

Population survey and habitat evaluation of white-cheeked gibbon (*Nomascus leucogenys*) in Xishuangbanna, China

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Background

Gibbons were widespread in Yunnan Province in historical times, but only a few nature reserves still support gibbon populations at present. To judge by an interview survey in 2008, supported by the Gibbon Conservation Alliance (GCA), the white-cheeked gibbon (*Nomascus leucogenys*) is on the very edge of extinction in China. Only three separated sites might still hold a very small gibbon population in Xishuangbanna Nature Reserve. However, a small captive population with 8 gibbons in a famous tourist site “Wild Elephant Valley” provided a good chance to raise gibbon conservation awareness and to conduct a gibbon rehabilitation project in China. One adult pair was released in the forest to attract tourists in 2008 and this pair gave birth in 2009. After 3 years since 2008, the other 6 infants and small juveniles are getting close to maturity, which provides a chance for the nature reserve to establish a reintroduced gibbon population at the site. To reintroduce gibbons to the forest, the first step for us is to evaluate the habitat quality in the potential site. “Wild Elephant Valley (WEV)” is close to original gibbon forest but is not reported to support a gibbon population in recent years. The specific objects of this project are 1) to confirm if white-cheeked gibbons still occur in China by field survey; 2) to evaluate the habitat quality in the potential gibbon reintroduction site.

Methods

Gibbon survey

In December 2008, we interviewed 78 people, mostly nature reserve rangers and old hunters, in 34 villages surrounding or inside Mengla Nature Reserve and Shangyong Nature Reserve where were thought to hold the last *N. leucogenys* population in China (Yang *et al.*, 1985; Hu *et al.*, 1989). Only three interviewees reported having seen or heard gibbons in three different sites (Zhaokanliang, Leigongyan, and Nangongshan) between 2006 and 2008 (Fan and Huo, 2009).

The first interviewee in Nanman village assisted soldiers in patrolling the international border between China and Laos about 8-10 times every year. He said he saw one adult male gibbon several times in Zhaokanliang in 2007 and 2008.

The second interviewee in Mankang village was a good hunter in the past and works

for the nature reserve as a ranger since 2007. This man reported his hunter friend saw a black gibbon in Leigongyan in 2006.

The last interviewee in Nangongshan had moved to this village less than 10 years ago and said he saw three black gibbons in Nangongshan around August 2008, but four other interviewees born in his village had not seen or heard any gibbons in this area in 20 years.

Based on this information, we conducted field surveys at two sites, Zhaokanliang and Leigongyan, between 7 and 23 December 2011 (Fig. 1). During the period, we interviewed five more hunters who knew Nangongshan very well to find out whether gibbons still occurred at that site. All of them confirmed that they have not seen or heard gibbons in 20 years in Nangongshan. Therefore, we did not survey Nangongshan.

During the gibbon surveys in Zhaokanliang and Leigongyan we used the auditory survey technique to assess the occurrence and population size of gibbons (Brockelman and Srikosamatara, 1993). We established 3-4 listening posts 300 to 1,300 m apart on mountain ridges in each site (Table 1, Figs. 2 and 3). These listening posts covered all ranges which might still support gibbons based on the interview information. One or two surveyors occupied each listening post at a site from c. 07:00 (before sunrise) to 12:00 for five consecutive days. Then we can use triangulation to estimate the location of calling gibbons. During the survey, we also recorded signs of human disturbance (grazing, hunting, logging, and agriculture) around our survey area.

Table 1. Survey site, listening posts and survey time in December 2011.

Survey site	Camp or listening post	Latitude (N)	Longitude (E)	Altitude (m)	Days occupied
Zhaokanliang	Camp 1	21°14.263'	101°27.518'	906	5
	LP1	21°14.246'	101°27.009'	994	5
	LP2	21°14.195'	101°26.841'	1110	5
	LP3	21°13.543'	101°27.135'	1248	5
Leigongyan	Camp 2	21°42.816'	101°26.316'	1170	1
	Camp 3	21°42.115'	101°28.064'	1371	5
	LP1	21°42.126'	101°28.212'	1436	5
	LP2	21°42.032'	101°28.629'	1629	5
	LP3	21°41.938'	101°28.787'	1690	1
	LP4	21°41.867'	101°28.230'	1693	4

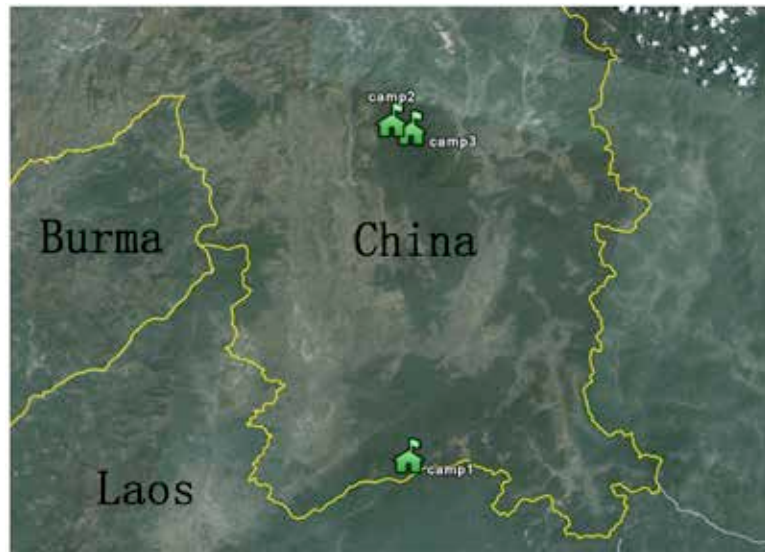


Fig. 1. Survey area in Xishuangbanna. Camp 1 is located in Zhaokanliang in Shangyong Nature Reserve. Camps 2 and 3 are located in Leigongyan in Mengla Nature Reserve.

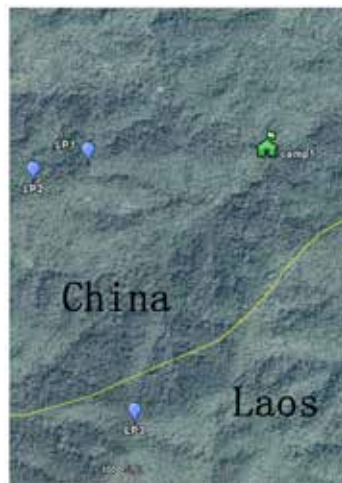


Fig. 2. Camp site and listening posts in Zhaokanliang along the China-Laos border in Shangyong Nature Reserve.



Fig. 3. Camp site and listening posts in Leigongyan in Mengla Nature Reserve.

Forest survey

We first established and studied 20 plot areas in Zhaokanliang (Shangyong Nature Reserve) between 7 and 23 December 2011. A botanist we hired to identify plants quit his work, therefore, we could not do the plot surveys in Leigongyan (which is located in the core area of Mengla Nature Reserve). Therefore, we came back to Xishuangbanna between 7 and 14 March 2012 and established and studied 30 plot areas in Niupeng. This site is also located in Mengla Nature Reserve. We could not study the plot areas in Leigongyan, because we got only a single visit permission from the reserve administration. It used to support gibbons until 2006, and the forest in Niupeng is still good (Fan and Hou, 2009). Finally, we established and studied 50 plant plots in Wild Elephant Valley between 15 and 21 March 2012.

Plot areas measured 20×20 m and were more than 100 m away from the established trails. For each plot, we chose one tree as the center tree and then established four 10×10 m plots in the four cardinal directions around this tree. In plots, we measured the tree height (with an accuracy of 0.1 m), crown diameter (with an accuracy of 0.5 m), and perimeter at breast height (PBH, with an accuracy of 1 cm) for each tree with $PBH \geq 30$ cm. Another botanist from Xishuangbanna Botanical Garden helped us to identify species in the field. For those trees we could not identify, we collected specimens for later identification.

In the statistical analysis, we compared the combined data for gibbon habitat (50 plot areas) to those for the Wild Elephant Valley (WEV) (also 50 plot areas). We selected the six most common families as “dominant families” and ten most common species as “dominant species”.

Results

Gibbon survey

We heard no gibbons in Zhaokanliang and Leigongyan. We saw a macaque group (*Macaca mulatta*) with 20-30 individuals on 11 December in Zhaokanliang. Besides that, we saw some fresh footprints of gaur (*Bos gaurus*) in Zhaokanliang. No logging or agriculture was found at both sites but local people grazed buffalos in Zhaokanliang. Illegal hunting was common at both sites. We heard 33 gunshots in five days and saw five hunters carrying four guns on 11 December 2011 in Zhaokanliang. During the seven days working in the forest, we heard 15 gunshots and saw eight campsites used by hunters. We saw four hunters with three guns on 23 December 2011 in Zhaokanliang. These hunters killed one Phayre's leaf monkey (*Trachypithecus phayrei*), two silver pheasants (*Lophura nycthemera*), one rufous-throated hill partridge (*Arborophila rufogularis*), one giant flying squirrel (*Petaurista philippensis*) and one unidentified mammal.

Gibbon population in Wild Elephant Valley (WEV)

In 2008, WEV had 8 individuals of white-cheeked gibbons, of which one adult pair was roaming freely in the forest at the tourist site. This pair gave birth in 2009. One male escaped from the cage and keepers could not find it again in 2009. Another male died at the Spring Festival of 2010 because of an unspecified disease. In December 2011, WEV had seven individuals (Table 2). The free-ranging adult male (Male 1 in Table 2) had injured six

people and was re-captured and kept in a small cage by December 2011. Only one adult female and her juvenile son were still free-ranging in the forest by December 2011. Both of them were observed to find some food in the forest, but they also obtained food from tourists. Tourists walked close to the gibbons and feed them. This behavior put them at risk of injury. The company in charge of WEV did not want to release all gibbons in the forest because the male gibbon had injured tourists. Tourist guides in WEV do not know gibbons very well and could not tell tourists how to treat gibbons. During the visit in WEV, one of us (Fan PF) gave a short introduction to a few tourist guides.

Table 2. White-cheeked gibbon individuals at Wild Elephant Valley (WEV), Xishuangbanna, China.

Number	Sex	Age	Status
1	Male	>10	Previously release in the forest, now kept in a cage with Female 4
2	Male	>10	Kept in a cage with Female 5 and 6
3	Female	>10	Released in the forest with juvenile male 7
4	Female	7-8	Kept in a cage with male 1. She was changing color from black to yellow.
5	Female	7-8	Kept in a cage with male 2. She already finished color change.
6	Female	5-6	Kept in a cage with male 2.
7	Male	2	Released in the forest with female 3.

Forest survey

We compared the tree characters between gibbon habitat and WEV forest (Table 3). Trees in gibbon habitat are higher than trees in WEV, but we found no differences between the two forest areas in the other characters (Table 3).

We further compared the characters of fig trees between sites (Table 4). Fig tree diversity is high at both sites. We recorded seven different fig species in gibbon habitat and ten species in WEV, but the density of fig trees is low at both sites. We recorded only 11 individual fig trees in gibbon habitat and 16 trees in WEV. Fig trees are significantly taller and bigger in WEV, as compared to gibbon habitat (Table 4). It should be noted, however, that because of the small sample size of fig trees, a few huge trees in WEV may have influenced the results. We recorded 147 tree species in gibbon habitat but only 87 species in WEV (Table 5). Shannon-Wiener index showed that tree diversity is higher (4.1472) in gibbon habitat than in WEV (3.6605).

The dominant families are similar at both sites, but the dominant species differ considerably between sites (Table 5). Based on the food list from Hu *et al.* (1990), gibbon habitat and WEV forest provide 29 and 26 food species for gibbons, respectively (Table 6).

Table 3. Characters of trees in gibbon habitat and Wild Elephant Valley (WEV) in Xishuangbanna, China.

Survey area		Height (m)	Perimeter at breast height (cm)	Diameter of crown (m)	Diameter at breast height (cm)
Gibbon habitat	Mean	14.8	75.9	6.0	24.2
	Max	42.5	320.0	15.0	101.9
	Min	4.1	30.0	1.0	9.5
	SD	5.6	54.1	2.4	17.2
	N	999	999	999	999
WEV	Mean	13.2	77.6	5.5	24.7
	Max	33.2	720.0	18.0	229.2
	Min	4.0	30.0	1.0	9.5
	SD	4.6	60.2	2.2	19.2
	N	1019	1019	1019	1019
	Mann-Whitney U	395143.5	495651.0	491702.5	495651.0
	Wilcoxon W	914833.5	1015341	1011393	1015341
	Z	-8.699	-1.020	-1.336	-1.020
	P	<0.001	0.308	0.182	0.308

Table 4. Characters of fig trees in gibbon habitat and Wild Elephant Valley (WEV), Xishuangbanna, China.

Survey area		Height (m)	Perimeter at breast height (cm)	Diameter of crown (m)	Diameter at breast height (cm)
Gibbon habitat	Mean	14.7	97.5	6.7	31.0
	Max	30.8	360.0	15.0	114.6
	Min	8.7	30.0	3.0	9.5
	SD	7.5	100.9	3.2	32.1
	N	11	11	11	11
WEV	Mean	22.6	371.6	13.3	118.3
	Max	33.2	720.0	18.0	229.2
	Min	4.0	95.0	5.0	30.2
	SD	4.6	179.2	3.9	57.0
	N	16	16	16	16
	Mann-Whitney U	33.5	13.5	20.5	13.5
	Wilcoxon W	99.5	79.5	86.5	79.5
	Z	-2.690	-3.677	-3.367	-3.667
	P	0.007	<0.001	0.001	<0.001

Table 5. Dominant family and dominant species in gibbon habitat and Wild Elephant Valley (WEV) in Xishuangbanna. Yellow colour indicates families and species which are dominant at both sites.

Survey area	Number of trees ¹	Number of families	Dominant families	Number of species	Dominant species
Gibbon habitat	999 / 925 / 74	43	Euphorbiaceae (101)	147	<i>Aporusa yunnanensis</i> (52)
			Fagaceae (326)		<i>Castanea</i> sp3. (103)
			Lauraceae (79)		<i>Castanopsis fleuryi</i> (46)
			Elaeocarpaceae (41)		<i>Castanopsis hystrix</i> (68)
			Leguminosae (23)		<i>Elaeocarpus austro-yunnanensis</i> (37)
			Myristicaceae (23)		<i>Castanopsis mekongensis</i> (35)
					<i>Millettia cubitti</i> (18)
	<i>Castanopsis echinocarpa</i> (15)				
	<i>Schima argentea</i> (22)				
	<i>Schima wallichii</i> (24)				
WEV	1019 / 931 / 88	35	Fagaceae (266)	87	<i>Aporusa yunnanensis</i> (60)
			Euphorbiaceae (148)		<i>Baccaurea ramiflora</i> (30)
			Theaceae (94)		<i>Adenanthera pavonina</i> var. <i>microsperma</i> (29)
			Lauraceae (64)		<i>Castanopsis hystrix</i> (80)
			Sterculiaceae (45)		<i>Castanopsis indica</i> (52)
			Leguminosae (40)		<i>Schima wallichii</i> (73)
					<i>Ternstroemia gymnanthera</i> (23)
	<i>Pterospermum acerifolium</i> (40)				
	<i>Melastoma imbricatum</i> (30)				
	<i>Phoebe lanceolata</i> (46)				

¹⁾ Numbers specify total / identified / unidentified trees

Table 6. Food species for gibbons in gibbon habitat and Wild Elephant Valley (WEV), based on the food list from Hu *et al.* (1990).

Chinese name	Family	Latin name	Habitat	WEV
八角枫	八角枫科 Alangiaceae	<i>Alangium chinense</i>	+	+
刺篱木	大风子科 Flacourtiaceae	<i>Flacourtia indica</i>	+	-
木奶果	大戟科 Euphorbiaceae	<i>Baccaurea ramiflora</i>	+	+
重阳木	大戟科 Euphorbiaceae	<i>Bischofia polycarpa</i>	+	+
滇南杜英	杜英科 Elaeocarpaceae	<i>Elaeocarpus austro-yunnanensis</i>	+	+
白榄	橄榄科 Burseraceae	<i>Canarium album</i>	+	-
湄公栲	壳斗科 Fagaceae	<i>Castanopsis mekongensis</i>	+	-
印度栲	壳斗科 Fagaceae	<i>Castanopsis indica</i>	+	+
红椿	楝科 Meliaceae	<i>Toona ciliata</i>	+	+
槟榔青	漆树科 Anacardiaceae	<i>Spondias pinnata</i>	+	+
林生芒果	漆树科 Anacardiaceae	<i>Mangifera sylvatica</i>	+	-
南酸枣	漆树科 Anacardiaceae	<i>Choerospondias axillaria</i>	-	+

Table 6. (ctd.)

Chinese name	Family	Latin name	Habitat	WEV
大叶滇南风吹楠	肉豆蔻科 Myristicaceae	<i>Horsfieldia tetratepala</i>	+	-
滇南风吹楠	肉豆蔻科 Myristicaceae	<i>Horsfieldia tetratepala</i>	+	-
风吹楠	肉豆蔻科 Myristicaceae	<i>Horsfieldia glabra</i>	+	+
垂叶榕	桑科 Moraceae	<i>Ficus benjamina</i>	-	+
野菠萝蜜	桑科 Moraceae	<i>Artocarpus lacucha</i>	+	-
钝叶榕	桑科 Moraceae	<i>Ficus curtipes</i>	-	+
高山榕	桑科 Moraceae	<i>Ficus altissima</i>	+	+
环纹榕	桑科 Moraceae	<i>Ficus annulata</i>	+	+
黄毛榕	桑科 Moraceae	<i>Ficus esquiroliana</i>	+	-
劲直榕	桑科 Moraceae	<i>Ficus stricta</i>	-	+
聚果榕	桑科 Moraceae	<i>Ficus racemosa</i>	-	+
落叶榕	桑科 Moraceae	<i>Ficus sp.</i>	-	+
苹果榕	桑科 Moraceae	<i>Ficus oligodon</i>	+	-
桑树	桑科 Moraceae	<i>Morus alba</i>	-	+
水同木	桑科 Moraceae	<i>Ficus fistulosa</i>	+	-
歪叶榕	桑科 Moraceae	<i>Ficus cyrtophylla</i>	+	-
细叶榕	桑科 Moraceae	<i>Ficus microcarpa</i>	-	+
疣枝榕	桑科 Moraceae	<i>Ficus maclellandi</i>	-	+
千果榄仁	使君子科 Combretaceae	<i>Terminalia myriocarpa</i>	+	+
野柿	柿科 Ebenaceae	<i>Diospyros kaki var. silvestris</i>	+	+
大叶藤黄	藤黄科 Guttiferae	<i>Garcinia xanthochymus</i>	-	+
云树	藤黄科 Guttiferae	<i>Garcinia cowa</i>	+	-
绒毛番龙眼	无患子科 Sapindaceae	<i>Pometia tomentosa</i>	+	+
翅子树	梧桐科 Sterculiaceae	<i>Pterospermum acerifolium</i>	-	+
窄叶半枫荷	梧桐科 Sterculiaceae	<i>Pterospermum lanceaefolium</i>	+	+
大参	五加科 Araliaceae	<i>Macropanax oreophilus</i>	+	-
鹅掌柴	五加科 Araliaceae	<i>Schefflera sp.</i>	-	+
幌伞枫	五加科 Araliaceae	<i>Heteropanax fragrans</i>	+	-
勐腊鹅掌柴	五加科 Araliaceae	<i>Schefflera rubriflora</i>	+	-
Total			29	26

Discussion

During the survey, we did not hear or see any signs of gibbons. It is possible that some gibbons still occur at these nature reserves and remained undetected by us, but the possibility is extremely low.

There were only 36 gibbons in 9 groups left in 1989 in Shangyong and Mengla Nature Reserves (Hu *et al.*, 1989). These groups were distributed in seven sites isolated by roads and villages, and the largest sub-population was only two groups with a total of eight individuals (Hu *et al.*, 1989). The distance between each sub-population was more than 20 km (Hu *et al.*, 1989), which might be too far to disperse for gibbons. Only with effective conservation activities could this small population have survived for a long time. For example, after more than 30 years strict protection, Hainan gibbon (*Nomascus hainanus*)

recovered from 7-8 individuals in late 1970s (Liu *et al.*, 1987) to only 13 individuals in 2003 (Zhou *et al.*, 2005).

Unfortunately, hunting was common inside Shangyong and Mengla Nature Reserves. We saw two hunter groups and heard 48 gunshots during the survey. People from the Yao and Aini ethnic groups including Chinese and Lao people hunt everything they find including tiger (Anonymous news, 2009), elephant (Anonymous news, 2011) and gaur (Anonymous news, 2011). They also hunt gibbons for food or traditional medicine (Fan and Huo, 2009). Although tiger, elephant, gaur and gibbon all are listed as Class I Protected Animal by Chinese Wildlife Conservation Law, law enforcement in southern Yunnan is low. Without effective protection, the small gibbon subpopulations recorded in the 1980s probably had no chance to survive under hunting pressure. Only three sites might still support very small gibbon populations by 2008 (Fan and Huo, 2009). In Zhaokanliang and Leigongyan, only one black individual was seen by local people between 2006 and 2008. Even if these individuals survived and remained undetected during our survey, it is unlikely that these gibbons could survive for long time and recover to a viable population.

Besides Mengla and Shangyong Nature Reserve, Huanglianshan National Nature Reserve also supported *N. leucogenys* in China in historical times. But a recent survey found no *N. leucogenys* in this reserve (Ni and Jiang, 2009). Given the conservation situation of gibbons inside these nature reserves, survival chance for gibbons is extremely low in unprotected forest. In fact, no gibbons survived outside nature reserves in southeastern Yunnan in recent years, with only one exception in Bajiaohe (Ni and Jiang, 2009). In Bajiaohe, killing a gibbon is considered a bad omen by local people so a very small population of four individuals of *N. concolor* survived there (Ni and Jiang, 2009). Therefore, we conclude that *N. leucogenys* is extinct, or at least ecologically extinct, in China.

Wild Elephant Valley now supports a mostly captive gibbon population of seven individuals. This provides an opportunity to build a provisioned gibbon population, but management for these gibbons is not in place. Only one female and her juvenile son were released in the forest. Other individuals are kept in cages to protect tourists from injuries.

The forest canopy was found to be a little lower in WEV than in the gibbon habitat, but it can provide some food, especially figs, for gibbons. Although fig species diversity is rich, fig tree density is low in both natural gibbon habitat and WEV forest. Both forests in Zhaokanliang and Niupeng are primary forests without selective logging, but the forest in Zhaokanliang had been degraded by grazing. A small part of the forest in WEV (15 plots) had been degraded by tourism, but most areas we surveyed (35 plots) look like primary forest. Furthermore, local people in Yunnan do not cut fig trees even close to villages. Therefore, we have no explanation for the low density of fig trees in both study areas. According to a preliminary study conducted intermittently from 1983 to 1988 by Hu *et al.* (1990), white-cheeked gibbon groups in Mengla Nature Reserve occupied home ranges larger 500 ha. This value is unusually high; home ranges of other gibbons usually are about ten times smaller (see review in Leighton, 1978). During our survey, field guides (hunters) told us gibbon density in 1970s was quite low. It is unclear whether the home ranges areas determined by Hu *et al.* (1990) are reliable, but if they are, the unusually large areas used by these white-cheeked gibbons may be a result of the low density of fig trees which may have

existed already during the 1980s.

We found, however, that plant diversity in WEV was much lower than that of gibbon habitat, although the numbers of food species in both sites were similar. So far, we cannot confirm that WEV can support gibbons without food provision.

China used to support one of the world's richest gibbon faunas with three genera (*Hylobates*, *Nomascus*, and *Hoolock*) and six species (*Hylobates lar*, *Nomascus concolor*, *N. nasutus*, *N. hainanus*, *N. leucogenys*, and *Hoolock leuconedys*) (Geissmann *et al.*, 2007), and is topped in this respect only by Indonesia (Grueter *et al.*, 2009). But all of these species are on the edge of extinction in China, and *H. lar* and *N. leucogenys* are presumed to be extinct from China (Grueter *et al.*, 2009; present study). Two species, *N. nasutus* and *N. hainanus*, each consist of only one remaining population in the world and consists of about 20 individuals in China (*N. nasutus*: Chan *et al.*, 2008; Fan *et al.*, 2010; *N. hainanus*: Zhou *et al.*, 2005). *Nomascus concolor* has the biggest population with ca 1000 individuals, but its fragmentd and distributed over several mountain areas (Jiang *et al.*, 2006). The population of *H. leuconedys* was estimated to be less than 200 individuals distributed in 17 forest patches in the most recent survey conducted between 2008 and 2009 (Fan *et al.*, 2011).

Small population size, habitat fragmentation and illegal hunting put all remaining gibbon populations of China on the edge of extinction (Jiang *et al.*, 2006; Fan *et al.*, 2011). Intensive patrol, conservation education, law enforcement and more ecological research might save these populations (eg. Hainan gibbon: Chan *et al.*, 2005). We hope that this report can get some attention from Chinese government and then contribute to gibbon conservation in China.

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References

- Anonymous (2009). A tiger was shot in Mengla, Xishuangbanna (in Chinese).
http://news.ycwb.com/2009-12/22/content_2373822_2.htm
- Anonymous (2011). A gaur gallbladder for sale (in Chinese).
<http://www.liebiao.com/xishuangbanna/qitatiozao/20459837.html>
- Anonymous (2011). Three Lao hunters have been arrested because they killed two elephants with rifles in Mengla Nature Reserve (in Chinese).
http://news.xinhuanet.com/legal/2011-05/04/c_121376801.htm
- Brockelman, W.Y., and Srikosamatar, S. (1993). Estimation of density of gibbon groups by use of loud songs. *American Journal of Primatology* **29**: 93-108.

- Chan, B.P.L., Fellowes, J.R., Geissmann, T., and Zhang, J. (2005). *Status survey and conservation action plan for the hainan gibbon*. Kadoorie Farm & Botanic Garden Technical Report No. 3, Kadoorie Farm & Botanic Garden, Hong Kong, 32 pp. Downloadable from www.gibbons.de
- Chan, B.P.L., Tan, X.F., and Tan, W.J. (2008). Rediscovery of the critically endangered eastern black-crested gibbon *Nomascus nasutus* (Hylobatidae) in China, with preliminary notes on population size, ecology and conservation status. *Asian Primates Journal* **1**: 17-25.
- Fan, P.F., Fei, H.L., Xiang, Z.F., Zhang, W., Ma, C.Y., and Huang, T. (2010). Social structure and group dynamics of the cao vit gibbon (*Nomascus nasutus*) in Bangliang, Jingxi, China. *Folia Primatologica* **81**: 245-253.
- Fan, P.F., and Huo, S. (2009). The northern white-cheeked gibbon (*Nomascus leucogenys*) is on the edge of extinction in China. *Gibbon Journal* **5**: 44-52.
- Fan, P.F., Xiao, W., Huo, S., Ai, H.S., Wang, T.C., and Lin, R.T. (2011). Distribution and conservation status of the Vulnerable eastern hoolock gibbon *Hoolock leuconedys* in China. *Oryx* **45**: 129-134.
- Fooden, J., Quan, G., and Luo, Y. (1987). Gibbon distribution in China. *Acta Theriologica Sinica* **7**: 161-167.
- Gao, Y., Wen, H., and He, Y. (1981). The change of historical distribution of Chinese gibbons (*Hylobates*). *Zoological Research* **2**: 1-8 (Chinese text, English summary).
- Geissmann, T. (2007). Status reassessment of the gibbons: Results of the Asian Primate Red List Workshop 2006. *Gibbon Journal* **3**: 5-15.
- Grueter, C.C., Jiang, X.L., Konrad, R., Fan, P.F., Guan, Z.H., and Geissmann, T. (2009). Are *Hylobates lar* extirpated from China? *International Journal of Primatology* **30**: 553-567.
- Hu, Y., Xu, H.W., and Yang, D.H. (1989). The studies on ecology in *Hylobates leucogenys*. *Zoological Research* **10**(Supplement): 61-67 (Chinese text, English summary).
- Hu, Y., Xu, H.W., and Yang, D.H. (1990). Feeding ecology of the white-cheeked gibbon (*Hylobates concolor leucogenys*). *Acta Ecologica Sinica* **10**: 155-159. (Chinese text, English summary).
- IUCN (2011). *IUCN Red List of Threatened Species. Version 2011.2*. www.iucnredlist.org. Downloaded on 31 March 2012.
- Jiang, X.L., Luo, Z.H., Zhao, S.Y., Li, R.Z., and Liu, C.M. (2006). Status and distribution pattern of black crested gibbon (*Nomascus concolor jingdongensis*) in Wuliang Mountains, Yunnan, China: implication for conservation. *Primates* **47**: 264-271.
- Leighton, D.R. (1987). Gibbons: Territoriality and monogamy. In Smuts, B.B., Cheney, D.L., Seyfarth, R.M., Wrangham, R.W., and Struhsaker, T.T. (eds.) *Primate societies* (University of Chicago Press, Chicago and London, pp. 135-145.
- Liu, Z., Jiang, H., Zhang, Y., Liu, Y., Chou, T., Manry, D., and Southwick, C. (1987). Field report on the Hainan gibbon. *Primate Conservation* **8**: 49-50.
- Ma, S., and Wang, Y. (1986). The taxonomy and distribution of the gibbons in southern China and its adjacent region - with description of three new subspecies. *Zoological Research* **7**: 393-410 (Chinese text, English summary).

- Ma, S., and Wang, Y. (1988). The recent distribution, status and conservation of primates in China. *Acta Theriologica Sinica* **8**: 250-260 (Chinese text, English summary).
- Ni, Q.Y., and Jiang, X.L. (2009). Crested gibbons in southeastern Yunnan, China: status and conservation. *Gibbon Journal* **5**: 36-43.
- Tan, B. (1985). The status of primates in China. *Primate Conservation* **5**: 63-81.
- Yang, D., Zhang, J., and Li, C.. (1985). A survey report on the number and distribution of gibbons in Yunnan. *Medical Biological Research* **1985**(3): 22-27 (Chinese text).
- Zhou, J., Wei, F.W., Li, M., Zhang, J.F., Wang, D.L., and Pan, R.L. (2005). Hainan black-crested gibbon is headed for extinction. *International Journal of Primatology* **26**: 453-465.