104°45'

Gibbons are reported in the feasibility study for Xuan Nha Nature Reserve (Anon., 1991). However, as no reference is given, this record cannot be considered reliable.

6.4 Southern white-cheeked crested gibbon, *Nomascus leucogenys siki*

The localities discussed in this section are mapped on Plate 5.

Pu Mat Nature Reserve (NGHE AN)

Special-use forest: Nature reserve

Gibbon status: Occurrence confirmed, last report in 1999 (Long, 1999)

(see Pu Mat Nature Reserve data sheet, p. 80)

In February 1924, a juvenile female (BMNH 1928.10.2.1) was collected in the "Chaîne Annamitique de la Province de Vinh" (according to original specimen label). The Annamite Mountains are located to the west of Vinh (on the right bank of the Ca River). It can be assumed that this gibbon was collected to the east of the area close to Pu Mat Nature Reserve.

During a survey in 1989, several local informants reported that gibbons inhabit the undisturbed forests of Con Cuong and Tuong Duong districts near the Laotian border (Ratajszczak *et al.*, 1990). In addition, the carcass of a gibbon that had apparently been shot for food was examined. The animal had reportedly been hunted in Anh Son district, also close to the Laotian border. Rozendaal (1990) reported that gibbons were heard calling close to Cao Veu village during a survey in June 1990.

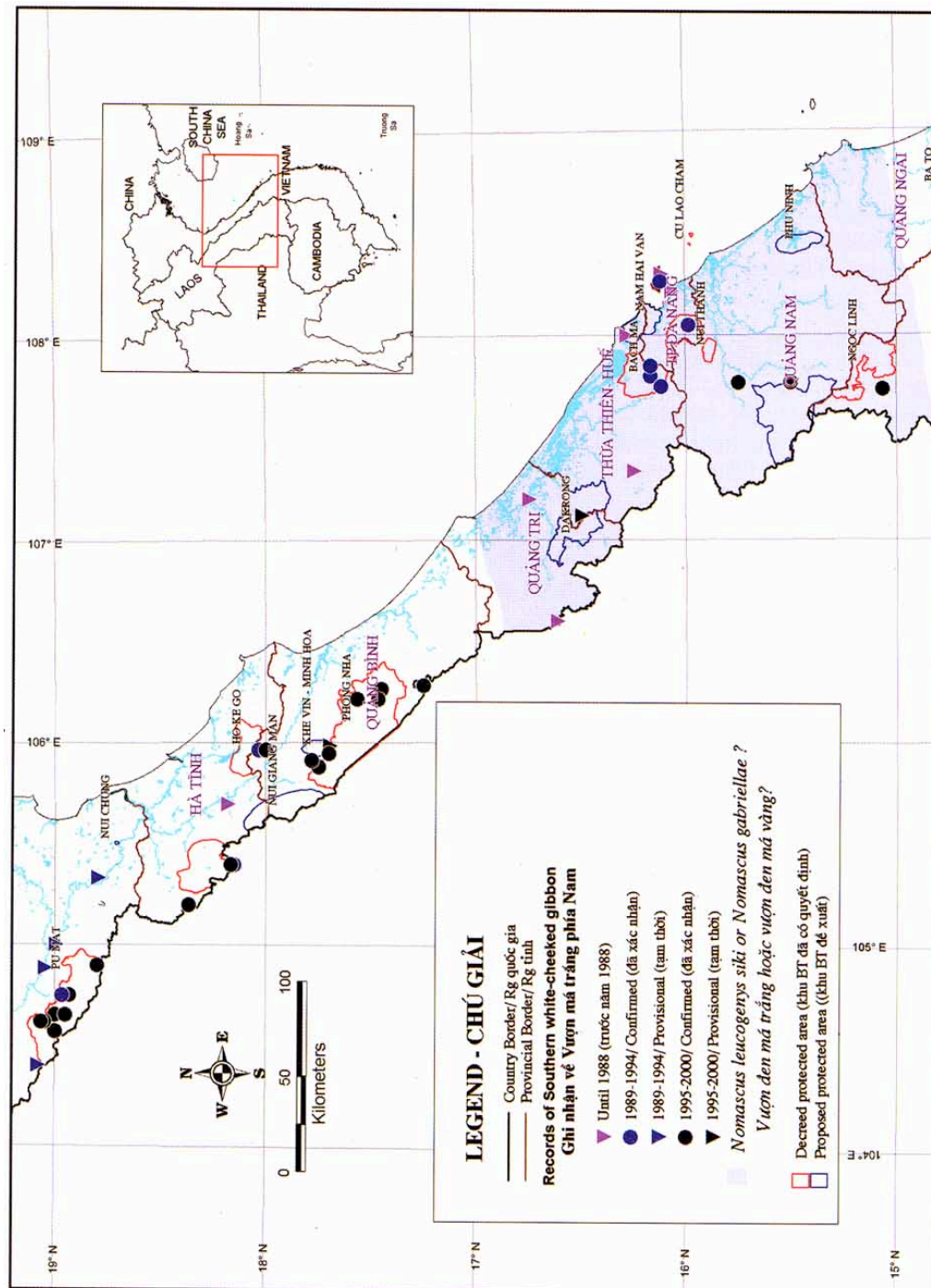
In November and December 1994, Frontier-Vietnam carried out a survey in Con Cuong district. They saw three gibbons on the upper slopes of Pu Nong, near the boundary of the reserve (Kemp *et al.*, 1995).

During a survey conducted in 1998 and 1999 by SFNC, gibbons were recorded (Timmins *et al.*, 1998). Gibbon songs were heard all days, and gibbons were seen on three occasions in the Houay Hair-Phu Xam Liem area (605043-545033) in July 1998. In July 1998, gibbon songs were also heard in the Phu K7 area (636044), from slopes to the south of Nam Pu (532012) and from slopes north of Huoi Chat (731929). One group was encountered in the Huoi Chat area. In October 1998, groups were heard below the main ridge of the peak above the Kim Toong Chinh valley (765947) and from the ridge between the Khe Mat and Khe Thoi (638083). In November 1998, groups were heard on mid hill slopes south of the Khe Thoi valley (600083) and to the east of camp in the Khe Khang (877/855). Compared to their earlier survey in Laos, however, Timmins *et al.* (1998) found the calling rate lower than expected, probably because of a higher hunting pressure.

Three gibbon groups were heard in the Cao Veu area during March and April 1999. Three plus groups were heard in the area around Pu Mat mountain in May 1999. Four groups were heard calling in the upper Khe Bu and two in the Kha Mat during September 1999 with two groups being observed. Two to three groups were heard in Thung Buc in October 1999. One group was heard west of the Khe Tun on July 30th 1999 (Long, 1999).

Because of the high quality of its forest, Pu Mat should be one of the best gibbon areas in Vietnam. The density of the gibbons, however, appears to be lower than in similar habitat in Laos (Timmins *et al.*, 1998), suggesting that the gibbon population suffers heavily from hunting.

Plate 5. Distribution of Southern white-cheeked crested gibbon (*Nomascus leucogenys siki*) in Vietnam.



6. Crested Gibbon Records in Vietnam

Huong Son district (HA TINH)

Special-use forest: None

Gibbon status: Occurrence confirmed, last report in 2000 (Osborn & Furey, in prep.)

Rozendaal (1990) reported that gibbons were heard on two occasions in An Bun River valley during a visit in June 1990. A single individual was seen in February 2000 during a survey conducted by Frontier-Vietnam in the district (Osborn & Furey, in prep.)

Vu Quang Nature Reserve, Huong Khe district (HA TINH)

Special-use forest: Nature reserve

Gibbon status: Occurrence confirmed, last report in 1999 (R. Eves, pers. comm. 2000) (see Appendix 2, Locality 11)

Dao Van Tien (1983) mentions four gibbon skulls from the IEBR collection which were collected in Huong Khe. No additional information is available. The specimens were not found in the collection during two visits by one of us (TG) in 1993 and 1998. The collecting date must have been before 1983.

In June and July 1994, gibbons were observed during a survey for endemic pheasants in the Annamite lowlands conducted by NWF, IUCN and WWF (Lambert *et al.*, 1994). No further details are given.

In 1995 and July-August 1997, two surveys were carried out by scientists from the VRTC in the reserve. Both times, gibbons signs were recorded (VRTC, 1997). During a field survey in July 1999, pairs were heard once and observed twice at the coordinates 18°10'N / 105°24'E (R. Eve, pers. comm. 2000).

Ke Go Nature Reserve, Huong Khe, Cam Xuyen and Ky Anh districts (HA TINH)

Special-use forest: Nature reserve

Gibbon status: Occurrence confirmed, last report in 1995 (Le Trong Trai *et al.*, 1996b) (see Appendix 2, Locality 12)

BirdLife and FIPI carried out a field survey between April and August 1995 for the investment plan for Ke Go Nature Reserve (Le Trong Trai *et al.*, 1996b). They reported that gibbons are extremely rare in the area and they could hear the songs only twice, both in the southern part of the nature reserve.

Khe Net forest, Tuyen Hoa district (QUANG BINH)

Special-use forest: None

Gibbon status: Unknown, last report in 1994 (Lambert *et al.*, 1994) (see Appendix 2, Locality 13)

In June-July 1994, gibbon songs were heard during a survey conducted by NWF, IUCN and WWF in the watershed protection forest near the Net River (Lambert *et al.*, 1994). No further details are given.

Phong Nha-Ke Bang proposed national park, Minh Hoa and Bo Trach districts (QUANG BINH)

Special-use forest: Partly included in Phong Nha Nature Reserve

Gibbon status: Occurrence confirmed, last report in 1998 (Timmins *et al.*, 1999)

(see Phong Nha-Ke Bang proposed national park data sheet, in: *Vietnam Primate Conservation Status Review 2000, Part II: Leaf Monkeys*)

During a survey for endemic pheasants in June and July 1994 at Phong Nha Nature Reserve, interviews conducted by NWF, IUCN and WWF indicated the probable presence of gibbons (Lambert *et al.*, 1994). In 1995, this area was surveyed for Ha Tinh langur (*Trachypithecus laotum hatinhensis*). Although no gibbons were sighted, gibbon songs were heard at Hoa Son and Thuong Hoa villages (Minh Hoa district) and at Phong Nha village (Bo Trach district).

In 1998, FFI-Indochina Programme recognised the importance of this forest in terms of biodiversity. With primates particularly in mind, a project was started with the overall objective of building the capacity of the forest protection staff to manage the conservation of the biological resources of the area. Field surveys were conducted from July to October 1998, during which four groups were heard in Ba Giang-Rao Thuong area and three other groups were heard in Thung Lau, Hoa Son and Co Khu (Pham Nhat & Nguyen Xuan Dang, 1999). One group was heard north of Ruc Ma Rin in August 1998. Single groups, probably the same one, were heard on three mornings from hills to the north of Cha Noi. Single groups, quite possibly the same one each time, were heard on three mornings in the Suoi Mo Chang valley in October 1998. Two groups were heard on two mornings to the west of the road south of Ban Cha Lo in October 1998 (Timmins *et al.*, 1999).

In January 1995, Dang Van Xuan collected a gibbon skull (FXCM 026, not found in the collection during a visit in 1998) in Thuong Hoa village (Fooden, 1996, p. 890).

Pu Mat Nature Reserve

Bettina Grieser Johns

The Pu Mat Nature Reserve (Plate 6) was established by Decision 3355/QD-UB of the People's Committee of Nghe An province, Vietnam, on December 28th 1995. It was gazetted with an area of 91,113 ha, of which about 20% is sub-tropical evergreen forest above 900 m altitude, and about 80% tropical evergreen forest below 900 m altitude. The reserve is surrounded by a designated buffer zone of around 86,000 ha, much of which consists of watershed protection forest. The reserve contains the largest remaining block of primary lowland tropical forest in Vietnam. Pu Mat Nature Reserve is currently the focus of a major international development project, the SFNC Project.

Topography and forest quality

The Pu Mat Nature Reserve is made up of steep mountains up to 1,841 m (Pu Mat mountain) and numerous, usually steep river valleys in between the mountains. Where the river valleys are broader, there is some cultivation, and three villages of the Dan Lai ethnic group are situated inside the reserve. Forest quality improves with increasing distance from the villages and the main rivers used for taking out illegal timber. Forest is virtually gone in the main valleys and heavily disturbed on the hills adjacent to the main valleys and villages. Forest quality also depends on the steepness of the terrain, and the closeness to the Laos border. Overall, it is estimated that approximately 50% of the forest in the core zone of the reserve is undisturbed; 20% is lightly disturbed and 30% is heavily disturbed.

Importance for primate conservation in Vietnam

The reserve is a globally important 'hotspot' for mammal conservation, containing several endangered animal species including five newly described mammals. Until the beginning of surveys conducted by the SFNC in early 1998, the reserve's primate fauna was largely undescribed. Some surveys were conducted by Lippold (1995), who recorded Red-shanked douc langur (*Pygathrix nemaeus nemaeus*), Phayre's langur (*Trachypithecus phayrei*), Southern white-cheeked crested gibbon (*Nomascus concolor siki*), Rhesus macaque (*M. mulatta*), Assamese macaque (*M. assamensis*) and Stump-tailed macaque (*M. arctoides*).

A survey programme commissioned by the SFNC and in part supported by PCI (Primate Conservation Inc.) was carried out in 1998 and 1999 and confirmed the presence of Rhesus macaque, Assamese macaque, Stump-tailed macaque, Southern white-cheeked crested gibbon and Phayre's langur (Grieser Johns, 1999). Three other species might still occur in the reserve. Although Pygmy lorises (*Nycticebus pygmaeus*) and Slow lorises (*N. coucang*) were not encountered, local hunters were familiar with these two species. One Red-shanked douc langur baby was encountered during the survey but, as it was in a cage being carried out of the forest by poachers, it could not be determined whether it had come from Pu Mat or from across the Laotian border.

As Pu Mat supports populations of several primate species of global conservation concern, it should be considered as a high priority for primate conservation in Vietnam. While these primates still occur in Pu Mat, their densities are very low. Out

of five areas where surveys were conducted, only one yielded enough encounters to actually calculate primate density (2.0 primate groups per sq. km or 0.12 primate groups seen per kilometre walked; Grieser Johns, 1999).

The reason for these low primate densities is the very high hunting pressure: all animals that can be hunted by shotgun occur at very low densities, not only primates. Surveys in 1999 recorded approximately one recently built hunting camp per kilometre of main river inside the reserve (B. Long, pers. comm.).

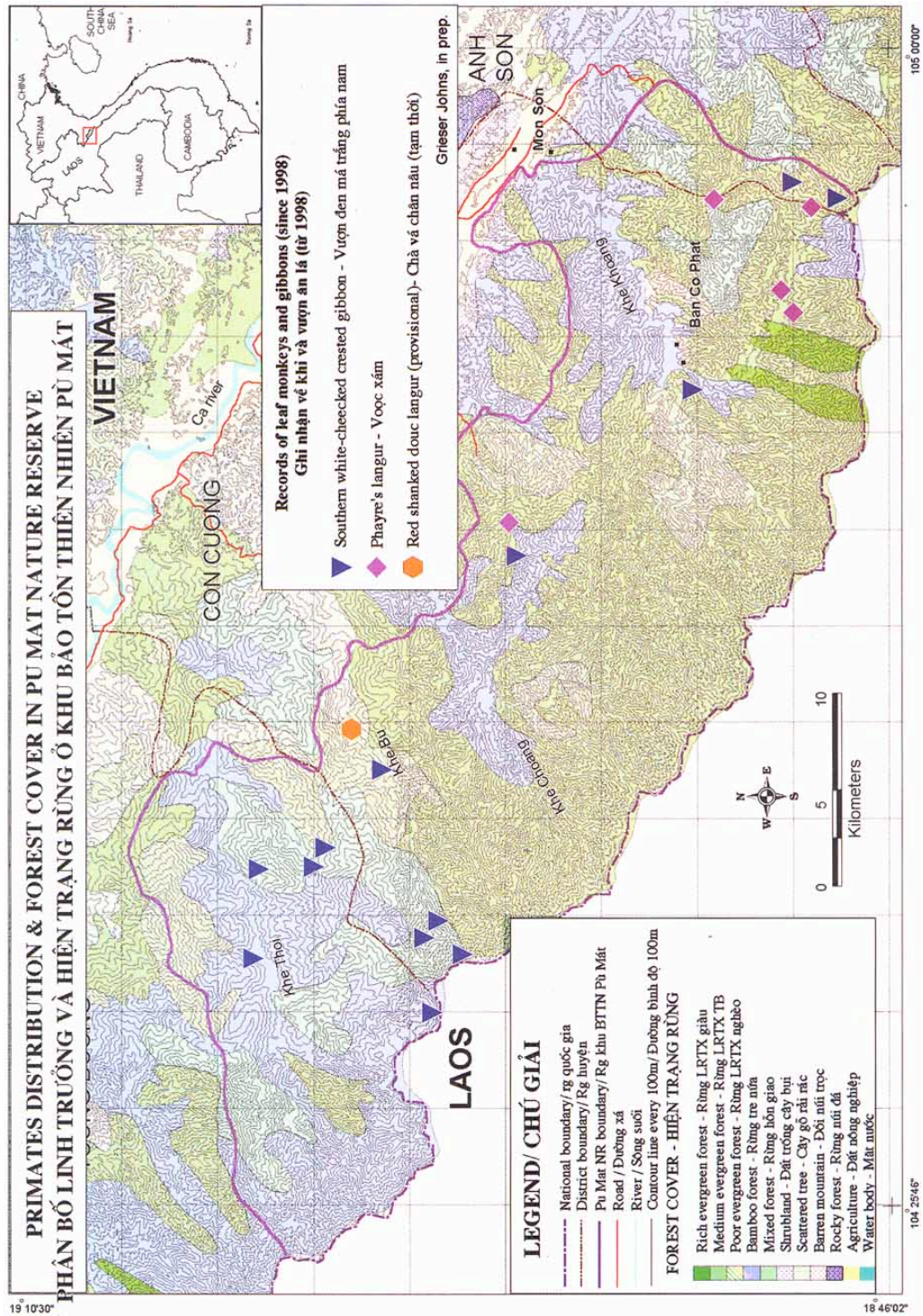
Conclusion

Pu Mat Nature Reserve should be considered a high priority for primate conservation in Vietnam for the following reasons:

- It still contains at least five species of primates.
- With a size of over 900 sq. km, it is one of the largest protected forest areas in Vietnam, and therefore one of the most viable.
- Approximately 50% of its forest is still undisturbed, which means that, although current primate densities are low, the primate populations would be able to recover if conservation measures were enforced.

6. Crested Gibbon Records in Vietnam

Plate 6. Primates distribution and forest cover in Pu Mat Nature Reserve.



6.5 White-cheeked crested gibbon (*N. leucogenys siki*) or Yellow-cheeked crested gibbon (*N. gabriellae*)?

The localities discussed in this section are mapped on Plate 5.

Lao Bao and Quang Tri vicinity (QUANG TRI)

Special-use forest: None

Gibbon status: Unknown, last report before 1951 (Delacour, 1951)

Delacour (1951) reported that he obtained specimens of *N. leucogenys siki* in the vicinity of Lao Bao and Quang Tri (specimens not seen during the present study). No further details are given.

Dakrong district (QUANG TRI) and Phong Dien district (THUA THIEN-HUE)

Special-use forest: None

Gibbon status: Occurrence confirmed, last report in 1998 (Le Trong Trai & Richardson, 1999a) (see Appendix 2, Locality 14)

In June and July 1998, gibbon songs were heard during a feasibility study conducted by BirdLife and FIPI in this area (Le Trong Trai & Richardson, 1999a).

Bach Ma National Park (THUA THIEN-HUE)

Special-use forest: National park

Gibbon status: Provisional occurrence, last report confirmed in 1991 (Eames & Robson, 1993) (see Appendix 2, Locality 15)

In February 1931, Delacour and Jabouille collected a juvenile male gibbon at the Thua Luu locality (BM(NH) 1933.4.1.6[a]). It constitutes the type of "*Hylobates siki*" (Delacour, 1951). Thua Luu is very close to Bach Ma National Park and gibbons labeled "Thua Luu" may actually have been collected in the Bach Ma area. One museum specimen (NRM 8747) collected in March 1939 by Björkegren does, indeed, bear a label with the locality information "Bach Ma, Thua Luu".

In July-November 1989, at least one other specimen was collected in Bach Ma by FIPI (not seen, cf. Eames & Robson, 1993, p. 150; Robson, 1990).

In January and February 1990, Eames and Robson (1993) reported that pairs of gibbons were heard in eight locations in the central and eastern parts of the park, and in April 1991, three males were heard in the south-west. The authors estimated that between 23 and 30 gibbon groups were living in the protected area.

6. Crested Gibbon Records in Vietnam

Ba Na-Nui Chua Nature Reserve (DA NANG)

Special-use forest: Nature Reserve

Gibbon status: Provisional occurrence, last confirmed report in 1994 (Ghazoul *et al.*, 1994)

Gibbons were reported in the feasibility study to establish Ba Na-Nui Chua Nature Reserve (Anon., 1994c). Songs were heard at Ba Na waterfall and on the east and west sides of Ong mountain. According to local hunters, the population was estimated to comprise 3 to 10 groups.

A survey conducted in 1994 by Frontier reported that gibbon calls could be heard almost every day in secondary and primary forest (Ghazoul *et al.*, 1994). Local hunters claimed the existence of *Hylobates lar* in the area. However, the authors noted that *N. leucogenys* was a more likely resident of the site. A second survey by Frontier in 1996 recorded gibbons based only on interviews (Hill *et al.*, 1996b).

A Sau, A Luoi district (THUA THIEN-HUE)

Special-use forest: None

Gibbon status: Unknown, last report in 1988 (Eames *et al.*, 1988)

The forest was particularly affected by aerial defoliant spraying during the Vietnam War. Based on interviews conducted during a pheasant survey in 1988, gibbons appear to occur at this locality close to the Laotian border (Eames *et al.*, 1988). No further details are given.

Giang and Phuoc Son districts (QUANG NAM)

Special-use forest: None

Gibbon status: Occurrence confirmed, last report in 1997 (Wikramanayake, 1997)

Gibbons songs were reported to have been heard in Giang and Phuoc Son districts during a survey conducted by WWF on March and April 1997 in the western part of Quang Nam province (Wikramanayake, 1997).

Ngoc Linh Nature Reserve, Dac Glei, Dac To and Tra My districts (KON TUM and QUANG NAM)

Special-use forest: Partly included in Ngoc Linh (Kon Tum) Nature reserve

Gibbon status: Occurrence confirmed, last report in 1998 (Le Trong Trai & Richardson, 1999b) (see Appendix 2, Locality 16)

In April-May 1996 and March-May 1998, gibbon songs were heard in Ngoc Linh (Kon Tum) Nature Reserve during a survey conducted by BirdLife and FIPI (Le Trong Trai & Richardson, 1999b). No further details are given. No gibbons were recorded during a field survey of the adjacent Ngoc Linh (Quang Nam) proposed nature reserve from March to June 1999 (Tordoff *et al.*, 2000b).

Locations where Southern white-cheeked crested gibbon or Yellow-cheeked crested gibbon was previously recorded and are now believed to be extinct

Son Tra and Da Nang vicinity (DA NANG)

Bourret (undated but about 1946) mentioned the occurrence of gibbons near Tourane (= Da Nang). Delacour (1951) reported that he obtained specimens of *N. leucogenys siki* (not seen during the present study) at the vicinity of Tourane. The authors do not give further details.

In June and August 1974, Lippold (1977) heard gibbon songs on Son Tra at an altitude of 500 m. It seems unlikely, however, that gibbons still occur there.

6.6 Yellow-cheeked crested gibbon (*Nomascus gabriellae*)

The localities discussed in this section are mapped on Plate 7.

Mom Ray Nature Reserve, Sa Thay district (Kon Tum)

Special-use forest: Nature reserve

Gibbon status: Provisional occurrence, last report in 1995 (Do Tuoc, 1995)
(see Appendix 2, Locality 17)

In January 1980, A. Don and Phan Duy Cong (CAUTGR) collected two gibbons (ZMVNU 734 and 735) at Jabok, and, in May 1982, Tran Hong Viet and Mr Ngat collected a gibbon (ZMVNU 733) at Sa Son (cf. Fooden, 1996). Additionally, Do Tuoc (1995) reported the occurrence of gibbons at the reserve based on a specimen.

Dac Lay district (Kon Tum)

Special-use forest: None

Gibbon status: Unknown, last report in 1991 (museum specimen)

Two skins (XMFC, one male, one female, both unnumbered) were collected in 1991 by Truong Son in Dac Lay district (Kon Tum province) (Fooden, 1996, p. 877). These specimens were not found during this study (visit in 1998). [The only skins seen were two mounted specimens (XMFC Th-H01, juvenile male, and XMFC unnumbered, adult female; skulls inside) which were bought in December 1992 in Gia Lai province. According to Pham Nhat, no further information is known on these two specimens.] No further records are available from this area.

Kong Ha Nung area (Gia Lai)

Special-use forest: Partly included in Kong Cha Rang and Kon Ka Kinh Nature Reserves

Gibbon status: Occurrence confirmed, last report in 1999 (Le Trong Trai, 1999b)
(see Appendix 2, Locality 18)

Roznov *et al.* (1986) presented an analysis of gibbon songs tape-recorded in December 1983 and January 1984 at two localities of the Tay Nguyen plateau, which are about 30 km apart, i.e. in Kong Cha Rang and near the hospital of Buon hamlet (Son Lang commune, K'Bang district). Their findings strongly differed from the crested gibbon songs described above (section 5) in many respects, including the following: only one type of phrases was heard, all fundamental frequencies were below 1.2 kHz, maximum frequency modulation was 460 Hz, the highest vocal activity (over 25% of all songs) was heard in the evening between 18:00-20:00 hr, and the latest song occurred at 20:54 hr (i.e. well after sunset: 18:30 hr). A reanalysis of the original tape-recordings by one of us (TG) revealed that the phrases were not produced by gibbons, but by crested argus pheasants.

Based on interviews conducted during a pheasant survey in 1988, gibbons appear to occur in Kong Cha Rang Nature Reserve (Eames *et al.*, 1988). No further details are given.

In October 1994 (15 days) the area was surveyed by Le Xuan Canh (1995) for large carnivores. The author reports sighting gibbons in Kong Ha Hung area, with no further details.

In April 1999, a field survey was conducted by BirdLife and FIPI, to collect data for the investment plan for Kon Cha Rang Nature Reserve (Le Trong Trai, 1999b). No gibbons were seen, but gibbon songs were commonly heard in the morning.

Between February and April 1999, BirdLife and FIPI carried out a field survey to collect data for the investment plan for Kon Ka Kinh Nature Reserve (Le Trong Trai, 2000). Gibbons were heard calling three times, all in the same area. The author noted that the calling density was relatively low, although this might have resulted from frequent rain during the study period, rather than from any underlying low density of gibbons.

Ea So commune, Ea Kar district (DAK LAK)

Special-use forest: None

Gibbon status: Provisional occurrence, last report in 1996 (Le Xuan Canh *et al.*, 1997a) (see Appendix 2, Locality 19)

In April and May 1997, interviews conducted during a survey by IUCN and WWF suggested that gibbons occurred in the north of the commune, near the Gia Lai provincial boundary. The last time gibbon songs were heard, however, reportedly dates back to October 1996.

Ea Sup district (DAK LAK)

Special-use forest: None

Gibbon status: Occurrence confirmed, last report in 1998 (Brickle *et al.*, 1998)

In March to May 1998, interviews conducted during a survey for the Green peafowl (*Pavo muticus*) by BirdLife and IEBR suggested that gibbons occurred in the northern part of this area at the boundary between Ea H'leo and Ea Sup districts (Brickle *et al.*, 1998). In March 1998, gibbon songs were heard on one occasion in Ea Wy commune, Ea H'leo district. Human presence appears to be low in the region, but most of the forest is deciduous and semi-deciduous and, therefore, less suitable as gibbon habitat. According to the interviews and the song heard, gibbons only occur in patches of hilly evergreen forest and riverine semi-evergreen forest.

Ea Trang commune, M'drak district (DAK LAK)

Special-use forest: None

Gibbon status: Occurrence confirmed, last report in 1998 (Brickle *et al.*, 1998)

In April 1998, gibbons were heard on two occasions during a BirdLife and IEBR survey for the Green peafowl (Brickle *et al.*, 1998).

Krong No district (DAK LAK)

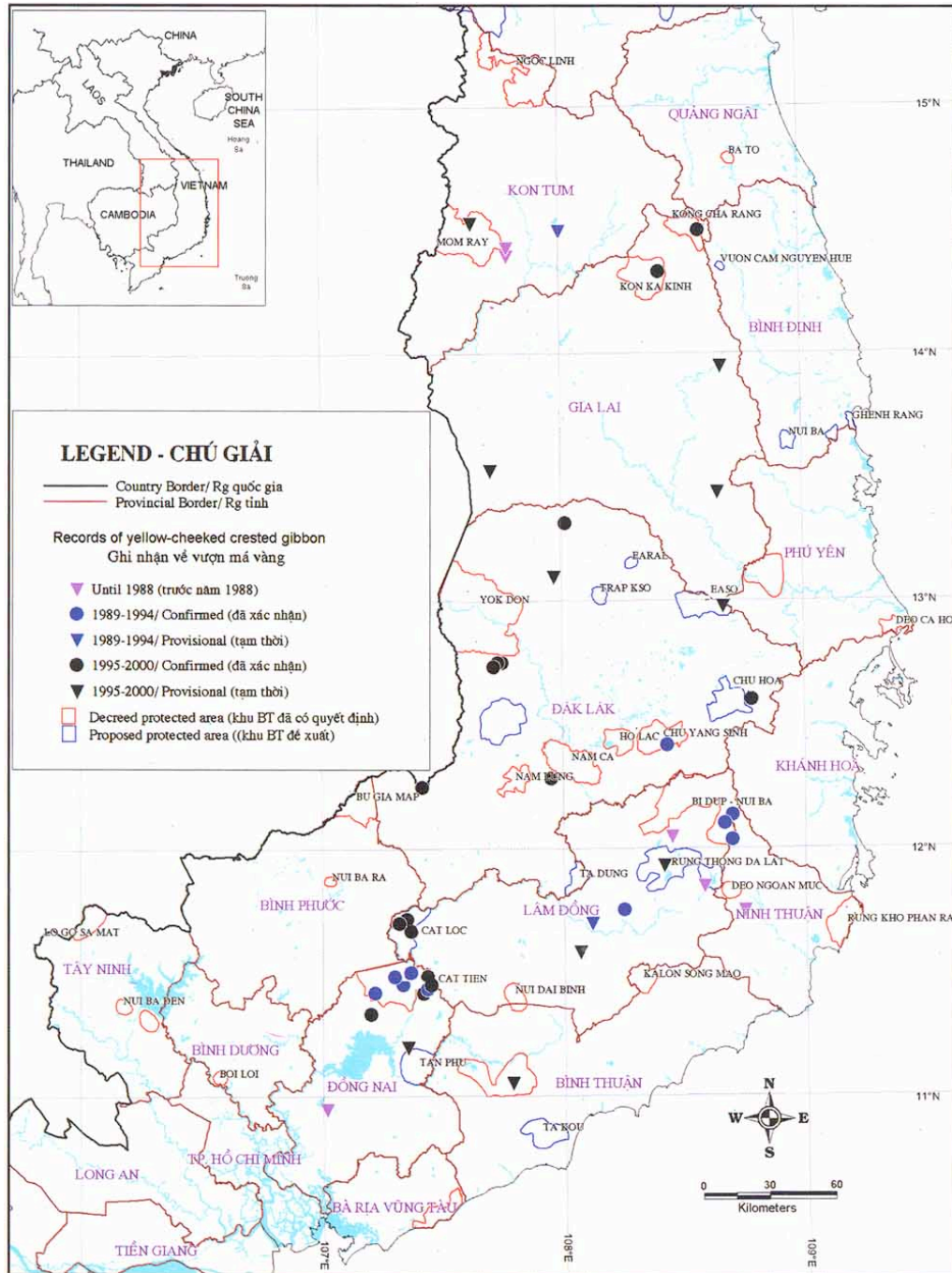
Special-use forest: Partly included in Nam Nung and Nam Ca Nature Reserves

Gibbon status: Occurrence confirmed, last report in 1998 (Brickle *et al.*, 1998)

In May 1998, gibbon songs were heard on one occasion in the district during a survey by BirdLife for Green peafowl (Brickle *et al.*, 1998).

6. Crested Gibbon Records in Vietnam

Plate 7. Distribution of Yellow-cheeked crested gibbon (*Nomascus gabriellae*) in Vietnam.



Quang Truc commune, Dak Lap district (DAK LAK)**Special-use forest:** None**Gibbon status:** Occurrence confirmed, last report in 1998 (Brickle *et al.*, 1998)

In April 1998, gibbons were heard on three occasions in Quang Truc commune during a survey for Green peafowl by BirdLife and IEBR (Brickle *et al.*, 1998).

Cu Jut district (DAK LAK)**Special-use forest:** None

Gibbon status: Occurrence confirmed, last report in 2000 (Ngo Van Tri, 2000)
(see Appendix 2, Locality 20)

In December 1999, the occurrence of Yellow-cheeked gibbon in the district was confirmed during an elephant survey by FFI. Gibbons were seen on two occasions in secondary forest: one pair at Dak Klaus stream and four to five individuals at Dak SIRR stream (12°44'46"N / 107°45'31"E). Gibbon songs were heard near Dak Klaus (12°44'56"N / 107°44'33"E) from 06:15 to 06:40 a.m. All records were from altitudes between 300 and 500 m (Trinh Viet Cuong & Ngo Van Tri, 2000).

In April 2000, FFI visited the district a second time (Ngo Van Tri, 2000). One group of three individuals (one female and two males) were seen between Dak Klaus and Dak SIRR (streams) (12°43'58"N / 107°43'23"E). It is likely that this was the same group whose the vocalisations were heard in December 1999.

Da Lat Plateau (LAM DONG, DAK LAK, KHANH HOA and NINH THUAN)**Special-use forest:** Partly included in Chu Yang Sinh and Bi Dup-Nui Ba Nature Reserves

Gibbon status: Unknown, last report in 1994 (Eames & Nguyen Cu, 1994)
(see Appendix 2, Locality 21)

Several gibbons were collected in this large area: In June 1908, Dr Vassal collected one adult male gibbon (BM(NH) 1908.11.1.1) in Lang Bian (at an altitude of 460 m), about "100 km inland of Phan Rang". This is the type of "*Hylobates gabriellae*" described by Thomas (1909).

In March 1918, C. B. Kloss collected five adult gibbons in Da Ban, Ninh Thuan province, near the border with Lam Dong province (ZRC 4-692, 4-693, 4-694, 4-695 and 4-696). In addition, in May 1918 he collected one adult male (ZRC 4-697) in Don Duong (Lam Dong), closer to the Da Lat plateau (Weitzel *et al.*, 1988, p. 34).

In August 1927, Delacour and Lowe collected one subadult female gibbon (MNHN CG1929 No. 451) in a "bosquet" (small forest) near Da Lat town (cf. Thomas, 1929).

In August-September 1938, B. Björkegren collected five gibbons from the area of Da Lat (NRM 8737, 8740, 8741, 8745, 8748). In June 1938, he collected one adult female gibbon (NRM 8736) near B'sre, which is situated in the north of the province, close to the border with Dak Lak province.

In June-July 1961, B. Feinstein collected three adult gibbons from an area 6 km south of Da Lat (USNM 320786, 320787 and 320789).

In May-June 1991, interviews conducted during a survey by Eames and Robson (1993) suggested that gibbons were occurred on the Da Lat plateau. During field

6. Crested Gibbon Records in Vietnam

surveys in January 1990 and May-June 1991, gibbon songs were heard on Bi Dup mountain at about 1,700 to 2,000 m and at one other, non-specified, locality. During 72 days, gibbon songs were heard only twice.

In January 1992, only one pair was heard, at Tuyan Lam lake, at an altitude of about 1,500 m (Eames & Robson, 1993).

Most of the surveys mentioned above were conducted at elevations ranging from 1,500 and 2,000 m. Gibbons were scarce or absent from most of the forest in this altitudinal range. Eames and Robson (1993) suggest that forest at this altitude represents a sub-optimal habitat for Yellow-cheeked crested gibbon.

Gibbons were recorded during the feasibility study to establish Thuong Da Nhim (currently Bi Dup-Nui Ba Nature Reserve) and Chu Yang Sin Nature Reserves between November 1993 and February 1994 (Eames and Nguyen Cu, 1994). Songs were regularly heard on Hill 1978, Bi Dup, Gia Rich and Chu Yang Sin mountains. One male was recorded on the summit of Nui Bi Dup mountain (2,287 m) in December 1993, which is probably the highest elevation recorded for the species.

Between 8 and 16 November 1994, Le Xuan Canh (1995) report gibbons based on interviews on Bi Dup mountain during a survey for large carnivores.

Di Linh Plateau (LAM DONG and BINH THUAN)

Special-use forest: Partly included in Nui Dai Binh Nature Reserve

Gibbon status: Unknown, last report in 1991 (Eames & Robson, 1993)

In March 1927, Delacour and Lowe collected one adult male gibbon (BM(NH) 1927.12.1.1) in Di Linh (=Djiring) (Thomas, 1928).

In May-June 1991, interviews conducted during a survey by Eames and Robson (1993) suggested that gibbons occurred on the Di Linh plateau.

Kalon Song Mao Nature Reserve, Bac Binh district (BINH THUAN)

Special-use forest: Nature reserve

Gibbon status: Provisional occurrence (Le Trong Trai & Tran Hieu Minh, 2000)

Gibbons were reported during a BirdLife and FIPI rapid field survey of the area in 2000. Local hunters reported that gibbons occurred in good quality forest at high altitude, where they were said to feed along streams deep in the forest. Given the distribution, it is probable that the species described by the hunters is Yellow-cheeked crested gibbon (Le Trong Trai & Tran Hieu Minh, 2000).

Cat Tien National Park (DONG NAI, BINH PHUOC and LAM DONG)

Special-use forest: National park

Gibbon status: Occurrence confirmed, last report in 1999 (Ling, 2000)

(see Cat Tien National Park data sheet, in *Vietnam Primate Conservation Status Review 2000, Part II: Leaf Monkeys*)

Adler (1991) heard two groups singing from neighbouring hills near the Dak Lua hamlet (in the north-eastern part of the park) in January 1989. A captive female kept at Dak Lua ranger station was identified as Yellow-cheeked crested gibbon. From December 1989 to January 1990, gibbons were heard in three localities in the north

and east of the park (Eames & Robson, 1993). In June 1991, gibbon songs were heard in nine localities in the park, including two of those identified during the previous survey (Eames & Robson, 1993).

In February and March 1992, an elephant survey conducted by WWF-Vietnam Programme reported gibbon calls and sightings in three locations, all in the north-western part of the park (Dawson *et al.*, 1993).

In September 1993, Geissmann (1995c) revisited the north-east of the Nam Cat Tien for a short survey of four days. He heard gibbon songs twice. On the basis of tape-recordings, he concluded that this population could be reliably identified as Yellow-cheeked crested gibbon.

A group of about six individuals was seen in the western part of the Cat Loc sector in April 1999 (Bui Huu Manh, pers. comm. 2000).

In November and December 1999, Ling (2000) carried out a survey in the park for the WWF Cat Tien conservation project. Close to the northern boundary and in the lowland forest of Nam Cat Tien sector, the author heard gibbons on most mornings. However, only once were two groups heard simultaneously, one to the west and one to the east of Bau Sau ("Crocodile lake"). From the headquarters, gibbons were heard only once and, then, only faintly. In the Cat Loc sector, songs were recorded once at K'Lo K'Lich.

In April 2000, a small group was observed at the end of the track to Heaven Rapids in the extreme east of Nam Cat Tien sector (C. Qruispel & J. Luijenijke, pers. comm. 2000). During the same month, a group was heard in the extreme south-west of the Nam Cat Tien sector (G. Polet, pers. comm. 2000). In June 2000, one group was heard on two occasions near village 4 in Cat Loc sector (B. Hayes & Nguyen Xuan Dang, pers. comm. 2000).

Although hunting is officially prohibited in Cat Tien, Geissmann (1995c) found a lower density of calls in the north-eastern park area in 1993 than during previous surveys of 1990 and 1991. Of two hills, from which Adler (1991) heard gibbon group calls in 1989, Geissmann found one completely deforested and the other half deforested by 1993. From the latter hill, only a female solo song was heard. Obviously, the gibbon population is decreasing (Geissmann, 1995c). More recently, Lings (2000) observed that, though gibbons were widespread in the park, they lived at low density. Considering that hunting ought not to be having a major impact on the population, the author suggested that their low density was possibly related to habitat quality.

Bien Lac-Nui Ong Nature Reserve (BINH THUAN)

Special-use forest: Nature reserve

Gibbon status: Provisional occurrence, last report in 1999 (Ngo Van Tri, 1999b)

In September 1999, FFI conducted a short (11 day) elephant survey in the area. Interviews suggested that gibbons still occur in the reserve and can be heard singing from Ong mountain. One captive gibbon, caught in the reserve in 1997, was kept close to the FPD station (Ngo Van Tri, 1999b).

Locations where Yellow-cheeked crested gibbon was previously recorded and is now believed to be extinct

Thong Nhat commune, and Tan Phu State Forest Enterprise, Bien Hoa district (DONG NAI)

In June 1918, C. B. Kloss collected two adult males (ZRC 4-690, 4-691) in Thong Nhat commune (= Trang Bom, Bien Hoa district) (Weitzel *et al.*, 1988, p. 34). In November 1932, E. Poilane collected two male gibbons (USNM 257995 and 257996) farther to the east in Bien Hoa district, one in Dinh Quan, at kilometre 46 of the "route coloniale no. 20", the other one at kilometre 58, both at an altitude close to sea level. These localities are situated near Tan Phu State Forest Enterprise.

No gibbon habitat or gibbons remain at Trang Bom. At Tan Phu, while about 7,000 ha of degraded forest remain, three months of intensive field surveys and interviews confirmed the absence of gibbons from the site (Ngo Van Tri & Day, 1999).

Discussed records

Bu Gia Map Nature Reserve, Phuoc Long district (BINH PHUOC)

Gibbons are reported in the feasibility study for the establishment of Bu Gia Map Nature Reserve (Anon., 1994a). As no reference is given, however, this record is not considered reliable.

In March-April 1937, W. H. Osgood collected 14 gibbons in Ban Ma Thuot (= Buon Me Thuot, e.g. Fooden, 1996, p. 875). Buon Ma Thuot is a trade centre in the area and, therefore, we cannot come to any conclusion about the exact provenance of the specimens.

7. GIBBON STATUS

The number of gibbons in Vietnam appears to be decreasing in every area where we have historic records. The degree of threat increases from the south to the north of the country.

7.1 Eastern black crested gibbon (*Nomascus* sp. cf. *nasutus*)

The Eastern black crested gibbon may not only be one of the most endangered primate species in Vietnam but, possibly, the singly most critically endangered primate species in the world (Geissmann, 1996, 1997; Geissmann & Vu Ngoc Thanh, in press). Although a reliable estimate is difficult, it is unlikely that the total population in north-eastern Vietnam and Hainan Island exceeds 50 individuals (Geissmann & Vu Ngoc Thanh, in press).

The population of Hainan Island, which is here referred to as *N. sp. cf. nasutus hainanus*, is very close to extinction. The population on Hainan fell from an estimated 2,000 animals in the 1950's to 30-60 animals in 1983, and to less than 30 in 1978 (Fooden *et al.*, 1987; Liu *et al.*, 1984, 1987; Ma & Wang, 1986; Ma *et al.*, 1988; Tan, 1985; Wang & Quan, 1986). Today, the distribution of Hainan gibbons appears to be restricted to the Bawangling Nature Reserve, where their numbers still appear to be decreasing. For instance, of 21 individuals recorded by Zhang *et al.* (1992), only three groups with less than 20 individuals remained during a survey in October 1993 (Geissmann, unpubl. observations).

In Vietnam, no viable population is known, and it is possible that the species will become extinct in the near future without capture and *ex-situ* conservation. In the three localities where Eastern black crested gibbons were provisionally reported (see section 3.2), only very few individuals possibly remain according to interviews, but no gibbons were actually sighted or heard during recent surveys (Geissmann & Vu Ngoc Thanh, in press; Geissmann *et al.* this study). In addition, human pressure (hunting, logging, deforestation, gold mining) is dramatically high throughout the range of this species.

7.2 Western black crested gibbon (*Nomascus concolor*)

Historically, black crested gibbons, were widely distributed in southern China and northern Vietnam. Thirty years ago, both Eastern and Western black crested gibbons reportedly were still fairly common (e.g. Bourret ?1946). This is not the case anymore. Massive deforestation reduced the available gibbon habitat so much that, now, only a few patches of primary forest remain which are able to support a viable population.

In Laos, Western black crested gibbon is naturally restricted to a small area. Twelve gibbon groups were estimated to occur in Nam Kan PNBCA (J.-F. Reumaux, pers. comm. in Duckworth *et al.*, 1999), although a recent survey by one of us (TG) in March 1999 revealed that this is probably an underestimate (see section 3.3). No population figures have been estimated.

In China, the status of the Western black crested gibbon has recently been reassessed (Bleisch *et al.*, 2000). One of this species' most important populations lives in the

Wuliang Mountains and was estimated to comprise between 215 and 450 individuals (certainly more than 50 and probably less than 150 groups). Western black crested gibbons in Yunnan province appear to be restricted to broadleaved evergreen forests. The total habitat available for gibbons in the Wuliang Mountains probably does not exceed 20,000 ha, of which less than 15,000 ha are currently protected. The Jingdong Wuliang Mountain Nature Reserve includes 12,400 ha of forest land, representing about 53% of the total area of the reserve.

The review (Bleisch *et al.*, 2000) came to the conclusion that Western black crested gibbon is endangered in China, with a total population of no more than 2,000 individuals.

The status of Western black crested gibbon is clearly different in Vietnam, where the species should be and is listed as "**Critically Endangered**"

In Vietnam, the recent field surveys carried out by FFI throughout most of the remaining larger forest areas in the historic range of the species lead to an estimate of less than 100 individuals. The two largest populations may live in Che Tao and Ho Nam Mu forests (Yen Bai and Son La provinces) with about 70 and 20 individuals, respectively.

The main threats to Western black crested gibbon are deforestation and hunting. In its range, shifting cultivation is predominant. This region is known to have some very valuable tree species, encouraging illegal logging. In addition, hunting pressure has increased in order to satisfy the demands of the nearby Chinese market.

Nomascus concolor, including *Nomascus* sp. cf. *nasutus*, is listed as "**Endangered**" in the *IUCN Red List of Threatened Species* (Hilton-Taylor, 2000): EN A1cd, C2a.

7.3 Northern white-cheeked crested gibbon (*Nomascus leucogenys leucogenys*)

Northern white-cheeked crested gibbon has suffered greatly from deforestation and hunting. Agricultural encroachment in the mountainous areas, and fuelwood cutting and timber extraction in the remainder of the forests have reduced and fragmented its habitat throughout its range. Hunting for local consumption or the wildlife trade has also greatly reduced population numbers.

In China, White-cheeked crested gibbon is naturally restricted to a small range. The human pressure is very high, and the remaining habitat can no longer support a significant population. The area containing this species possibly includes Mengla county of Xishuangbanna Autonomous Prefecture, Jiangchen county and Luchun county (Ma & Wang, 1986). Ma *et al.* (1988, cited in Zhang *et al.*, 1992) considered that Chinese *N. leucogenys* became extinct outside of Mengla county during the early 1980's. However, according to Lan (in prep.), no data are available in Jiangchen and Luchun counties. The situation in these areas is likely to be poor. The two counties are located near the border area; in the past one and a half decades, all border areas of Yunnan province have suffered from serious commercial logging or human disturbance (Lan, in prep.). Although more than 100 individuals are estimated to remain, the exact ranges of only a few groups are known (Yang & Xu, 1988; Hu *et al.*, 1989 cited in Lan, in prep.). An optimistic estimate of the present range of *N. leucogenys leucogenys* in China is about 300 to 500 km² (Lan, in prep.).

Population numbers are much higher in Laos than in China and Vietnam. The larger amount of remaining natural habitat accounts for this and may provide some protection. However, wildlife in Laos has been rapidly declining, especially since 1990. The wildlife trade continues to increase in order to supply the Thai and Vietnamese markets, the latter of which, in turn, is heavily supplying the Chinese market. Northern Laos suffers more from hunting and human pressure than other parts of the country. In Nam Ha and in Phou Dendin NBCAs, in the extreme north-west of the country, there are no direct records of gibbons. The species appears to be widely found from the Mekong plains to Phou Louey, Nam Et and Nam Xam NBCA, although the number of sightings is much lower here than for the other gibbon taxa further in the south (Duckworth *et al.*, 1999). It is locally considered “**At Risk**” (Duckworth *et al.*, 1999).

In Vietnam, the forested areas within the range of Northern white-cheeked crested gibbon are particularly fragmented. Given the recent data from Lai Chau and Son La provinces, it is unlikely that these two regions support forest patches that are large enough to sustain a significant population of gibbons.

It is impossible to estimate population numbers of the Northern white-cheeked crested gibbon in Vietnam, due to the lack of surveys. Most of the remaining gibbon groups appear to be confined to a narrow band of forest near the Laotian border in Thanh Hoa and Nghe An provinces. Considering the small size of the original range in Vietnam, the small size of the remaining forest areas, the high level of fragmentation of primary forest and the intense hunting pressure in this area, the population today must be very small. As a consequence, White-cheeked crested gibbon may also be critically endangered in Vietnam, but this assumption is based on circumstantial evidence only and should be regarded with caution. Its current status in the country is “**Endangered**” (Pham Nhat *et al.*, 1998).

Although the subspecies *N. leucogenys leucogenys* has recently been upgraded to “**Endangered**”, *N. leucogenys* is classed as “**Data Deficient**” in the *IUCN Red List of Threatened Species* (Hilton-Taylor, 2000) and should be upgraded to “**Vulnerable**”.

7.4 Southern white-cheeked crested gibbon (*Nomascus leucogenys siki*)

We do not have enough data to estimate the status of Southern white-cheeked crested gibbon in Indochina, but its status appears to be less critical than of other crested gibbon taxa (except perhaps Yellow-cheeked crested gibbon). Nevertheless, human pressure on their populations and habitat continues to increase.

In Laos, as compared to Vietnam, Southern white-cheeked crested gibbon is relatively well protected by the sheer size of intact habitat and the low human population density. Since 1990, however, habitat destruction and hunting have increased. For instance, the gibbon populations in Phou Xang He NBCA now appear to be scattered and are absent in disturbed or fragmented forests (Duckworth *et al.*, 1995). The gibbons' presence in other disturbed forests where hunting is low suggests that hunting pressures have played an important part in their extirpation from many places (Duckworth *et al.*, 1999). Besides local consumption, a significant proportion of hunted animals are brought to Thailand or, via Vietnam, to China in order to supply pet traders or traditional medicine producers. Since wildlife is so rare in Vietnam,

Vietnamese hunters often cross the border to hunt in Laos (Duckworth *et al.*, 1999; Timmins *et al.*, 1999).

The remaining forested areas in the Vietnamese range of Southern white-cheeked crested gibbon are heavily disturbed. Most lowlands forests have been cleared since the Vietnam War in order to be converted into agricultural fields. Forests in Thua Tien-Hue and Quang Tri provinces were highly degraded by aerial defoliant spraying during the war. Most of the suitable habitat now appears to be restricted to areas along the Laotian border, from Nghe An to Quang Binh provinces, including protected areas such as Pu Mat, Vu Quang and Phong Nha. In addition, these areas are contiguous with protected areas in Laos such as Nam Chouan PNBCA, Nakai-Nam Theun NBCA and Hin Namno NBCA. Although habitats in these neighbouring areas are comparable, gibbons on the Vietnamese side are much rarer as a result of the greater hunting pressure. Forested areas which do not extend into Laos, such as Ke Go, Dakrong and Bach Ma, are too disturbed and too heavily hunted to provide significant protection for gibbon populations.

The *IUCN Red List of Threatened Species* (Hilton-Taylor, 2000) now classes the Southern white-cheeked crested gibbon as a subspecies of *leucogenys*, whereas previously it was undecided as to whether it should be *leucogenys* or *gabriellae*. However, the subspecies is still recognised as “**Data Deficient**”, the same as the overall species status.

7.5 Yellow-cheeked crested gibbon (*Nomascus gabriellae*)

It is likely that Yellow-cheeked crested gibbon is the most common of the crested gibbons. However, its exact status is difficult to assess.

The status of the species in Cambodia is unknown (see Long & Swan, 2000). A large part of the area included in the species' range is covered by a deciduous forest. Therefore, this region is unable to support a large gibbon population. For instance, no information on gibbons could be collected during recent surveys in southern Ratanakiri province (Timmins & Men Soriyun, 1998) and north-eastern Mondulakiri province (Long & Swan, 2000; Long *et al.*, 2000c). The species occurs, however, in areas further south, which are covered by a higher proportion of evergreen forest (Walston *et al.*, in press). Gibbons have been reported to occur, for instance, in eastern Mondulakiri province (Desai & Vuthy, 1996), in the Samling logging concession in southern Mondulakiri province, and in the Snoul Wildlife Sanctuary, Kratie province (Walston *et al.*, in press).

If Yellow-cheeked crested gibbons occurs in Laos at all, the species must be restricted to the southernmost part of the country. The identity of the Laotian Yellow-cheeked crested gibbons has been questioned since it was discovered that their songs, even in southern Laos, differ from those of typical Yellow-cheeked crested gibbons from southern Vietnam and show some similarities with those of White-cheeked crested gibbons (see section 5.5).

Independent of their affinities, Laotian Yellow-cheeked crested gibbons are more common than both Southern and Northern white-cheeked crested gibbons further to the north. In Xe Pian and Dong Hua Sao NBCAs, they occur at relatively high densities, and these areas are of major significance for their conservation (Duckworth *et al.*, 1995, 1999). The local conservation significance of the species is “**Little known**”.

Very little is known about the status of Yellow-cheeked crested gibbons in Vietnam. This is mainly due to its range being in an area of primary forest that has not yet been comprehensively surveyed. Although forested areas in southern Vietnam have been heavily degraded by aerial defoliant spraying, agricultural encroachment and logging, it appears that the species can survive in moderately disturbed forests, as suggested by the continued occurrence of gibbons in Cat Tien National Park (Dong Nai province) and Dak Uyn State Forest Enterprise (Cu Jut district, Dak Lak province). Brickel *et al.* (1998) reported that the species was fairly common in some areas of Dak Lak province. Although no comprehensive surveys have been conducted on the Da Lat plateau in the last five years, the area seems able to support a relatively large population of this species. The species is considered as “**Endangered**” in Vietnam (Pham Nhat *et al.*, 1998).

Nomascus gabriellae has recently been upgraded to “**Vulnerable**” in the *IUCN Red List of Threatened Species* (Hilton-Taylor, 2000).

8. THREATS TO GIBBONS IN VIETNAM

8.1 Hunting and wildlife trade

Hunting is the main threat to gibbon population stability in Vietnam. Such activity has a considerable impact in the country due to high human population density, easy access to guns and the existence of a traditional, well-connected wildlife trade in South-East Asia.

The use of guns for hunting is widespread and uncontrolled. Possession of firearms is common and they are easily available. Several decades of war have considerably increased the availability of weapons (Timmins *et al.*, 1998). On the other hand, some ethnic groups, such as the H'mong in northern Vietnam, use home-made muskets. In a two month period in 1992, policemen in Nghe An province confiscated 10,124 weapons, including 3,829 army guns, 5,895 shotguns and 317 sport guns (Nhan Dan Newspaper No. 15150, cited by Pham Binh Quyen & Truong Quang Hoc, 1997). Shooting animals is often opportunistic, and every mammal and bird species constitutes a potential target. Use of non-selective trapping methods is also common and widely reported.

Although the proportion of wildlife in the local diet is not well assessed, it is clear that it represents an important protein source, mainly in remote mountainous areas where agricultural resources are poor (e.g. Che Tan in Yen Bai province, see data sheet p. 65, and Van Ban district, Lao Cai province, Long *et al.*, 2000a). Being a target of relatively large size, gibbons are systematically shot when encountered, and the meat is widely considered "tasty" by local people, who traditionally eat most primate species. However, if we consider the extremely low density of gibbons in Vietnamese forests, they cannot be expected to constitute an essential food source for local human populations.

The main threat, however, is posed by commercially oriented hunting. Sale of wildlife products makes a significant contribution to the income of many local people. Gibbons are sold for food, medicine and as pets, and their skins are often used for decorative purposes (e.g. bags). The internal wildlife trade in Vietnam is particularly active. However, a number of people implicated in this lucrative trade point out that most animals are destined to be sold in China. It is clear that demand for wildlife products in China has played, and is playing, an important role in biodiversity loss in Vietnam. Furthermore, Vietnam is at the centre of the South-East Asian wildlife trade. Trade is well organised. Wildlife is bought in Laos (Duckworth *et al.*, 1999) or Cambodia (Martin and Phipps 1996), then taken as far as China to supply the wildlife trade of that country. In addition, since hunting in Vietnam is often not profitable due to the scarcity of valuable animals, Vietnamese hunters often operate in adjacent Laotian forests (Duckworth *et al.*, 1999; T. Osborn, pers. comm. 2000).

One of the main reasons primates are hunted in Vietnam is to produce traditional medicine. This activity is widely reported in several areas, and may constitute the most serious threat for the survival of gibbon populations. Evidence of commercial exploitation of primates for this purpose suggests that this activity is particularly intensive and of major concern. In the Phong Nha-Ke Bang area, where there are known to be several groups of Southern white-cheeked crested gibbon, Timmins *et al.* (1998) cited various sources reporting organised hunting groups from local

communities going into the forest to hunt diurnal primates with the apparent objective of selling the animals for medicine preparation. Each year, several tons of dried carcasses are prepared for sale (Pham Nhat & Nguyen Xuan Dang, 1999).

Primates are also sold as trophies. A large quantity of wildlife trophies, including stuffed primates, was observed by Eames and Robson (1993) in Da Lat town and along the road between Da Lat and Bao Loc towns, principally for sale to domestic tourists or to be used as ornaments in local hotels. Chazoul and Le Mong Chan (1994) reported the same activity in Sa Pa market (Lao Cai province). There has, however, been a decrease in such trade in Sa Pa, suggesting a reinforcement of controls or reflecting a reduced density of wildlife (Tordoff *et al.*, 1999).

The keeping of wild animals as pets is widespread in Vietnam. Of the primates, macaques and lorises are most commonly kept. However, leaf monkeys and gibbons have also been reported. It is still easy to find globally threatened primates on sale in markets, even though the sale of these species is prohibited by Vietnamese law.

Zoological gardens attract many visitors in Vietnam and contain a variety of exotic species. Primates are very popular and an important attraction. Unfortunately, many of the animals exhibited in zoological gardens are caught in the wild, although trade in them is illegal.

The contribution of hunting to the dramatic declines in primate populations in Vietnam is illustrated by the fact that, although significant areas of suitable habitat still remain in the country, even in the north, primate densities in these areas are very low. Examples of such areas are Hoang Lien and Pu Mat Nature Reserves. Conversely, areas well protected from hunting, such as Cat Tien National Park, can still support healthy primate populations, even when forest in these areas has been subjected to a certain degree of disturbance.

8.2 Habitat disturbance

Forest destruction in Vietnam was massive during the second half of the 20th century and still continues. Strategic herbicide spraying and intensive bombing by American forces during the Vietnam War (1963-1975) contributed to the destruction of large areas of forest, mainly in the centre and south of the country. It was estimated that about 22,000 km² of agricultural land and forest was destroyed during this period (Collins *et al.*, 1991, cited by Eames & Robson 1993). Although the forests of northern Vietnam did not suffer as greatly from the direct effects of the war, the indirect impacts were considerable. For instance, bombing of the north of the country resulted in an exodus of people from the plain of the Red River Delta to mountainous areas, where they subsequently cleared forest to create agricultural land (Pham Binh Quyen & Truong Quang Hoe, 1997).

After the war, the demographic explosion and the subsequent increase in demand for agricultural land led to a considerable reduction in forest extent. This phenomenon was particularly apparent in the lowlands and in the northern part of the country, where the human population density was higher. Particularly in northern Vietnam, most of the lowland forests were lost and montane forests were very reduced and highly fragmented. Between 1943 and 1995, natural forest cover in Vietnam declined from 44% to 28% (Wege *et al.*, 1999).

8. Threats to Gibbons in Vietnam

Although the central region was previously cleared at a slower rate, this trend may soon be reversed. In the first place, remnant forest blocks in other parts of the country are often too inaccessible to be the subject of profitable commercial logging or converted into agricultural land. In the second place, human population density in the Central Highlands is increasing dramatically due to transmigration from the overpopulated northern provinces. The region received 600,000 migrants between 1976 and 1988 (Pham Binh Quyen & Truong Quang Hoc, 1997). Dak Lak province, which had the highest immigration rate of any province in Vietnam, saw its human population rise from 1,026,000 to 1,242,000 between 1990 and 1995 (Brickle *et al.*, 1998). Some of these migrants were officially resettled as part of official population redistribution programmes but a large number of spontaneous migrants followed them. The latter were often relatives or friends of officially resettled people. Many of the migrants were farmers, who cleared forest land for subsistence agriculture.

Beside agricultural encroachment, various disturbances to natural habitat are caused by the collection of timber and non-timber forest products, such as rattan, bamboo, fuelwood, fruits, honey, fragrant tree oil and medicinal plants.

Timber extraction by state forest enterprises and illegal loggers has resulted in the loss and degradation of large areas of forest. From official sources, it has been estimated that about 80,000 ha of forest were degraded per year as a result of these activities in 1991 (Pham Binh Quyen & Truong Quang Hoc, 1997).

Timber and non-timber forest products collectors, who must often spend several days in the forest, subsist on natural resources, including primate meat. Trees supporting fruits or bee nests are sometimes cut down to facilitate collection. The collection of fragrant tree oil has been reported to have a severe negative impact on the environment. The distillation process involves boiling the wood, which requires a large quantity of firewood. It is estimated that, for each tree fragrant oil is distilled from, 10 ha of forest is negatively affected (Lambert *et al.*, 1994; Le Trong Trai *et al.*, 1996b).

Habitat destruction is also associated with hydro-electricity, road and other infrastructure development. Hydro-electric dams cause a three-fold problem. Firstly, the reservoir may inundate large areas of forest; it has been estimated that as much as 30,000 ha of forest is lost per year due to the creation of reservoirs (World Bank, 1995, cited by Pham Binh Quyen & Truong Quang Hoc, 1997). Secondly, human settlements must be relocated in other places, which often means forest areas. Thirdly, areas surrounding the reservoir became more accessible to loggers and hunters. Such consequences are illustrated in Luc Yen district, Yen Bai province, where the forest has been entirely cleared following the construction of a hydro-electric dam (Pham Nhat, 1991).

Development of the road network in an area of high biodiversity value does not only involve clearance of a large area of forest during construction. Road development also facilitates exploitation of forest products, and may act as a focus for settlement of migrants. These problems are associated with the current project to develop the Ho Chi Minh National Highway between Ha Noi and Ho Chi Minh City. This new route will pass through, and seriously threaten, several areas of high importance for primate conservation, including Ngoc Linh (Kon Turn) Nature Reserve, from where there is a confirmed record of Yellow-cheeked or White-cheeked crested gibbon.

Special mention must be made of mining activities, principally gold mining. These have been frequently reported in limestone areas in northern Vietnam that are of a

high importance for primate conservation, such as Kim Hy in Bac Kan province (Geissmann & Vu Ngoc Thanh, in press; Ngo Van Tri & Lormée, 2000) and Na Hang in Tuyen Quang province (Ratajszczak et al., 1992; Dang Ngoc Can & Nguyen Truong Son, 1999). Large areas of forest are cleared for ore exploitation. Furthermore, this activity attracts a large number of workers, who subsist on forest products or exploit them to supplement their incomes.

Deforestation and habitat fragmentation are major threats to the long-term survival of primate populations. Not only do these processes reduce the area of suitable habitat and the number of animals but they also increase the accessibility of forest areas to people. Furthermore, these processes, particularly habitat fragmentation, tend to isolate gibbon populations, leading to inbreeding. The long-term consequences of inbreeding may include decreased resistance to disease and higher incidence of infertility. The degree to which gibbons can disperse across areas of non-forest has not been clearly demonstrated, but it is unlikely that these most arboreal of species can travel significant distances across grassland, scrub or cultivated areas to reach nearby forest patches.

9. RECOMMENDATIONS

This section will first discuss general conservation policy in response to the threats described above, before discussing species-specific recommendations.

9.1 Hunting and wildlife trade

Hunting, mainly for commercial purposes, is threatening many wild animals with extinction in Vietnam. Primate species in particular suffer from this activity due to their high value in the wildlife trade. Urgent conservation measures must be implemented to control hunting and the wildlife trade, and to more effectively implement existing laws.

Officially a licence is required to keep and use a gun in Vietnam. However, possession of firearms is widespread in the countryside and guns are used without any licence. In response to the dramatic increase in hunting, gun confiscations have been undertaken in some areas, such as Phong Nha-Ke Bang (Le Xuan Canh et al., 1997b; Timmins et al., 1998; Pham Nhat & Nguyen Xuan Dang, 1999), by provincial and central government authorities. This policy has resulted in, at least, a partial decrease in this form of hunting. Gun confiscations must be continued and generalised, and the production and sale of firearms must be controlled.

According to Decision No. 18/HDI3T of the Chairman of the Council of Ministers, dated 17 January 1992, the highest level of legal protection is conferred upon every species of gibbon. This law strictly prohibits hunting or use of any parts of these animals. According to Governmental Decree No. 77/CP, dated 29 November 1996, each violation of Decision 18/FIDI3T enacts a fine of VND 2 to 10 million, equivalent to US\$ 150 to US\$ 700. However, this law is not effectively applied. For instance, FFI teams recorded that at least 11 Western black crested gibbons and three Eastern black crested gibbons were killed during the last five years. However, no judicial procedures were reported against the hunters responsible. Forest Protection Department staff lack knowledge about which species are protected and the punishment for people who break the law.

As well as hunting, trade in protected primate species is strictly forbidden by Vietnamese law, and any violation is normally subject to punishment. However, it is still easy to find threatened animals in both urban and rural markets, and wildlife traders act with impunity, although they are usually known to local authorities. No effective control occurs inside the borders of the country, and wildlife products cross the borders without control.

Illegal hunting practices and the trade in threatened primates in Vietnam can be curbed through improved law enforcement. This can be done by creating incentive systems for effective law enforcement by forest guards, police officers and customs officials. Moreover, gun confiscations or gun bounty schemes should be conducted in order to reduce hunting pressure.

9.2 Population management

The isolation of forested areas and the reduction of populations by hunting have resulted in the present populations of several gibbon taxa in Vietnam being reduced to scattered sub-populations of 10 or so animals, which are unable to interbreed.

Captive breeding programmes cannot be considered a long-term solution to the conservation of gibbon species, because, unless sufficient suitable habitat can be preserved and factors leading to the decline of these species removed, there will never be a future for these species in the wild. Moreover, the success of such programmes cannot be guaranteed. In the case of Eastern black crested gibbon, for instance, there exists insufficient knowledge about how the species survives in captivity, and it has previously been recommended that there should be no attempt to capture the species for any purpose until there is a better understanding of its ecology and behaviour. However, the results of this review suggest that, given the extremely low population size of some gibbon species and their occurrence in small, isolated groups, captive breeding programmes may be necessary to avoid the rapid extinction of these populations.

Species for which captive breeding can play an important role include Eastern and Western black crested gibbons, although *in-situ* conservation measures must be implemented simultaneously.

As recommended by Nadler (see Golden-headed langur chapter in: *Vietnam Primate Conservation Status Review 2000, Part II: Leaf Monkeys*), confiscated young or injured animals should be kept in captivity. In addition, if any gibbons are caught for a translocation programme, some individuals could be used to establish a captive population.

An alternative to captive breeding is *in-situ* population management. This would take the form of translocations of isolated small groups or single individuals to areas where other groups exist. Unfortunately, at the present time, there is no area in Vietnam where the level of protection is sufficient to justify such a translocation.

9.3 Habitat disturbance

In order to minimise habitat disturbance and degradation by local people at key sites for gibbon conservation, sustainable income alternatives to unsustainable exploitation of forest resources should be developed. If such alternative income generating activities are developed, they should be linked to commitments by local people to halt hunting of gibbons, through means of village conservation agreements, forest protection contracts or commune forest management regulations. Care must be exercised when designing and implementing any community development activities around areas of gibbon habitat so that they do not attract migrants to the area and, thereby, increase pressure on natural resources.

The development of infrastructure, such as hydroelectric dams or roads, is necessary for economic development at the national and local levels. However, environmental impact assessments should be conducted and made public, in order that alternatives with the lowest impact on biodiversity can be selected, and mitigation measures can be formulated.

9.4 Protected areas system review

Wege et al. (1999) stated that 1,345,000 ha of land in Vietnam is decreed as special-use forest. However, they pointed out that 575,000 ha of this area is non-forest land, comprising scrub, grassland and agriculture land. They recommended that the boundaries of several protected area should be revised to exclude areas that do not support forest. On the other hand, they recommended that areas of greater biodiversity value should be added to the current protected areas network. With regard to gibbon conservation, Table 9.1 lists proposed protected areas or extensions to existing protected areas that should be added to Vietnam's protected areas network in order to increase conservation coverage of gibbon species. Without improved enforcement of protected area management regulations, however, protected area designation alone will fail to ensure the protection of endangered primates at the sites in Table 9.1.

Table 9.1. Proposed revisions of Vietnam's protected areas network to Increase conservation coverage of gibbon species.

Proposed new protected area or extension	Province	Target Species
Hoang Lien Nature Reserve extension (exclusion of non-forest land in the east of the reserve; extension to the west into Than Uyen district and to the south into Van Ban district)	Lao Cai	<i>Nomascus concolor</i>
Kim Hy area	Bac Kan	<i>Nomascus</i> sp. cf. <i>nasutus</i>
Pu Hoat area	Nghe An	<i>Nomascus leucogenys</i>
Khe Net area	Quang Binh	<i>Nomascus leucogenys</i>
Dakrong-Phong Dien area	Quang Tri and Thua Thien-Hue	<i>Nomascus leucogenys</i> or <i>N. gabriellae</i>
Song Thanh-Dakpring area	Quang Nam	<i>Nomascus leucogenys</i> or <i>N. gabriellae</i>
Ngoc Linh (Quang Nam) area	Quang Nam	<i>Nomascus leucogenys</i> or <i>N. gabriellae</i>
Kong Cha Rang - Kon Ka Kinh Nature Reserves extension (inclusion of intervening area)	Gia Lai	<i>Nomascus leucogenys</i> or <i>N. gabriellae</i>
Yok Don National Park extension (extension to the north in Ea Sup district and to the south in Cu Jut district)	Dak Lak	<i>Nomascus gabriellae</i>
Chu Yang Sin Nature Reserve extension; Bi Dup-Nui Ba Nature Reserve extensions; Ta Dung area; South-west Lam Dong area; and Kalon Song Mao Nature Reserve extension (see Wege et al., 1999)	Lam Dong, Dak Lak, Khanh Hoa and Binh Thuan	<i>Nomascus gabriellae</i>

9.5 Education and awareness raising

The development of education and awareness raising programmes are necessary but must be sensitive to the specific educational needs of both local and national level target audiences. Locally targeted programmes working in communities adjacent to areas identified as priorities for gibbon conservation must address the needs of adults as well as children. Specific interventions should focus on concepts of extinction and basic ecology, as well as seeking to generate and enhance appreciation of the intrinsic value of living gibbons.

At the national level, there is great potential to generate support for primate conservation through campaigns in the press, television, radio and other popular media, such as postage stamps and postcards. Many Vietnamese people are unaware of the importance of their country for primate conservation, or of the threats currently facing primates.

9.6 Research and field surveys

This gibbon status review is far from comprehensive and must be expanded by incorporating the results of future surveys. The authors hope that this work can serve as a starting point for a national monitoring programme for gibbons.

Several areas of high potential for gibbon conservation have been poorly surveyed to date and are under-represented in the current protected areas network. Future gibbon surveys should focus on these areas, in particular Ha Giang, Kon Tum and Lam Dong provinces. Further surveys are also recommended for areas identified in this review as being of high importance for gibbon conservation, especially Van Ban in Lao Cai province and Che Tao in Yen Bai province.

9.7 Species-specific recommendations

9.7.1 Eastern black crested gibbon (*Nomascus* sp. cf. *nasutus*)

Even though the continued presence of Eastern black crested gibbon at Kim Hy (Bac Kan province) remains unconfirmed, this nature reserve remains a high priority for primate conservation because of the occurrence of the largest known population of Francois's langur in Vietnam. However, because no on-the-ground conservation management exists and the currently proposed reserve boundaries do not reflect the current forest cover, immediate conservation intervention is necessary.

Although hardly any forest is left in Lang Son, Ha Giang and Cao Bang provinces, remnant forest areas should be urgently surveyed to search for any surviving gibbons. At Kim Hy Nature Reserve, the Thung Khi (*monkey*) valley between Con Minh and An Tinh forests appears to be a promising candidate, and should preferably be surveyed on sunny days between April and July. Because of the near extinct status of this gibbon species, the first priority consists of actually finding the animals, and estimating their numbers should be a secondary objective. As a direct result of this constraint, any surveys for this species should not use a transect technique, because more gibbon songs are missed while walking in the forest. Instead, listening posts on hills should be visited, each for several consecutive days. The observer should already

9. Recommendations

be in place before dawn, because most songs start at dawn. From such listening posts, songs can be heard for distances of several kilometres, and tape-recordings from fixed listening positions are often of sufficient quality for species identification (see Long et al., 2000b).

On a larger scale, surveys should take place to investigate whether gibbons survive east of the Red River in Yunnan province, China (e.g. in Mt. Dawei, Hekou-Pingbian county, and Guangting, Jianshui county). In order to assess the taxonomic affinities of any such gibbons, tape-recordings of their songs are required. These animals may be *N. concolor*, as suggested by the only adult female skin from that area available for this study (see section 4.2), although only *N. sp. cf. nasutus* specimens have been collected east of the Red River from Vietnamese localities. Considering the extremely critical status of *N. sp. cf. nasutus*, however, every action should be taken that has even a small chance of discovering a surviving population of this species on the mainland.

9.7.2 Western black crested gibbon (*Nomascus concolor*)

Although Hoang Lien Nature Reserve (Lao Cai province) does not support a large gibbon population, its boundaries should be reviewed. It is possible that gibbons are more common in contiguous forest areas outside of the reserve. This is not only supported by interview results, but also by interpretation of forest cover maps, which show that most of the primary forest in the Hoang Lien mountain range lies outside of the protected area. Instead, a large part of the reserve consists of agricultural land, grassland and scrub. Further biological surveys with specific focus on gibbons should also be conducted in the adjacent forest areas in northern Van Ban district and north-eastern Than Uyen district, in order to assess a possible revision of the reserve boundaries.

The forests of Che Tao (Yen Bai and Son La provinces) and Ho Nam Mu (Lao Cai province) may hold the largest populations of Western black crested gibbons in Vietnam. In addition, these two localities are the only places where the occurrence of this species has been confirmed during the present review. The large size and the good quality of these forests are exceptional for the Tonkin region. These are two of the last areas of upper montane evergreen forest in northern Vietnam. Unfortunately, they had never previously been surveyed by any biological teams in the past. The recent surveys conducted by FFI field teams must be built upon and conservation measures must urgently be taken in order to halt shifting cultivation, illegal logging and hunting activities, which are very intensive in these areas. A plan to establish two protected areas, specifically for the protection of Western black crested gibbons, should immediately be implemented.

A short survey in Moc Chau district (Son La province), where Western black crested gibbons have been recorded in 1963, should be conducted in order to assess the current status of gibbons in the area. According to forest cover maps, the remaining forest in that area is small and highly fragmented.

9.7.3 Northern white-cheeked crested gibbon (*Nomascus leucogenys leucogenys*)

The only confirmed recent records of Northern white-cheeked crested gibbon in Vietnam come from Xuan Lien Nature Reserve and Ben En National Park (both in

Thanh Hoa province). Due to the high level of disturbance of the forest at Ben En, it is unlikely that a large gibbon population remains there.

Xuan Lien, on the other hand, covers a narrow band of forest close to the Laotian border, which is contiguous with a larger area to the south in Que Phong district (Nghe An province). Although little forest remains undisturbed, this area might possess the most important population of Northern white-cheeked crested gibbon in Vietnam. Therefore, the immediate establishment of the nature reserve, as recommended by BirdLife and FIPI (Le Trong Trai, 1999a) is of utmost importance. Further surveys for gibbons should be conducted in Nghe An and Thanh Hoa provinces, in the forest areas along the Laotian border.

Largely as a result of shifting cultivation, the forest cover of Muong Nhe Nature Reserve (Lai Chau province) is now less than 20%. Surveys should be conducted to identify forest blocks where viable gibbon populations still occur. Following this, the boundaries of the nature reserve should be revised to exclude settlements, agricultural land and grassland, and conservation efforts should be directed at the forest blocks which still support gibbon populations.

9.7.4 Southern white-cheeked crested gibbon (*Nomascus leucogenys siki*)

Forested areas close to the Laotian border, between Nghe An and Quang Binh provinces, are covered by three protected areas: Pu Mat (Nghe An province), Vu Quang (Ha Tinh province) and Phong Nha (Quang Binh province) Nature Reserves. However, a large part of primary forest is still excluded from the protected areas system, as a result of which these protected areas are not contiguous. Unless intervening forest areas are included within the protected areas system, clearance of forest as a result of infrastructure development, human settlement or logging activities, threatens to destroy the opportunity of extending contiguous conservation coverage to the major remaining area of Southern white-cheeked crested gibbon habitat in Vietnam.

Gibbons have recently been observed in Huong Son district (Ha Tinh province), where forest quality and overall levels of biodiversity appear to be very high. In addition, the area is contiguous with Vu Quang Nature Reserve. Further surveys are necessary to assess the status of the gibbon population at this site.

No data is available from Nui Giang Man proposed nature reserve (Quang Binh province). Surveys should be conducted in order to assess the quality of this forest and the status of gibbons. A boundary for this protected area has not yet been defined but this should aim to include intervening forest areas between Vu Quang Nature Reserve and Phong Nha-Ke Bang proposed national park.

Phong Nha-Ke Bang proposed national park is certainly one of the most important sites for primate conservation in Vietnam. Besides the occurrence of two species of loris and four species of macaque, the site is known to support populations of Ha Tinh langur (*Trachypithecus hatinhensis*), endemic to Vietnam; Black langur (*Trachypithecus laotum ebenus*), officially described in 1996; Red-shanked douc langur (*Pygathrix nemaeus nemaeus*) and Southern white-cheeked crested gibbon (*Nomascus leucogenys siki*). Although the provincial people's committee and MARD have approved the extension of the Phong Nha Nature Reserve to include the Ke Bang limestone area and the upgrade of the two areas to national park status, no conservation measures have been implemented so far in the Ke Bang area. Infrastructure development, boundary delineation, assignment and training of rangers,

9. Recommendations

and the development of a national park management plan should happen as soon as possible, because hunting pressure is increasing (see Phong Nha-Ke Bang special data sheet, in: *Vietnam Primate Conservation Status Review 2000, Part II: Leaf Monkeys*).

9.7.5 Yellow-cheeked crested gibbon (*Nomascus gabriellae*)

Although very limited data is available about gibbons in forests in the Central Highlands, it is possible that the largest populations of Yellow-cheeked crested gibbon in Vietnam inhabit this area. Further surveys are necessary in order to assess the status of this species in Quang Nam-Danang, Kon Tum, Gia Lai, Quang Ngai, Binh Dinh and Phu Yen provinces.

Although the above provinces are listed under the heading Yellow-cheeked crested gibbon, it should be stressed that the identity of the gibbons in a large area of Vietnam, stretching from Thua Thien-Hue province in the north to Phu Yen province in the south, has recently been questioned and is essentially unknown. In previous studies, crested gibbons have usually been identified on the basis of fur colouration characteristics alone. Preliminary results based on the analysis of tape-recorded songs of wild crested gibbons suggest that the situation in this area may be much more complex than previously thought (see section 5.5). Tape-recordings of gibbon songs should urgently be carried out in each of the provinces mentioned above.

The forests on the Da Lat and Di Linh plateaus (Lam Dong province) have been heavily disturbed and the evergreen forests are now very fragmented. However, considering the size of these areas, it is very possible that they still support important gibbon populations. Surveys should be conducted in order to assess the gibbon status in these areas.

At Cat Tien National Park, the current status of gibbons should be reassessed and specific conservation measures should be implemented (e.g. a village and school-based conservation awareness programme with particular reference to primates).

9.8 General recommendations

The widespread extinction of crested gibbons from most parts of China (see section 3.1) appears to be a process that is extending into virtually every part of the genus's range.

Today, crested gibbons are among the most threatened primates in the world. Using the IUCN categories of threat (for definitions, see Eudey, 1997), the global populations of White-cheeked crested gibbon should be considered, at least, "Vulnerable" (VU A1cd A2cd), whilst the Yellow-cheeked crested gibbon has recently been recognised as "Vulnerable" (VU A1cd + A2cd). The global status of Western black crested gibbon is clearly "Endangered" (EN A1cd C2a), while the status of Eastern black crested gibbon can only be described as "Critically Endangered" (CR D) (see also Geissmann & Vu Ngoc Thanh, in press), although the taxonomic definition of the species needs to be clarified in order that this classification is appropriately assigned. As shown in the previous sections, the status of the Vietnamese sub-populations appears to be considerably more precarious for each species.

The status of Eastern black crested gibbon is most alarming. The probability that the species will survive the next 50 years is very low. First, it is unclear whether either of the two mainland subspecies still survive in the wild. The Berlin female was caught in 1962, and no second specimen of this taxon has turned up since. There is more museum material of the second mainland subspecies, but the most recently shot museum specimens from north-eastern Vietnam stem from 1965 or 1966. No recent sightings of gibbons have been reported from north-eastern Vietnam, and a survey by one of the authors (TG) on Hainan in 1993 revealed that the population of the island form is probably less than 20 individuals. All available evidence suggests that this may be one of the rarest primate species in the world.

As demonstrated in this article, crested gibbon taxonomy is in a state of flux and is obviously much more complex than assumed only few years ago. Much of the increased knowledge has been brought about by the comparative analysis of gibbon vocalisations pioneered by Marshall and Marshall (1976) and Marler and Tenaza (1977). Still, many details of the crested gibbon radiation and the taxonomy of this group remain unknown. Molecular data may eventually help resolve some of the remaining questions. Tape-recordings are, however, the cheapest method to get at least some information on the affinities of wild gibbon populations.

Vocal data have already proved useful taxonomic tools in various groups of primates (Gautier, 1988; Geissmann, 1993, in press b; Haimoff *et al.*, 1982; Macedonia & Stanger, 1994; Nietsch, 1999; Oates & Trocco, 1983; Snowdon, 1993; Zimmermann, 1990). We recommend that making tape-recordings of loud calls should become a standard procedure when making field surveys of endangered primates.

In this context, it is particularly important to consider, once more, the shrinking areas of suitable habitat in Indochina and the critical status of wild populations of crested gibbons. We can only guess at the number of crested gibbon taxa that may have lived in China in historical times and become extinct during the last 1,000 years. Our concern about vanishing taxa should be directed at saving the remaining populations of crested gibbons. Some of the taxa are virtually on the brink of extinction and some, like the undescribed taxon represented by the enigmatic female which lived at the Berlin Tierpark, may already have died out while we have not even determined the exact origin of this animal. Whereas we may simply have discovered this taxon too late to save it from extinction, it is possible that some other unrecognised taxa may still exist. The zone between the gibbons of the *siki* and the *gabriellae* phenotype is a likely contender, and tape-recordings should urgently be carried out at various latitudes in this large area. Conservation organisations should become aware that this kind of systematic research is of fundamental importance to conservation biology. One cannot efficiently protect animals that have not even been discovered yet.

No long term ecological and behavioural studies have apparently been conducted on crested gibbons. Although it would be important to learn more about the behavioural ecology of these species, we cannot recommend undertaking a long term study in any locality of Vietnam at the present time. Long term studies on behavioural ecology usually necessitate habituating at least one study group of gibbons. Unfortunately, gibbons which are habituated to human observers are ideal targets for hunters. Although gibbon hunting is illegal in Vietnam and although nature reserves exist that are supposed to provide well protected areas for gibbons, we are not aware of any Vietnamese nature reserve which, at this time, can offer efficient and reliable protection of its wild gibbons, habituated or not.

10. REFERENCES

- Adler, H. J., 1991. The crested gibbon *Hylobates (Nomascus) concolor* Harlan 1826, in the Nam Cat Tien Reserve, southern Vietnam. *Primate Report* 29: 59-64.
- Anon., 1990. [*Feasibility study report for establishment of Xuan Son Nature reserve*] (Summary report). FPD of Vinh Phu province, Viet Tri (Vietnamese text).
- Anon., 1991. [*Feasibility study for Xuan Nha Nature Reserve, Son La province*]. People's Committee of Son La province and Provincial FPD, Son La (Vietnamese text).
- Anon., 1993a. [*Feasibility study for Hang Kia-Pa Co Nature Reserve, Mai Chau district, Hoa Binh province*]. People's Committee of Hoa Binh province, Hoa Binh (Vietnamese text).
- Anon., 1993b. [*Investment plan for Dong Son-Ky Thuong Nature Reserve, Hoanh Bo district, Quang Ninh province*]. North-eastern Sub-FIPI, Viet Tri (Vietnamese text).
- Anon., 1993c. [*Management plan for Vu Quang Nature Reserve*]. People's Committee of Ha Tinh province, Ha Tinh (Vietnamese text).
- Anon., 1994a. [*Feasibility study for Bu Gia Map Nature Reserve, Phuoc Long district, Song Be province*]. People's Committee of Song Be province (Vietnamese text).
- Anon., 1994b. [*Investment plan for Tay Con Linh I Nature Reserve, Ha Giang province*]. People's Committee of Ha Giang province, Ha Giang (Vietnamese text).
- Anon., 1994c. [*Feasibility study for Ba Na Nui Chua, Quang Nam-Da Nang province*]. People's Committee of Quang Nam-Da Nang province and MoF (Vietnamese text).
- Anon., 1995a. [*Feasibility study of the Bi Dup-Nui Ba Nature Reserve in Lam Dong*]. People's Committee of Lam Dong province, Da Lat (Vietnamese text, English summary).
- Anon., 1995b. [*Investment plan for Pu Huong Nature Reserve, Nghe An province*]. People's Committee of Nghe An province, Vinh (Vietnamese text).
- Anon., 1995c. [*Management feasibility study for expanding Ben En National Park, Nhu Xuan district, Thanh Hoa province*]. People's Committee of Thanh Hoa province, Thanh Hoa (Vietnamese text).
- Anon., 1997. *Proposed second revision of the Bach Ma National Park management plan*. WWF and European Community, Hue.
- Anon., 1998a. [*An investment plan for Pu Luong Nature Reserve, Thanh Hoa province*]. People's Committee of Thanh Hoa province, Thanh Hoa (Vietnamese text).
- Anon., 1998b. [*Investment plan for Pu Hu Nature Reserve, Thanh Hoa province*]. People's Committee of Thanh Hoa province, Thanh Hoa (Vietnamese text).
- Anon., 1998c. [*Wildlife and plant resources of Xuan Son Nature Reserve, Thanh Son district, Phu Tho province*]. FPD of Phu Tho province, Viet Tri and Management oard of Xuan Son Nature Reserve (Vietnamese text).
- Anon., 1999. [*An investment plan for Kon Cha Rang Nature Reserve, Gia Lai province*]. FIPI, Hanoi (Vietnamese text).
- Bailey, W. J.; Fitch, D. H. A.; Tagle, D. A.; Czelusniak, J.; Slightom, J. L. & Goodman, M., 1991. Molecular evolution of the yb-globin gene locus: Gibbon phylogeny and the hominoid slowdown. *Molecular Biology and Evolution* 8: 155-184.
- Benchley, B. J., 1942. *My friends, the apes*, Little, Brown & Co., Boston.
- Biegert, J., 1973. Dermatoglyphics in gibbons and siamangs. Pp: 163-184 in Rumbaugh, D. M. (ed.), *Gibbon and siamang*, vol. 2, Karger, Basel and New York.
- Bleisch, W. & Chen Nan, 1991. Ecology and behavior of wild black-crested gibbons (*Hylobates concolor*) in China with a reconsideration of evidence of polygyny. *Primates* 32(2): 539-548.
- Bleisch, W. & Jiang, X. L., 2000. *Action plan for conservation of the gibbons of the Wuliang Mountains*, Sino-Dutch Forest Conservation and Community Development Project, Kunming, China.

- Bourret, R., undated but about 1946. *Les mammifères de l'Indochine: Les Gibbons*. Laboratoire des Sciences Naturelles de l'Université Indochinoise, Hanoi.
- Brandon-Jones, D., 1995. A revision of the Asian pied leaf monkeys (Mammalia: Cercopithecidae: superspecies *Semnopithecus auratus*), with a description of a new subspecies. *Raffles Bulletin of Zoology* 43(1): 3-43.
- Brickle, N.; Nguyen Cu; Ha Quy Quynh; Nguyen Thai Tu Cuong & Hoang Van San, 1998. *The status and distribution of Green peafowl, Pavo muticus, in Dak Lak province, Vietnam*. BirdLife International Vietnam Programme (Conservation Report No. 1) and IEBR, Hanoi.
- Brockelman, W. Y. & Schilling, D., 1984. Inheritance of stereotyped gibbon calls. *Nature* 312: 634-636.
- Brockelman, W. Y. & Srikosamatar, S., 1984. Maintenance and evolution of social structure in gibbons. Pp: 298-323 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. & Creel, N. (eds.) *The lesser apes. Evolutionary and behavioural biology*, Edinburgh University Press, Edinburgh, UK.
- Chivers, D. J., 1977. The lesser apes. Pp: 539-598 in Prince Rainier III of Monaco & Bourne, G. H. (eds.) *Primate conservation*, Academic Press, New York.
- Chivers, D. J., 1984a. Feeding and ranging in gibbons: A summary. Pp: 267-281 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. & Creel, N. (eds.) *The lesser apes. Evolutionary and behavioural biology*, Edinburgh University Press, Edinburgh.
- Chivers, D. J., 1984b. Gibbons. Pp: 415-419 in MacDonald, D. (ed.) *The encyclopedia of mammals, vol. 1*, Allen & Unwin, London.
- Collins, N. M.; Sayer, J. A. & Whitmore, T. C., eds. (1991). *The conservation atlas of tropical forests. Asia and the Pacific*. Macmillan Press Ltd., London.
- Couturier, J. & Lernould, J.-M., 1991. Karyotypic study of four gibbon forms provisionally considered as subspecies of *Hylobates (Nomascus) concolor* (Primates, Hylobatidae). *Folia Primatologica* 56: 95-104.
- Cowlshaw, G., 1992. Song function in gibbons. *Behaviour* 121: 131-153.
- Cowlshaw, G., 1996. Sexual selection and information content in gibbon song bouts. *Ethology* 102: 272-284.
- Cox, C. R.; Vu Van Dung & Pham Mong Giao, 1992. *Report of a management feasibility study of the Muong Nhe Nature Reserve (November/December 1991)*. WWF, Ministry of Forestry, Hanoi.
- Creel, N. & Preuschoft, H., 1984. Systematics of the lesser apes: A quantitative taxonomic analysis of craniometric and other variables. Pp: 533-613 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. & Creel, N. (eds.) *The Lesser Apes: Evolutionary and Behavioural Biology*. Edinburgh University Press, Edinburgh, UK.
- Dang Ngoc Can & Nguyen Truong Son, 1999. [Field report of survey on Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) in Bac Can, Thai Nguyen and Tuyen Quang provinces (October and November 1999)]. Unpublished report to FFI-Indochina Programme, Hanoi (Vietnamese text).
- Dao Van Tien, 1983. On the north Indochinese Gibbons (*Hylobates concolor*) (Primates: Hylobatidae) in North Vietnam. *Journal of Human Evolution* 12: 367-372.
- Dao Van Tien, 1985. [Scientific results of some mammals surveys in North Vietnam (1957-1971)]. Scientific and Technics Publishing House, Hanoi (Vietnamese text, English summary).
- Darga, L. L.; Baba, M. L.; Weiss, M. L. & Goodman, M., 1984. Molecular perspectives on the evolution of the lesser apes. Pp: 448-466 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. & Creel, N. (eds.) *The lesser apes. Evolutionary and behavioural biology*, Edinburgh University Press, Edinburgh.
- Dawson, S.; Do Tuoc; Le Vu Khoi & Trinh Viet Cuong, 1993. *Elephant surveys in Vietnam*. WWF-Vietnam Programme, Hanoi.

10. References

- Delacour, J., 1933. On the Indochinese gibbon (*Hylobates concolor*). *Journal of Mammalogy* 14: 71-73.
- Delacour, J., 1934. Les gibbons indochinois. *La Terre et la Vie, Paris* 4(1): 1-12 (French text).
- Delacour, J., 1942. Gibbons – the smallest apes. *Animal Kingdom, New York* 45(2): 34-39.
- Delacour, J., 1951. La systématique des gibbons indochinois. *Mammalia* 15: 118-123 (French text).
- Dene, H. T.; Goodman, M. & Prychodko, W., 1976. Immunodiffusion evidence on the phylogeny of the primates. Pp: 171-195 in Goodman, M., Tashian, R. E. & Tashian, J. H. (eds.), *Molecular anthropology. Genes and proteins in the evolutionary ascent of the primates*, Plenum Press, New York.
- Deputte, B. L., 1982. Duetting in male and female songs of the white-cheeked gibbon (*Hylobates concolor leucogenys*). Pp: 67-93 in Snowdon, S. T., Brown, C. H. & Petersen, M. R. (eds.) *Primate Communication*. Cambridge University Press, Cambridge, UK.
- Desai, A. A. & Vuthy, L., 1996. *Status and distribution of large mammals in eastern Cambodia. Results of the first foot surveys in Mondulhiri and Rattanakiri provinces*. IUCN/FFI/WWF Large Mammal Conservation Project, Phnom Penh, Cambodia.
- Dittrich, L., 1979. Jugendentwicklung, Geschlechtsreife und Wechsel der Färbung des Haarkleides beim Schopfgibbon (*Hylobates concolor leucogenys*). *Bijdragen tot de Dierkunde* 49(2): 247-254 (German text).
- Do Tuoc, 1995. [Features and values of fauna component of the Chu Mom Ray Nature Reserve]. FIPI, Hanoi (Vietnamese text).
- Dong Thanh Hai & Lormée, N., 1999. *Status assessment of the black gibbon (Hylobates concolor concolor) in Van Ban district, Lao Cai province, North Vietnam, 14-28 November 1999*. Unpublished report to FFI-Indochina Programme, Hanoi.
- Duckworth, J. W.; Salter, R. E. & Khounboline, K. (comp.), 1999. *Wildlife in Lao PDR, 1999 status report*. IUCN, WCS and CPAWM, Vientiane
- Duckworth, J. W.; Timmins, R. J.; Anderson, G. Q. A.; Thewlis, R. M.; Nemeth, E.; Evans, T. D.; Dvorak, M. & Cozza, K. E. A., 1995. Notes on the status and conservation of the gibbon *Hylobates (Nomascus) gabriellae* in Laos. *Tropical Biodiversity* 3(1): 15-27.
- Eames, J. C., 1995. Endemic birds and protected area development on the Da Lat plateau, Vietnam. *Bird Conservation International*. 5(4): 491-523.
- Eames, J. C. & Nguyen Cu, 1994. *A management feasibility study of Thuong Da Nhim and Chu Yang Sin Nature Reserves on the Da Lat plateau, Vietnam*. WWW Vietnam Programme, Hanoi.
- Eames, J. C. & Robson, C. R., 1993. Threatened primates in southern Vietnam. *Oryx* 27: 146-154.
- Eames, J. C.; Robson, C. R.; Wolstencroft, J. A.; Nguyen Cu & Truong Van La, 1988. *Pheasant surveys 1988*. Vietnam Forest Project.
- Edmont-Blanc, F., 1932. Les gibbons d'Indochine. *La Terre et la Vie, Paris* 2(6): 363-365.
- Eudey, A. A., 1997. Asian primate conservation: The species and the IUCN/SSC primate specialist network. *Primate Conservation* 17: 101-110.
- Felsenstein, J., 1987. Estimation of hominoid phylogeny from a DNA hybridization data set. *Journal of Molecular Evolution* 26: 123-131.
- Fischer, W., 1965. *Das Jahr mit den Gibbons*, A. Ziemsen Verlag, Wittenberg Lutherstadt (German text).
- Fischer, W., 1980. Einige Ergänzungen zur Haltung und Entwicklung des Schopfgibbons, *Hylobates (Nomascus) concolor* (Harlan). *Milu Berlin* 5: 167-193 (German text).
- Fischer, W., 1981. Forschende Kamera – Farbwechsel beim Schopfgibbon. *Urania, Leipzig* 57(10): 2-5 (German text).
- Fleagle, J. G., 1999. *Primate adaptation and evolution, second edition*, Academic Press, San Diego and London.

- Fooden, J., 1987. Type locality of *Hylobates concolor leucogenys*. *American Journal of Primatology* 12: 107-110.
- Fooden, J., 1996. Zoogeography of Vietnamese Primates. *International Journal of Primatology* 17(5): 845-899.
- Fooden, J., Quan G. & Luo Y., 1987. Gibbon distribution in China. *Acta Theriologica Sinica* 7(3): 161-167.
- Gao, Y.; Wen, H. & He, Y., 1981. [The change of historical distribution of Chinese gibbons (*Hylobates*)]. *Zoological Research* 2: 1-8 (Chinese text, English summary).
- Garza, J. C. & Woodruff, D. S., 1992. A phylogenetic study of the gibbons (*Hylobates*) using DNA obtained noninvasively from hair. *Molecular Phylogeny and Evolution* 1: 202-210.
- Garza, J. C. & Woodruff, D. S., 1994. Crested gibbon (*Hylobates* [*Nomascus*]) identification using noninvasively obtained DNA. *Zoo Biology* 13: 383-387.
- Gautier, J.-P., 1988. Interspecific affinities among guenons as deduced from vocalizations. Pp: 194-226 in Gautier-Hion, A.; Bourlière, F.; Gautier, J.-P. & Kingdon, J. (eds.) *A primate radiation. Evolutionary biology of the African guenons*, Cambridge University Press, Cambridge and New York.
- Geissmann, T., 1984. Inheritance of song parameters in the gibbon song, analyzed in 2 hybrid gibbons (*Hylobates pileatus* x *H. lar*). *Folia Primatologica* 42: 216-235.
- Geissmann, T., 1989. A female black gibbon, *Hylobates concolor* subspecies, from northeastern Vietnam. *International Journal of Primatology* 10: 455-476.
- Geissmann, T., 1991. The Spaeth gibbon collection. *Natural History Bulletin of the Siam Society* 39: 53-70.
- Geissmann, T., 1993. *Evolution of communication in gibbons (Hylobatidae)*, Ph.D. thesis, Anthropological Institute, Philosoph. Faculty II, Zürich University.
- Geissmann, T., 1994. Systematik der Gibbons. *Zeitschrift des Kölner Zoo* 37: 65-77 (German text, English abstract).
- Geissmann, T., 1995a. Captive management and conservation of gibbons in China and Vietnam, with special reference to crested gibbons (*Hylobates concolor* group). *Primate Report* 42: 29-41.
- Geissmann, T., 1995b. Gibbon systematics and species identification. *International Zoo News* 42: 467-501.
- Geissmann, T., 1995c. The yellow-cheeked gibbon (*Hylobates gabriellae*) in Nam Bai Cat Tien (southern Vietnam) revisited. *Primates* 36: 447-455.
- Geissmann, T., 1996. Einsichten in der Affensystematik. *UniZürich (Magazin der Universität Zürich)* 1996(2): 71 (German text).
- Geissmann, T., 1997. New sounds from the crested gibbons (*Hylobates concolor* group): First results of a systematic revision. Pp: 170 in Zissler, D. (ed.) *Verhandlungen der Deutschen Zoologischen Gesellschaft: Kurzpublikationen – Short Communications, 90. Jahresversammlung 1997 in Mainz*, Gustav Fischer, Stuttgart.
- Geissmann, T., 1998. Body weight in wild gibbons (Hylobatidae). *Abstracts, XVIIth Congress of the International Primatological Society*, August 10-14, 1998, abstract no. 282.
- Geissmann, T., 1999. Duet songs of the siamang, *Hylobates syndactylus*: II. Testing the pair-bonding hypothesis during a partner exchange. *Behaviour* 136: 1005-1039.
- Geissmann, T., 2000. Gibbon songs and human music from an evolutionary perspective. Pp: 103-123 in Wallin, N. L.; Merker, B. & Brown, S. (eds.) *The origins of music*. MIT Press, Cambridge, Massachusetts.
- Geissmann, T. in press a. Duett-splitting and the evolution of gibbon songs. *Biological Reviews* 77.
- Geissmann, T. in press b. Taxonomy and evolution of gibbons. In Soligo, C.; Anzenberger, G. & Martin, R. D. (eds.) *Anthropology and primatology into the third millennium: The Centenary Congress of the Zürich Anthropological Institute (Evolutionary Anthropology Vol. 11, Supplement 1)*. Wiley-Liss, New York.

10. References

- Geissmann, T. & Lim, K. K. P., 1994. Extraction of bacula from tanned gibbon skins. *Raffles Bulletin of Zoology* 42: 29-41.
- Geissmann, T. & Orgeldinger, M., 2000. The relationship between duet songs and pair bonds in siamangs (*Hylobates syndactylus*). *Animal Behaviour* 60: 805-809.
- Geissmann, T. & Vu Ngoc Thanh, in press. Preliminary results of a primate survey in northeastern Vietnam, with special reference to gibbons. *Asian Primates* 7(3-4): 0-4.
- Gerhardt, U., 1909. Ueber das Vorkommen eines Penis- und Clitorisknochens bei Hylobatiden. *Anatomischer Anzeiger, Jena* 35: 353-358 (German text).
- Ghazoul, J. & Le Mong Chan, 1994. *Nui Oang Lien Nature Reserve*. SEE Vietnam Forest Research Programme, Hanoi.
- Ghazoul, J.; Le Mong Chan & Listen, K., 1994. *Scientific report for Ba Na Nature Reserve, Vietnam*. SEE, London, MoF, Hanoi and Department of Forestry, Danang.
- Goldman, D.; Giri, P. R. & O'Brien, S. J., 1987. A molecular phylogeny of the hominoid primates as indicated by two-dimensional protein electrophoresis. *Proceedings of the National Academy of Sciences, USA* 84: 3307-3311.
- Goodman, M.; Porter, C. A.; Czelusniak, J.; Page, S. L.; Schneider, H.; Shoshani, J.; Gunnell, G. & Groves, C. P., 1998. Toward a phylogenetic classification of primates based on DNA evidence complemented by fossil evidence. *Molecular Phylogenetics and Evolution* 9: 585-598.
- Goodman, M.; Tagle, D. A.; Fitch, D. H. A.; Bailey, W.; Czelusniak, J.; Koop, B. F.; Benson, P. & Slightom, J. L. (1990). Primate evolution at the DNA level and a classification of hominoids. *Journal of Molecular Evolution* 30: 260-266.
- Goustard, M., 1976. The vocalizations of *Hylobates*. Pp. 135-166 in Rumbaugh, D. M. (ed.), *Gibbon and siamang, vol. 4*, Karger, Basel and New York.
- Goustard, M., 1984. Patterns and functions of loud calls in the concolor gibbon. Pp. 404-415 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. & Creel, N. (eds.) *The lesser apes. Evolutionary and behavioural biology*, Edinburgh University Press, Edinburgh.
- Gray, J. E., 1861. List of mammalia, tortoises and crocodiles collected by M. Mouhot in Camboja. *Proceedings of the Zoological Society, London* 1861: 135-140.
- Groves, C. P., 1972. Systematics and phylogeny of gibbons. Pp. 1-89 in Rumbaugh, D. M. (eds.), *Gibbon and Siamang, Vol. 1 Evolution, Ecology, Behavior, and Captive Maintenance*. S. Karger, Basel, Switzerland.
- Groves, C. P., 1984. A new look at the taxonomy and phylogeny of the gibbons. Pp. 542-561 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. & Creel, N. (eds.) *The Lesser Apes: Evolutionary and Behavioural Biology*. Edinburgh University Press Edinburgh, UK.
- Groves, C. P., 1989. *A theory of human and primate evolution*. Clarendon Press, Oxford, UK.
- Groves, C. P., 1993. Speciation in living hominoid primates. Pp. 109-121 in Kimbel, W. H. & Martin, L. B. (eds.) *Species, species concepts, and primate evolution*, New York and London, Plenum Press.
- Groves, C. P. in press. *Primate taxonomy*, Smithsonian Institution Press, Washington, D.C.
- Groves, C. P. & Wang, Y., 1990. The gibbons of the subgenus *Nomascus* (Primates, Mammalia). *Zoological Research* 11(2): 148-154.
- Haimoff, E. H., 1983. *Gibbon songs: An acoustical, organizational, and behavioural analysis*, Ph.D. diss., University of Cambridge.
- Haimoff, E. H., 1984a. Acoustic and organizational features of gibbon songs. Pp. 333-353 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. & Creel, N. (eds.) *The lesser apes. Evolutionary and behavioural biology*, Edinburgh University Press, Edinburgh.
- Haimoff, E. H., 1984b. The organization of song in the Hainan black gibbon (*Hylobates concolor hainanus*). *Primates* 25: 225-235.
- Haimoff, E. H.; Chivers, D. J.; Gittins, S. P. & Whitten, A. J., 1982. A phylogeny of gibbons (*Hylobates* spp.) based on morphological and behavioural characters. *Folia Primatologica* 39: 213-237.

- Haimoff, E. H.; Gittins, S. P.; Whitten, A. J. & Chivers, D. J., 1984. A phylogeny and classification of gibbons based on morphology and ethology. Pp. 614-632 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. & Creel, N. (eds.), *The lesser apes. Evolutionary and behavioural biology*, Edinburgh University Press, Edinburgh.
- Haimoff, E. H.; Yang, X.-J.; He, S.-J. & Chen, N., 1986. Census and survey of wild black-crested gibbons (*Hylobates concolor concolor*) in Yunnan province, People's Republic of China. *Folia Primatologica* 46: 205-214.
- Haimoff, E. H.; Yang, X.-J.; He, S.-J. & Chen, N., 1987. Preliminary observations of wild black-crested gibbons (*Hylobates concolor concolor*) in Yunnan province, People's Republic of China. *Primates* 28: 319-335.
- Hellekant, G.; Du Bois, G.; Geissmann, T.; Glaser, D. & Van der Weel, H., 1990. Taste responses of chorda tympani proper nerve in the white-handed gibbon (*Hylobates lar*). Pp. 115-131 in Døving, K. B. (ed.), *ISOT X. Proceedings of the Tenth International Symposium on Olfaction and Taste held at the University of Oslo, Norway, July 16-20, 1989*, GCS (Graphic Communication System) A.S., Oslo.
- Hill, M.; Hallam, D. & Bradeley, J., 1996a. *Ba Be National Park biodiversity survey 1996*. SEE Vietnam Forest Research Programme, Hanoi and SEE, London.
- Hill, M.; Nguyen Kiem Son; Le Mong Chan & Harrison, E.-M., 1996b. *Site description and conservation evaluation: Ba Na forest reserve, Quang Nam-Da Nang province, Vietnam*. Frontier Vietnam Forest Research Programme, Hanoi.
- Hill, M.; Hallam, D. & Bradeley, J., 1997. *Muong Nhe Nature Reserve biodiversity survey 1997*. Frontier Vietnam Forest Research Programme, Hanoi.
- Hilton-Taylor, C., 2000. *2000 IUCN Red list of threatened species*. Listing for Cambodia, Laos, and Vietnam. Cat Tien National Park, Vietnam.
- Hu, Y.; Xu, H. & Yang, D., 1989. [The studies on ecology in *Hylobates leucogenys*]. *Zoological Research* 10(Supplement): 61-67 (Chinese text, English summary).
- Ibscher, L., 1964. *Verhaltensstudien an Weisschandgibbons (Hylobates lar) im Zürcher Zoologischen Garten*, Diploma thesis, Zoologisches Institut, Universität Zürich (German text).
- Jenkins, P. D., 1990. *Catalogue of primates in the British Museum (Natural History) and elsewhere in the British Isles; part V: The apes, superfamily Hominoidea*, British Museum (Natural History), London.
- Jiang, X.; Ma, S.; Wang, Y.; Sheeran, L. K.; Poirier, F. E. & Wang, Q., 1994. [Group size and composition of black crested gibbons]. *Zoological Research* 15(2): 15-22 (Chinese text, English summary).
- Kemp, N. & Dilger, M., 1996. *Site description and conservation evaluation: Bu Huong proposed nature reserve Quy Chau district, Nghe An province, Vietnam*. Frontier Vietnam Forest Research Programme, Hanoi.
- Kemp, N.; Le Mong Chan & Dilger, M., 1994. *Site description and conservation evaluation: Ba Be National Park, Cao Bang province, Vietnam*. Frontier Vietnam Forest Research Programme, Hanoi, Vietnam.
- Kemp, N.; Le Mong Chan & Dilger, M., 1995. *Site description and conservation Evaluation: Pu Mat Nature Reserve, Con Cuong district, Nghe An province, Vietnam*. Frontier Vietnam Forest Research Programme, Hanoi.
- Kloss, C. B., 1929. Some remarks on the gibbons with a new subspecies. *Proceedings of the Zoological Society of London* 1929: 113-127.
- Kon Tum Provincial FPD, 2000. Questionnaire returned to Forest Protection Department of the Ministry of Agriculture and Rural Development.
- Kunckel d'Herculais, J., 1884. Le gibbon du Tonkin rapporté par le Docteur Harmand. *Science et Nature* 2(33): 86-90 (French text).
- Lambert, F. A.; Eames, J. C. & Nguyen Cu, 1994. *Surveys for endemic pheasants in the Annamese lowlands of Vietnam, June-July, 1994*. NWF, IUCN, WWF Programme for Endangered Species in Asia.

10. References

- Lan, D., 1989a. [Study on the group composition, behavior, ecology and conservation of the black gibbons (*Hylobates concolor*) in south-west Yunnan]. M.Sc. thesis, Kunming Institute of Zoology, Kunming (Chinese text, English summary).
- Lan, D., 1989b. [Preliminary study on the group composition, behavior and ecology of the black gibbons (*Hylobates concolor*) in south-west Yunnan]. *Zoological Research* 10(Supplement): 119-126 (Chinese text, English summary).
- Lan D., 1993. Feeding and vocal behaviours of black gibbons (*Hylobates concolor*) in Yunnan: a preliminary study. *Folia Primatologica* 60: 94-105.
- Lan, D. in prep. *Ecology and behavior of black gibbon in Yunnan, China*. Ph.D. thesis, Sub-Department of Veterinary Anatomy, University of Liverpool.
- Lan, D. & Guo, G., 1995. Present status on conservation of primates in Lincang district of Yunnan. *Chinese Primate Research and Conservation News* 4(2): 4-7.
- Lan, D. & Sheeran, L. K., 1995. The status of black gibbons (*Hylobates concolor jingdongensis*) at Xiaobahe, Wuliang Mountains, Yunnan province, China. *Asian Primates* 5(1-2): 2-4.
- Lan, D.; He, S. & Shu, L., 1990. Preliminary observations on the group composition of the wild concolor gibbons (*Hylobates concolor*) in Yunnan, China. *Primate Report* 26: 89-96.
- Le Trong Trai, 1999a. *A feasibility study for the establishment of Xuan Lien Nature Reserve, Thanh Hoa province, Vietnam*. BirdLife International Vietnam Programme and FIPI, Hanoi.
- Le Trong Trai, 1999b. [Fauna and flora of Kon Chu Rang Nature Reserve, Gia Lai province]. MARD and FIPI, Hanoi (Vietnamese text).
- Le Trong Trai, 2000. *An investment plan for Kon Ka Kinh Nature Reserve, Gia Lai province, Vietnam. A Contribution to the Management Plan*. BirdLife International Vietnam Programme and FIPI, Hanoi.
- Le Trong Trai; Nguyen Cu; Le Van Cham; Eames, J. C. & Tran Van Khoa, 1996a. [Biodiversity study to consider the feasibility to extend Chu Yang Sin Nature Reserve, Dak Lac province]. MARD and People's Committee of Dak Lak province, Buon Na Thuot (Vietnamese text).
- Le Trong Trai; Nguyen Huy Dung; Nguyen Cu; Le Van Cham; Eames, J. C. & Chicoine, G., 1996b. *An investment plan for Ke Go Nature Reserve, Ha Tinh province, Vietnam. A Contribution to the Management Plan*. BirdLife International Vietnam Programme and FIPI, Hanoi.
- Le Trong Trai & Richardson, W. J., 1999a. *A feasibility study for the establishment of Phong Dien (Thua Thien Hue province) and Dakrong (Quang Tri province) Nature Reserves, Vietnam*. BirdLife International Vietnam Programme and FIPI, Hanoi.
- Le Trong Trai & Richardson, W. J., 1999b. *An investment plan for Ngoc Linh Nature Reserve, Kon Tum province, Vietnam. A Contribution to the management plan*. BirdLife International Vietnam Programme and FIPI, Hanoi, Hanoi.
- Le Trong Trai & Tran Hieu Minh, 2000. *A rapid field survey of Kalon Song Mao Nature Reserve (Binh Thuan province) and Lo Go-Sa Mat Nature Reserve (Tay Ninh province), Vietnam*. BirdLife international Vietnam Programme and FIPI, Hanoi.
- Le Xuan Canh, 1995. *A report on the survey for large carnivores in Tay Nguyen plateau, South Vietnam with emphasis on tiger (Panthera tigris)*. WCS, Hanoi.
- Le Xuan Canh & Pham Nhat, 1997. *Report on preliminary results of survey on Hainan gibbon (Hylobates concolor hainanus)*. Unpublished survey report, March 1997, Hanoi.
- Le Xuan Canh; Pham Trong An; Duckworth, J.W.; Vu Ngoc Thanh & Vuthy, L., 1997a. *A survey of large mammals in Dak Lak province, Vietnam*. WWF and IUCN, Hanoi.
- Le Xuan Canh; Truong Van La; Dang Thi Dap; Ho Thu Cuc; Ngo Anh Dao; Nguyen Ngoc Chinh; Nguyen Quoc Dung; Pham Nhat; Nguyen Thai Tu; Nguyen Quoc Thang & Tran Minh Hien, 1997b. *A report on field surveys on biodiversity in Phong Nha-Ke Bang Forest (Quang Binh province) central Vietnam*. WWF and UNDP, Hanoi.

- Leighton, D. R., 1987. Gibbons: Territoriality and monogamy. Pp. 135-145 in Smuts, B. B., Cheney, D. L., Seyfarth, R. M., Wrangham, R. W. & Struhsaker, T. T. (eds.) *Primate societies*, University of Chicago Press, Chicago and London.
- Lekagul, B. & McNeely, J. A., 1977. *Mammals of Thailand*, Sahakarnbhat Co., Association for the Conservation of Wildlife, Bangkok.
- Lewis, N., 1951. *A dragon apparent. Travels in Cambodia, Laos, and Vietnam*, Eland Books, London.
- Ling, S., 2000. *A survey of wild cattle and other mammals, Cat Tien National Park*. WWF-Cat Tien Conservation Project.
- Lippold, L. K., 1977. The douc langur: A time for conservation. Pp. 513-538 in Prince Rainier III & Bourne, G. H. (eds.) *Primate conservation*. Academic Press, New York.
- Lippold, L. K., 1995. Distribution and conservation status of Douc langurs in Vietnam. *Asian Primates* 4(4): 4-6.
- Liu, Z. & Tan, C., 1990. [An analysis on habitat structure of the Hainan gibbon]. *Acta Theriologica Sinica* 10(3): 163-169 (Chinese text, English summary).
- Liu, R.; Shi, L. & Chen, Y., 1987a. [A study on the chromosomes of white-browed gibbon (*Hylobates hoolock leuconedys*)]. *Acta Theriologica Sinica* 7: 1-7 (Chinese text, English summary).
- Liu, Z.; Jiang, H.; Zhang, Y.; Liu, Y.; Chou, T.; Manry, D. & Southwick, C., 1987b. Field report on the Hainan gibbon. *Primate Conservation* 8: 49-50.
- Liu, Z.; Yu, S. & Yuan, X., 1984. [The resources of the Hainan black gibbon at its present situation]. *Chinese Wildlife* 1984(6): 1-3 (Chinese text).
- Liu, Z.; Zhang, Y.; Jiang, H. & Southwick, C., 1989. Population structure of *Hylobates concolor* in Bawanglin Nature Reserve, Hainan, China. *American Journal of Primatology* 19: 247-254.
- Long, B., 1999. *The large mammals of Pu Mat Nature Reserve, Nghe An province, Vietnam*. Report to SFNC in Nghe An province, Vinh.
- Long, B. & Swan, S. R., 2000. *Cambodian Primates: Surveys of the Cardamom mountains and Monduliri province, Cambodia*. FFI - Indochina Programme, Hanoi.
- Long, B.; Le Khac Quyet; Phung Van Khoa & Haupt K., 2000a. *An assessment of the potential and priorities for conservation in Van Ban district, Lao Cai province*. FFI - Indochina Programme, Hanoi.
- Long, B.; Tallents, L. & Tran Dinh Nghia, 2000b. *The biological diversity of Che Tao district, Yen Bai province*. FFI - Indochina Programme, Hanoi.
- Long, B.; Swan, S. R. & Kry Masphal, 2000c. *Biological surveys in northeast Monduliri, Cambodia*. FFI - Indochina Programme and the Wildlife Protection Office, Hanoi and Phnom Penh.
- Ma S. & Wang Y., 1986. [The taxonomy and distribution of the gibbons in southern China and its adjacent region, with description of three new subspecies]. *Zoological Research* 7: 393-410 (Chinese text, English summary).
- Ma S.; Wang Y. & Poirier, F. E., 1988. Taxonomy, distribution, and status of gibbons (*Hylobates*) in Southern China and adjacent areas. *Primates* 292: 277-286.
- Macedonia, J. M. & Stanger, K. F., 1994. Phylogeny of the Lemnidae revisited: Evidence from communication signals. *Folia Primatologica* 63: 1-43.
- Marler, P. & Tenaza, R., 1977. Signaling behavior of apes with special reference to vocalization. Pp. 965-1033 in Sebeok, T. A. (ed.) *How animals communicate*, Indiana University Press, Bloomington and London.
- Marshall, J. T. & Marshall, E. R., 1976. Gibbons and their territorial songs. *Science* 193: 235-237.
- Marshall, J. T. & Marshall, E. R., 1978. *The gibbons: Songs of all species recorded in their natural forest habitat (phonograph disc)*, ARA-Records, Hardy, J.W. & Hardy, C.K. (eds.) 1615 NW 14th Ave., Gainesville, FL 32605, USA.

10. References

- Marshall, J. T. & Sugardjito, J., 1986. Gibbon systematics. Pp. 137-185 in Swindler, D. R. & Erwin, J. (eds.), *Comparative primate biology, vol. 1: Systematics, evolution, and anatomy*, Alan R. Liss, New York.
- Martin, E. B. & Phipps, M., 1996. A review of the wild animal trade in Cambodia. *TRAFFIC Bulletin Vol.16 No.2*. Pp: 45-60.
- McCann, C., 1933. Notes on the colouration and habits of the white-browed gibbon or hoolock (*Hylobates hoolock* Harl.). *Journal of the Bombay Natural History Society* 36: 395-405, + 2 plates.
- Merker, B. & Cox, C., 1999. Development of the female great call in *Hylobates gabriellae*: A case study. *Folia Primatologica* 70: 97-106.
- Mitani, J. C., 1990. Experimental field studies of Asian ape social systems. *International Journal of Primatology* 11: 103-126.
- Napier, J. R. & Napier, P., 1967. *A handbook of living primates*. Academic Press, London.
- Ngo Van Tri, 1999a. *Preliminary assessment on the mammal in Tuong Limestone Mountain, Ba Thuoc district, Thanh Hoa province*. Unpublished report to FFI-Indochina Programme, Hanoi.
- Ngo Van Tri, 1999b. *The result on mammals survey in Bien Lac-Nui Ong Nature Reserve, Thanh Linh district, Binh Thuan province*. Unpublished report to FFI-Indochina Programme, Hanoi.
- Ngo Van Tri, 2000. *Survey of elephants in Cu Jut and Dak Mil districts, Dak Lak province (April 2000)*. Unpublished report to FFI-Indochina Programme, Hanoi.
- Ngo Van Tri & Day, A., 1999. *The biological diversity on the mammals in Tan Phu State forest enterprise*. Unpublished report to FFI-Indochina Programme, Hanoi.
- Ngo Van Tri & Long, B., 1999. *A report of survey on black gibbon - Hylobates concolor concolor in Son La province (North Vietnam), October-November, 1999*. Unpublished report to FFI-Indochina Programme, Hanoi.
- Ngo Van Tri & Lormée, N., 2000. *Survey on primates in Kim Hy proposed nature reserve, Na Ry district, Bac Can province, northeastern Vietnam*. Unpublished report to FFI-Indochina Programme, Hanoi.
- Nguyen Xuan Dang & Lormée, N., 1999. *A report of survey on black gibbon (Hylobates concolor concolor) in Yen Bai and Phu Tho provinces (North Vietnam), October-November, 1999*. Unpublished report to FFI-Indochina Programme, Hanoi.
- Nietsch, A., 1999. Duet vocalizations among different populations of Sulawesi tarsiers. *International Journal of Primatology* 20: 567-583.
- Oates, J. F. & Trocco, T. F., 1983. Taxonomy and phylogeny of black-and-white colobus monkeys. Inferences from an analysis of loud call variation. *Folia Primatologica* 40: 83-113.
- Peart, J. F., 1935. Notes on the colouration of the white-browed gibbon (*H. hoolock* Harl.). *Journal of the Bombay Natural History Society* 37: 214.
- Pham Binh Quyen & Truong Quang Hoc, 1997. *Study on socio-economic root causes of biodiversity loss in two distinct regions of Vietnam. Case studies of Ba Be National Park and Na Hang Nature Reserve in the mountainous north and Yok Don National Park in the Central Highlands: final report*. Centre for Natural Resources and Environmental Studies, Hanoi.
- Pham Nhat, 1991. [To protect the Tonkin snub-nosed monkey]. *Forestry College* 2: 15-17, Xuan May, Vietnam (Vietnamese text).
- Pham Nhat & Nguyen Xuan Dang, 1999. *Primates in Phong Nha-Ke Bang area: the status overview and recommendations for further survey and monitoring*. (Draft). Forestry College of Vietnam, Xuan May, IEBC and WWF-Indochina Programme, Hanoi.
- Phung Van Khoa & Lormée, N., 2000. *Primate status assessment in Bac Kan province, North Vietnam, January 2000, with a special reference to the black gibbon (Hylobates concolor)*. Unpublished report to FFI-Indochina Programme, Hanoi.

- Pham Nhat; Do Tuoc; Tran Quoc Bao; Pham Mong Giao; Vu Ngoc Thanh & Le Xuan Canh, 1998. Distribution and status of vietnamese primates. *Proceedings Workshop on a Conservation Action Plan for the Primates of Vietnam, Hanoi; November 1998*.
- Pocock, R. I., 1905. Observations upon a female specimen of the Hainan gibbon (*Hylobates hainanus*), now living in the Society's Gardens. *Proceedings of the Zoological Society, London* 1905(2): 169-180, + 1 plate.
- Pousargues, E., de 1896. Sur un gibbon d'espèce nouvelle provenant du Haut-Tonkin. *Bulletin du Muséum d'Histoire Naturelle, Paris* 2(8): 367-369.
- Prouty, L. A.; Buchanan, P. D.; Pollitzer, W. S. & Mootnick, A. R., 1983a. *Bunopithecus*: A genus-level taxon for the hoolock gibbon (*Hylobates hoolock*). *American Journal of Primatology* 5: 83-87.
- Prouty, L. A.; Buchanan, P. D.; Pollitzer, W. S. & Mootnick, A. R., 1983b. A presumptive new hylobatid subgenus with 38 chromosomes. *Cytogenetics and Cell Genetics* 35: 141-142.
- Raemaekers, J. J. & Raemaekers, P. M., 1985. Field playback of loud calls to gibbons (*Hylobates lar*): territorial, sex-specific and species-specific responses. *Animal Behavior* 33: 481-493.
- Raintree, J. B.; Le Thi Phi & Nguyen Van Duong, 1999. *Report on a diagnostic survey of conservation problems and development opportunities in the buffer zone of Ke Go Nature Reserve*. MARD and Forest-Science Institute of Vietnam.
- Ratajszczak, R.; Cox, R. & Ha Dinh Duc, 1990. *A preliminary survey of primates in north Viet Nam*, Unpublished Report, WWF Project 3869.
- Remane, A., 1921. Beiträge zur Morphologie des Anthropoidengebisses. *Wiegmann-Archiv für Naturgeschichte* 87 (Abt. A)(11): 1-179.
- Robson, C., 1990. *Primate surveys in Viet Nam 1989-90*, Unpublished report.
- Rowe, N., 1996. *The pictorial guide to the living primates*, Pogonias Press, East Hampton, New York.
- Rozendaal, F., 1990. *Report on surveys in Hoang Lien Son, Lai Chau and Nghe Tinh provinces*. Unpublished report to WWF.
- Roznov, V. V.; Nikolski, A. A. & Kuznetsov, G. V., 1986. [Vocal activity of gibbons on the Tainguen-Plateau]. Pp. 23-30 in Sokolov, V. E. (ed.) *[Fauna and ecology of mammals and birds in Vietnam]*, Academy of Sciences of the USSR, Institute for Evolutionary Morphology and Ecology of Animals "A.N. Severtsov", Nauka, Moscow, (Russian text).
- Sarich, V. M. & Cronin, J. E., 1976. Molecular systematics of the primates. Pp. 141-170 in Goodman, M.; Tashian, R. E. & Tashian, J. H. (eds.) *Molecular anthropology. Genes and proteins in the evolutionary ascent of the primates*, Plenum Press, New York.
- Sawalischin, M., 1911. Der Musculus flexor communis brevis digitorum pedis in der Primatenreihe, mit spezieller Berücksichtigung der menschlichen Varietäten. *Morphologisches Jahrbuch* 42: 557-663.
- Schilling, D., 1984. Song bouts and duetting in the concolor gibbon. Pp. 390-403 in Preuschoft, H.; Chivers, D. J.; Brockelman, W. Y. and Creel, N. (eds.) *The lesser apes. Evolutionary and behavioural biology*, Edinburgh University Press, Edinburgh.
- Schultz, A. H., 1933. Observations on the growth, classification and evolutionary specialization of gibbons and siamangs. *Human Biology* 5: 212-255, and 385-428.
- Schultz, A. H., 1973. The skeleton of the Hylobatidae and other observations on their morphology. Pp. 1-54 in Rumbaugh, D. M. (ed.) *Gibbon and siamang, vol. 2*, Karger, Basel and New York.
- Shafer, D. A., 1986. Evolutionary cytogenetics of the siabon (gibbon-siamang) hybrid apes. Pp. 226-239 in Taub, D. M. & King, F. A. (eds.) *Current perspectives in primate biology*, Van Nostrand Reinhold Company, New York.
- Sheeran, L. K., 1993. *A preliminary study of the behavior and socio-ecology of black gibbons (Hylobates concolor) in Yunnan province, People's Republic of China*, Ph.D. thesis, Ohio State University.

10. References

- Sheeran, L. K., 1995. Behavior of wild black gibbons (*Hylobates concolor jingdongensis*). Pp., 203-220 in Xia W. & Zhang Y. (eds.) *Chinese primate research and conservation*, China Forestry Publishing House, Beijing.
- Sheeran, L. K. & Poirier, F., 1990. The black-crested gibbon of China. *Primate Conservation* 11: 20-22.
- Sheeran, L. K.; Zhang, Y.; Poirier, F. E. & Yang, D., 1998. Preliminary report on the behavior of the Jingdong black gibbon (*Hylobates concolor fuvogaster*). *Tropical Biodiversity* 5: 113-125.
- Sibley, C. G. & Ahlquist, J. E., 1984. The phylogeny of hominoid primates, as indicated by DNA-DNA hybridization. *Journal of Molecular Evolution* 20: 2-15.
- Sibley, C. G. & Ahlquist, J. E., 1987. DNA hybridization evidence of hominoid phylogeny: Results from an expanded data set. *Journal of Molecular Evolution* 26: 99-121.
- Simonetta, A., 1957. Catalogo e sinonimia annotata degli ominoidi fossili ed attuali (1758-1955). *Atti Soc. Toscana Sci. Nat., Pisa, Ser. B* 64: 53-113.
- Srikosamatara, S. & Brockelman, W. Y., 1987. Polygyny in a group of pileated gibbons via a familial route. *International Journal of Primatology* 8: 389-393.
- Tan, B., 1985. The status of primates in China. *Primate Conservation* 5: 63-81.
- Tenaza, R., 1985. Songs of hybrid gibbons (*Hylobates lar* x *H. muelleri*). *American Journal Primatology* 8: 249-253.
- Thai Truyen, 1997. *Integrative approaches for biodiversity conservation in Vietnam with a case study of the Chu Mom Ray Nature Reserve, Kon Tum province, Central Highlands*. Masters thesis submitted to Department of Forestry, Australian National University.
- Thomas, O., 1892. Notes on the gibbon of the island of Hainan (*Hylobates hainanus*, sp. n.). *Ann. Mag. Nat. Hist.* (Ser. 6) 9:145-146.
- Thomas, O., 1909. A new gibbon from Annam. *The Annals and Magazines of Natural History, London* 4: 112-113.
- Thomas, O., 1929. The Delacour exploration of French Indo-China. – Mammals, III: Mammals collected during the winter of 1927-1928. *Proceedings of the Zoological Society, London* 1928(4): 831-841.
- Timmins, R. J.; Baltzer, M. C. & Round P. D., 1998. *Technical report on the biodiversity survey of Pu Mat Nature Reserve, Ch. 7: Large mammals*. SFNC in Nghe An province, Vinh, Vietnam.
- Timmins, R. J.; Do Tuoc; Trinh Viet Cuong & Hendrichsen, D. K., 1999. *A preliminary assessment of the conservation importance and conservation priorities of the Phong Nha-Ke Bang National Park, Quang binh province, Vietnam*. FFI-Indochina Programme, Hanoi.
- Tordoff, A. W.; Siurua, H. & Sobey, R., 1997. *Ben En National Park, biodiversity survey 1997*. Frontier Vietnam Forest Research Programme, Hanoi.
- Tordoff, A. W.; Swan, S.; Grindley, M. & Siurua, H., 1999. *Hoang Lien Nature Reserve, biodiversity survey and conservation evaluation 1997/98*. Frontier Vietnam Forest Research Programme, Hanoi.
- Tordoff, A. W.; Fanning, E. & Grindley, M., 2000a. *Ben En National Park: biodiversity survey 1998*. Frontier Vietnam Forest Research Programme, Hanoi.
- Tordoff, A. W.; Tran Hieu Minh & Tran Quang Ngoc, 2000b. *A feasibility study for the establishment of Ngoc Linh Nature Reserve, Quang Nam province, Vietnam*. BirdLife International Vietnam programme and FIPI, Hanoi.
- Tordoff, A. W.; Tran Quang Ngoc; Le Van Cham & Dang Thang Long, 2000c. *A rapid field survey of five sites in Bac Kan, Cao Bang and Quang Ninh provinces, Vietnam. A Review of the Northern Indochina subtropical forests ecoregion*. BirdLife International Vietnam Programme and FIPI, Hanoi.

- Trinh Viet Cuong & Ngo Van Tri, 2000. *Survey of elephants in Cu Jut district, Dak Lak province and Kon Plong district, Kon Tum province (December 1999 to January 2000)*. Unpublished report to FFI-Indochina Programme, Hanoi.
- UNDP 1997. *Creating protected areas for resource conservation using landscape ecology (PARC)*. VIE/95/G31, VIE/95/G31/1G/31 and VIE/95/G41/A/1G/99.
- U.S. Board on Geographic Names 1986. *Gazetteer of Vietnam, Vols. I and II*, Defense Mapping Agency, Washington, DC.
- van Gulik, R. H., 1967. *The gibbon in China. An essay in Chinese animal lore*, E.J. Brill, Leiden.
- van Tuinen, P. & Ledbetter, D. H., 1983. Cytogenetic comparison and phylogeny of three species of Hylobatidae. *American Journal of Physical Anthropology* 61: 453-466.
- van Tuinen, P. & Ledbetter, D. H., 1989. New, confirmatory and regional gene assignments in the white-cheeked gibbon *Hylobates concolor*. *Cytogenetics and Cell Genetics* 51: 1094-1095 (Abstract only).
- Walston, J.; Davidson, P. & Men Soriyun, in press. *A wildlife survey of southern Mondulkiri province, Cambodia*. The Wildlife Conservation Society (WCS) Cambodia Program, Phnom Penh, Cambodia.
- Wege, D. C.; Long, A. J.; May Ky Vinh; Vu Van Dung & Eames, J. C., 1999. *Expanding the protected areas network in Vietnam for the 21st century. An analysis of the current system with recommendations for equitable expansion*. BirdLife International Vietnam Programme and FIPI, Hanoi.
- Weitzel, V.; Yang, C. M. & Groves, C. P. (1988). A catalogue of primates in the Singapore Zoological Reference Collection. *The Raffles Bulletin of Zoology* 36: 1-166.
- Wienberg, J. & Stanyon, R., 1987. Fluorescent heterochromatin staining in primate chromosomes. *Human Evolution* 2: 445-457.
- Wikramanayake, E. D.. Vu Van Dung & Pham Mong Giao, 1997. *A biological and socio-economic survey of West Quang Nam province with recommendations for a nature reserve*. UNDP, WWF and MARD, Ha Noi.
- Wislocki, G. B., 1929. On the placentation of primates, with a consideration of the phylogeny of the placenta. *Contributions to Embryology* 20(111): 51-80, + 7 plates.
- Wislocki, G. B., 1932. On the female reproductive tract of the gorilla, with a comparison of that of other primates. *Contributions to Embryology* 23(135): 163-204, + 12 plates.
- Wu, M., 1993. The present status of primates in Guangxi. *Chinese Primate Research and Conservation News* 2(1): 7-8.
- Xu, L., Liu, Z. & Yu, S., 1983. Mammalia. Pp. 278-401 in Xu, L., Liu, Z. & Yi, X. (eds.) *[Birds and mammals of Hainan Island]*, Scientific Publishing Agency, Beijing, (Chinese text).
- Yang, D. H. & Xu, P. K., 1988. Observation on the white-cheeked gibbons in Xishuangbanna. *Sichuan Journal of Zoology*, 7(1):36-38
- Yang, D. & Xu, P., 1990. A preliminary study on the food of *Hylobates concolor concolor*. *Primate Report* 26: 81-87.
- Zehr, S., Ruvolo, M., Heider, J. & Mootnick, A., 1996. Gibbon phylogeny inferred from mitochondrial DNA sequences. *American Journal of Physical Anthropology* Suppl. 22: 251 (Abstract only).
- Zhang, Y., 1992a. Hainan black gibbon threatened. *Chinese Primate Research and Conservation News* 1(1): 4.
- Zhang, Y., 1992b. Hainan gibbon (*Hylobates concolor hainanus*) threatened. *Asian Primates* 2(1): 6.
- Zhang, Y., 1997. Mitochondrial DNA sequence evolution and phylogenetic relationships of gibbons. *Acta Genetica Sinica* 24: 231-237.

10. References

- Zhang, Y., Quan, G., Yang, D., Liu, Z. & Sheeran, L., 1995. Population parameters of the black gibbon in China. Pp. 203-220 in Xia, W. & Zhang, Y. (eds.) *Chinese primate research and conservation*, China Forestry Publishing House, Beijing.
- Zhang, Y.; Quan, G; Zhao, T. & Southwick, C. H., 1992. Distribution of primates (except *Macaca*) in China. *Acta Theriologica Sinica* 12: 81-95.
- Zhang, Y. & Sheeran, L., 1994. Current status of the Hainan black gibbon (*Hylobates concolor hainanus*). *Asian Primates* 3(3-4): 3.
- Zimmermann, E., 1990. Differentiation of vocalizations in bushbabies (Galaginae, Prosimiae, Primates) and the significance for assessing phylogenetic relationships. *Zeitschrift für Zoologische Systematik und Evolutionsforschung* 28: 217-239.

11. APPENDICES

Appendix 1. Gibbon species in the protected area network of Vietnam

Protected areas (governmental decree)	Province	<i>N. cf. sp. nasutus</i>	<i>N. concolor</i>	<i>N. l. leucogenys</i>	<i>N. l. siki</i>	<i>N. gabriellae</i>
Ba Be	Bac Kan	E?				
Bach Ma	Thua Thien-Hue				?	
Ban Dao Son Tra	Da Nang				E?	
Bana-Nui Chua	Da Nang				?	
Ben En	Thanh Hoa			X		
Bi Dup-Nui Ba	Lam Dong					?
Bien Lac-Nui Ong	Binh Thuan					?
Cat Ba	Hai Phong					
Cat Tien	Dong Nai, Binh Phuoc, Lam Dong					X
Chu Yang Sin	Dak Lak					?
Cuc Phuong	Hoa Binh, Ninh Binh, Thanh Hoa			E?		
Hoang Lien	Lao Cai		?			
Huu Lien	Lang Son					
Ke Go	Ha Tinh				X	
Kalon Song Mao	Binh Thuan					?
Kon Ka Kinh	Gia Lai					X
Kong Cha Rang	Gia Lai					X
Lo Go Sa Mat	Tay Ninh					
Mom Ray	Kon Tum					?
Muong Nhe	Lai Chau			?		
Nui Pia Oac	Cao Bang	E?				
Phong Nha	Quang Binh				X	
Pu Huong	Nghe An			X		
Pu Mat	Nghe An				X	
Tam Dao	Vinh Phuc, Thai Nguyen, Tuyen Quang	E?				
Trung Khanh	Cao Bang	E?				
Vu Quang	Ha Tinh				X	
Xuan Lien	Thanh Hoa			X		
Xuan Son	Phu Tho		?			

11. Appendices

Protected areas (no governmental decree)	Province	<i>N. cf. sp. nasutus</i>	<i>N. concolor</i>	<i>N. l. leucogenys</i>	<i>N. l. siki</i>	<i>N. gabriellae</i>
Dakrong and Phong Dien	Quang Tri, Thua Thien-Hue				X	
Ea So	Dak Lak					?
Khe Net	Quang Binh				X	
Kim Hy	Bac Kan	?				
Ky Thuong	Quang Ninh	E?				
Pu Hoat	Nghe An			X		
Pu Hu	Thanh Hoa			?		
Pu Luong	Thanh Hoa			?		
Ta Sua	Son La		?			
Tan Phu	Dong Nai					E?
Than Xa	Thai Nguyen	?				
Yok Don extension	Dak Lak					X

X: Confirmed occurrence; ?: Provisional occurrence; E?: Extinct?

Appendix 2. Localities list

The following list provides further details about several locations mentioned in this work. The following localities have been chosen because they are representative of the different habitats, levels of human impact and conservation status of different regions of Vietnam.

For forest size and type criteria, see Conventions (p. x). Each locality contains a listing of the gibbon species recorded in the area. If the occurrence is provisional the species is noted in brackets.

1. Thang Hen Forest, Tra Linh district (CAO BANG)

Special-use forest: None

Forest size: ~1,000 ha (Tordoff *et al.*, 2000c)

Forest type: limestone

Elevation: 600 to 906 m

[*Nomascus* sp. cf. *nasutus*]

Thang Hen is situated in Quoc Toan commune, Tra Linh district. Most of the forest in the district has been cleared, and only a small area of limestone forest remains. The forest extends to the north, into Luu Ngoc commune, and to the west, into Ngu Lao and Nguyen Hue communes, Hoa An district (Tordoff *et al.*, 2000c).

In this area, logging and hunting are very intensive. An anecdotal report of H'mong hunters shooting bulbuls and other small birds illustrates the level of hunting activity (Tordoff *et al.*, 2000c).

2. Than Xa Forest, Vo Nhai district (THAI NGUYEN)

Special-use forest: None

Forest size: NA

Forest type: limestone

Elevation: NA

[*Nomascus* sp. cf. *nasutus*]

During their survey in March 1998, Geissmann and Vu Ngoc Thanh (in press) repeatedly met hunters and loggers in Than Xa forest, and hunting pressure appeared to be particularly high in this area. The resident human population of Than Xa is relatively high (about 2,000 people). Furthermore, Than Xa harbours an even larger population of immigrant gold miners (about 10,000 people) who add to hunting pressure in the forest. Geissmann and Vu Ngoc Thanh (in press) reported that, every morning, about 300 people climbed the path leading from La Hien to Kim Son communes in order to transport food to gold miners working in the "mining city" adjacent to Xuyen Son.

Inhabitants of Xuyen Son, who had traditionally collected their drinking water from a little river, which they had channelled in picturesque canals through the whole village, are no longer able to do so, because the mining city was erected upstream of the village. Because the chemicals used to bind the gold poisoned the river, the villagers now have to collect and carry their drinking water from water holes and brooks situated further up the mountain (Geissmann & Vu Ngoc Thanh, in press).

3. Hoang Lien Nature Reserve and proposed extension, Sa Pa and Than Uyen districts (LAO CAI)

Special-use forest: Partly included in Hoang Lien Nature Reserve

Forest size: ~20,000 ha, 11,071 ha of which is in Hoang Lien Nature Reserve (Tordoff *et al.*, 1999)

Forest type: montane evergreen, mixed

Elevation: 383 to 3,143 m (Phan Si Pan, highest mountain in Vietnam). Most of the land is above 1,000 m

[*Nomascus concolor*]

Hoang-Lien Nature Reserve (22°08'–22°23' N / 103°46'–104°00' E) was established in 1986. It currently comprises parts of four communes: San Sa Ho, Lao Chai, Ta Van and Ban Ho, all of which belong to Sa Pa district. These four communes are inhabited by over 7,000 people live, who belong to the H'mong, Dao, Giay and Tay ethnic groups (Tordoff *et al.*, 1999).

The reserve covers 24,658 ha, less than 50% of which is natural forest. The original investment plan included two communes in Than Uyen district with a large area of forest land, but these were excluded in a revision of the boundary in 1997 and are now under the management of the Song Da Watershed National Management Board (Tordoff *et al.*, 1999). The forest in Than Uyen district is steeper and less accessible than that in Sa Pa district (A. Tordoff, pers. comm. 2000).

Large areas of natural habitat have been lost, particularly as a result of shifting cultivation. Almost all of the forest below 1,600 m has already been cleared. Illegal timber extraction, particularly of the valuable timber species *Fokienia hodginsii*, still occurs. Cardamom (*Amomum aromaticum*) plantations are common in the forest. This plant grows only under forest canopy, requiring clearance of the ground flora. However the canopy remains intact and, after cessation of cultivation, forest is able to return to a natural state. Hunting is also intensive (Tordoff *et al.*, 1999).

4. Xuan Son Nature Reserve, Thanh Son district (PHU THO)

Special-use forest: Nature reserve

Forest size: 5,631 ha (Anon., 1990)

Forest type: montane evergreen, limestone

Elevation: 200 to 1,390 m (Nui Voi)

[*Nomascus concolor*]

Xuan Son Nature Reserve was decreed by the Vietnamese government in 1986. The reserve is located in Xuan Son commune, Thanh Son district (21°05'N–21°11'N / 104°50'E–104°58'E). The total area of the reserve is about 10,000 ha and natural forest occupies at least 50% of the area. Forest extends to the south-west, into Son La and Hoa Binh provinces. About 1,040 people in five villages live inside the reserve (Anon., 1990).

It appears that timber extraction and forest fire are quite low but guns are still common in the villages inside and outside the reserve, and hunters still go into the forest.

5. Muong Nhe Nature Reserve, Muong Te and Muong Lay districts (LAI CHAU)

Special-use forest: Nature reserve

Forest size: 58,368 ha (Wege *et al.*, 1999), very fragmented

Forest type: lowland evergreen, montane evergreen (mainly secondary), mixed, bamboo

Elevation: ~400 to 1,948 m (Phu Den Dinh)

[*Nomascus leucogenys leucogenys*]

Muong Nhe Nature Reserve was decreed in 1986, covering 182,000 ha (Wege *et al.*, 1999). A proposal to extend the reserve in March 1997 gave the total area as 314,642 ha. However, no investment plan for the reserve has been approved by MARD. Although Muong Nhe is the largest protected area in Vietnam, less than 20% of the land is actually covered by forest.

The topography is dominated by steep hills. A major part of the reserve is covered by grassland, and the great majority of the remaining forest is secondary. The population has increased very fast during recent years. From 10,000 to 12,000 immigrants, mainly belonging to the H'mong ethnic group, moved into the area between 1989 and 1997. Shifting cultivation is widely practised and forest cover is still decreasing (from 28% of the reserve in 1991 (Cox *et al.*, 1992) to under 20% in 1997 (Hill *et al.*, 1997)). Hunting is also very intensive.

6. Xuan Lien Nature Reserve, Thuong Xuan district (THANH HOA)

Area conservation status: Partly included in Xuan Lien Nature Reserve

Forest size: 18,522 ha (Le Trong Trai, 1999a)

Forest type: montane evergreen, mixed, bamboo

Elevation: up to 1,605 m

Nomascus leucogenys leucogenys

Xuan Lien Nature Reserve was decreed in 1999 and covers 23,610 ha. The topography is characterised by low mountains with deep and narrow valleys. The reserve includes 18,522 ha of forest, only 1,572 ha of which is primary. A large proportion of the forest is bamboo forests (36.8%) with varying degrees of disturbance. Undisturbed forest only occurs above 700 m and is now severely fragmented (Le Trong Trai, 1999a).

7. Pu Luong proposed nature reserve, Quan Hoa and Ba Thuoc districts (THANH HOA)

Special-use forest: None

Forest size: 13,305 ha (Anon., 1998a)

Forest type: limestone

Elevation: up to 1,665 m (Pu Luong)

[*Nomascus leucogenys leucogenys*]

The investment plan for Pu Luong was approved by MARD in February 1999 but the site has yet to be decreed by the government. The proposed nature reserve covers 17,663 ha (12,243 ha in Ba Thuoc district and 5,419 ha in Quan Hoa district) (Anon., 1998a).

Pu Luong is located on the north-western end of a contiguous limestone mountain range. People living in Pu Luong mainly belong the Thai and Muong ethnic groups (Baker, 1999b).

8. Ben En National Park, Nhu Xuan and Nhu Thanh districts (THANH HOA)

Special-use forest: National park

Forest size: 23,062 ha (Anon., 1995c)

Forest type: lowland evergreen, limestone (patches), bamboo

Elevation: 20 to 497 m

Nomascus leucogenys leucogenys

Ben En was decreed as a nature reserve in 1986 and was upgraded to national park status in 1992. Currently, the park covers 16,634 ha, although there exists a proposal to extend it to 38,153 ha (Anon., 1995c).

No areas in Ben En remain undisturbed, as a result of commercial logging activities, which took place until 1993. In addition, more than 10,000 people inhabit the buffer zone and exploit forest products, such as bamboo shoots and rattan. However, forest protection activities are being implemented by the park, and no evidence of hunting was recorded during a survey between July and September 1997 (Tordoff *et al.*, 1997).

9. Pu Hoat proposed nature reserve (NGHE AN)

Special-use forest: None

Forest size: 67,934 ha

Forest type: lowland evergreen, montane evergreen, limestone

Elevation: NA, up to 2,452 m

Nomascus leucogenys leucogenys

Pu Hoat proposed nature reserve stands in the north-western part of Nghe An province. It is contiguous with the recently decreed Xuan Lien Nature Reserve in Thanh Hoa province, and, together, these sites cover 90,841 ha (Le Trong Trai, 1999a).

The forest in the southern part of the proposed protected area is heavily disturbed, mainly as a result of agricultural encroachment by H'mong communities. In the northern part of the proposed nature reserve, near Xuan Lien Nature Reserve, the natural habitat is better preserved (Le Trong Trai, pers. comm. 2000).

10. Pu Huong Nature Reserve, Que Phong, Quy Chau, Quy Hop, Con Cuong and Tuong Duong districts (NGHE AN)

Special-use forest: Nature reserve

Forest size: 35,729 ha (Anon., 1995b)

Forest type: lowland evergreen, montane evergreen, limestone, bamboo

Elevation: ~200 to 1,447 m (Phu Lon)

Nomascus leucogenys leucogenys

Pu Huong Nature Reserve is situated on a mountain range, running from north-west to south-east, in the centre of Nghe An province. The south-eastern part is occupied by a limestone area.

In 1986, Pu Huong was decreed a nature reserve by the government of Vietnam. In the original decree, the area is given as 5,000 ha. However, the area of reserve given in the investment plan is 49,000 ha (Anon., 1995b). The two main ethnic groups in the area are Thai and Thanh (Kemp & Dilger, 1996).

A significant area of forest remains at Pu Huong. However, rates of forest clearance for agriculture are significant, illegal logging is intensive and hunting pressure is high (Kemp & Dilger, 1996).

11. Vu Quang Nature Reserve, Huong Khe district (HA TINH)

Special-use forest: Nature reserve

Forest size: 38,100 ha (Anon., 1993c)

Forest type: montane evergreen, lowland evergreen, bamboo

Elevation: 30 to 2,235m (Rao Co)

Nomascus leucogenys siki

Vu Quang is located in the northern part of the Annamite mountains. Originally, Vu Quang was decreed as a cultural and historical site, with an area of 16,000 ha. However, following the discovery of a new species of large mammal, *Saola Pseudoryx nghetinhensis*, Vu Quang was upgraded to nature reserve status in 1993, with a total area of 55,950 ha (Anon., 1993c).

Most of the reserve is covered by forest, 61% of which is primary. Only some areas near the Ngan Truoi river have been disturbed by local people (VRTC 1997). There is a strong tradition of hunting in this area. Lambert *et al.* (1994) reported that half of the 104 households in Kim Quang village included a hunter. Habitat destruction is mainly due to selective timber extraction. Collection of rattan is also significant (Lambert *et al.*, 1994).

12. Ke Go Nature Reserve, Huong Khe, Cam Xuyen and Ky Anh districts (HA TINH)

Special-use forest: Nature reserve

Forest size: 24,280 ha (Le Trong Trai *et al.*, 1996b)

Forest type: lowland evergreen

Elevation: up to 500m (Moc Bui)

Nomascus leucogenys siki

Ke Go Nature Reserve was established in 1996, and covers 24,801 ha. Nearly 40,000 people live in the buffer zone, 99% of whom belong to the Kinh ethnic group (Le Trong Trai *et al.*, 1996b). The topography is mainly formed by gently undulating land. Until 1990, the forest was commercially logged, as a result of which no undisturbed forest remains and only a quarter of the forest can be considered lightly disturbed (Le Trong Trai *et al.*, 1996b).

A large proportion of the population of the buffer zone is dependent on forest products collected inside the reserve. Raintree *et al.* (1999) reported that charcoal and fuelwood collection for commercial use constitute, respectively, 36% and 21% of the total income for the households living in the buffer zone. Fragrant oil distillation, mainly from *Cinnamomum parthenoxylum* trees, is widely practised and is a significant cause of forest degradation (Le Trong Trai *et al.*, 1996b). Distillation takes place in situ and requires a large quantity of firewood: it is estimated that, for each tree fragrant oil is distilled from, 10 ha of forest is negatively affected. Rattan and valuable timber species are exploited for local use and illegal exportation. Hunting pressure is significant and trade in wildlife has been reported. Other threats include destructive harvesting of forest fruit trees and over-exploitation of some medicinal plants (Raintree *et al.*, 1999).

Ke Go Nature Reserve has high conservation importance because it protects one of the largest remaining areas of lowland evergreen forest in central Vietnam (Le Trong Trai

11. Appendices

et al., 1996b). Several threatened and endemic species occur there, including the only known population of Vietnamese Pheasant *Lophura hatinhensis* in the world. However, as a result of intensive human pressure, many wildlife species are becoming increasingly rare.

13. Khe Net forest, Tuyen Hoa district (QUANG BINH)

Special-use forest: None

Forest size: NA

Forest type: lowland evergreen

Elevation: NA

[*Nomascus leucogenys siki*]

The Khe Net area is located in the north of Tuyen Hoa district. The area has been proposed as a nature reserve with an area of 16,500 ha (Wege *et al.*, 1999). In this area, much of the forest is disturbed as a result of commercial logging activities that continued up until 1991 and on-going illegal timber extraction (Lambert *et al.*, 1994). Lambert *et al.* (1994) also reported the collection of *Cinnamomum* sp. tree oil, which requires a number of trees to be cut in order to supply fuel for the distillation process. Collection of rattan and hunting are among the other threats to biodiversity in the area.

14. Dakrong district (QUANG TRI) and Phong Dien district (THUA THIEN-HUE)

Special-use forest: None

Forest size: 53,721 ha (Le Trong Trai & Richardson, 1999a)

Forest type: lowland evergreen

Elevation: up to 1,408 m (Coc Lepar)

Nomascus leucogenys siki or *gabriellae*

A recent feasibility study, prepared by BirdLife and FIPI, proposes establishing two contiguous nature reserves: Phong Dien, in Thua Thien-Hue province, and Dakrong, in Quang Tri province. The proposed areas of the two nature reserves are 35,072 ha and 34,406 ha respectively. About 90,000 people inhabit the buffer zones of the two proposed nature reserves, most of whom belong to the Van Kieu ethnic group (Le Trong Trai & Richardson, 1999a).

The topography is dominated by low mountains, although the north-eastern part of the area is flatter. Aerial defoliant spraying during the Vietnam War may have contributed to forest disturbance, although it appears that biodiversity has recovered well since this time. The level of timber extraction is quite low, mainly because of the defoliant spraying but also because timber extraction by local people has restricted valuable timber trees to inaccessible areas. It appears that large mammals are under intense hunting pressure and may occur in only small numbers (Le Trong Trai & Richardson, 1999a).

15. Bach Ma National Park (THUA THIEN-HUE)

Special-use forest: National park

Forest size: 39,089 ha (Anon., 1997)

Forest type: lowland evergreen, montane evergreen, bamboo

Elevation: up to 1,448 m (Nui Bach Ma)

[*Nomascus leucogenys siki* or *gabriellae*]

Bach Ma was decreed as a national park in 1986. It covers 22,030 ha, with a buffer zone of 21,300 ha. A proposed extension would extend the total area to 80,000 ha (Anon., 1997). More than 60,000 people live in the buffer zone.

The terrain is steep, with slopes averaging 15 to 25°. Most of the park was subjected to defoliant spraying during the Vietnam war. After reunification, timber companies worked in the park. Logging was officially stopped in 1989. However, illegal exploitation of forest products, such as timber, rattan and fuelwood, still continues. The result is that large areas of the park are now deforested and no forest remains undisturbed (Anon, 1995d).

16. Ngoc Linh mountain, Dac Glei, Dac To and Tra My districts (QUANG NAM and KON TUM)

Special-use forest: Partly included in Ngoc Linh (Kon Tum) Nature Reserve

Forest size: 50,296 ha, 36,290 ha of which is in Ngoc Linh (Kon Tum) Nature Reserve and 14,060 ha of which is in Ngoc Linh (Quang Nam) proposed nature reserve (Le Trong Trai & Richardson, 1999b; Tordoff *et al.*, 2000b)

Forest type: lowland evergreen, montane evergreen, mixed

Elevation: 150 to 2,598 m (Ngoc Linh)

Nomascus leucogenys siki or *gabriellae*

In 1986, Ngoc Linh Nature Reserve was decreed by the government of Vietnam, with a total area of 20,000 ha. In 1994, FIPI prepared an investment plan for Ngoc Linh Nature Reserve in Kon Tum and Quang Nam (formerly Quang Nam-Da Nang) provinces. However, this investment plan was not approved at the ministry level. Therefore, an investment plan for Ngoc Linh (Kon Tum) Nature Reserve was prepared by FIPI and BirdLife in 1998 and approved by MARD in 1999. A feasibility study for Ngoc Linh (Quang Nam) was published by FIPI and BirdLife in 2000 (Tordoff *et al.*, 2000b), and an investment plan will be prepared in January 2001 (A. Tordoff, pers. comm. 2000).

Ngoc Linh (Kon Tum) Nature Reserve covers 41,240 ha in Dac Glei and Dac To districts, Kon Tum province. About 14,000 people live in the buffer zone, belonging mainly to the Xe Dang, De and Trieng Re ethnic groups (Le Trong Trai & Richardson 1999b). Ngoc Linh (Quang Nam) proposed nature reserve covers 18,430 ha, in Tra My district, Quang Nam province. About 11,600 people live in the buffer zone, belonging mainly to the Xe Dang, Ca Dong and Mnong ethnic groups. Ngoc Linh (Quang Nam) proposed nature reserve is unique in Vietnam because it supports an undisturbed gradient of natural habitats from 150 to 2,598 m (Tordoff *et al.*, 2000b).

Ngoc Linh mountain is situated in the mountainous central highlands, and is the highest point in southern Vietnam. The area in Kon Tum province lost approximately 13% of its forest cover between 1976 and 1995, mainly as a result of shifting cultivation (Le Trong Trai & Richardson 1999b). However, it is reported that, on the Quang Nam side of the mountain, swidden fields are only created on land covered by

secondary forest or scrub and that local people do not clear primary forest for agriculture; consequently, rates of forest loss are very low (Tordoff *et al.*, 2000b). Small quantities of timber are extracted for local use but the impact of this activity is relatively low (Le Trong Trai and Richardson 1999b, Tordoff *et al.*, 2000b). Hunting is widespread in the area and trade in wildlife has increased recently. National Highway 14, which bisects Ngoc Linh (Kon Tum) Nature Reserve in the west, is earmarked for upgrading as part of the Ho Chi Minh National Highway project. This project would facilitate access to the forest and may act as a focus for spontaneous immigration (Le Trong Trai & Richardson, 1999b; Tordoff *et al.*, 2000b).

17. Mom Ray Nature Reserve, Sa Thay and Ngoc Hoi districts (KON TUM)

Special-use forest: Nature Reserve

Forest size: 36,352 ha

Forest type: lowland evergreen, montane evergreen, mixed, bamboo

Elevation: ~200 to 1,800 m

[*Nomascus gabriellae*]

Mom Ray was decreed as a nature reserve in 1982, with an area of 10,000 ha. An investment plan was prepared in 1995, which gave the area of the nature reserve as 48,658 ha. The buffer zone covers about 51,000 ha in eight communes in Sa Thay and Ngoc Hoi districts, and has a total population of 27,411 people (Kon Tum Provincial FPD, 2000). The inhabitants of the buffer zone can be divided into three groups: indigenous ethnic minorities, in-migrant ethnic minorities, and Kinh settlers (Thai Truyen, 1997).

The main threats to biodiversity at Mom Ray include shifting cultivation, fuelwood, bamboo and rattan collection, and hunting (Thai Truyen, 1997).

18. Kon Ha Nung area (GIA LAI)

Special-use forest: Partly included in Kong Cha Rang and Kon Ka Kinh Nature Reserves

Forest size: 77,355 ha (Le Trong Trai, 2000)

Forest type: montane evergreen

Elevation: up to 1,452m (Kon Ka Kinh)

Nomascus gabriellae

There are two nature reserves in the Kon Ha Nung area: Kon Cha Rang, which covers 15,900 ha (Anon., 1999), and Kon Ka Kinh, which covers 41,710 ha (Le Trong Trai, 2000). These two reserves were decreed by the government in 1986.

Previously, all the forest in the area was managed by Kon Ha Nung State Forest Enterprise and was selectively logged, particularly for the valuable timber species *Fokienia hodginsii*. However, following the creation of the nature reserves, official logging activities in these areas ceased, although small-scale, illegal timber extraction still continues (Le Trong Trai, 2000). The forest area between Kon Cha Rang and Kon Ka Kinh Nature Reserves is still under the management of Dak Roong and Tram Lap State Forest Enterprises, although Le Trong Trai (2000) recommends revising the reserve boundaries to make them contiguous.

The principal cause of forest clearance in the area is shifting cultivation. For instance, 35 ha of forest was cleared in March 1999 in K'Bang district. The development of coffee plantations has led to increased pressure on the forest in K'Bang and Mang Yang districts, as local people clear forest and sell the land to migrants from northern

Vietnam or to landowners from Ka Nak, Plei Ku and Quy Nhon towns (Le Trong Trai, 2000).

Ba Na ethnic minority people rarely use timber for construction. In Kon Ka Kinh, most illegal logging is conducted by Kinh people from northern Vietnam, who travel to the area for this purpose. Rattan collection is intensive, and this non-timber forest product is reportedly becoming increasingly rare in the forest. Hunting is an important part of Ba Na culture, and signs of it were frequently recorded during a field survey in 1999 (Le Trong Trai, 2000).

19. Ea So proposed nature reserve, Ea Kar district (DAK LAK)

Special-use forest: None

Forest size: 14,960 ha

Forest type: semi-deciduous, lowland evergreen

Elevation: up to 1,014m (Chu Dle Ya)

[*Nomascus gabriellae*]

Because of the high density of wild cattle, the Ea So area was proposed as a nature reserve in 1997 (Le Xuan Canh *et al.*, 1997a). The total area of the nature reserve is 22,000 ha.

The topography of Ea So proposed nature reserve is fairly flat, with numerous small hills, which often have rock outcrops at their summit (Le Xuan Canh *et al.*, 1997a). A large area of the proposed nature reserve is covered by natural grassland, while evergreen forest is found in the north of the area and along streams. The remainder of the proposed nature reserve supports semi-deciduous forest.

A survey by IUCN and WWF, in April and May 1997 found no evidence of any intensive logging activity. However, the main threat to biodiversity is hunting. Since 1996, many migrants from northern Vietnam have settled in the area. Population growth rates have been very high, and large areas of natural habitat have been converted into agricultural land. The current forested area is totally surrounded by human habitation and cultivation, and is, therefore, isolated from other forest blocks (Le Xuan Canh *et al.*, 1997a).

20. Cu Jut district (DAK LAK)

Special-use forest: None

Forest size: 30,000ha in proposed southern extension of Yok Don National Park (Trinh Viet Cuong & Ngo Van Tri, 2000),

Forest type: deciduous and semi-deciduous, lowland evergreen, mixed, bamboo

Elevation: 200 to 450 m

Nomascus gabriellae

Cu Jut district is situated in a hilly area in the watershed of the Srepok River. The main forest types in the district are deciduous and semi-deciduous forest. However, evergreen forest is distributed along the Dak Klau and Dak Sirr streams (Trinh Viet Cuong & Ngo Van Tri, 2000).

In 1992, the population of the district was 22,500 people. Following the settlement of migrants from northern Vietnam, this figure had increased to about 88,000 by 1997. The eastern part of the district is already densely populated and newcomers continue to arrive all the time (Trinh Viet Cuong & Ngo Van Tri, 2000).

The forest fringes are subject to encroachment for subsistence agriculture and cash-crop cultivation. It seems probable that the flat land, fertile soils and continued immigration will promote increased rates of deforestation in the future (Trinh Viet Cuong & Ngo Van Tri, 2000).

The western part of Cu Jut district has been proposed as a southern extension of Yok Don National Park. This area is currently under the management of Dak Uyn State Forest Enterprise.

21. Da Lat Plateau (LAM DONG, DAK LAK, KHANH HOA and NINH THUAN)

Special-use forest: Partly included in Chu Yang Sinh and Bi Dup-Nui Ba Nature Reserves

Forest size: NA

Forest type: montane evergreen, coniferous, mixed, bamboo

Elevation: up to 2,442 m (Chu Yang Sin)

[*Nomascus gabriellae*]

In 1986, the government decreed two nature reserves north of Da Lat town: Thuong Da Nhim (7,000 ha) and Nui Ba (6,000 ha) (Wege *et al.*, 1999). Both these areas were later incorporated within Bi Dup-Nui Ba Nature Reserve, Lam Dong province. An investment plan for Bi Dup-Nui Ba was prepared in 1995, and gave the total area of the reserve as 71,062 ha, including 58,516 ha of natural forest (Anon., 1995a).

Chu Yang Sin Nature Reserve, Dak Lak province, was decreed by the government in 1986, with an area of 20,000 ha (Eames & Nguyen Cu, 1994). According to Le Trong Trai *et al.* (1996a), the protected area covers 34,237 ha, including 33,827 ha of forest. This report proposed an extension of the reserve to cover 59,280 ha, including 58,752 ha of forest (Le Trong Trai *et al.*, 1996a).

As part of the European Union-funded project *Expanding the Protected Areas Network in Vietnam for the 21st Century*, BirdLife and FIPI proposed extending Bi Dup-Nui Ba Nature Reserve by 45,600 ha to the south-west, in Lam Dong province, and to the east, into Khanh Hoa province. They also proposed extending Chu Yang Sin Nature Reserve by 16,400 ha to the south, into Lam Dong province, which would connect this protected area with Bi Dup-Nui Ba (Wege *et al.*, 1999).

Shifting cultivation, practised by ethnic minorities, is believed to be having a great impact on vegetation cover on the Da Lat plateau. This activity has reduced the area of evergreen forest and led to its fragmentation. Most remaining areas of evergreen forest are distributed at high elevations and on steep slopes. Frequent use of fire is preventing the regeneration of evergreen forest, and promoting the spread of a fire-climax coniferous forest dominated by *Pinus kesiya*, which is now the most widespread forest type on the plateau (estimated at 120,000 ha in 1990). Furthermore, land covered by evergreen forest is preferred by shifting cultivators because of the better soil quality. As evergreen forest has higher biodiversity value than pine forest, shifting cultivation is a major threat to biodiversity (Eames, 1995).

Arrival of new migrants, spontaneous under the governmental programme to develop new economic zones increase the pressure on the environment, mainly in Krong Bong district, in which Chu Yang Sin Nature Reserve is situated (Eames, 1995).

Logging is a major activity on the Da Lat plateau. Demand for charcoal and fuelwood in Da Lat town is high, resulting in degradation of the forest on Nui Ba mountain. The expansion of the town is likely to accelerate this process. Settlement of migrants from

northern Vietnam into new economic zones near Chu Yang Sin Nature Reserve is increasing the pressure on the natural resources of this reserve (Eames, 1995).

Primates are subject to hunting on the Da Lat plateau. Besides being used locally for food and medicinal purposes, the wildlife trade is well developed. Stuffed animals and mounted horns are sold in Da Lat and Bao Loc towns, principally to domestic tourists. In addition, a number of primates are sent to markets in Ho Chi Minh City (Eames & Robson, 1993).



ABOUT FFI

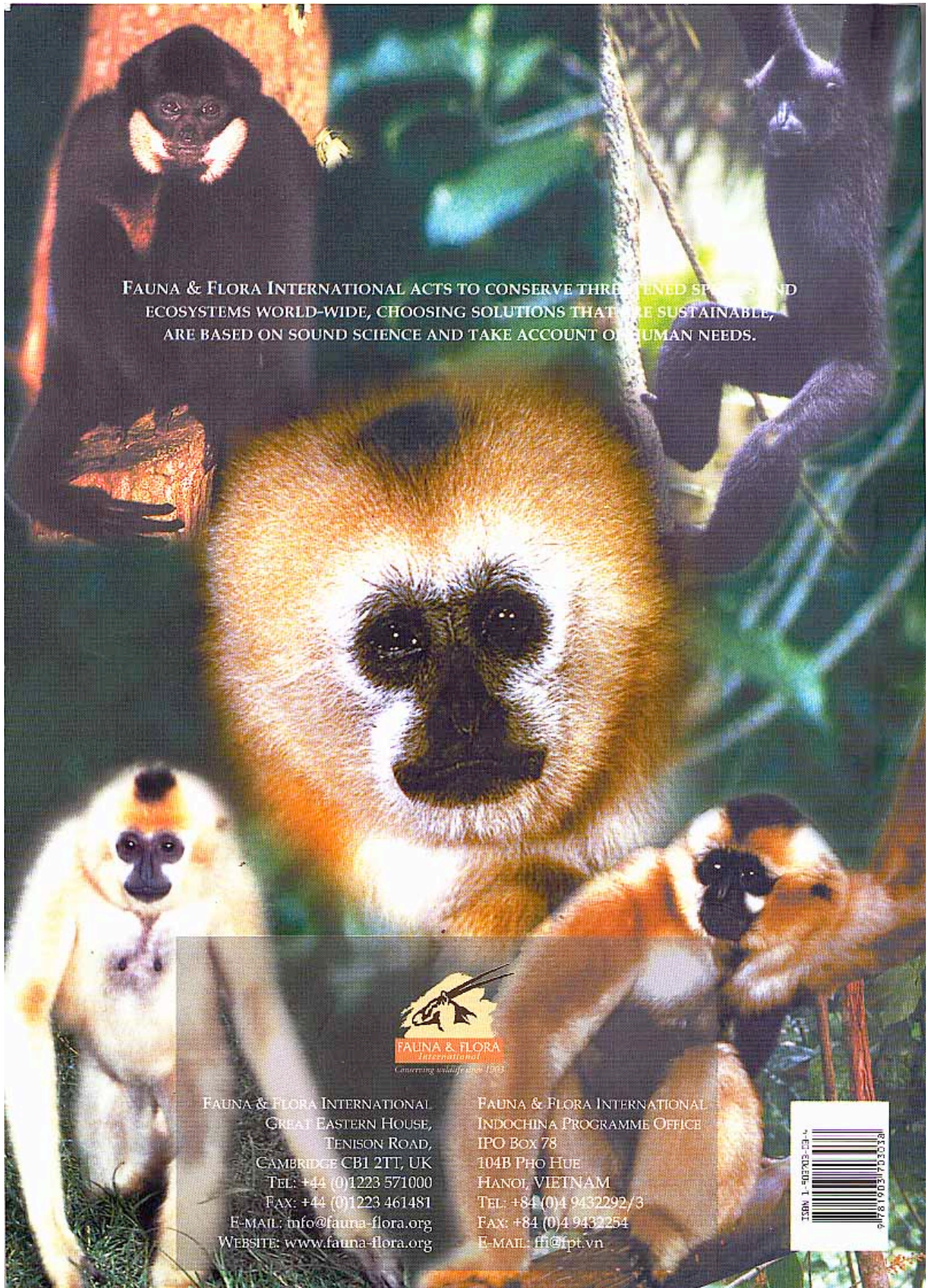
Fauna & Flora International (FFI) is the world's oldest international conservation body and has played a key role in establishing much of today's global conservation infrastructure. It is one of the few organisations whose remit is to protect the entire spectrum of endangered plant and animal species on the planet. FFI provides support to conservation initiatives throughout the world, in the form of partnerships, technical assistance, direct funding and consultancy. It works with a broad spectrum of local, national and international partners. These include governments, NGOs, bilateral and multilateral donors, academic institutions, businesses and, most importantly, the local communities whose wildlife and ecosystems are at stake.

FFI is active in more than 60 countries around the world. Regional programmes cover Africa, the Americas (including the Caribbean), Asia-Pacific and Eurasia. It also manages thematic programmes that deal with crucially important global issues including the implementation of international conventions, sustainable wildlife use and the conservation of priority species groups.


Fauna and Flora International (FFI) initiated its Indochina programme in Vietnam in 1996, when it signed a Memorandum of Understanding with the Ministry of Agriculture and Rural Development (MARD). FFI-Indochina has been active in Cambodia since 1996, working with the Department of Forestry and Wildlife (Ministry of Agriculture, Forestry, and Fisheries) and the Department for Protected Area Management (Ministry of the Environment) to conduct biological survey work and institutional capacity building.

The aims of FFI-Indochina are to promote and support the conservation of biodiversity in the region through research and conservation of endangered species and ecosystems, while increasing the capacity of its partner organisations to undertake conservation work through professional training and technical assistance.

Since its establishment, FFI-Indochina has been involved in a number of projects including biological research, biodiversity surveys, community-based conservation awareness, socio-economic research, and activities aimed at increasing the institutional capacity of protected area management through technical assistance and training.



FAUNA & FLORA INTERNATIONAL ACTS TO CONSERVE THREATENED SPECIES AND ECOSYSTEMS WORLD-WIDE, CHOOSING SOLUTIONS THAT ARE SUSTAINABLE, ARE BASED ON SOUND SCIENCE AND TAKE ACCOUNT OF HUMAN NEEDS.


FAUNA & FLORA INTERNATIONAL
GREAT EASTERN HOUSE,
TENISON ROAD,
CAMBRIDGE CB1 2TT, UK
TEL: +44 (0)1223 571000
FAX: +44 (0)1223 461481
E-MAIL: info@fauna-flora.org
WEBSITE: www.fauna-flora.org

FAUNA & FLORA INTERNATIONAL
INDOCHINA PROGRAMME OFFICE
IPO BOX 78
104B PHO HUE
HANOI, VIETNAM
TEL: +84 (0)4 9432292/3
FAX: +84 (0)4 9432254
E-MAIL: ffi@ipt.vn

