CURRENT STATUS OF THE HAINAN GIBBON (*Nomascus hainanus*): PROGRESS OF POPULATION MONITORING AND OTHER PRIORITY ACTIONS

John R. Fellowes[1], Chan Bosco Pui Lok[1], Zhou Jiang[2], Chen Shenghua[3], Yang Shibin[3] and Ng Sai Chit[4]

[1] Kadoorie Farm & Botanic Garden, China Programme, Lam Kam Road, Tai Po, N.T., Hong Kong SAR, China.
[2] Institute of Grassland Science, Northeast Normal University, 128 Renmin Street, Changchun, Jilin Province, 130024, China; Current address: The Geography and Biology College of Guizhou Normal University, Guiyang City, Guizhou Province, 550001, China.
[3] Hainan Bawangling National Nature Reserve, Changjiang County, Hainan, China.
[4] Kadoorie Farm & Botanic Garden; Current address: Division of Science and Technology, United International College, Beijing Normal University - Hong Kong Baptist University, Beijing Normal University Zhuhai Campus, Zhuhai, Guangdong, 519085, China.

ABSTRACT

We report on recent developments with respect to the status of the world's rarest ape, the Hainan Gibbon *Nomascus hainanus*. Since it was intensively surveyed in October 2003, the sole known population, at Bawangling National Nature Reserve, Hainan Island, has increased to 17-20 individuals, including two social groups and up to five solitary adults. The larger group, Group A, currently contains one adult male, two adult females, two subadults, two juveniles and two infants; the smaller Group B contains one adult male, two adult females, one subadult, one juvenile and one infant. The solitary gibbons, which are rarely seen, include up to three adult-sized black individuals (with two confirmed as males by their male solo calls) and up to two adult females; observations from recent years suggest individuals of both sexes can be black even beyond the point of migration from the natal group. An update is also given on other conservation actions, including patrolling, forest restoration, understanding threats, surveys of other forests, gathering of information relevant to landscape-scale restoration and management, nature-reserve capacity-building, and promoting public awareness. The progress in these directions provides a platform for future conservation efforts.

Keywords: *Nomascus hainanus*, Hainan gibbon, population, status, conservation actions.

INTRODUCTION

Hainan Gibbon *Nomascus hainanus* (Thomas) is currently the world's rarest ape (Chan *et al*., 2005; Zhou *et al*., 2005)*. Endemic to Hainan Island, its decline was rapid; the population was estimated to be over 2,000 in the 1950s but only 30 by the 1980s (Liu *et al*., 1984). Scientific studies began in the 1960s (Liu *et al*., 1984; Liu and Tan, 1990), and focused on the Bawangling forest area, which by 1990 would be the sole confirmed refuge (although it may have hung on into the 1990s in three to four other remote localities: Chan *et al*., 2005). The known Bawangling gibbon population was considered as low as seven to eight individuals in the 1970s, but had reportedly recovered to 21 by the late 1980s, when it comprised four groups in an area of 1,200ha (Liu *et al*., 1989; Wang, 1995). In the early 1990s it had dropped again to 15 individuals (Zhang and Sheeran, 1994).

Local reserve staff, trained to accompany Prof. Liu Zhenhe in the field, continued intermittently to monitor the gibbons at Bawangling (since 1988 a National Nature Reserve) during the 1990s, but doubt grew internationally over the continued existence of the population, since local reports were not independently verified until the visit of the Hong Kong-based Kadoorie Farm & Botanic Garden (KFBG) team in 1998 (KFBG, 2001). At that time according to the most experienced of the Bawangling National Nature Reserve (BNNR) field staff, Chen Qing, who guided the KFBG team to see and photograph the gibbons, the known population was 17 (KFBG, 2001). An official status survey that year, however, reported 23 gibbons, in four groups

* English nomenclature of this gibbon varies. It is sometimes called Hainan Crested Gibbon or Hainan Black Gibbon, though in these *Nomascus* gibbons both the full crest and black coloration are absent in the adult female. The widely used name Hainan Black Crested Gibbon is also easily confused with the name Hainan Black-crested Gibbon which includes redundancy as all extant crested gibbon taxa have black crests. Since the name Hainan Gibbon is self-explanatory and simple, we use it here.

(State Forestry Administration Survey & Planning Institute and the BNNR Management Office, 2001). A postgraduate study in 2001-2002, involving around three months of fieldwork and 17 sightings, estimated 12-19 individuals in four groups, of which the fourth was not seen (Wu *et al*., 2004).

Postgraduate field research by one of us (ZJ) began in September 2002, when BNNR field staff recognized two social groups of gibbon. Through daily contact with the gibbons over two years (Zhou, 2007), the study confirmed the presence of only two groups, termed A and B, with an uncertain number of solitary males. In-depth work was conducted on Group B, which initially comprised one adult male, two adult females and one adolescent. At the time Group A comprised five individuals, which were also individually recognizable within the group. Immature animals could not be reliably sexed; external genitalia are similar and only full adult males and females can be sexed by their coloration (predominantly black and yellow respectively) (Pocock, 1905; 1927).

It is possible that two of the four groups reported in 1998 and 2001-2002 had disbanded by the end of 2002, when more intensive survey work began. But it seems more likely that the discrepancy in the number of groups stems from the lack of wide-scale simultaneous survey over the potential area of occupancy, and from unexpressed assumptions about group home ranges. Home ranges in the species as reported earlier (Liu *et al*., 1989; Liu and Tan, 1990) were only 100-500ha. Those revealed by ZJ's study, based on months of direct tracking, were higher at 987ha and 548ha for Groups A and B respectively (Zhou, 2007); they also overlapped. This made it difficult to distinguish adjacent groups without either reliable individual recognition - very difficult for wild gibbons, especially after only brief visual contact - or simultaneous observations.

To resolve the uncertainty over the gibbon population, in October 2003 a comprehensive rapid survey was invited by Hainan Wildlife Conservation Centre (HWCC), the conservation division of Hainan Forestry Department. It was conducted with KFBG funding, and coordinated by one of us (BC). Trained by Thomas Geissmann, 16 teams of observers from HWCC (including staff of BNNR and other Hainan nature reserves), KFBG, the China Programme of Fauna & Flora International (FFI-China), Northeast Normal University and Kunming Institute of Zoology were stationed at different fixed locations throughout the gibbons' known range, recording all vocalizations, for the whole morning call period, over 11 days (14-24 October). A supplementary survey followed on 25-29 October with 13 teams covering the well-forested Qichadaling and Yajiadaling parts of the reserve's new extension area; here no gibbons were found. The methodology assumed all mature gibbons would call at least once during the 11-day main survey period (and probably during the 5-day supplementary survey), as suggested by previous experience with other gibbons (Chan *et al*., 2005); it should be noted that gibbon calling frequency can be depressed in areas of high human disturbance (Johns, 1985; Nijman, 2001) or low gibbon density (Chivers, 1974). The survey detected the two known social groups (A and B), by then with six and five individuals respectively, and two lone males, comprising a total of 13 individuals (Geissmann & Chan, 2004; Fellowes & Chan, 2004; Chan *et al*., 2005; Zhou *et al*., 2005).

Immediately after the comprehensive survey a first Workshop to Conserve the Hainan Gibbon was convened at Bawangling, again at HWCC's initiation, and with coordination and partial funding from KFBG (Fellowes & Chan, 2004; Chan *et al*. 2005). Among those invited were past and present researchers, field personnel, representatives of other interested parties including FFI-China, East China Normal University (ECNU) and the Zoological Society of Paris (ZSP), and officials from the province, counties and townships. Following a series of scientific presentations, participants discussed various constraints, actual or possible, on population recovery, including poaching, habitat quality, age structure, sex ratio, social and genetic barriers. While not all of these could be addressed, participants agreed a series of priority actions required to conserve the gibbons: to continue and intensify monitoring of the gibbon population in BNNR; to reinforce patrolling effectiveness; to afforest degraded habitats in strategic locations with tree species valuable to gibbons; to understand the direct threats to gibbon survival; to locate

any additional gibbons surviving in Hainan; to instigate a visionary strategy of ecological restoration; to build the capacity of BNNR to conserve the Hainan Gibbon and the forest ecosystem; and to implement a publicity campaign. We report here on recent developments with respect to these priority actions and the species' status.

1. Population Monitoring

Although BNNR has been unable to secure core funding for scientific monitoring, it has provided personnel. From 2003 two BNNR staff were funded by ECNU-ZSP to monitor Group A, while FFI-China funded one of us (ZJ) to monitor Group B from December 2003, on completion of his postgraduate fieldwork, until November 2004. Monitoring work met with difficulties in funding; KFBG has since early 2005 been funding ZJ to carry out ecological research on the two groups, and since April 2005 funding eight reserve staff (in two rotating teams of two) to conduct daily monitoring of the two groups, which has continued to the present day (May 2007).

These intensive efforts show that the population of Hainan Gibbon has increased in the past five years. The two groups have produced newborn infants every two years, as previously noted (Liu *et al*., 1989), while a single individual departed from each group during the same period (Table 1). These changes brought the composition of Groups A and B to nine and six individuals respectively.

A constant problem in monitoring the Hainan Gibbon has been the elusiveness of solitary individuals, and the difficulty of observing more than one group on the same date to exclude the possibility of double-counting. The 2003 survey detected two solitary males by call, but they were not seen (Geissmann & Chan, 2004). Sightings are rare even by the field staff who patrol the gibbon range daily. At present the field staff believe there could be up to five solitary individuals: up to three adult-sized black individuals (with two confirmed as males by their male solo calls) and up to two adult females. Not all, however, have been seen this year. There is also the possibility that individual group members occasionally stray further from their groups than usual, and so some doubt remains over these. If all five of these individuals are indeed solitary and are still alive, the population would appear to have reached 20 individuals.

In spite the normal birth rate, no new social group has been formed since 2000. Survival outside the natal group was suspected to be a limiting factor in 2003, but there remains a lack of evidence in this regard.

Table 1. Size of each group, and of extra-group population, 2002-2007.

	Initial number	Additions	Losses	Final number
Group A				
2002	5	0	0	5
2003	5	1 born ~Oct	0	6
2004	6	0	0	6
2005	6	2 born ~Apr	1	7
2006	7	0	0	7
2007	7	2 born ~Mar	0	9
Group B				
2002	4	1 born ~Nov	0	5
2003	5	0	0	5
2004	5	1 born ~Dec	1	5
2005	5	0	0	5
2006	5	0	0	5
2007	5	1 born ~Jan	0	6
Solitary population				
2002-2007	2-3	2	0-5	0-5
Overall				
2007				15-20

The recorded home ranges of Group A and Group B are 987ha and 548ha respectively; higher than the previously recorded ranges of 100 to 500ha (Liu *et al*., 1989; Liu & Tan, 1990). These figures are also higher than those for most Nomascus (40-500ha) and far higher than those for other gibbons (20-40ha) (Chan *et al*., 2005), although some past figures are minimum estimates. It is uncertain whether the large home ranges at Bawangling are a sign of suboptimal habitat or expansion due to lack of neighboring groups, or else a natural trait of the species. Larger groups have both higher nutritional needs and, presumably, greater competitive ability; during our observations since 2005, when the population of Group A increased to seven individuals they temporarily invaded one-third of the territory of Group B during the dry season of 2006 when food sources were scarce.

2. Patrolling Efectiveness

In 2003 opinions differed on the likelihood of poaching. It certainly occurred in the past at Bawangling; the Tropical Exposition Museum of Hainan of Hainan Forestry Department holds two gibbon specimens hunted by a local villager in 1984. There were rumors of gibbons being hunted in 2000 and 2003, but these were difficult to validate due to the high penalties attached to hunting such Class I Nationally Protected species. No systematic hunting of gibbons has occurred in recent years, as there has been little if any hunting mortality, but even occasional incidental losses would be significant. Reliable patrolling is therefore key, and is taken seriously by BNNR staff, who arrest hunters and destroy illegal camping shelters in the forest. To assist in these efforts KFBG bought a patrolling vehicle and a fine-scale satellite map of the gibbon range, and is producing a map with the detailed trail system and other landscape features. Since the introduction of the daily monitoring system, hunting in the core forest has decreased, with a much higher frequency of observing "game animals" such as the Black Giant Squirrel *Ratufa bicolor*, Hainan Giant Flying Squirrel *Petaurista hainanus*, and Wild Boar *Sus scrofa*, and much less frequent evidence of hunting including gunshots and gin traps.

Morale of patrol staff is a consideration, since monitoring and patrolling teams are obliged to stay in difficult conditions in the forest. Since 2003 KFBG has undertaken various interventions to boost morale, with the erection of permanent forest base camps for the monitoring teams, the introduction of a reserve logo for identity, field clothing, binoculars, long-zoom cameras, GPSs and other necessary field gear.

3. Forest Restoration in Areas Adjacent to the Core Gibbon tange

The current area of continuous primary forest available to the gibbons is just 1,600ha, occurring between 800m and 1,280m asl, higher than the typical elevation of primary lowland rainforest in Hainan and with lower diversity and abundance of gibbon food plants. The monitoring revealed gibbon groups frequently forage in narrow strips of suitable lowland-forest habitat adjacent to degraded shrublands and monoculture pine plantations, indicating a shortage of food sources in the "safer" upland forest habitats. The 2003 workshop identified habitat extent and quality as a major potential constraint on the number of gibbons, and gibbon groups, that could be supported at Bawangling. Consequently BNNR agreed to stop the harvesting of resin in these pine plantations, and restore them to mixed native forest suitable for gibbons. A gibbon habitat restoration project with funding and technical support from KFBG was launched in early 2004; reserve staff, in particular members of the gibbon monitoring team, were asked to collect seeds of gibbon food plants from the forest, and a native tree nursery was established. In 2005-2006 a total of 32 species, the majority (>90%) of which were gibbon food trees, were planted: 14,410 saplings over 16ha in the rainy season of 2005 and 27,561 saplings over 57ha in 2006. Major gibbon food plants which grow relatively rapidly (e.g. *Acmena acuminatissima, Endospermum chinensis, Syzygium cumini, Bischofia javanica, Elaeocarpus dubius, Caryota ochlandra, Canarium album* and *Nephelium topengii*) were planted in especially large numbers, along with other fast-growing species to ensure a usable forest canopy within 10-15 years; the pine canopy has been progressively

thinned by ring-barking. Initial progress of the young trees has been encouraging, with only minor damage (by Sambar *Cervus unicolor* and Wild Boar) and over 80% survival after 2 years. BNNR has also planted some areas using similar techniques, with government funding. Further planting is planned for c. 100ha with c. 80,000 saplings, funded by KFBG and the Gibbon Conservation Alliance, and additional planting of other degraded areas is planned by BNNR pending funds from national and provincial sources. BNNR is monitoring the saplings planted, with KFBG's support.

4. Understanding Direct Threats

Local human activity was an obvious potential threat to gibbon survival. In 2003-2004 a preliminary participatory rural appraisal (PRA) study in ten neighboring villages was conducted by FFI-China and Hainan Environmental Ecological Education Centre (HEEEC). The appraisal revealed some conflict in land use between the reserve and neighboring communities. Hunting, collecting fuelwood, logging to provide coffins and building-materials, grazing and agricultural encroachment in lowland regenerating forest were all potentially inimical to gibbon conservation and forest biodiversity conservation. FFI subsequently organized two workshops attended by ten local community leaders, from villages closest to the gibbon territories, along with other local, provincial and national officials, and KFBG. Some residents reported perceptions different from those of reserve staff regarding reserve boundaries and laws, indicating a need for greater engagement (FFI China Programme, 2005; Gao, 2006).

Since 2003 scientific studies have been funded by KFBG to understand the food availability to the gibbons, by a better understanding of the ecology of food plants. To date 80 food plants have been detected (Lin *et al*., 2006a & 2006b). Food availability is particularly likely to be a constraint between February and April when a limited number of the major foods are available, and less favored foods are eaten in larger quantities. Plant community quadrats and phenological studies showed the higher-altitude home range of Group A has a less diverse and less abundant food plant community in comparison with that of Group B (Lin Jiayi, pers. comm., August 2006), which may explain its larger home range, and the temporary intrusion into Group B's territory during the winter lean season in 2006. This was taken into account during the habitat restoration actions above.

5. Surveys for Additional Populations

In 2003 there were rumors of gibbons being heard or seen at several other sites in Hainan. Following concerted investigations by HWCC and KFBG, only two sites yielded consistent reports: the unprotected forest at Exianling to the southwest of Bawangling, and the extensive forest in the newly-established Yinggeling Nature Reserve to the southeast. A series of general surveys at Yinggeling were unable to confirm these reports, as was a specialized survey of Exianling between 13 and 19 March 2007 by HWCC and KFBG. While further work is under way at Yinggeling, it must be considered doubtful that any additional populations survive.

6. Landscape-Level Restoration

It was clear in 2003 that if the Hainan Gibbon population was to recover from its current low level and restricted range to long-term viability, a larger-scale habitat restoration and *in-situ* population management would be required. Satellite maps of different scales were obtained by FFI and KFBG. In addition KFBG has supported two relevant doctoral research projects: an analysis of habitat selection and potential distribution of Hainan Gibbons, by a student of the Kunming Institute of Zoology, Yunnan Province; and a study on the phenology and ecology of the gibbons' main food plants by a student from South China Agricultural University, Guangdong Province. These studies are nearing completion at the time of writing, and will be useful references in future conservation and restoration work.

7. Capacity Building of BNNR for Conservation

There has been gradual improvement in the capacity of BNNR in recent years. Through regular involvement KFBG has been able to

help identify gaps in the capacity of the nature reserve and support improvements (e.g. in species identification, survey and monitoring techniques, ecological and conservation concepts). In addition FFI conducted a training-needs assessment at Bawangling early in 2004, confirming the need for capacity building in many aspects of nature reserve management. New reserve management since 2005 has been directed by HWCC to give heightened attention to conserving the gibbons and their habitat; positive steps include the replacement of a road from Dongliu to Bawangling Town with a new one further from the core area, an enlarged team of reserve wardens, and new warden substations surrounding the forest. Perhaps most encouragingly, the field staff show increased signs of initiative and engagement in the work of gibbon conservation relative to 2003. There remains scope for improvements in various core competences.

8. Publicity and Community Engagement

Attempts to engage the local human population in gibbon conservation have included a scheme by Seacology, with the Zoological Society of Shanghai, ZSP and HEEEC, awarding scholarships to poor children in four villages to the south of the gibbon range in exchange for agreements to protect the forest and the gibbons (Anon., 2007); work by FFI and the Unicorn Foundation in Qingsong township, Baisha County to the east, including teacher training and the co-management workshops reported above; school-based activities with the distribution of Hainan Gibbon-themed calendars and fai chun (Chinese New Year posters) in various neighboring communities by KFBG; and donation of Hainan Gibbon T-shirts to local stakeholders by FFI. While no evaluation of the impact of this work has been done, it is likely that local communities have a more informed attitude toward the gibbons and the reserve than hitherto, although some of the community engagement work has suffered from unstable funding. In terms of raising visitor awareness, BNNR has begun discussions to establish an education centre, which has the potential to give visitors a better insight into the world of gibbons, their habitat and their plight.

Wider public awareness of the gibbons in Hainan has been fostered by HWCC and KFBG through close collaboration with the media including the Hainan Daily newspaper (whose readers also received the fai chun in 2005); HWCC also arranged the distribution of Hainan Gibbon calendars by volunteers in various Hainan cities. In 2005 KFBG, BNNR, the University of Hong Kong and Hainan Normal University organized university students from Hainan and Hong Kong to participate in a tree-planting activity to commemorate the commencement of the gibbon habitat restoration project (Lam *et al*., 2005). Meanwhile international recognition is promoted through continued inclusion of the species in the "25 most endangered primates" list of Conservation International and the IUCN Primate Specialist Group (Mootnick *et al*., 2005 and in press).

OVERALL OUTLOOK

Although the Hainan Gibbon still breeds at natural birth intervals, the population has struggled to increase since the establishment of Bawangling Nature Reserve in 1980, after 27 years of forest protection by law. The various proactive conservation measures reported here are only a beginnings. Controlling illegal activity remains a challenge, and there is no room for complacency regarding basic protection. Habitat quality is still a concern, and it will be some 15 years before the initial success of the present restoration effort is known. There are also concerns regarding population viability, including social constraints on reproduction and group formation (with most surviving individuals suspected to be genetically related, and mate choice highly restricted), fertility (with at least one female apparently too old to give birth), genetic constraints, and the unconfirmed possibility of a male-skewed birth sex ratio (Liu *et al*., 1989). These complex influences indicate the need for open scientific discussion of conservation options, and a second Hainan Gibbon conservation workshop is provisionally planned for late 2007. In the meantime the priorities remain strict protection of the gibbons and their recovering habitat, along with sustained positive engagement with local communities.

ACKNOWLEDGMENTS

We would like to thank the BNNR gibbon monitoring team for their hard work, and for supplying information reported here. Zhou Jiang's research was supported by KFBG; the National Natural Science Foundation of China for Distinguished Young Scholars, obtained by Wei Fuwen (30125006); the State Forestry Administration, China; the US Fish and Wildlife Service; and FFI-China. We also respectfully acknowledge all whose dedication has contributed to conserving the species, including BNNR staff past and present, Wang Chundong and Su Wenba of HWCC, Liu Zhenhe, Jiang Haisheng, Zhang Rongzu, Bill Bleisch, Ramesh Boonratana, Chen Chao, Sharon Chow, Francoise Claro, Richard Corlett, Frederique Darragon, Deng Weijie, Fan Nanhong, Thomas Geissmann, Michael Lau, Ruthie Lau, Lee Kwok Shing, Liang Wei, Lu Gang, Pierre Moisson, Alan Mootnick, Duane Silverstein, Ken So, Wang Lijun, Wang Xiaoming, Wei Fuwen, Wu Wei and Zhang Yingyi. We are conscious of other unsung contributions, and apologies to those not mentioned here.

REFERENCES

Anon. 2007. China, Hainan Island - November 2003. Seacology website, www.seacology.org, accessed in May 2007.

Chan, B.P.L., Fellowes, J.R., Geissmann, T., and J.F. Zhang (eds.). 2005. *Hainan Gibbon Status Survey and Conservation Action Plan - Version I (last updated November 2005)*. Kadoorie Farm & Botanic Garden Technical Report No. 3. Hong Kong SAR: KFBG, iii + 33 pp. www.gibbons.de/main/books/2005hainan-gibbon-status.pdf.

Chivers, D.J. 1974. The Siamang in Malaysia: a field study of a primate in tropical rain forest. *Contributions to Primatology* **Vol. 4**. Karger, Basel.

Fellowes, J.R. and Chan, B. 2004. Hainan Gibbon: concerted action for the world's most endangered ape. *Living Forests* **7**: 22-24.

FFI China Programme. 2005. *Action Plan for Implementing Co-management in the Bawangling National Nature Reserve and Adjacent Communities in Qingsong Township (2005-2007)*. Beijing: Fauna & Flora International.

Gao, L. 2006. The impact of conservation policy on attitudes towards the environment: A case study on Hainan Island, China. Masters dissertation, Imperial College, London, UK. www.iccs.org.uk/papers/LailaGao.pdf.

Geissmann, T. and Chan, B. 2004. The Hainan black crested gibbon: Most critically endangered ape. *Folia Primatol.* ***75***(Supplement 1): 116 (Abstract only).

Johns, A.D. 1985. Differential detectability of primates between primary and selectively logged habitats and implications for population surveys. *Am. J. Primatol*. **8**: 31-36.

KFBG (Kadoorie Farm & Botanic Garden). 2001. Report of Rapid Biodiversity Assessments at Bawangling National Nature Reserve and Wangxia Limestone Forest, Western Hainan, 3-8 April 1998, pp. ii+33. South China Forest Biodiversity Report Series: No. 2. KFBG.

Lam, V.Y.Y., P.H. Wan, and W.K. Fu. 2005. Environmental Life Science (ENS) students in Hainan, China. *Porcupine* **33**: 12-15. www.hku.hk/ecology/porcupine/por33/33-misc2-hainan.htm.

Lin, J.Y., L.J. Mo, X.Y. Zhuang, Q. Chen, S.H. Chen, and J.F. Zhang. 2006a. Niche breadth and overlap of the feeding plants in the forest communities as habitats for *Nomascus hainanus*. *J. South China Agri. Univ.* **27**(4): 52-57.

Lin, J.Y., L.J. Mo, X.Y. Zhuang, Q. Chen, S.H. Chen, and J.F. Zhang. 2006b. The biogeographical study of Hainan Gibbon's food. *Tropical Forestry* **34**(3): 21-25.

Liu, Z.H. and C.F. Tan. 1990. An analysis of habitat structure of the Hainan gibbon. *Acta Theriol. Sinica* **10**: 163-169. (In Chinese with English summary).

Liu, Z.H., S.M. Yu, and X.C. Yuan. 1984. Resources of the Hainan black gibbon and its present situation. *Chinese Wildlife* **6**: 1-4. In Chinese.

Liu, Z.H., Y.Z. Zhang, H.S. Jiang, and C.H. Southwick. 1989. Population structure of *Hylobates concolor* in Bawangling Nature Reserve, Hainan, China. *Am. J. Primatol*. **19**: 247-254.

Mootnick, A.R., Rylands, A.B., and Konstant, W.R. 2005. Hainan Black-crested Gibbon, *Nomascus nasutus hainanus* Thomas, 1892. **In**: *Primates in peril: The world's 25 most endangered primates 2004-2006*, R.A. Mittermeier, C. Valladares-Pádua, A.B. Rylands, A.A. Eudey, T.M. Butynski, J.U. Ganzhorn, R. Kormos, J.M. Aguiar and S. Walker (eds.), pp. 30-31. Washington, DC.

Mootnick, A.R. 2006. Gibbon (Hylobatidae) species identification recommended for rescue and breeding centers. *Primate Conservation* **21**: 103-138.

Nijman, V. 2001. Effects of behavioural changes due to habitat disturbance on density estimation of rainforest vertebrates as illustrated by gibbons (Hylobatidae). **In**: *The Balance between Biodiversity*

Conservation and the Sustainable Use of Tropical Rainforests, P.J.M. Hillegers and H.H. de Iongh (eds.), pp. 217-225. Wageningen: Tropenbos Foundation.

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* **2**: 169-181. London.

Pocock, R.I. 1927. The gibbons of the genus Hylobates. *Proceedings of the Zoological Society* **1927** (2): 719-741. London.

State Forestry Administration Survey & Planning Institute and the BNNR Management Office. 2001. Hainan Bawangling National Nature Reserve Master Plan (2002-2010). Internal Report. (In Chinese).

Wang, C. 1995. Current status of conservation of the Hainan black gibbon (*Hylobates concolor hainanus*). **In**: *Primate Research and Conservation, the Second China Primate Conference*, W. Xia and Y. Zhang (eds.), pp. 176-177. Beijing: China Forestry Publishing House. (In Chinese with English abstract).

Wu, W., X.M. Wang, F. Claro, Y.Z. Ding, A.C. Souris, C.D. Wang, C.H. Wang, and R. Berzins. 2004. The current status of the Hainan black-crested gibbon *Nomascus* sp. cf. *nasutus hainanus* in Bawangling National Nature Reserve, Hainan, China. *Oryx* **38** (4): 452-456.

Zhang, Y. and L. Sheeran. 1994. Current status of the Hainan black gibbon (*Hylobates concolor hainanus*). *Asian Primates* **3** (3-4): 3.

Zhou, J. 2007. The study of the population ecology of Hainan Black-crested Gibbon. Doctoral dissertation, Grassland Science Institute of Northeast Normal University, Jilin, China.

Zhou, J., F.W. Wei, M. Li, J.F. Zhang, D.L. Wang, and R.L. Pan. 2005. Hainan Black-crested Gibbon is headed for extinction. *Int. J. Primatol*. **26** (2): 453-465.