

Hainan Gibbon Status Survey and Conservation Action Plan – VERSION I (Last Updated November 2005)

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Photo: Lu Gang

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The Hainan Gibbon is considered a distinct taxon *Nomascus sp. cf. nasutus hainanus* endemic to Hainan. It has been tentatively considered conspecific with the mainland Eastern black crested gibbon *Nomascus sp. cf. nasutus nasutus*, currently only known from 26-28 individuals in Cao Bang Province, Northeast Vietnam (Geissmann *et al.*, 2000, 2003a, 2003b; Geissmann, 2003). Many authorities expect further taxonomic study to reveal it as distinct at the species level.

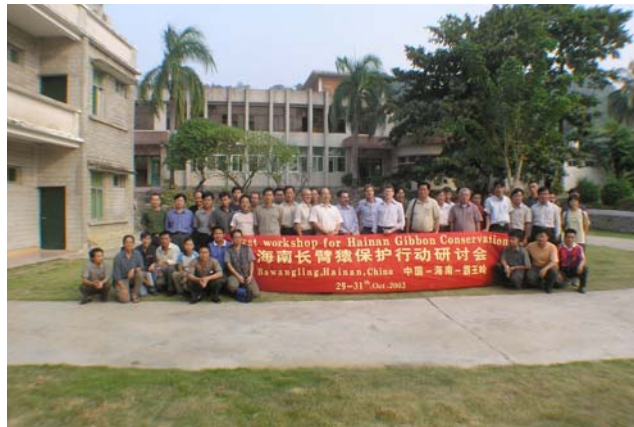
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Participants of the 2003 survey



Participants of the 2003 survey



Team member surveying in the Nanchahe area

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Chapters in this report were extracted and compiled with permission from information provided by various contributors during and after the workshop, in particular from communications with ZHOU Jiang (Beijing Institute of Zoology, CAS) and CHEN Qing (Bawangling National Nature Reserve Management Office), and from workshop presentations by JIANG Haisheng (South China Institute of Endangered Animals), LI Dajiang (Bawangling Forestry Bureau), ZHANG Yingyi (FFI China) and WU Wei (East China Normal University).

I. Acronyms and Abbreviations

a.s.l. = above sea level

BFB = Bawangling Forestry Bureau

BNNR = Bawangling National Nature Reserve

ca. = *circa*

CAS = Chinese Academy of Sciences

ECNU = East China Normal University

FFI = Fauna & Flora International China Programme

KFBG = Kadoorie Farm & Botanic Garden

ha = hectare

HWCC = Hainan Wildlife Conservation Centre of Hainan Forestry Department

IoZ = Institute of Zoology

IUCN = International Union for Conservation of Nature

km = kilometre

km² = square kilometre

NGO = Non-Government Organisation

NR = Nature Reserve

NNR = National Nature Reserve

PRC = People's Republic of China

SCIEA = South China Institute of Endangered Animals

ZSP = Zoological Society of Paris

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Executive Summary

This report presents the results of a comprehensive status survey and the first workshop for the conservation of the Hainan Gibbon. Hainan Gibbon is one of five gibbon taxa currently known to occur in China, and is endemic to Hainan. It has a social structure similar to other gibbons in that individuals live in small social groups and occupy territories, which they advertise by characteristic morning songs. This gibbon was once widespread in the tropical forest of Hainan Island, but following protracted deforestation and hunting it is now confirmed only from Bawangling National Nature Reserve, which was established as a nature reserve in 1980 with the main objective to conserve the gibbons and their habitat.

According to past studies, the gibbon population at Bawangling recovered from just seven individuals in two groups in the early 1980s to 23 individuals in four groups in 1998. To update the status, a comprehensive survey was conducted in October 2003. With training and survey methodology provided by Thomas Geissmann of Zürich University, funding and coordination by Bawangling National Nature Reserve (BNNR), Bawangling Forestry Bureau (BFB), Hainan Wildlife Conservation Centre of Hainan Forestry Department (HWCC), Kadoorie Farm & Botanic Garden (KFBG) and South China Institute of Endangered Animals (SCIEA), human resources from Hainan's nature reserves, Fauna & Flora International (FFI) China, Beijing and Kunming Institute of Zoology (Chinese Academy of Sciences), it was a truly collaborative effort. The 16 survey teams systematically covered all potential gibbon habitats in the ca. 300-km² BNNR over a 16-day period (14-29 October 2003).

The survey was able to confirm only a total of 13 gibbons. These included two family groups; one group was found to contain six individuals (including two infants), another five (including one infant), with two additional solitary adult males detected by their solo songs. While there was no instance when both groups and both solitary males were audible from a single listening point at the same time (crested gibbon groups avoid starting and ending song bouts simultaneously), it is safe to assume from their locations that the two solitary males detected are different from the 11 animals observed in the two groups. A group of three individuals has occasionally been sighted by researchers and reserve staff in recent years; it is possible that one of the two solitary males recorded may in fact represent a third group, but the present results precluded a firm conclusion. In December 2004, a baby was born in Group B, making the world total of Hainan Gibbons to 14 individuals at present. The population is restricted to the severely fragmented primary forest around Futouling, of which less than 15 km² is suitable gibbon habitat. The result indicates that this endemic ape is on the brink of extinction.

A workshop on Hainan Gibbon Conservation was held in Bawangling Town during 29-31 October 2003 to formulate a conservation strategy. Representatives from local authorities, NGOs and research institutions participated. Presentations were given by gibbon researchers and local stakeholders on the first day, enhancing participants' understanding of the gibbon and the problems it faces. The second day started by site visits to learn more about the reserve environment and the surrounding communities, followed by open discussion on problems and opportunities. The final day was spent converging on conclusions and recommendations through further discussion.

Although hunting of gibbons in BNNR is reported to have stopped in the past decade, gunshots were heard regularly and illegal trapping and collecting of forest products were evident during the survey. Other indirect disturbances, such as road and hydropower station construction, and frequent human activities in the protected area (e.g. road traffic and management of plantations) probably disturb gibbon behaviour and may affect their long-term prospects. Other potential threats associated with small population size, for example reduced mate choice, heightened impacts of disease and intraspecific aggression, and impaired fitness due to low genetic diversity, may also be significant limitations on popula-

tion recovery. A critical review of all known factors possibly responsible for the stagnation of the gibbon population in Bawangling revealed that suboptimal habitat quality might be the most likely key threat.

Despite the strong regulatory framework in place, participants unanimously agreed that the gibbon is under immense pressure from the high human population residing in and around Bawangling; urgent multidisciplinary measures need to be taken for the gibbons to survive another half-century. Less certain was precisely why the gibbon population has remained at such a low level. Factors likely to be important in limiting recovery include the limited availability of optimal habitat, and ongoing hunting and habitat disturbance by people, coupled with the limited capacity of BNNR to overcome threats. These factors call for action on many fronts.

The following actions, already under way or planned by one or more partners, will form the basis of a conservation action plan:

- (a) Continue and intensify monitoring of the gibbon population in BNNR.
- (b) Reinforce patrolling effectiveness by provision of appropriate equipment to prevent all harmful human activities (e.g. hunting, logging, forest clearance and infrastructure developments) in areas likely to be used by gibbons.
- (c) Afforest degraded habitats in strategic locations with tree species valuable to gibbons.
- (d) Understand the direct threats to gibbon survival.
- (e) Locate any additional gibbons surviving in Hainan.
- (f) Instigate a visionary strategy of ecological restoration in the enlarged reserve area.
- (g) Build the capacity of BNNR to conserve the Hainan Gibbon and the forest ecosystem as a whole.
- (h) Implement a publicity campaign to raise awareness of the Hainan Gibbon and efforts being made to conserve it.

Workshop participants from Bawangling and Changjiang County also discussed the problems created by activities of former loggers, indigenous minority people and other residents living in and around the reserve, and the need to provide alternative, sustainable livelihoods. It was agreed that this was beyond the immediate scope of the present workshop, but that greater collective understanding of human activities and aspirations would help in both gibbon conservation and the resolving of general conflicts between biodiversity conservation and human development.

The Hainan Gibbon is the most critically endangered ape on earth, and its survival depends on the habitat integrity of mature forest. Hainan Gibbon is also an “umbrella species” for the tropical forest of Hainan, whose continued survival also tells us that the forest and its biota, time-tested guardians of Hainan’s water, air and soil, are in a healthy state. We call upon the governments of China and Hainan to recognise the value of the Hainan Gibbon as a flagship species for conservation; we urge the people of Hainan and China to recognise it as an irreplaceable national treasure. The present partners, including KFBG, FFI China, SCIEA, East China Normal University (ECNU), Zoological Society of Paris (ZSP) and Chinese Academy of Sciences (CAS), are determined to work together in support of BNNR, Changjiang County and Baisha County to protect this unique ape.

1. Introduction

This report presents the findings of an up-to-date and the most comprehensive Hainan Gibbon status survey and the recommendations made from the first Workshop for Hainan Gibbon Conservation, both of which were carried out in October 2003 at the request of HWCC, BNNR and BFB. The objective is to develop a conservation strategy to ensure the species' long-term survival, which cannot be achieved without collaborative intervention of government officials, concerned NGOs and the local communities.

Although the results and conclusions were made after merely 16 days of fieldwork and 3 days of workshop, this represents over 1,000 person-days of survey effort, and the recommendations are backed up by a strong scientific understanding of gibbons in general, and Hainan Gibbon in particular. The fieldwork was designed, organised and led by one of the world's gibbon authorities and the workshop had the active participation of the scientists and fieldworkers most knowledgeable on Hainan Gibbon. We hope that this report will be useful for drawing both national and international attention to the importance of BNNR for biodiversity conservation at the national and global levels.

Successful conservation outcomes depend on identifying the causes of problems, and designing and implementing various actions to resolve them, based on sound biological understanding of the species and its habitat. An adaptive multidisciplinary approach needs to be taken in order to maximise the conservation benefits with minimised costs. A conservation action plan for the Hainan Gibbon is outlined in this report, which is collated from ongoing or planned projects to be implemented by BNNR and various partners.

2. Taxonomy of the Hainan Gibbon

The gibbons form the family Hylobatidae. In early studies on gibbon systematics, the Hylobatidae were grouped into two distinct genera: the Siamang (*Symphalangus*) on one hand, and all the remaining gibbons (*Hylobates*) on the other. Research carried out during the 1980s provided increasing evidence that four distinct groups had to be recognized (Table 1). All four groups appear to have evolved at roughly the same time. Based on comparative analysis of molecular data, the four groups of gibbons are currently recognized as four distinct genera. Each of the four groups is identified by, among other characteristics, a distinctive karyotype, the diploid number of chromosomes being 50 (*Symphalangus*), 52 (*Nomascus*), 38 (*Bunopithecus*) and 44 (*Hylobates*). Other distinctive characteristics include skull anatomy and vocalizations (e.g. Corbet & Hill, 1992; Geissmann, 1995, 2002a).

Hainan Gibbon was mentioned in local gazetteers and western travellers' notes as early as the seventeenth century (Allen, 1906; Liu *et al.* 1984). Scientifically, however, the Hainan Gibbon remains a little-known taxon of crested gibbon, whose taxonomy has been, and still is, a subject of debate. Its discovery by the scientific world was summarised by Allen (1906); Swinhoe (1870) reported the occurrence of a 'black ape' on Hainan, based on descriptions by the local people. In 1892 Oldfield Thomas formally described Hainan Gibbon as *Hylobates hainanus* from a specimen deposited in the British Natural History Museum, which was presented to W.T. Lay who kept the specimen alive for four years in captivity (Thomas, 1892). Since its discovery it has usually been regarded as a subspecies of the 'concolor gibbon' *Hylobates concolor* species complex (e.g. Pocock, 1927; Delacour, 1951), and treated as a subspecies *Hylobates concolor hainanus* endemic to Hainan (e.g. Schilling, 1984a; Ma and Wang, Y. 1986; Corbet & Hill, 1992; Zhang *et al.*, 1997; Groves and Wang, Y. 1990¹; Zhang *et al.*, 2002).

¹ Groves (2001) notes "by a failure of communication between the authors, Groves and Wang (1990), the name *nasutus* was mistakenly applied to mainland *hainanus*". He thinks the Hoa Binh and Cao Bang specimens are definitely *H. hainanus*, as reported by Dao V.T. (1983. On the North Indochinese gibbons (*Hylobates concolor*) (Primates, *Hylobates*) in North Vietnam. *Journal of Human Evolution* 12, 367-372.

Table 1. Main divisions of the family Hylobatidae (after Geissmann *et al.*, 2000; Geissmann, 2002a. See also Groves, 1984; Haimoff *et al.* 1984; Groves, 2001).

Genus	Diploid number of chromosomes	Other division names	Species	Common name
<i>Hylobates</i>	44	<i>Lar</i> group	<i>H. agilis</i> ²	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> ³	Müller's Gibbon
			<i>H. pileatus</i>	Pileated Gibbon
<i>Bunopithecus</i> ¹	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> ⁴	Eastern Black Crested Gibbon
			<i>N. gabriellae</i>	Yellow-cheeked Gibbon
			<i>N. leucogenys</i>	White-cheeked Crested Gibbon
<i>Symphalangus</i>	50		<i>S. syndactylus</i>	Siamang

¹ The applicability of this (sub-)genus name to the Hoolock Gibbon is doubted by Groves (2001), who considers *Bunopithecus* to represent an extinct taxon. Groves considers this an obstacle to raising the extant subgenera to generic status.

² including *H. agilis albibarbis*

³ including *H. muelleri abbotti* and *H. muelleriflinereus*

⁴ including *N. sp. cf. nasutus hainanus*

⁵ including *N. leucogenys siki*

It has been calculated using mitochondrial DNA data that the gibbon subgenera *Hylobates*, *Symphalangus* and *Nomascus* diverged about 6 million years ago (Hayashi *et al.*, 1995), suggesting the need for full generic separation (Groves, 2001). Subsequently, Roos and Geissmann (2001), based on DNA sequences, showed that the molecular distances among the four gibbon subgenera are in the same range as those between humans (*Homo*) and chimpanzees (*Pan*), or even higher. This provided further support for raising all four gibbon subgenera to genus rank. Geissmann (1997) further confirmed that *Nomascus concolor*, the Western Black Crested Gibbon in Yunnan and northern Indochina west of the Red River (the 'Yuan Jiang' in Chinese territory) is distinct from the species distributed in northeast Vietnam east of the Red River and South China including Hainan; he called this taxon Eastern Black Crested Gibbon and referred it to *Nomascus sp. cf. nasutus*² (Geissmann *et al.*, 2000). But the Hainan Gibbon differs from *Nomascus nasutus* on the Vietnamese mainland in fur coloration (see also Ma and Wang, Y. 1986) and vocal characteristics (Geissmann *et al.*, 2000). Recently certain taxonomists have followed Thomas (1892) and regarded Hainan Gibbon as a separate species, *Hylobates hainanus* (e.g. Groves, 2001; Wang, Y. 2003).

² The name *nasutus* was first applied by Kunkel d'Herculais (1884) to a specimen[?] collected "near Along Bay, Tonkin, N Vietnam". Delacour (1951) later considered the correct locality to have been Chapa, Tonkin (Corbet & Hill, 1992).

3. Biology of Hainan Gibbon

Gibbons are a relatively homogeneous group of ape distributed throughout the tropical rainforests of South-East Asia. They are strictly arboreal and mainly frugivorous. Their arm-swinging form of locomotion (brachiation), unique suspensory behaviour and habitual erect posture are extreme specializations which evolved in connection with the animals' arboreal lifestyle and diet. All species of gibbons are known to produce elaborate, species- and sex-specific patterns of vocalization often referred to as 'songs'. 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 (Goustard, 1984; Schilling, 1984b; Geissmann, 2002a). Calls by mated pairs of crested gibbon typically consist of duet song bouts. Solo songs appear to be produced by non-mated individuals only, and are heard more frequently from males than from females (e.g. Haimoff, 1984; Geissmann *et al.*, 2000; Geissmann, 2002a).

Wild crested gibbons have an average body weight of 7-8 kg. In males, the crown hair is erect and elongated and forms a crest (thus 'crested gibbons'). Adult females usually have a dark cap which contrasts sharply with the surrounding lighter fur. The crown fur (including the cap) of the female is erect but is not elongated into a crest. Adult crested gibbons exhibit a strong sexual dichromatism: males are generally black, whereas females are light yellow, orange yellow or light beige, apart from the blackish occipital patch (Geissmann, 1995; Geissmann *et al.*, 2000). Ontogenetic changes in fur coloration are pronounced. Infants are born with a light natal coat, somewhat similar in coloration to that of the adult female. At the age of about one year, or during the second year of life, the infants change coloration and assume a dark coat virtually identical to that of an adult male. At about the time of sexual maturity (around 5-8 years of age), females change coloration a second time and adopt the light coloration typical of adult females. See also Liu *et al.* (1989) and Pocock (1927) for descriptions of fur coloration changes in Hainan Gibbon of different age classes based on their observations in the wild and in captivity, respectively.

Knowledge of Hainan Gibbon biology is limited. Few specimens (skins, skeletons, skulls) are known to exist in museum collections worldwide, and no individuals are held in captivity today. Field studies on Hainan Gibbon started in the 1960s when Prof. Liu Zhenhe of SCIEA studied Hainan Gibbon in the Bawangling area. Through his efforts its basic ecology and conservation status was made known to the world (Liu *et al.* 1984; Liu and Tan, 1990) and Bawangling, the Gibbon's last stronghold, was given protected status in 1980. Liu's successor at SCIEA is Prof. Jiang Haisheng, who has studied Hainan Gibbon from the mid-1980s until today (e.g. Liu *et al.*, 1989). At the moment four research projects are under way on habitat selection and conservation biology of the Hainan Gibbon; led by Mr. Zhou Jiang of Beijing Institute of Zoology (CAS), Mr. Lin Jiayi of South China Agricultural University, Ms. Zhang Mingxia of Kunming Institute of Zoology (CAS) and Mr. Wu Wei of ECNU.

Available data suggest that the behaviour and ecology of the Hainan Gibbon are similar to those of other crested gibbons in tropical Asia, but with a few exceptions (see Chivers, 1980; Liu *et al.* 1984; Liu and Tan, 1990). The average group size in non-crested gibbons ranges from 3 to 5 individuals (Leighton, 1987), whereas larger average group sizes of 5-6 individuals were recorded in several, but not all, field studies on crested gibbons (Table 2). In Bawangling, the only place where Hainan Gibbon has been studied, the largest recorded group size observed was eight individuals, with an average group size of five to six (Liu *et al.* 1984). The average home range size of most non-crested gibbons is about 20-40 ha (e.g. Chivers, 1984; Leighton, 1987), whereas average home range sizes of more than 70 ha have been found in most field studies on crested gibbons (**Table 2**). Reported home range sizes of the Hainan Gibbon vary from 200-500 ha (Liu *et al.*, 1989; Liu and Tan, 1990. See Table 2).

Table 2. Crested gibbon group size and ranging (from Geissmann *et al.*, 2000, expanded).

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
Western black crested gibbon (<i>N. concolor</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
Eastern black crested gibbon (<i>N. sp. cf. nasutus</i>):						
Cao-vit gibbon (<i>N. sp. cf. nasutus nasutus</i>)						
Trung Khanh distr., Cao Bang prov., Vietnam	640-800	5.2-5.6, 5-6 (5)	>1.25	<80		Geissmann <i>et al.</i> , 2002
Hainan gibbon (<i>N. sp. cf. nasutus hainanus</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
Bawangling Nature Reserve, Hainan, China	700-1,200			250-500		Zhou Jiang, pers. communication
Bawangling Nature Reserve, Hainan, China	700-1,200	5.5, 5-6 (2)				Present study
White-cheeked crested gibbon (<i>N. leucogenys</i>)						
Mengla Nature Reserve, Xishuangbanna, Yunnan prov., China	700-1,000	3.78, 3-5 (9)		200-500	1305, 748-2,158	Hu <i>et al.</i> , 1989

Another anomaly is the social organisation of mating pairs; existing data indicate that the Hainan Gibbon is polygynous. Whether these phenomena (i.e. larger group size, larger home range and polygyny) are characteristic of either crested gibbons in general or Hainan gibbons in particular is unresolved, as they may be results of the extremely small population size

(affecting the mate availability and the size of territory that can be defended) and/or poor habitat quality (the need to travel longer distances to obtain enough food) (see also Liu *et al.*, 1989; Geissmann *et al.*, 2000). Although lowland rainforests probably represent the optimal gibbon habitat, most lowland forests have been destroyed within the distribution area of the crested gibbons and most populations live at much higher altitudes (Table 2). The Hainan gibbon in BNNR presently occurs at relatively high elevations of 700-1,200 m (Zhou Jiang, IoZ, pers. comm. October 2003), probably as a result of forest clearance in the lowland areas. For instance, Hainan gibbons used to occur in the lowland of Diaoluoshan before forest clearance and hunting extirpated the subpopulation (Liu *et al.*, 1989; Liu and Tan, 1990).

Hainan Gibbon is mainly frugivorous and has been seen to feed on over 40 species of plants. Fleshy fruits are the favourite food for Hainan Gibbon; young leaves and animal proteins are taken only occasionally, in small quantities. The most difficult time for the gibbons to find food in BNNR is between February and April, when only seven known food-plant species are available for the gibbons (for details see *Reduced forest quality* under Chapter 8) (Zhou Jiang, IoZ, pers. comm. October 2003; Chen Qing, BNNR, pers. comm. December 2003). Potential competitors for food sources in the BNNR include other arboreal frugivores, such as Rhesus Monkey *Macaca mulatta*, civets (e.g. Masked Palm Civet *Paguma larvata* and Asian Palm Civet *Paradoxurus hermaphroditus*) and squirrels (e.g. Black Giant Squirrel *Ratufa bicolor* and flying squirrels), which have been observed feeding on the same fruiting tree with the gibbons (Liu *et al.*, 1989). Other frugivorous animals, for example fruit bats and large-bodied frugivorous birds such as pigeons may also compete for limited food sources at times. In BNNR species reported as potential predators on the gibbons include Clouded Leopard *Neofelis nebulosa* and two species of eagles, Mountain Hawk Eagle *Spizaetus nipalensis* and Black Eagle *Ictinaetus malayensis* (Liu *et al.*, 1989). An eagle, probably Mountain Hawk Eagle, was seen attempting to capture a juvenile of the Group B gibbon at Nanchahe area, but was driven away by the mother (Zhou Jiang, IoZ, pers. comm. October 2003). Other potential predators, including Asiatic black bear (*Ursus thibetanus*), yellow-throated marten (*Martes flavigula*) and large Indian civet (*Viverra zibetha*) may still occur in BNNR, but are not known to be a threat to gibbons and are themselves likely to be rare.

Reproductive biology is not well known; Hainan Gibbons appear to pair for many years, like other gibbon species. There is no pronounced breeding season as far as records show (Jiang Haisheng, pers. comm. October 2003). Each mated female gives birth to a single infant about every two years, which the mother carries around for almost two years (Liu *et al.*, 1989). This birth rate is similar or even higher than the one reported for non-crested gibbons (Chivers, 1980). The offspring remains in the natal group until the age of about seven or eight and then is usually driven out by the breeding pair. From 1982 to 1989, a total of 12 infants were born in BNNR; 11 of these (92%) survived until they were subadults (Liu *et al.*, 1989). Nothing is known about the fate of the subadults after they leave their natal groups; solitary gibbons have never been seen by researchers, and only briefly a few times by BNNR staff (Liu and Tan, 1990; Zhou Jiang, IoZ, pers. comm. October 2003). Liu *et al.* (1989) observed that nine of the 12 infants (75%) born between 1982-1989 have been males; although it may be by chance, but also possibly a socio-ecological phenomenon (Johnson, 1988; Dittus, 1998; Cowlishaw and Dunbar 2000), such skewed sex ratio may also affect future population expansion because of the availability of mate choices. Since many more incidents of subadults leaving natal groups have been observed than formation of new mating pairs (see Liu *et al.*, 1989), it is likely the most critical life-stage for the extant population is the survival of solitary individuals after leaving the natal groups. In July 1999 and November 2000, BNNR staff observed the two social groups mixing in which individuals were interacting peacefully. The consequences of such behaviour in terms of population dynamics is of interest and warrant further studies.

4. Historical Changes in the Status and Distribution of Hainan Gibbon

Crested gibbons (genus *Nomascus*) are distributed over rainforests of Indochina, mostly east of the Mekong River, including eastern Cambodia, southwestern China, Laos and Vietnam. As shown in **Figure 1**, the eastern black crested gibbon species complex (*Nomascus* sp. cf. *nasutus*) was originally distributed in Indochina east of the Red River, i.e. in Vietnam and southwest China (Hainan Island, southwest Guangxi and southeast Yunnan) (Geissmann *et al.*, 2000). All ‘concolor gibbons’ of China are Class I National Protected species, and the eastern black crested gibbon *Nomascus nasutus* (provisionally including Hainan Gibbon) is listed as Critically Endangered in the 2003 *IUCN Red List of Threatened Species* (Geissmann, 2003).

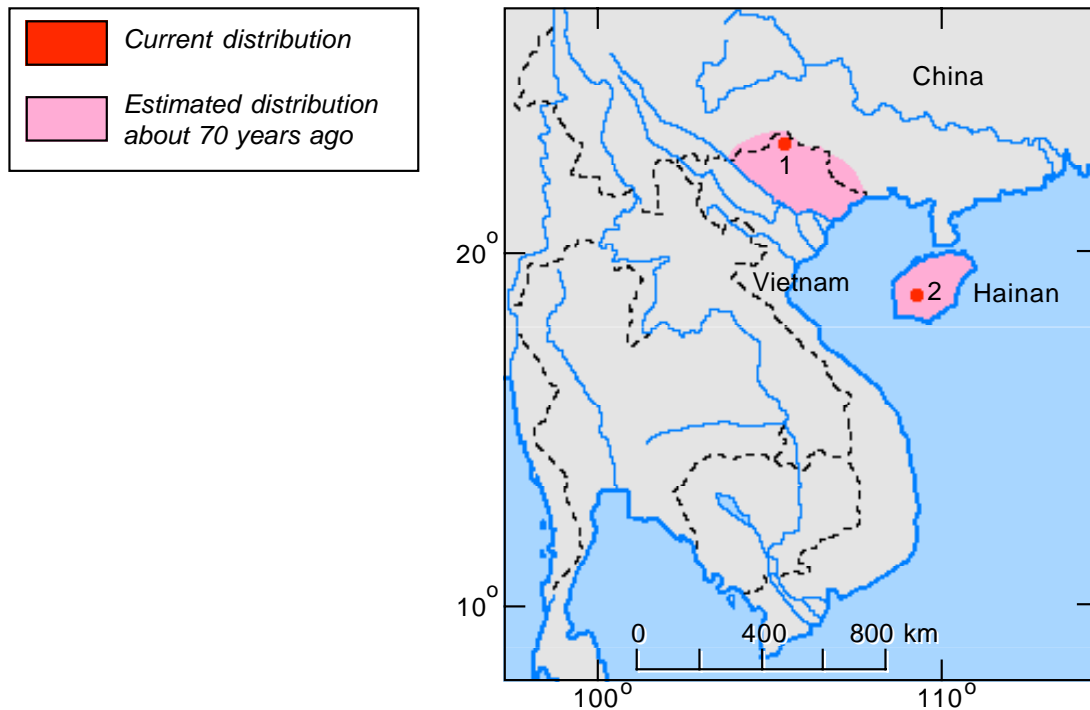


Figure 1. Current and estimated past distribution of the eastern black crested gibbon (*Nomascus* sp. cf. *nasutus*). Only two populations are known to exist and are indicated as red dots. (1) Cao Bang province, Vietnam, 26-28 individuals. (2) Bawangling National Nature Reserve, Hainan, China, 14 individuals. The two populations are currently believed to be distinct subspecies, but their taxonomy is still being investigated.

Hainan Gibbon is an obligate tropical forest specialist; thus its maximum historic range can be inferred by the coverage of primary forest on Hainan. Hainan is the second largest island in China after Taiwan, with a land area of 33,600 km². In the 17th century 60% of the island was covered by primary tropical forest. Following various historic events the forest cover dropped to 35% in the early 1950s and further shrunk to less than 10% in the 1980s (Jiang *et al.*, 2002; Li, 2004). The most severe blow was probably the economic development in the second half of the 20th century, notably between 1950 and 1979 when large-scale deforestation occurred (Jiang *et al.*, 2002). One key factor was the promotion of rubber plantations, in which government departments designated ca. 8,000 km² of low-lying area, over half of it lowland tropical rainforests, as plantation areas; this destroyed half of Hainan’s remaining natural forest and most of the tropical forest. Substantial deforestation continued on Hainan until the commercial logging ban on natural forest was enforced in 1994, and the present cover of ‘good quality’ forest is only 6% (Li, 2004). **Figure 2** illustrates the change in forest cover on Hainan.

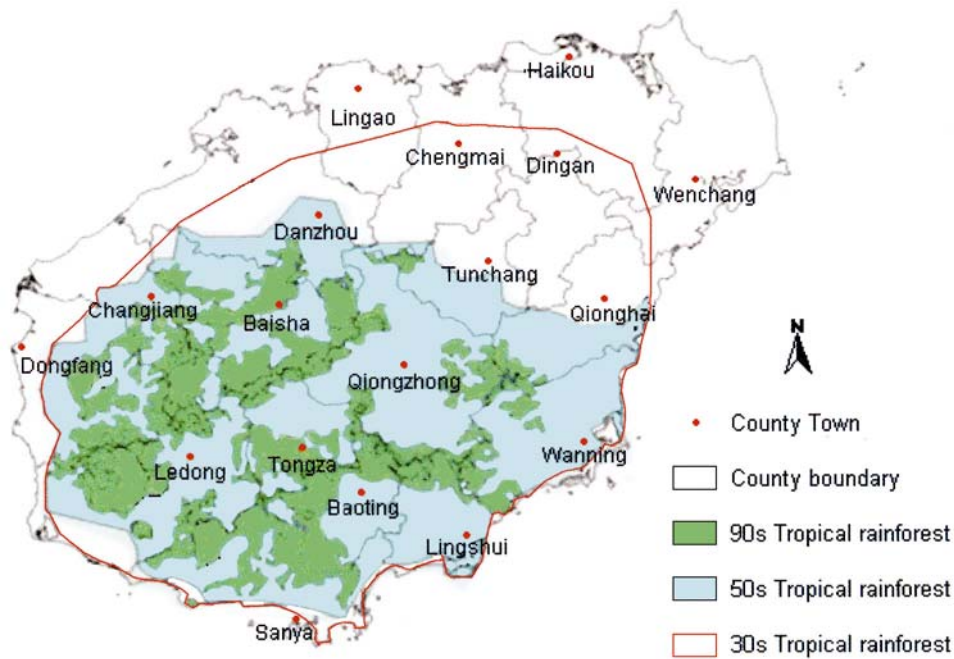


Figure 2. Map showing change in forest cover on Hainan

Hunting has also played a major role in the drastic decline of the Hainan Gibbon population. Because of its social and behavioural characteristics, the gibbons are easy game for skilled hunters. The body of Hainan Gibbon is believed to have superior medicinal properties by Hainan's minority groups, especially as a 'paste' made from the whole body; for example villagers in the Diaoluoshan area (Xiaomei and Dali villages) have a long history of hunting gibbons, and they "love to hunt gibbons, once detected gibbons were always hunted by an organised hunting team." (Tang and Li, 1957, 246). Liu *et al.* (1984) described the elimination of subpopulations in various forest tracts of Hainan by gibbon hunters, especially those of the Miao minority.

Before the 1960s Hainan Gibbon was widely distributed across 12 counties in Hainan, with an estimated population of over two thousand individuals (Liu *et al.*, 1984). But the combination of habitat loss and hunting pressures resulted in a dramatic decline in number, to around 30 individuals in the 1980s, at Bawangling and Limuling (Liu *et al.*, 1984). By the early 1990s it was believed BNNR was the only place with a viable population; in the late 1970s only a relict population of seven or eight individuals was believed to remain in BNNR, with protection the number increased to four groups of 21 individuals in the late 1980s (Liu *et al.*, 1989; Wang C., 1995). It was reported, however, the number underwent another marked decline with only 15 individuals left in the early 1990s due to a lack of financial support for proper management of the reserve, resulting in forest clearance and gibbon being poached within the reserve (Zhang, 1992; Zhang and Sheeran, 1994). A status survey conducted in 1998 and covering the western side of Futouling reported 23 gibbons in four groups (State Forestry Administration Survey and Planning Institute & BNNR Management Office, 2001). **Figure 3** illustrates the change in gibbon distribution on Hainan. The closest relative, the mainland population of eastern black crested gibbon, is called the Cao-vit gibbon *Nomascus sp. cf. nasutus nasutus*, and has recently been rediscovered in Cao Bang Province in northeast Vietnam. To date only 26-28 individuals in five groups have been confirmed to survive; they live in an area of less than 4 km² (Geissmann *et al.*, 2003a).

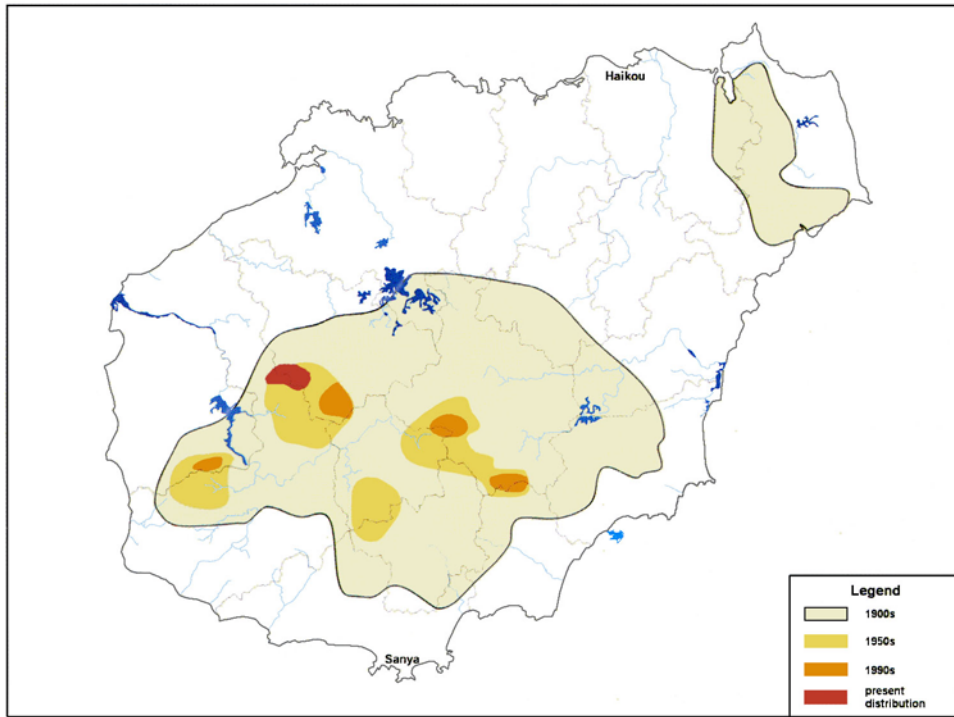


Figure 3. Map showing change in Hainan gibbon distribution

5. Bawangling National Nature Reserve (BNNR)

BNNR is on the border of Changjiang and Baisha Counties, West Hainan (Figure 4). Its coordinates are 18°57'–19°11'N, 109°03'–109°17'E. Bawangling Nature Reserve was established in 1980 with the objective to protect the Hainan Gibbon, and it was upgraded to a National Nature Reserve in 1988, with a reserve area of 66.3 km². In September 2003, the State Council approved an expansion proposal and BNNR was enlarged to include the mountain ranges of Qichadaling and Yajiadaling, with a total area of 299.8 km².

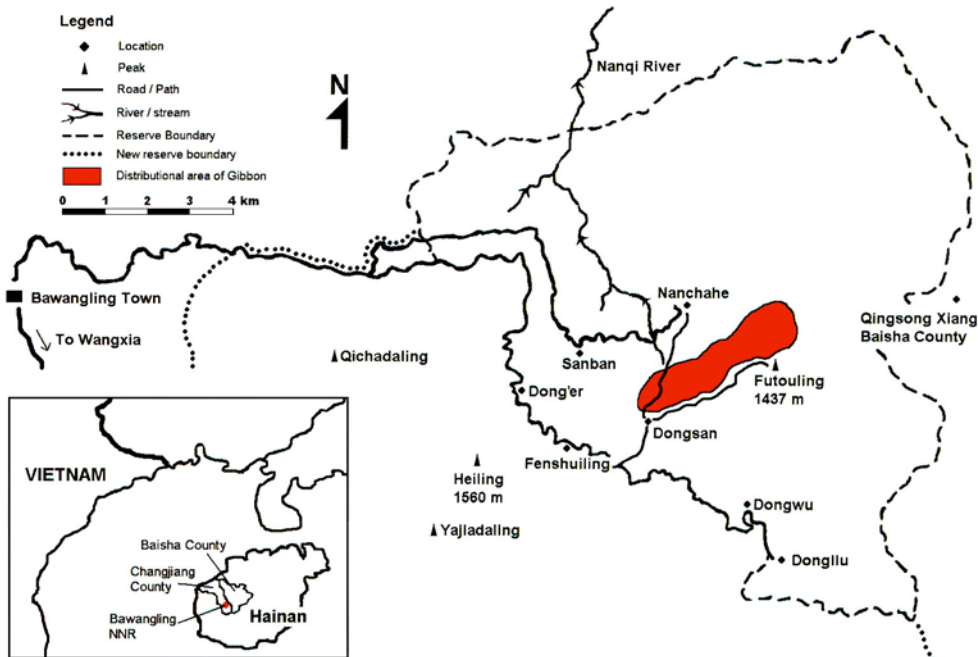


Figure 4. Map showing locations of Hainan and BNNR with locations mentioned in text

Mean annual temperature at the Dongsan research station (known as 'Laodian', ca. 1,150 m a.s.l.) is 19.6°C, the hottest month being June with a mean temperature of 22.5°C; the coolest month is December with a mean temperature of 15°C. The absolute minimum temperature recorded between 1985 and 1987 was 3°C. Annual rainfall is 1,620 mm with a mean relative humidity of 88.6% (Liu *et al.*, 1989; Liu and Tan, 1990). Futouling, a peak of 1,441 m, is the most prominent landscape feature in BNNR, and has the only substantial block of primary tropical rainforest within BNNR (see **Figure 4**). BNNR is biologically very diverse; apart from being the only locality with a confirmed gibbon population it supports the majority of Hainan's forest fauna and flora; studies have recorded 2,213 species of vascular plants and over 140 bird species to date (Kadoorie Farm and Botanic Garden, 2001; State Forestry Administration Survey and Planning Institute & BNNR Management Office, 2001; Chan *et al.*, 2005).

The BNNR Management Office is located in Bawangling Town, Qicha Township, and there are three substations: at Dong'er and Nanchahe of Changjiang County and Qingsong of Baisha County. In 2001 there were only 13 staff, at the moment there are 28 staff; the area of the expanded BNNR was originally a group of state-owned forest farms under the management of BFB (State Forestry Administration Survey and Planning Institute & BNNR Management Office, 2001, 6, 21). In 2001 the human population within the new BNNR was 2,900 with an average annual income of RIVIB 4,944 yuan. BNNR is surrounded by three townships (Qingsong, Qicha and Wangxia) with a human population of 27,000. There are 46 villages in Qicha township with a population of 20,000, half of the villages are within five kilometres from the reserve boundary. The majority (90%) of the population is of the Li Minority and the rest of the Miao Minority, with an average annual income of RIVIB 650-900 yuan (State Forestry Administration Survey and Planning Institute & BNNR Management Office, 2001).

As with other reserves in Hainan, BNNR suffered a period of negligence in terms of financial support and scientific research between 1989-1994, when Hainan was made a province during national administrative reform. It was reported, due to a lack of financial support for proper management of the reserve, forest clearance and hunting of gibbons have happened within BNNR in the early 1990s (Zhang, 1992; Zhang and Sheeran, 1994).

6. The New Status Survey – Methods and Results

Aims and Methods

The aim of the present survey was to provide the information necessary for conserving the gibbon population at BNNR. This involved:

1. a comprehensive and up-to-date survey of the number of gibbons present, covering all forest known to be used by the population and some additional forest tracts, and using the largest, best-trained survey team yet employed; and
2. an assessment of the constraints on population recovery.

Like other gibbons the Hainan gibbon produces loud morning song bouts that can be heard for distances of more than one km. The majority of songs start immediately after dawn, but songs may occur, at decreasing probability, later in the morning and occasionally in the early afternoon. The most effective technique for determining the number of gibbons during a survey is a variant of fixed-point survey (e.g. Brockelman & Srikosamatara, 1993) in which the observer quietly remains stationary in one location and records all gibbons that can be heard or seen from there. This variant has been optimised for gibbon surveys by one of us (TG). The fixed points in this case are called listening posts. A listening post should be in a vantage point where gibbon calls can be detected particularly well, such as elevated positions away from streams and rivers. In the optimal case, listeners in several teams should be

working together in coordination, and listening posts should be evenly spaced at about 1 km apart as far as topography allows.

To maximise the chance of detecting all gibbon groups within hearing distance, survey teams had to be ready at the listening post throughout the whole song activity period of the gibbons, i.e. from before the first gibbon song starts and for the whole morning. Since new gibbon groups can still be discovered after listening from the same post for five days in a row, each team needed to occupy its own pre-determined listening post for at least five consecutive days, and preferably 7-10 days, to ensure detection of all gibbon groups within hearing distance. For each listening post, a series of readings needed to be collected: GPS reading (showing longitude and latitude), altitude, and, when gibbons were detected, data on what was heard and seen. Singing data included the singing time and duration, compass bearings of all calls from the position of the listeners, estimated distance between singing gibbons and listeners, types of calls (duet song bout, male solo song bout, female solo song bout, alarm calls). Song vocalisations produced at reliably determined intervals of more than 5 min were considered distinct song bouts. Sighting data included number of individuals, description of fur coloration of each individual, size class of each individual (infant, juvenile, adult), and type and duration of all behaviour seen, as exactly as possible. An example of data collected is illustrated in **Appendix 1**. In order to obtain data on group composition, two days near the end of survey (see below) survey teams were allowed to approach gibbons that were singing a short distance from the observers to determine group size. Results of all teams were compared and plotted and, by triangulation of timed data recorded by nearby teams, the number of gibbon groups and the position of their home range in the study area were obtained.

Prior to the present survey Thomas Geissmann of Zürich University gave a presentation to introduce gibbons, and delivered a training course on survey techniques and identification of gibbon song types to the survey team on 12-13 October 2003 in Bawangling Town. The survey team members were mostly nature reserve wardens from Hainan, with participation of gibbon researchers and staff of KFBG, Beijing and Kunming Iozs (CAS) and FFI.

The present survey was conducted over 16 days in two stages. For stage one, from 14-24 October 2003, 16 listening posts were selected to cover the “old reserve” area, effectively the foothills of Futouling where gibbons are known to occur. In stage two, from 25-29 October 2003, the participants split into 13 teams and surveyed the reserve’s well-forested extension area of Qichadaling and Yajiadaling for the presence of Hainan gibbons.

Results

During the course of the 16-day survey, 34 gibbon song bouts were reliably confirmed, and seven additional song bouts may have occurred but were not heard well enough for reliable identification. The peak singing time occurred in the time interval of 06:00-07:00, when 32% (11 of 34) of the song bouts started.

Two social groups plus two solitary males were confirmed; the two social groups are termed “Group A” and “Group B”. Group A was seen to contain six individuals (including two infants), Group B consisted of five gibbons (including one infant). The two additional solitary adult males were detected by their solo songs. On two of the survey days both groups and both solitary males all sang at least once, though never all at the same time (crested gibbon groups avoid starting and ending song bouts simultaneously). While there was no instance when both groups and both solitary males were audible from a single listening point at the same time, it is safe to assume from their locations that the two solitary males detected are different from the 11 animals observed in the two groups, making a total of 13 individuals confirmed from the present survey. A group of three individuals has occasionally been sighted in recent years; it is possible that one of the two ‘solitary’ males recorded may in fact represent a third group, but it is also possible that one of the two solitary male is the sole remaining member of an earlier group. In early December 2004, Group B gave birth to a new

baby and it was photographed, making the world total of Hainan Gibbons to 14 individuals at present.

The gibbons in BNNR are restricted to the severely fragmented primary forest on the northwest slope of Futouling, within which less than 15 km² is suitable gibbon habitat (Figure 4) (see also Liu *et al.*, 1989). The home range of Group A is in the Dong'er-Dongsan area while Group B is resident in the Nanchahe area, and regularly travels to the northeast tip of Futouling in Baisha County (Zhou Jiang, IoZ, pers. comm. October 2003). No gibbons or signs of their presence were detected during the five-day survey in the new reserve extension area, where gibbons used to exist before the 1990s (Liu and Tan, 1990).

Anthropogenic disturbances were assessed during the survey. Gunshots were heard regularly throughout the survey, except in the Dong'er-Dongsan area. Hunting with rifles appears to be particularly severe in the Baisha side of Futouling, in the Dongwu area and in the extension area of Qichadaling and Yajiadaling. Leg traps and hunters'/collectors' huts were found in the Dong'er, Dong'san and Dongwu areas, and in the extension area of Qichadaling and Yajiadaling. All gunshots were heard downhill from the listening posts where there is no occupied gibbon habitat at present, but hunting was evidently a major problem, if only from the disturbance it causes.

7. First Workshop for Hainan Gibbon Conservation

Participants in the workshop held after the survey included government and NGO representatives, researchers and local stakeholders. Workshop participants began their discussions by reviewing past and ongoing studies on the gibbons. Prof. Liu Zhenhe of SCIEA spoke modestly of his pioneering studies from the 1960s to the 1990s. Thomas Geissmann (Zürich University) reviewed research work conducted and conservation measures implemented on gibbons worldwide. More recent work on the Bawangling population was reported by Prof. Jiang Haisheng, Liu's successor at SCIEA, and by postgraduates Zhou Jiang of IoZ and Wu Wei of ECNU. Zhang Yingyi of FFI China introduced their conservation work on the Vietnam black crested gibbons. Li Dajiang of BFB described the efforts of the BFB to get the NNR enlarged and improved, culminating in the acceptance this summer of a 232-km² extension by the State Council. He, and other officials from Changjiang County, Qicha Township and Bawangling Town, welcomed the workshop's input to their conservation work. Results of the present survey were presented by Thomas Geissmann and Bosco Chan (KFBG). Opportunities and pitfalls in the implementation of a conservation action plan were discussed by John Fellowes (KFBG). Post-presentation discussions led to a preliminary impression of the possible limits on the recovery of the Hainan Gibbon population, including human activity and habitat limitations.

On the second day the delegation split into groups for field excursions to consider different aspects of the conservation challenge. Two groups considered the human populations living around the reserve in Changjiang and Baisha Counties. Two other groups considered short- and longer-term improvements in habitat quality and connectivity. Each group reported its observations and suggestions to the main workshop later in the day, and discussions continued late into the evening on how to overcome threats.

On the last day, the workshop members summarised their collective impressions of threats and actions required. These are outlined in the following sections; the detailed workshop agenda is attached in **Appendix 2** and a brief workshop report attached in **Appendix 3**.

8. Major Constraints on the Recovery of Hainan Gibbons

The constraints on population increase are uncertain. Bawangling appears to contain sufficient forest area to support a larger gibbon population, but the gibbon population is undoubtedly depressed below the carrying capacity of the forest as a result of various past and present human impacts. As noted in Chapter 3, the birth rate among Hainan gibbons, with each adult female giving birth about once every two years, appears to be at least as high as those reported for viable populations of other gibbons. Yet, the Hainan gibbon population has clearly failed to increase during the last ten years. The main limiting life-history stage could be the survival of maturing subadults leaving the natal groups, and/or the formation of new mating pairs. Drawing from data of scientific studies, long-term observations from BNNR staff, and results of the present survey, the major constraints on recovery of the Hainan gibbon in BNNR are as follows.

Reduced Forest Quality

It was the consensus at the workshop that Hainan gibbons, like most other extant gibbon taxa in the world, actually favour *lowland* tropical rainforest, but their distribution contracted to higher elevations when large-scale forest clearance eliminated lowland rainforest during the last century on Hainan. These processes can be clearly seen in the patterns of primary forest cover and gibbon distribution range changes (see **Figures 2** and **3**, respectively). It is also believed that the southeast part of Hainan, with significantly higher annual rainfall and plant diversity (Jiang *et al.*, 2002), had the most suitable habitat for Hainan gibbons before deforestation. For example the gibbons at Diaoluoshan occurred at much lower altitude than in BNNR today (Tang and Li, 1957; Liu Zhenhe, pers. comm., October 2003). Bawangling, situated in western Hainan, is in the driest part of the island and has been subject to forest encroachment on gentle low-altitude slopes. Very little natural forest remains below 700 m, and, at present, the fruiting trees preferred by gibbons are restricted to ravine rainforest with favourable microclimate (Liu *et al.*, 1989; Liu and Tan, 1990). As a result, Hainan gibbons in BNNR are currently restricted to ravine forests between 650-1200 m a.s.l. The limited amount of prime habitat available in BNNR for the gibbons may have an effect on population expansion, as suggested by Liu *et al.* (1989).

This hypothesis is supported by various long-term gibbon habitat use studies; Liu and Tan (1990) found, based on a one-year study on Group A, that the group utilised the ravine forest most frequently. Zhou Jiang's (IoZ, *in litt.* December 2003) study on the gibbon's current food choice in BNNR during 2002-2003 revealed that important gibbon food plants included *Bischofia javanica*, *Caiyota uchiandra*, *Endospermum chinense*, *Litchi chinensis* var. *euspontanea*, *Polyalthia lauii* and various *Ficus* species. These food plants are relatively common in the remaining ravine rainforests, but uncommon in the extensive montane rainforest above 800 m. In the most difficult time of year (i.e. between February and April), the Hainan gibbon has a very limited choice of food: the fruits and leaves of *Schefflera heptophylla*, and the fruits of *Ficus altissima*, *Polyalthia lauii*, *Diospyros susarticulata*, *Elaeocarpus sphaericus*, *Pouteria annamensis* and *Podocarpus neriifolius*. The forest above 800 m in BNNR is dominated either by Fagaceae or *Dacrydium pierrei*, and the diversity of tree species declines as altitude increases (Liu and Tan, 1990; Jiang *et al.*, 2002). Furthermore, plant diversity is higher in the southern part of BNNR than in the northern part (Jiang *et al.*, 2002); the current gibbon range (i.e. forest above 700 m a.s.l. in the northeast part of BNNR) is floristically the least diverse within BNNR. Therefore, foraging efficiency (the ratio of energy gained over energy spent while foraging) of the gibbons is expected to be low and energy expenditure (energy used per unit of time during foraging trips) high, with potentially negative consequences for population recovery. The longer and spatially constricted foraging trips may also make the gibbons more susceptible to hunting, predation and other unfavourable events.

Suboptimal habitat quality may also make primates more vulnerable to predation risk (e.g. by preventing group size from increasing in response to higher predation levels) and disease (e.g. when in poor condition due to reliance on low-quality foods; Cowlshaw and Dunbar, 2000). It is possible that the gibbon population in montane forest at Bawangling is naturally a “sink” (Cowlshaw and Dunbar, 2000), with lower population growth rates than the “source” populations of lowland rainforest; while there have been few studies of such natural “rescue effects” in primates such a system has been documented at high altitudes for Gelada Baboons *Theropithecus gelada* in Ethiopia (Ohsawa and Dunbar, 1984; Cowlshaw and Dunbar, 2000).

Hunting

Evidence of continued poaching at Bawangling, with both guns and traps, was encountered throughout the survey, and hunting remains a major ongoing threat to wild animals in BNNR. Hunting by rifles appears to be particularly severe on the Baisha side of Futouling, in the Dongwu area and in the extension area of Qichadaling and Yajiadaling. Leg traps and hunters'/collectors' huts were found in the Dong'er, Dong'san and Dongwu area, as well as in the extension area of Qichadaling and Yajiadaling. The impact of hunting on gibbons in recent years is uncertain, but it must be considered a major potential threat. Existing legal deterrents (a heavy penalty of up to 15 years imprisonment for first-time offenders) and local beliefs (some of the minority people around BNNR reportedly believe killing a gibbon brings bad luck to the family) apparently limit the motivation to hunt gibbons, but the possibility of accidental shooting (while hunting other arboreal animals), or deliberate hunting by a small number of poachers, should be taken seriously. The loss of any surviving individual would be a very significant blow to future recovery of the Hainan Gibbon population. Moreover the disturbance caused by hunting is likely to be an additional stress on gibbons.

Human Pressures

There are many indirect factors that could prevent population recovery, in particular habitat fragmentation and various anthropogenic disturbances inside the forest. Within the forest block occupied by the gibbons, their movement is interrupted by habitat barriers including pine plantation, fire-maintained grassland, power lines and disused logging tracks, forcing gibbons to travel by circuitous routes. A large number of people live around the nature reserve margins and many collect fuel wood and clear (mainly secondary) forests for new plantation plots, hindering regeneration of natural forest, especially in the lowlands.

Currently, the high level of human activity incompatible with conservation is probably the major problem for reserve management. Forest encroachment, for example slash-and-burn cultivation, is still practised by minority villagers on the lower slopes of Futouling in the Baisha area. During the present survey tree felling was frequently seen, reportedly for the valuable seeds for ornamental purposes and a medicine called *Chen Xiang* from the Class II National Protected and globally Threatened Incense Tree *Aquilaria sinensis*. Illegal collection of other forest products was also frequent; for instance, several huts built by poachers/collectors were found deep inside the reserve.

Infrastructure development also poses a serious threat to canopy specialists such as the gibbons, which rarely if ever travel on the ground (Liu and Tan, 1990). A hydropower station, together with kilometres of catchment and power line systems, was built in the Nanchahe area in 2000, and the busy main road bisecting Dong'er and Heiling are all major barriers for gibbon movement. The frequent human activities along the main road from Bawangling Town to Dongliu and other pine plantations and orchards, also disturbs the gibbons' daily activity and may affect their long-term prospects.

There is a pressing need to provide alternative, sustainable income to former loggers and other residents in and around the reserve, for both gibbon conservation and the resolving of general conflicts between biodiversity conservation and human development. It was agreed that this was beyond the immediate scope of the workshop and actions, and it lies outside the

responsibility of BNNR, but a greater collective understanding of human activities and aspirations will be essential for conservation efforts to succeed.

Limitations in Reserve Management and Funding Allocation

Due to competing priorities and the lack of human resources, resources and capacity, the management of BNNR allocates inadequate resources to ensure proper enforcement, and a comprehensive management plan is lacking. Absence of a well-defined management plan may hamper smooth implementation of conservation actions because staff may not be clear on their duties and the limits of their jurisdiction. Although it is clear that the Hainan Gibbon would be extinct were it not for the protection provided by BNNR, the current level of protection is clearly inadequate to ensure continued survival of the gibbons in the long term. In BNNR problem of enforcement is compounded by the steep terrain within the forest, and the long-standing reliance of minority people on forest products.

Small Population Size

Small populations are known to be more susceptible to extinction due to chance demographic variation, chance environmental variation, increased expression of harmful recessive genes due to inbreeding and loss of genetic diversity, the change in quantitative characters that allow adaptation, the accumulation of mildly harmful mutations, and disruption of social structure (Cowlshaw and Dunbar, 2000; Soulé and Orians, 2001). A chance imbalance in sex ratio, as reported for Hainan Gibbon in the late 1980s when nine male and three females were born (Liu *et al.*, 1989), could have a major negative effect, as could risks associated with intraspecific aggression, natural disasters and disease. The problem of lost genetic diversity is of concern, particularly if the quoted population figure of seven to eight individuals in the 1970s is accurate, although the ability of mammal populations to survive a genetic bottleneck is attested to by various examples (e.g. Golden Hamster *Mesocricetus auratus*, Cheetah *Acinonyx jubatus*, Père David's Deer *Elaphurus davidianus*, Arabian Oryx *Oryx leucoiyyx*, Hainan Eld's Deer *Cervus eldii hainanus*). Social disruption seems inevitable in such a small population; it has been shown that gibbons choose their mates carefully (Chivers, 1980) and reduced mate choice is therefore likely to be a significant limitation on population recovery (Dobson and Lyles, 1989). The severity of each of these potential threats warrants further consideration and study.

9. The Hainan Gibbon Conservation Action Plan for the 21st Century

The Hainan Gibbon is the rarest ape on earth, and should be considered of utmost conservation priority for the people of Hainan and China. The governments of China and Hainan should be encouraged to treat the gibbon as a flagship species for conservation; our closest living relative in the country. Survival of the Hainan Gibbon depends on the habitat integrity of mature forest; an "umbrella species" whose continued survival also tells us the forest and its biota, time-tested guardians of Hainan's water, air and soil, are in a healthy state.

It is difficult to say categorically why the gibbon population has not recovered from its alarmingly low level. But factors likely to important in limiting recovery include the limited availability of optimal habitat, and ongoing hunting and habitat disturbance by people, coupled with the limited capacity of BNNR to overcome threats. These factors call for action on many fronts. The following actions, the majority already under way or planned by one or more partners, were agreed as priorities at the workshop and will form the basis of the Hainan Gibbon Conservation Action Plan:

- (a) Continue and intensify monitoring of the gibbon population.

- (b) Reinforce patrolling effectiveness by provision of appropriate equipment to prevent all harmful human activities (e.g. hunting, logging, forest clearance and infrastructure developments) in areas likely to be used by gibbons.
- (c) Afforest degraded habitats in strategic locations with species valuable to gibbons.
- (d) Understand the direct threats to gibbon survival.
- (e) Locate any additional gibbons surviving in Hainan.
- (f) Instigate a visionary strategy of ecological restoration in the enlarged NR area.
- (g) Build the capacity of BNNR to conserve Hainan Gibbon and the forest ecosystem as a whole.
- (h) Implement a publicity campaign to raise awareness of the Hainan Gibbon and efforts being made to conserve it.

For effective implementation and to ensure sufficient and sustainable financing, there should be meaningful goals and timetables for these actions. Effective implementation of actions will call for allocation of specific responsibilities for the executants to achieve the above goals, backed up by processes to measure and evaluate progress and ensure accountability. To fulfil these goals various partners are conducting or planning immediate actions as follows:

- 1) **Continue monitor and guard the gibbon groups year-round**
To safeguard the remaining gibbons and at the same time obtain invaluable ecological and habitat information. **Status of action:** KFBG is supporting BNNR to monitor the two known gibbon groups daily, and two new base camps and additional field equipments to stay in the forest over a long period have been provided. **Constraints:** funding, skills, human resources, motivation of BNNR staff.
- 2) **Scientific study on the Hainan Gibbons**
To obtain as much information on the gibbon's ecology and habitat requirements to enhance its chance of long-term survival. **Status of action:** KFBG is supporting Dr. Zhou Jiang and two Ph.D. students to study the ecology and habitat requirements of the gibbons. **Constraints:** funding, skills, human resources, cooperation and motivation of BNNR.
- 3) **Link vital gibbon habitats (mainly ravine rainforest)**
At present suitable forest habitat for the gibbons is fragmented and mostly restricted to higher altitude. Recent study has revealed that gibbon food plant species are much more abundant in lower-altitude ravine forests than in higher-altitude continuous forest in BNNR, and that the gibbon has to travel a long distance daily to obtain enough food. By studying the current forest cover of the Futouling Core Area using a combination of satellite imagery and ground-truthing fieldwork, KFBG has identified pine plantations, grassland and disused logging tracks to restore its value as gibbon habitat and to link vital ravine rainforest habitats. Priority will be given to planting gibbon food plant species in the lowland area to expand the usable habitat for the gibbons, especially species fruiting in late winter months when natural food source is scarce. **Status of action:** KFBG has funded to established two native tree nurseries in Nanchahe and Dong'er, and collected seeds of 30 food plant species for restoration work. About 16,000 seedlings have been planted in selected degraded habitats in the rainy season of 2005. **Constraints:** funding, sapling and seed supply, skills, human resources, cooperation and motivation of BNNR staff.
- 4) **Provide technical/financial support for better enforcement and management**
Capacity building at the individual, community and institutional levels is essential for effective protection of the species and its ecosystem. As mentioned in 1) partners have provided field equipment facilities for BNNR to aid patrolling. It is hoped that good management ideas/practices can be introduced into the daily operation of

BNNR. In addition, it is important to clarify reserve boundaries and laws by erecting educational, warning and boundary signs around or inside the NR, clearly stating the laws and promoting environmental awareness among local communities. There are currently many villages between the Qingsong substation and the reserve boundary, and the management office of BNNR reported this area is the most problematic for management. Offenders caught typically claim they are unaware of the reserve boundary and are not familiar with the relevant regulations. **Status of action:** Equipment for better enforcement have been provided by KFBG and FFI, and training courses for capacity building have been organised. Erection of educational, warning and boundary signs need to be implemented. **Constraints:** funding, skills, human resources, relationship with villagers and motivation of BNNR staff.

5) **Improve communication between substations, management office and relevant government agencies**

The Qingsong substation is currently almost 2 km from the reserve on the Baisha side of Futouling, with villages between it and the reserve boundary. It is also difficult to communicate with other substations and BNNR management office. It is recommended to relocate the substation close to the forest, or else build a new post (with basic facilities for on-duty wardens to live in) in the most problematic village(s). **Status of action:** to be implemented. **Constraints:** funding, land ownership, motivation of BNNR staff, relationship with villagers.

6) **Understand, anticipate and resolve threats from people**

By conducting appraisal (including PRA) of community activities and attitudes and consequent community-based conservation work. Various historical and socio-economic factors underlie villager-reserve conflicts, and so it is essential to conduct detailed appraisal of resource utilisation and attitudes of local communities including present and past Forestry Bureau staff, to discover the occurrence and impacts of harmful practices and enable the formulation of sustainable alternatives including, potentially, co-management of resources in some areas of the reserve's Experimental Zone. Besides the current gibbon territories, priority should also be given to addressing human activity in those forests likely to support gibbons in future years. **Status of action:** FFI is implementing community co-management work in Qingsong Township, and ZSP/ECNU is conducting community-based conservation work in Qicha Xiang. **Constraints:** funding, skills, motivation of BNNR staff, relationship with villagers.

7) **Raise public awareness**

The Hainan Gibbon must be seen as a flagship species of Hainan and an indicator "umbrella species" for the ecological integrity of Hainan forest ecosystems. Benefits of conserving it should ultimately be shared with local people (see below) and recognised by them; in the immediate-term all efforts should be made to make living gibbons more valued. **Status of action:** KFBG, FFI and ZSP/ECNU are all initiating publicity/educational campaigns locally, nationally and internationally. **Constraints:** time, skills, awareness of the public.

8) **Survey for population(s) outside Bawangling**

Outside BNNR, all remaining Hainan Gibbon populations are apparently extirpated, but reports of gibbon were received in recent years from other major forest areas in Hainan (i.e. Yinggeling NR, Wuzhishan NNR, Diaoluoshan NR and Jianfengling NNR). Reserve staff from each site should thoroughly investigate the gibbon reports received since 2000. **Status of action:** to be implemented under coordination of HWCC. Various partners expressed willingness to follow up on plausible reports.

Constraints: funding, time, skills, human resources, motivation of NR staff.

Besides the actions mentioned above, the following **mid-term actions**, to be initiated/implemented in the next five years are proposed:

- 1) **Study the genetic diversity of the current population at Bawangling** by appropriate non-destructive sampling methods to study the genetic consequence of such small population size over four decades. Emphasis should be on how this can be applied to maximise survival chances.
- 2) **Ensure the benefits of gibbon and forest conservation are fairly shared.** As espoused by the Convention on Biological Diversity, conservation should bring benefits to all parties, especially those whose past and future activities are influential. A commitment and a strategy is needed to ensure local communities benefit from the survival of gibbons and their habitat.
- 3) **A review of the implementation of relevant policies and programmes in the region** might be undertaken to improve the value of afforested land to the environment and to local stakeholders. Several national environmental policies are being/to be implemented in Hainan, for example 'Ecological Community Forest', 'Grain for Green' and 'Natural Forest Protection Programme'. The Natural Forest Management component of the internationally supported Sustainable Forestry Development Programme will soon be activated in the nearby Wangxia area. BNNR management and those interested in gibbon conservation should look for opportunities to co-ordinate with these programmes. Involvement of the nature reserve in implementing these programmes could help to ensure effective local implementation, as well as benefiting gibbon conservation.
- 4) **Restore an extensive area of low-altitude forest in BNNR.** Converting lowland plantations/cultivated fields into gibbon-useable forest is the priority. For gibbon population recovery in the medium to long term a visionary strategy of ecological restoration is required. Ecological restoration must be conducted with good understanding of environmental parameters that may influence the survival of the gibbons, and actions taken to directly benefit the threatened habitats with immediate effect. The mapping of potential habitat in the extended NNR and nearby areas should be the first step, building on past and ongoing research efforts. It is recommended to re-establish extensive areas of natural lowland broadleaf forest in BNNR, with a monitoring programme to ensure the recovery of forest integrity and functionality. Another suggestion is to replace the current road from Bawangling Town to the Dongwu area with a route circumnavigating the forest area. Feasibility of resuming all plantations within BNNR should be thoroughly investigated in order to restore the ecological integrity of the greater Bawangling area.
- 5) **Produce a nature reserve management plan**, based on the conservation objectives and taking into account the structure of the management office and socio-economic needs of the local communities as they impact the forest and its biota. Management actions related to gibbon conservation should be clearly formulated, scheduled, implemented, monitored, reported and modified as necessary, alongside other important conservation work. The management plan should carefully weigh the need and feasibility of options not yet fully discussed, including manipulation of gibbons or their food plants (Leighton and Whitten, 1984).

The **long-term goal** of this action plan is to ensure Hainan Gibbon lives free in the forests of Hainan for perpetuity, with an ultimate objective to reintroduce Hainan Gibbon to other suitable habitats where it has been extirpated. The culmination of the above actions will be:

- Population and habitat management (where necessary) based on thorough understanding
- Minimal conflict between people on the one hand, and gibbons and their habitat on the other
- Ecosystems of adequate size and quality to be self-sustaining
- Reserve staff capable of responding effectively to all problems.

This will require an unprecedented collaborative commitment and effort, not only by the BNNR management and relevant government sectors, but also NGOs, local and indigenous communities, the scientific community, and other stakeholders. **Table 3** summarises the list of actions for conserving the Hainan Gibbon.

Table 3. Summary of actions for conserving the Hainan Gibbon

	URGENT (beginning 2004)	SHORT-TERM	LONG-TERM
Understanding gibbon distribution & biology	(1) Intensively (daily) monitor and guard groups (2) Survey for other populations	(1) Clarify vital environmental parameters (2) Genetic study	Population and habitat management (where necessary) based on thorough understanding
Community engagement	(3) Understand community activities and attitudes (4) Ensure clarity of reserve boundaries and laws to users (5) Raise public awareness and support	(3) Ensure community benefits (4) Review implementation of policies and programmes	Minimal conflict between (a) people and (b) gibbons and their habitat
Habitat restoration	(6) Link vital habitats (7) Collect information for larger-scale habitat restoration	(5) Restore extensive lowland forest	Ecosystems of adequate size and quality to be self-sustaining
Capacity building	(8) Provide technical/ financial support for NR management (9) Improve staff access at Baisha side (10) Produce NR management plan	SUGGEST: (6) Produce NR management plan	Reserve staff capable of responding effectively to all problems

The present publication is the “VERSION I” of this “living document”, the success of this action plan depends on smooth and effective implementation of each action, and for it the partners have formed a Steering Committee to meet roughly twice a year. Responsibility to provide resources for the listed actions will be shared by BFB, BNNR Management Office, HWCC and various partners attending the workshop. Following wider dissemination of information on the dire situation of Hainan Gibbon, more attention will be drawn from national and international bodies, including technical and financial support.

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11. Appendices

Appendix 1. Example of Survey Data Sheet

海南长臂猿野外调查记录表

(南明区)

调查人员: 徐永平, 周思颖
 Name: Xu Yongping, Zhou Siying

调查日期: 2007.10.20
 Date: 2007.10.20

天气: 晴
 Weather: Clear

出发时间: 7:07
 Departure time: 7:07

到达时间: 7:28
 Arrival time: 7:28

海拔: 966m
 Alt.: 966m

经纬度: N 19°07'15.6", E 109°03'21.2"
 Coordinates: N 19°07'15.6", E 109°03'21.2"

观测点位置: N 19°07'06.8", E 109°03'15.9"
 Observation point: N 19°07'06.8", E 109°03'15.9"

日出时间: 6:17
 Sunrise: 6:17

日落时间: 18:15
 Sunset: 18:15

鸣叫资料		Call data		目击资料		Sighting data		体形等级及体毛颜色	行为	采食食物	偷猎行为
开始时间	停止时间	方位	距离	鸣叫种类	个体数量	各个体	目击时间				
Starting time	Ending time	Direction	Distance	Type of song	No. of Individuals	Direct sighting time for each individual	Infant	juvenile	adult	Food categories	Hunting evidence
6:50	7:01	NE 38	150m	A	1	7:13	√	×	√		
7:15	7:16		20m	D		7:15		√			
						7:14					
						7:16					
						7:20					
						9:26					

注: 鸣叫种类分为: A, 合唱; B, 雄性独唱; C, 雌性独唱; D, 警戒性叫声
 Type of call: A, Duet; B, Male; C, Female; D, Alarm

行为种类: 1, 休息; 2, 取食; 3, 觅食; 4, 移动; 5, 理毛; 6, 玩耍; 7, 鸣叫; 8, 打斗
 Type of behaviour: 1, Resting; 2, Feeding; 3, Foraging; 4, Traveling; 5, Grooming; 6, Playing; 7, Calling; 8, Fighting

食物种类: 1, 果实; 2, 花; 3, 叶; 4, 芽; 5, 动物; 6, 未知
 Type of Food: 1, Fruit; 2, Flowers; 3, Leaves; 4, Buds; 5, Animals; 6, Unknown

Appendix 2. Workshop Agenda

Organisers:	BFB, Hainan, PRC BNNR Management Office, Hainan, PRC HWCC, Hainan Forestry Department, PRC China Programme, KFBG, Hong Kong, PRC
Co-organiser:	SCIEA, Guangzhou, PRC
Venue:	Bawangling Town, Ohangjiang County, Hainan, PRC
Date:	29-31 October 2003

Agenda

29 OCT 2003 (Wednesday)		
OPENING		
09:30	Welcome, introductions	Wu Zuhai (HWCC) / Zhou Xujian (BFB)
09:40	Introduction by the Workshop Chair	John Fellowes (KFBG)
10:10	Gibbon research: a global overview	Thomas Geissmann (Zürich University)
10:40	Past studies of Hainan gibbons	Jiang Haisheng (SCIEA)
11:10	BREAK	
11:30	Ongoing study results	Wu Wei (ECNU)
11:50	Ongoing study results	Zhou Jiang (IoZ, CAS)
12:15	FFI conservation work for black crested gibbons in northern Vietnam	Zhang Yingyi (FFI China)
12:45	LUNCH	
14:35	History of Hainan gibbon conservation	Liu Zhenhe (SCIEA)
15:05	Bawangling National Nature Reserve Extension Master Plan	Li Dajiang (BFB)
15:40	BREAK	
16:00	Results of the new census	Bosco Chan (KFBG) / Thomas Geissmann (Zürich University)
18:00	Action Plans: capabilities and limitations	John Fellowes (KFBG)
18:25	Conclusion	
18:00	DINNER	
After dinner	Video footage of wild Hainan gibbons	
30 OCT 2003 (Thursday)		
08:00	Small group excursions	
	Group A: Visit to local villages, focus on local attitudes towards conservation – Qicha Xiang in Changjiang County and Qingsong Xiang of Baisha County	Qicha Xiang group leader: Su Wenba (HWCC) Qingsong Xiang group leader: Michael Lau (KFBG)
	Group B: Visit to proposed short-term habitat management sites	Group leaders: Zhou Jiang (IoZ) and Bosco Chan (KFBG)
	Group C: Visit to proposed long-term habitat management sites	Group leaders: Li Dajiang (BFB) and Ng Sai-chit (KFBG)
16:50	Reports by each group, began discussions and recommendations for a Hainan Gibbon Conservation Action Plan	
19:00	DINNER	
20:10	Discussions continued	
22:35	End day	
31 OCT 2003 (Friday)		
08:30	Introduction by Workshop Chair of new participants	
08:45	Free discussion of problems and recommendations	
10:15	BREAK	
10:35	Free discussion continued	
12:00	LUNCH	
13:30	Agreement on actions needed, actions ongoing/planned, and wrap-up	
16:00	ADJOURN	

**Report of the “First Workshop for Hainan Gibbon Conservation”,
Bawangling, Hainan Province, PRC, 29-31 October 2003**

1. The first “*Workshop for Hainan Gibbon Conservation*” was held on 29-31 October 2003, at Bawangling Town adjacent to Bawangling National Nature Reserve (BNNR), Changjiang County, Hainan Province, China. It was coorganized by the Hainan Wildlife Conservation Centre of Hainan Forestry Department (HWCC), Bawangling Forestry Bureau (BFB), BNNR Management Office, Kadoorie Farm & Botanic Garden of Hong Kong (KFBG) and South China Institute of Endangered Animals (SCIEA). KFBG, BFB and Prof. Jiang Haisheng of SCIEA provided financial support.
2. During the workshop participants reviewed past and ongoing studies on the gibbons, which began with the pioneering studies of Prof. Liu Zhenhe of SCIEA in the 1960s, summarized current knowledge of the population, discussed known and potential threats to their continued survival, and recommended actions to address them.
3. Workshop participants paid tribute to the people of Changjiang and Baisha Counties, and the dedication of the staff of BFB and BNNR, for their unique achievement in sustaining a population of Hainan gibbons into the 21st Century. They commended the recent extension of BNNR to increase the habitat available for gibbons and other biota, and the courageous and wise step of conducting another internationally-recognised census of the gibbons and of holding the present workshop, enlisting national and international expertise to conserve this Critically Endangered primate.
4. It is recognised that despite past and ongoing efforts the gibbon population has a high risk of extinction due to its very small population size and continued threats. The thorough survey conducted in October 2003 by the staff of BNNR and HWCC, under the expert guidance of Dr. Thomas Geissmann and supported by KFBG, SCIEA and FFI, could confirm only twelve individuals and two social groups. One group was found to contain six individuals, another five, with one additional solitary adult male [Post-workshop note: After re-analysis of the survey data, an additional individual male is confirmed east of Dong'er; making the total confirmed population to thirteen individuals (Thomas Geissmann, Zürich University, *in litt.*, 10 November 2003)]. Outside Bawangling no populations are confirmed on Hainan, though rumours of gibbons have been received by survey participants from Wuzhishan, Diaoluoshan and Jianfengling in recent years.
5. The constraints on population increase are uncertain. The birth rate in the social groups appears to be normal, with each adult female giving birth every two years – above the average for other wild gibbon species. The main limiting lifehistory stage appears to be survival of maturing individuals and the establishment of new groups.
6. Major threats to survival include:
 - low quality (limited food availability) in the remaining habitat;
 - limited habitat area within the forest block occupied by gibbons;
 - interruption of suitable habitat by unsuitable habitat (including pine plantation, grassland, power lines and the disused logging track near Dongwu), necessitating circuitous movements by gibbons; and
 - logging by the large number of people living around the nature reserve margins.

Hunting is a major threat to wild animals in the nature reserve; the impact of hunting on gibbons in recent years is uncertain, but it must be considered a major potential threat. Existing legal deterrents and local beliefs may limit the motivation to hunt gibbons, but the possibility of accidental shooting (while hunting other arboreal animals), or deliberate hunting by a small number of people, should be taken seriously. Reduced mate choice may also be a significant limitation on population recovery. The severity of other potential threats associated with small population size, heightened impacts of disease and intraspecific aggression, and impaired fitness due to low genetic diversity, may warrant further consideration.

7. While not all threats can necessarily be controlled, certain interventions could help minimise these known and potential threats. Urgent actions likely to improve the survival chances include the following:

- (a) Continue and intensify monitoring of the gibbon population.
 - Daily following of the confirmed gibbon groups and additional individuals by skilled field personnel is recommended, with emphasis on understanding the stresses on survival of infants and maturing individuals, and monitoring the impacts of various conservation actions.
 - Interpretation would be aided by plotting the results of ranging observations on a Geographic Information System against habitat variables.

Relevant action is ongoing and/or planned by BNNR with Mr. Zhou Jiang of CAS, supported by Fauna & Flora International (FFI), Mr. Wu Wei of East China Normal University (ECNU), and Dr. Jiang Haisheng of SCIEA.

- (b) Prevent all harmful human activities (e.g. hunting, logging, forest clearance and infrastructure developments) in areas likely to be used by gibbons.
 - Priority should be given to stopping all potentially damaging activity within the existing gibbon range area. Existing enforcement actions should be maintained and increased as necessary.
 - Nature reserve boundaries should be clearly marked at all possible entry points, and laws clearly stated.
 - Patrolling efforts could be modified to collect *ad-lib* information on what brings people into this area, and how their needs could be met elsewhere.
 - Further habitat damage should be strictly forbidden, including damage for infrastructure (e.g. power lines).
 - Permissibility of all existing human activities (including road traffic and plantation management) in the current gibbon activity zone should be re-examined. It is recommended to replace the current road to the pine plantations at Dongliu and further with a route circumnavigating the forest area. Feasibility of restoring all plantations inside BNNR to natural forest should be thoroughly investigated.
 - Measures should also be considered to enlist the active support of frequent forest visitors/users in gibbon conservation, by providing creative incentives for them to assist the conservation work.

These actions would build on those already conducted by BNNR and BFB, in consultation with other partners as needed. Where capacity building is required to implement these recommendations, this should be made explicit (see below).

- (c) Afforest degraded habitats in strategic locations with species valuable to gibbons.
- Implement a fast and well-targeted programme to plant a mix of fast-growing, native gibbon food plants in current plantation/grassland areas between narrow habitat strips (notably ravine forests) and in other lowland areas adjoining gibbon territories, notably along roadsides and lower slopes at Nanchahe area. Optimal technical details of species selection, propagule collection, seedling production, cutting establishment and planting arrangements should be derived by combining knowledge on forestry and gibbon feeding behaviour.

It is anticipated this action could be undertaken by BNNR and BFB, with technical support from Mr. Zhou Jiang and KFBG.

- (d) Understand the direct threats to gibbon survival.
- Conduct more detailed appraisal of the resource utilisation of local communities including present and past forestry staff, to discover the occurrence and impacts of harmful practices and to enable the formulation of sustainable alternatives and/or co-management of resources. Besides the current gibbon territories, priority should also be given to human activity in forests likely to support gibbons in future years.

Relevant action is planned by FFI, ECNU and the Zoological Society of Paris, and SCIEA, in collaboration with BNNR and BFB.

- (e) Locate any additional gibbons surviving in Hainan.
- Thoroughly investigate the gibbon reports from Wuzhishan NNR, Diaoluoshan National Forest Park and Jianfengling NNR received since 2000.

Reserve staff from each site will investigate reports, coordinated by HWCC. Various partners including Dr. Thomas Geissmann, FFI and KFBG expressed willingness to follow up on plausible reports.

- (f) For gibbon population recovery in the longer term a visionary strategy of ecological restoration is required. This should include several elements:
- The mapping of potential habitat in the extended NNR and nearby areas. Mapping should build on past and ongoing efforts by Prof. Zhang Rongzu and Mr. Zhou Jiang.
 - Re-establishment of natural lowland broadleaf forest in extensive areas.
 - A monitoring programme for forest integrity and functionality.
 - A review of the implementation of relevant policies in the region might be undertaken to improve the value of afforested land.
 - More comprehensive understanding of the habits and requirements of the gibbon population will be needed, building on the studies mentioned above.

This strategy should be derived from the existing Hainan Bawangling NNR Master Plan 2002-2010, compiled by BFB and BNNR, in consultation with other partners.

- (g) Build the capacity of the NNR to conserve the Hainan gibbon and the forest ecosystem as a whole.
- An in-depth dialogue is proposed between BNNR and BFB and other partners, with reference to the Hainan Bawangling NNR Master Plan 2002-2010, exploring needs and opportunities for capacity building.

Certain partners have expressed willingness to assist in elements of capacity building, such as on drafting a management plan (FFI and KFBG), reinforcement of the enforcement system (SCIEA) and on monitoring capacity (KFBG and FFI).

- (h) Implement a publicity campaign to raise awareness of the Hainan gibbon and efforts being made to conserve it.
- High-profile publicity would help the Hainan gibbon become a flagship species, attracting support for its conservation from the whole spectrum of society.
 - A cooperative approach to using images and information is urged among partners to achieving this awareness-raising goal.
 - It was suggested that public education and fund-raising might be assisted by clarifying the scientific status of the Hainan gibbon. This would call for systematic research on the black-crested gibbon genus *Nomascus*, and specifically on the relationship between various populations of all black crested gibbons.
8. Various parties expressed willingness to help with awareness-raising within the region. Dr. Thomas Geissmann proposed to take a lead in raising global awareness, partly through his website, while Dr. Jiang Zhigang undertook to raise awareness and support at the national level. Workshop participants from Bawangling and Changjiang County placed emphasis on the problems faced by former loggers and other residents living in and around the reserve, and the need for provision of alternative, sustainable livelihoods. It was agreed that this was beyond the immediate scope of the present workshop, but that greater collective understanding of human activities and aspirations would help in both gibbon conservation and the resolving of general conflicts between biodiversity conservation and human development.
9. Workshop participants expressed strong willingness to assist Bawangling Forestry Bureau and National Nature Reserve in their efforts. This would best be done by means of a co-ordinated *Hainan Gibbon Conservation Action Plan*, with co-operation at its heart, in pursuing the common goal of gibbon survival. To this end an informal Action Partnership was formed between Hainan Wildlife Conservation Centre, Kadoorie Farm & Botanic Garden, South China Institute for Endangered Animals, Fauna & Flora International, Mr. Zhou Jiang, East China Normal University, Zoological Society of Paris, Changjiang County, Dr. Jiang Zhigang, Prof. Zhang Rongzu, Prof. Liu Zhenhe, and Hainan Environmental Education Centre of Hainan Normal University.

