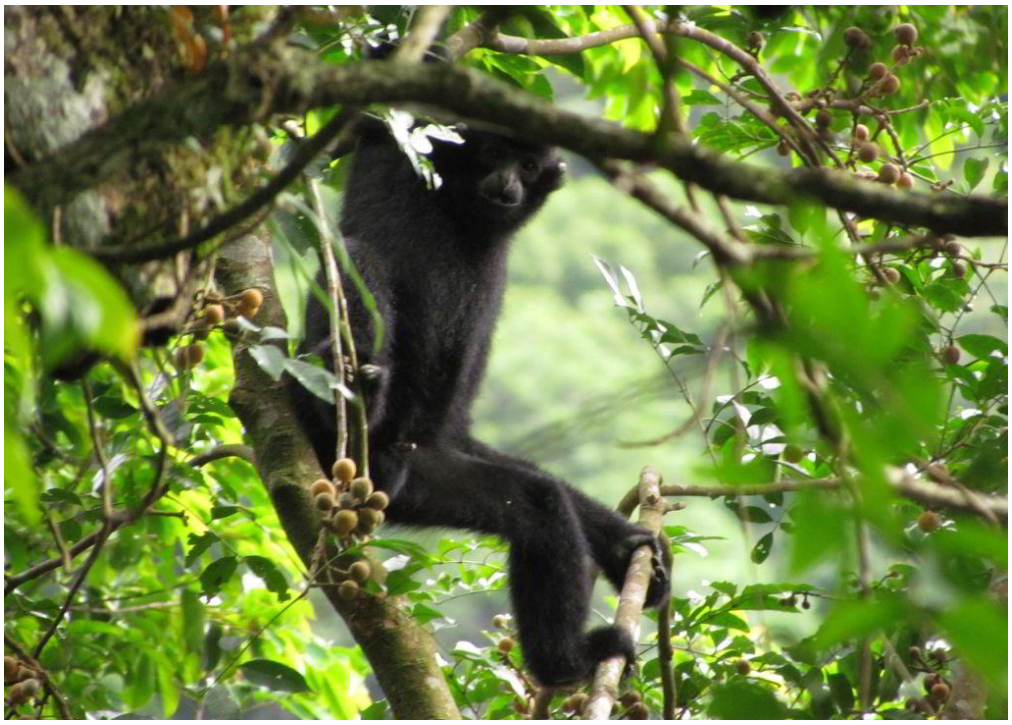
EMERGENCY RESPONSE PLAN FOR THE HAINAN GIBBON



Report and recommendations of the
Emergency Response Plan Advisory Meeting

Haikou, Hainan, China

8-9th September, 2016

arcus FOUNDATION

海南霸王岭国家级自然保护区 Hainan Bawangling National Nature Reserve

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Workshop organised by Zoological Society of London and Bawangling National Nature Reserve Management Office.

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A PDF of this report can be downloaded at http://www.zsl.org and www.gibbons.asia.

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Abbreviations and acronyms

BNNR	Bawangling National Nature Reserve
BNNRMO	Bawangling National Nature Reserve Management Office
ERP	Emergency Response Plan
FFI	Flora and Flora International
HFB	Hainan Forestry Bureau
TB	Tuberculosis (*Mycobacterium* spp.)
XTBG	Xishuangbanna Tropical Botanical Garden
ZSL	Zoological Society of London

Background and rationale

The Hainan gibbon, the world's rarest primate and possibly the world's rarest mammal, consists of a single population of approximately 26 individuals restricted to one protected area on Hainan Island, China, which has persisted for over 30 years at exceptionally low population size. When populations of Critically Endangered species reach such low sizes, in this case just a handful of individuals, the likelihood of population extinction via stochastic events—such as disease outbreak, fire or typhoon—becomes extremely high. In these instances there is often little time to react, and therefore contingencies must be put in place beforehand that anticipate such stochastic events, in order to expedite response actions should such events occur.

As previous cases have demonstrated, species including the Mauritius kestrel (*Falco punctatus*), Chatham Islands black robin (*Petroica traversi*), and Mauritius parakeet (*Psittacula echo*) have been successfully recovered from the brink of extinction when only a few individuals remained. However, other species such as the po'ouli (*Melamprosops phaeosoma*, a Hawaiian honeycreeper endemic to Maui) have not been so fortunate, with extinction of the species following last-ditch attempts at conservation, including translocation attempts and capture of the last few remaining individuals for captive breeding (Groombridge *et al.* 2004).

One way to reduce the risk of the Hainan gibbon facing a similar fate is through the provision of an Emergency Response Plan (ERP), which states a population threshold or cutoff point at which the plan should come into operation, along with specific new management actions that should be taken; such actions form a rapid response to a pre-decided set of circumstances. An ERP is intended to avoid an unnecessary delay in decision-making that can occur when a catastrophic event places an already highly threatened species at immediate risk of extinction. To date, there has been no ERP in place that would deal with a rapid decline in the Hainan gibbon population due to an unpredictable event.

In order to address this deficit, as recommended as a priority action for the species by experts in the Catastrophic Decline Subgroup at the 2014 International Conservation Planning Workshop for the Hainan Gibbon, an Emergency Response Plan Advisory Meeting of key stakeholders in Hainan gibbon conservation and experts in conservation in China was convened in Haikou, Hainan, China from 8-9th September, 2016, to develop an ERP for the Hainan gibbon. This document reports on the meeting process and the issues and considerations that were discussed. It identifies the threats that could cause a catastrophic decline for the Hainan gibbon, and outlines a preliminary ERP for the species, providing details of required actions, timelines, and parties responsible for carrying out all identified steps.

Brief report on meeting activities

Attendees at the Hainan gibbon Emergency Response Plan Advisory Meeting, 8-9th September, 2016, Hainan Longquan Hotel, Datong Road, Longhua District, Haikou, Hainan, China.

Meeting attendees (listed alphabetically by family name)

Name	Affiliation	Email
Dr Jessica BRYANT	Postdoctoral Researcher, Institute of Zoology, Zoological Society of London	jessica.bryant@ioz.ac.uk
Mr CHEN Qing	Bawangling National Nature Reserve Management Office	bwlbhq@126.com
Miss Becky Shu CHEN	China Project Manager, Conservation Programmes, Zoological Society of London	shu.chen@zsl.org
Dr Susan CHEYNE	Lecturer, Oxford Brookes University / Director of Gibbon & Felid Research, Orangutan Tropical Peatland Project	s.cheyne@borneonature.org
Prof. FAN Pengfei	Professor, School of Life Sciences, Sun Yat-Sen University	fanpf1981@gmail.com
Mr HONG Qixuan	MSc student, Sun Yat-Sen University	
Mr HONG Xiaojiang	Deputy Director, Bawangling National Nature Reserve Management Office	hnhxj168@163.com
Miss Heidi MA	Project Coordinator, Institute of Zoology, Zoological Society of London	heidi.ma@ioz.ac.uk
Mr MENG Bingbo	Hainan Programme, Flora & Fauna International	mengbingbo@ffichina.org
Miss Lisa MOGENSEN	PhD student, University College London / Institute of Zoology	lisa.mogensen.14@ucl.ac.uk
Dr REN Guopeng	Institute of Eastern-Himalaya Biodiversity, Dali University	guopeng.ren@gmail.com
Dr Samuel TURVEY	Senior Research Fellow, Institute of Zoology, Zoological Society of London	samuel.turvey@ioz.ac.uk
Dr ZHANG Mingxia	Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences	zhangnn2003@126.com

Overview of meeting framework

The meeting commenced with individual introductions by each participant outlining their affiliation and relevant experience, followed by a general welcome by the chair, Dr. Turvey, during which the need, purpose and agenda of the meeting were briefly outlined.

Meeting aims

Two principal aims for the advisory meeting were identified:

1) To gather a series of expert recommendations and decisions as to what should go into an Emergency Response Plan for the Hainan gibbon – this should identify gaps in knowledge and additional expertise needed to decide what should be done;

2) To clarify the process by which these recommendations can be formalised into an official strategy (ERP) and develop a process for carrying out the recommendation actions.

Questions posed

In line with these aims, a number of guiding questions were posed at the outset of the meeting for participants to consider, which required resolution in order to generate a detailed and effective ERP:

- What kind of factors could cause sudden Hainan gibbon population decline?
- What population threshold or novel threat would constitute an 'emergency situation' for the Hainan gibbon? A population state, population trend, new threat, or change in habitat state?
- How would an emergency situation be detected?
- What alternative management strategies should be considered in an emergency situation? A single alternative? Or different strategies for different scenarios?
- Who would carry out the emergency response activities? How quickly could they be carried out?
- What resources would be required to carry out the emergency response activities, and where might these be sourced?
- What is the official process by which an agreed ERP can be approved and integrated into formal management policy for BNNRMO?

Meeting outputs

A single major output for the advisory meeting was recognised:

A report (this document), summarizing the advisory meeting process and outlining the recommendations for a preliminary ERP for the Hainan gibbon, to be circulated amongst attendees and other key stakeholders and experts for comment and consultation prior to government approval at the required levels (provincial, national).

Introductory/background talks

To ensure all participants were up to speed on the issues and considerations involved and to promote discussion of the key points, a series of talks outlining key background information and the current state of play along with the tools and technology available to improve current monitoring and management of the Hainan gibbon were presented at relevant points during the meeting:

Dr. J. Bryant: "*What factors might cause a 'catastrophic population decline' for the Hainan gibbon?*"

Dr. S. Turvey: "*Introduction to problems faced by very small populations and the need for an Emergency Response Plan*"

Dr. S. Cheyne: "*Brief overview of the Emergency Response Plan successfully employed for the Orangutan Tropical Peatland Project site in Indonesia in response to the fire crisis of 2015: the process of developing the plan and enacting it*"

Miss B. Chen: "*Using Spatial Monitoring and Reporting Tool (SMART) systems to monitor wildlife and threats and improve population and reserve management*"

Dr. S. Cheyne: "*Responding to and managing disease within gibbon populations: insights from the IUCN 'Guidelines for Wildlife Disease Risk Analysis' and 'Manual of Procedures for Wildlife Disease Risk Analysis'"*

Summary of meeting discussion

Threshold for emergency response

Discussion regarding the population threshold, change in population state, population trend, habitat state (quality/quantity of habitat), or emergence of novel threat 'triggers' that could constitute an 'emergency situation' for the Hainan gibbon and require enactment of emergency response actions in a formalised ERP revealed the following considerations:

The current population (as of September 2016) constitutes 26 known individuals in four social groups:

Group A: 2F 1M of breeding age, 6 total

Group B: 1F 1M: 1subdult F is changing colour, 5 total

Group C: 2F 1M, 9 total –includes animals previously in Group A (not clear how many breeding)

Group D: 1F 1M: 3 total

Solitary individuals: 3, 1 of which is adult F (yellow pelage)

Many conservationists would consider the current situation to already be at the level of an emergency, but participants could not agree on this point.

The apparent population increase since the 1980s to the current observed population size may or may not constitute a population 'recovery' (given concerns regarding inconsistencies in census methods, effort etc. over time) and may not necessarily happen again if the population suffers any losses – it may have 'got lucky' so far.

Conservation action plans for other Chinese species have been triggered at much higher population size thresholds than the current Hainan gibbon population size, e.g. the panda response plan was triggered at 1,000 animals and it was successful at that point.

Population Viability Modelling carried out at the 2014 International Conservation Planning Workshop for the Hainan Gibbon using the most up-to-date information regarding species ecology and genetic status (based upon data from Bryant 2014 and Bryant et al. 2015, 2016, 2017), and a relatively conservative estimate of the impact of inbreeding in the Hainan gibbon population (less than the default value generally used for other vertebrates), suggests that loss of even half of the adult (breeding) population, i.e. a reduction to two adult males and three adult females, leads to a 47% chance of

extinction. Furthermore, a population crash to fewer than two adult males and three adult females has a 92-99% chance of extinction in the long-term (150 years).

Participants suggested that a decline of 6 breeding females to just 3 breeding females in the population is not acceptable and would widely be considered as catastrophic, requiring some form of action, although exactly what form that would take will be cause/factor-dependent.

It is also important to consider that for captive breeding to ever be successful (should this be deemed a necessary action at any point), a breeding programme would require 2 females and 2 males as a minimum to form a breeding population, preferably from different groups to ensure they are likely to form breeding pairs and to maintain some genetic diversity.

The loss of one individual could also be deemed sufficient to change the current overall management approach. However, depending on the cause of the loss/death of the animal (e.g. poaching, disease), it may or may not be necessary for require an 'emergency response' to be triggered.

As a result, an exact threshold for population size/status at which to trigger an 'emergency response' was not agreed upon, as it was generally thought that emergency response action should instead be risk factor/event dependent.

Likely threats/factors that may require an emergency response

Extensive discussion during the meeting identified the following likely factors and threats that could cause a potential catastrophic population decline for the Hainan gibbon in BNNR, and the key points, concerns and considerations regarding each threat:

Fire

A detailed ERP already exists for fire management in protected areas across China, developed and overseen by the Chinese Central Government, and which is applicable to BNNR: this outlines a rapid, centralised response for minimizing fire extent and damage. Satellite images are presently used to monitor forests for fires across China (both on Hainan and the mainland) and to detect any fires that emerge so that a response can be mounted. Any fires detected within BNNR must be reported to the Central Government's State Forestry Administration within 24 hours; following this

protocol then entitles BNNRMO to support of the national army etc. for manpower to fight fires within BNNR.

At present, there is no link between the Central Government's forest fire response plan and management of conservation-priority wildlife species – this existing action plan is for fire control only, and contains no specific response actions for gibbons or any other species.

BNNRMO considers that risk of fire is low due to humidity levels in BNNR's forests. BNNRMO also considers that the existing general fire ERP is adequate, and that a separate ERP for what to do in the event of a fire regarding specific responses to safeguard gibbons is not required. As a result, there was no additional discussion regarding an emergency response plan for fire events in BNNR.

It was thought that provisioning of supplementary food and water for gibbons may be warranted after a fire event if forest loss/damage is extensive and impacts gibbon territories.

Typhoon

There was some disagreement between participants regarding the risk that typhoons pose to the Hainan gibbon population in BNNR. BNNRMO does not consider that typhoons are a high risk factor for the Hainan gibbon population, and thought that typhoons have little to no impact on forest in BNNR. This opinion is based on past experience of only 2 high-impact typhoons occurring in BNNR in recent years (2014, 2016), with the main impacts observed being increased rainfall and surface water, and landslides (30-40 mu/2-3 hectares of forest lost in the 2014 typhoon due to landslides).

No data are available regarding specific impacts of typhoons on the Hainan gibbon population, or on other gibbon populations more generally. However, examples from the literature from other sites/species indicate that typhoons or hurricanes can negatively impact primate survival and reproduction. There is a negative association between hurricane occurrence and average yearly birth rates for Milne-Edward's sifaka (*Propithecus edwardsi*) in Madagascar (Dunham *et al.* 2011), and between hurricane occurrence and adult survival for Mexican howler monkey (*Alouatta palliata mexicana*) (Ameca y Juárez *et al.* 2015). Typhoons and hurricanes can impact frugivorous species such as gibbons most severely (Lynch 1991).

At present, there is no ERP for typhoon management from the Central Government to respond to typhoons in the same pre-planned manner as forest fires, only a reactive response to past typhoons.

Concerns that BNNRMO staff cannot enter the forest during a typhoon and so cannot act to rescue gibbons during a typhoon event were expressed, along with fears that intervention in such circumstances could prevent/reduce ability of the Hainan gibbon population to respond and react adaptively to such pressures. However, it was made clear that due to the extremely reduced number of individuals remaining in the Hainan gibbon population, the more likely risk is that the species will be unable to respond adaptively, with the species' current adaptive potential likely already compromised due to its tiny population size and associated genetic issues such as low diversity and inbreeding. If no conservation intervention is provided during or immediately after a typhoon, the species may therefore decline rapidly and become extinct.

In terms of possible response actions following a typhoon, it was again thought that provisioning of supplementary food and water may be warranted if forest loss/damage is extensive and impacts gibbon territories.

No other additional emergency response actions for the threat of a typhoon (e.g. translocation of gibbons from typhoon-impacted forest to a safe forest site or to a temporary housing facility) were discussed.

Disease

Participants expressed a general concern that disease transfer from humans to gibbons may be a risk to the surviving Hainan gibbon population. Previous cases of disease transfer occurring in African ape populations indicates that disease is also likely to represent a general risk factor for wild gibbon populations, including the Hainan gibbon. For example, in wild chimpanzees, ebola has caused 25% and 50% population declines (Le Guenno *et al.* 1995, Formenty *et al.* 1999), and pneumonia has caused a 31% population decline within one week (Leendertz et al. 2006, Boesch 2008). Disease outbreaks have also caused mortalities of gibbons in captivity. For example, one *Hylobates lar* individual died due to human herpesvirus type 1 (HHV-1) (Landolfi *et al.* 2005), and two separate outbreaks of the common cold caused 6 gibbon deaths in Kunming Zoo (Fan Pengfei, pers. comm.).

The level of interaction between humans and Hainan gibbons is presumed to be low, so the risk of gibbons contracting disease from humans via disease transmission is also likely to be low. However, it is clear from previous disease transmissions that it does not require many people to be in close proximity for an outbreak to occur in apes.

At present, there is no understanding of the current disease or parasite load in the Hainan gibbon population. Scat and blood sampling programmes are required to

establish a baseline understanding of disease in the population, and to monitor for emerging diseases.

It is clear that TB is present in the human population on Hainan, so this is not a novel disease in the region, meaning that gibbons may be at risk of contracting it.

It was thought that breeding females carrying a high parasite load could represent a significant risk to the Hainan gibbon population. If a breeding female has a high parasite load, they may pass this onto their young. An adult with a high parasite load is likely to be able to survive; however, a young individual may not. The combined stress of having a high parasite load, giving birth and nursing an infant may also result in rejection and death of the infant and/or possibly death of the mother, therefore representing a high risk to both the young and the adult female.

The IUCN documents '*Guidelines for Wildlife Disease Risk Analysis'* (World Organisation for Animal Health 2014) and *'Manual of Procedures for Wildlife Disease Risk Analysis'* (Jakob-Hoff *et al.* 2014), along with information about the diseases that gibbons are susceptible to in '*Best Practice Guidelines for the Rehabilitation and Translocation of Gibbons'* (Campbell *et al.* 2015), provide a good basis for an ERP for disease outbreaks in the Hainan gibbon population.

Appropriate response actions for disease events will depend upon the nature of the pathogen (bacteria/virus/parasite) and severity of the outbreak. Potential response actions include antibiotics in provisioned food, and capture for vaccination/course of treatment in an *ex situ* rehabilitation centre (which will require identification of a possible treatment centre and an experienced wildlife vet based in China).

Reportedly, naturally occurring plants (e.g. papaya leaves) can aid in treatment of ape parasites. Planting of such species may therefore be a management option, but only if non-invasive species are used, and the action is in line with general biodiversity conservation management of BNNR more widely.

Again, there was general agreement that supplementary provisioning of food must be trialled using the latest successful methods for gibbons in other sites, to determine if medicines could be administered to the Hainan gibbon population in this way should an infectious disease be detected.

Hunting

There was some limited discussion of the risk of hunting to Hainan gibbons within BNNR. BNNRMO representatives felt that at present there is a low risk of poaching of

gibbons, as hunters going into the forest to hunt animals are reportedly old, and very few people around BNNR reportedly own guns.

Other participants had, however, heard gunshots during time spent in the forest in BNNR in recent years (at least as recently as 2011-12), so there was some disagreement about the level of hunting activity in BNNR and the risk that this activity may pose to the gibbon population.

It was agreed that if even one gibbon were to die from a poaching event, BNNR and the State Forestry Administration would be concerned, and if there was compelling and direct evidence for a poaching-related gibbon mortality, it would likely lead to a response and change in conservation management of the gibbons and the reserve. The exact nature of the likely change in management was not stipulated or discussed further.

Possible response actions

Below are the key points raised during discussions about possible response actions that could be employed to address factors that could cause a potential catastrophic depopulation decline for the Hainan gibbon. Some actions may be an appropriate response for several different threats, and so were discussed in a general sense; others are threat-specific and so were discussed in more detail.

Improved monitoring of the gibbon population

There was extended discussion regarding the need for increased and improved monitoring, in terms of both the need for more continuous monitoring in order to be able to detect an emergency situation for the Hainan gibbon population, and also as a specific component of an ERP. It was felt that unless current monitoring efforts are intensified, it will not be possible to detect events that may produce a catastrophic decline for the gibbon population (e.g. a poaching event), let alone the catastrophic population decline itself.

Data need to be collected that are accurate, reliable, and in real time. This includes information on individually identified gibbons. Data need to be evaluated regularly to permit appropriate and timely management decisions to be made, emergency or otherwise.

It was made clear that any increase in monitoring will require additional funding from either local government or an external source (e.g. NGO), and support from the Chinese government (Hainan Forestry Bureau) to allow a new monitoring team to be set up

which is solely dedicated to tracking and observing the gibbon population. The current forest warden team members are required to each be responsible for a designated patch of forest (to monitor damage to the forest etc.), and they do not currently have the capacity to look for gibbons systematically while fulfilling these other requirements.

Wardens are currently in the forest for approximately 20 days out of each month to fulfil all of their duties. Of these 20 days, 5-10 include getting up early to go and listen for gibbon calls so that information can be gathered about the gibbon population. There is no longer a dedicated gibbon monitoring team, and the existing wardens cannot dedicate the time required to monitor the gibbon population intensively.

A provisional figure for the investment required to establish a new gibbon-specific monitoring team would be in the region of approximately 80,000 yuan/year.

An increased monitoring presence may also act to deter individuals from nearby villages from hunting within the reserve, and so minimise the risk of gibbon individuals being purposefully or accidentally poached.

By using SMART software to improve monitoring efficiency and randomise forest patrolling efforts, it may be possible to prevent hunters from learning monitoring team routines and routes.

Furthermore, for several response efforts to be successful (e.g. disease screening, supplementary feeding), it will be necessary to obtain information on the feeding, sleeping and singing trees of the existing gibbon groups. Obtaining such information and keeping it up-to-date will require more intensive monitoring of the gibbon population, to allow key locations to be targeted for scat sampling and for provisioning of food/water if and when required following an emergency event.

Disease screening and treatment

At present, there is no understanding of the current disease or parasite load in the Hainan gibbon population, nor any form of disease screening under way to enable the establishment of a baseline understanding of disease in the population or to monitor for emerging diseases.

It was recommended that to rectify this problem and to permit early detection of potential diseases within the Hainan gibbon population, regular scat (and if possible blood) sampling programmes are required to screen for parasites, viruses, bacterial infections, and other pathogens.

A number of considerations relating to disease testing/screening were raised:

- Only some diseases (e.g. parasite loads) can be detected in faeces
- Other more serious diseases (e.g. TB) can only be detected via blood samples
- It will likely be very difficult to obtain blood samples from the Hainan gibbon population, so it may be necessary to recognise some of these more serious diseases via close observation, e.g. animals may visibly cough up blood
- However, not all diseases will produce symptoms in all animals, e.g. an animal can carry TB all its life and not be affected, but can spread it and infect others
- It will be crucial to find a lab in China that has the correct equipment, facilities and skills to carry out the tests (and so minimise the risk of false positives and false negatives)

Using scat samples, it will be possible to monitor the Hainan gibbon population for certain diseases, as well as animal hormone-related stress levels and for genetic sampling. Scat sampling should use three different preservation methods:

i) formalin (for parasites, diseases)
ii) distilled water (for ketones, stress hormones)
iii) ethanol (for DNA)

It was suggested that this scat-based disease (and wider) screening should be implemented now, prior to the any disease emergence events requiring an emergency response, by collection of scat samples from the population at least once a month, ideally with more than two samples collected per month.

If cost/manpower is an issue, monitoring should focus on breeding females as a priority, as these individuals are most at risk and constitute important individuals to ensure long-term survival of the species.

Treatment for any detected diseases will depend upon the nature of the pathogen and severity of the disease symptoms:

> 'Low risk'* diseases/infections could be treated with medication hidden in food supplementation parcels (if this proves successful)
>
> 'High-medium risk'* diseases/infections (e.g. TB, hepatitis, ebola) require treatment and/or vaccination, which therefore requires animals (infected or not) to be captured. Any planned gibbon captures will require appropriate planning (e.g. in safe darting and netting procedures).

Note: See "Box 1" for more details about diseases previously reported in gibbons, and the level of risk (low/medium/high) associated with each disease.

Box 1

List of diseases reported in / assayed for in wild, rehabilitating, or confiscated gibbons (inclusive of all species/subspecies) from the published literature. Red cells indicate 'high risk', amber cells indicate 'medium risk', and green cells indicate 'low risk' category pathogens or diseases.

Taken from Campbell *et al.* 2015: *IUCN Best Practice Guidelines for the Rehabilitation and Translocation of Gibbons*, p 31.

Pathogen	Likely Prevalence in Wild	Transmission Route Risk	Risk of Transmission to Wild Gibbons	Morbidity	Severity	Risk of Fatality	Total Score
Mycobacterium spp. (tuberculosis)*	1.3	4.3	3.7	4.0	4.3	4.3	21.9
Plasmodium hylobati	2.8	4.0	4.0	2.8	2.6	2.2	18.4
Ternidens spp.	1.8	3.3	2.3	2.3	2.8	2.3	14.8
Trichuris spp.	2.3	3.0	2.5	2.5	2.3	2.0	14.6
Strongyloides fuelleborni	2.2	3.0	2.0	2.3	2.7	2.2	14.4
Brugia malayi	1.6	2.8	2.8	2.2	2.4	2.2	14.0
Brugia pahangi	1.8	2.8	2.8	2.2	2.2	2.0	13.8
Human herpes virus 1	1.0	3.0	2.0	2.0	3.0	2.6	13.6
Hepatitis b virus	3.3	3.0	2.2	2.0	1.6	1.4	13.5
Human herpes virus 4	1.3	3.0	2.2	2.7	2.2	1.8	13.2
Cercopithecine herpes virus 5	1.5	3.2	1.8	2.5	2.3	1.8	13.1
Balantidium coli	1.6	2.1	1.9	2.1	2.8	2.4	12.9
Lymphocryptovirus spp.	1.7	2.8	2.2	2.2	2.0	1.8	12.7
Necator spp.	1.8	2.3	1.3	2.3	2.5	2.0	12.2
Human herpes virus 2	1.0	2.8	1.5	2.2	2.4	2.2	12.1
Ascaris spp.	2.1	2.1	1.7	2.1	2.3	1.7	12.0
Parastrongylus cantonensis	1.3	2.5	1.8	1.3	2.3	2.0	11.1
Cryptosporidium spp.	1.3	1.8	1.5	1.8	2.0	1.7	10.1
Trichostrongylus spp.	1.3	2.3	1.7	1.7	2.0	1.0	10.0
Simian foamy virus	1.6	2.2	1.6	1.8	1.2	1.0	9.4

Supplementation/provisioning (food and water)

Provision of food and/or water may be required to supplement naturally available resources following a fire or typhoon, or could be used to administer medication to animals after detection of a disease/parasite infection.

BNNRMO did attempt to provide supplementary food for Hainan gibbons previously (in the 1980s) but had poor success: they found the gibbons tended to avoid the food and then avoid the sites used in the trials. It was thought that the approach previously used to test supplementation in BNNR may not have been optimal; it was only trialled for a period of 2-3 days each for a few times over six months, employed bananas and apples as food (apple is not normally considered enticing for primates), and provided this food within approximately 30m of gibbon ranging area.

Since this single, unsuccessful trial in the 1980s, there have been vast improvements in supplementary feeding methods, making it more likely that this approach could be more successful if attempted again. Information on the materials required and manner in which to place receptacles into suitable trees for provision of food/water was provided:

- Successful supplementary feeding for other gibbon species at other sites has always been achieved by offering something 'juicy' (e.g. banana, which primates prefer), which has been left as untouched as possible (e.g. unpeeled, with a small cut for addition of medication if required).
- The food was always placed towards the top of the tree, close to the trunk.
- The choice of tree for food placement is also important; previous successful efforts have always placed the offered food in trees that are located near to sleeping or singing trees, in the centre of the group's home range.
- Use of containers made of natural materials (e.g. rattan) to store/offer the food, rather than artificial materials (e.g. metal), is of paramount importance.
- For water, a plastic receptacle will be required. Use of high-quality plastic is recommended to prevent rapid degradation under environmental conditions. See figure taken from Campbell *et al.* 2015 below.

These principles and considerations apply to supplementary feeding and water provision, and to provisioning of medicine within food parcels.

Example of a water vessel that mimics natural water sources, which could be used for water supplementation/provisioning following a fire or typhoon

Taken from Campbell *et al*. 2015: *IUCN Best Practice Guidelines for the Rehabilitation and Translocation of Gibbons*, p 25.

(Image Copyright Gibbon Rehabilitation Project)

It was recommended that food/water receptacles should be installed into appropriate trees using an established, tested technique known as the 'flag-pole' system, which has previously been used successfully to place various items (e.g. butterfly traps) high into trees. Details can be found in Purwanto *et al*. (2015), and are summarised here.

Materials required: receptacle (for food/water), slingshot, fishing line (minimum length of three times the desired maximum tree height for positioning the receptacle), nylon rope around 2-3 mm thickness (minimum length at least twice the desired tree height for positioning the receptacle), lead fishing weight or piece of wood from forest, food/water to add to receptacle.

The procedure is as follows:

1. Tie lead weight/ piece of wood to one end of fishing line
2. Tie other end of fishing line to nylon rope
3. Tie other end of nylon rope to food/water receptacle
4. Slingshot fishing line up into the tree over a high, sturdy branch (close to trunk) using the weight
5. Once over the desired branch, pull fishing line to bring nylon rope over branch
6. Add food/water to receptacle
7. Pull receptacle up to desired height
8. Remove fishing line once rope is over branch

9. Tie rope on and leave it attached to a branch
10. Create a loop similar to a flag pole (see diagram below): the rope should be looped through a root or other tying point on the ground, then tied to the bottom of the receptacle and pulled tight. It is usually necessary to attach a cord to the bottom of the receptacle so that it can be pulled down
11. Take everything away when leaving
12. Some trial and error will be needed to perfect this method for food/water receptacle installation

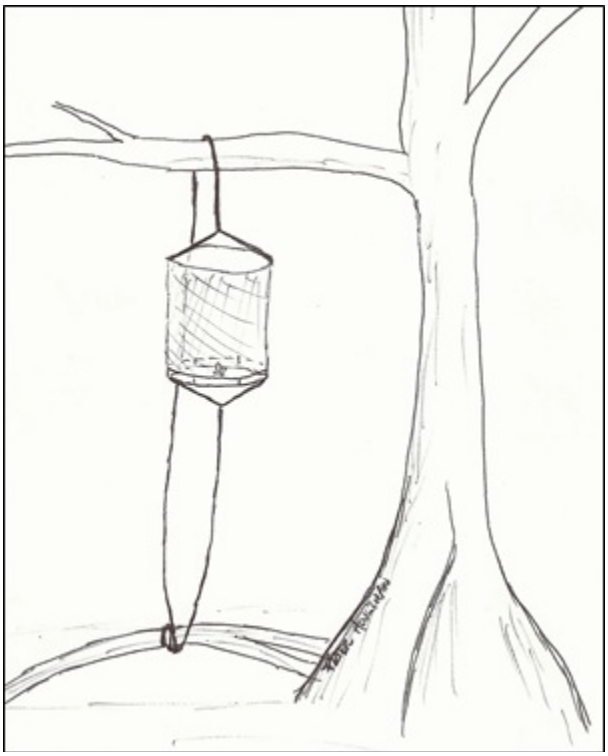

Diagram of the 'flag-pole' system for placing object high into the canopy, which could be used to install food/water receptacles for supplementation/provisioning for gibbons in the forest in BNNR.

Taken from Purwanto *et al*. 2015: *Good Practice Guidelines: Butterfly Canopy Trapping*, p 13.

For supplementary feeding to be successful at BNNR, it will be necessary to obtain information on the sleeping and singing trees of the existing groups. More intensive monitoring of the population will be required to gather this information and keep it up to date to provision food/water if and when required following an emergency event.

Some concern was expressed that provisioning of supplementary resources could lead some Hainan gibbon individuals to become habituated to human presence, associate humans with food, and/or come to rely on food/water provisioning. It was felt that this risk will be low, provided that supplementary feeding/water provisioning is infrequent and used in one-off, short emergency periods only.

It was reiterated that supplementary feeding (including with medicine) is not recommended as an everyday management action, but only as an emergency response to an appropriate event (e.g. disease outbreak, fire/typhoon forest damage).

Translocation

Translocation of all or some of the surviving Hainan gibbons from one location to another could be considered as a response to certain emergency situations. Such translocation could involve either moving individuals to a different forest patch inside BNNR or another reserve, or to a secure *ex situ* facility, as either a temporary measure for the duration of the emergency event or as a permanent solution to safeguard a further reduced population. The general concerns and considerations associated with this possible response option were discussed to identify and resolve these aspects.

It was recommended that any such translocation action should follow the *IUCN Best Practice Guidelines for the Rehabilitation and Translocation of Gibbons* (Campbell *et al.* 2015). This document outlines the issues and potential solutions associated with translocation of gibbons. These guidelines are now available in both English and Chinese.

Some general recommendations were given by those present with some knowledge of the issues and processes involved in translocating wild gibbons:

- Blowpipe darts should be used to administer anaesthetic
- Once anaesthetised, gibbons often fall asleep holding a branch, so it is possible to catch them by hand and put them into a cage directly; however, a safety net should always be erected underneath in case animals fall at any point
- Cages made of rattan, not metal cages, should be used to transport the captured animals
- It is best to raise the cage up to the level of the gibbon in the forest canopy (using a pulley system) when placing the animal inside, to minimise risks of an accidental animal fall

If this action is to be considered seriously, BNNRMO should consult other conservation practitioners with extensive expertise in translocating gibbons now. Such practitioners including Chanee (Project Kalaweit, Indonesia), who has 10 years' experience in successful gibbon translocations, and Dilip Chetry and his team in India, who have conducted successful relocations of hoolock gibbons. Such consultation is essential in order to ensure all possible issues are identified and resolved before any translocation is attempted.

The translocation process is not without risk of gibbon injury/death (however, no fatalities have been reported to date for the Kalaweit Project or the Orangutan Tropical Peatland Project). However, the risk involved needs to be balanced against risk of gibbon death if animals are left to remain in the forest in face of threat (e.g. fire, starvation).

There have been no known previous capture efforts for gibbons in China for translocation or other conservation purposes (e.g. radio-tracking collar fitting). However, other primates in China have been captured to fit GPS collars (although not for translocation). These species include Yunnan snub-nosed monkeys (*Rhinopithecus bieti*) in Laojunshan Nature Reserve, Yunnan, and golden snub-nosed monkeys (*Rhinopithecus roxellana*) in the Qinling Mountains, Shaanxi.

It is clear that it is very difficult to get necessary permission to capture wild primates (and other State I protected species) in China; it can take several months to get permission from the State Forestry Administration. Because the surviving Hainan gibbon population is so low, the provincial-level government may be unlikely to allow removal or translocation of any individuals. The general feeling from Chinese participants was that the State Forestry Administration is unlikely to give permission for any capture efforts, even for conservation monitoring (e.g. fitting collars).

The overall assumption was that any translocation of Hainan gibbon individuals would only likely be permitted (i.e. approved by State Forestry Administration etc.) as a reactive response to a specific emergency event, rather than approved 'in principle' in advance of any drastic population decline to a specified threshold for whatever reason (e.g. a sudden event such as typhoon, or a less obvious intrinsic driver such as inbreeding depression).

Captive Breeding

The establishment of a captive gibbon population, to be maintained locally in Hainan, has been raised previously as a possible way of safeguarding the species, and captive breeding as a possible recovery option in response to an emergency event has previously been suggested. Captive management of the species has been discussed on a number of occasions at previous Hainan gibbon conservation workshops (2003, 2014). The State Forestry Administration has never been supportive of the idea.

At the time of this meeting, the Hainan gibbon population has increased to 26 individuals. It was therefore felt that it is even less likely that the State Forestry Administration will approve captive breeding as a possible management or emergency response action. Many (but not all) participants felt that any captive breeding efforts

should wait until there are more Hainan gibbon individuals (e.g. 100) so that there is less risk in taking in some individuals from the wild to start the programme.

The Hainan Forestry Bureau, BNNRMO, and Chinese academics are all concerned about the risk of capturing gibbons. They feel that the chance that an individual may die during capture presents too much risk for the species.

BNNRMO and researchers in China are anxious about attempting gibbon capture or breeding, as they do not feel that the skills and expertise currently available in China are sufficient to support these efforts. The Chinese government is cautious about captive breeding for gibbons because of past failures. In the 1980s, when captive breeding was a relatively new approach, it was used for many species in China including gibbons, but these initial efforts resulted in many deaths and many of the schemes were unsuccessful; as such, it is not viewed favourably.

It was suggested that perhaps the methods used in the past in China are now outdated, and any modern attempt would be more likely to be more successful. There are now much better techniques and advancements in gibbon and other primate husbandry, and many western zoos have detailed protocols that could be followed to prevent/manage disease and promote animal health and breeding.

There is evidence that gibbons can be bred in captivity in China. Nanning Zoo has successfully breed northern white-cheeked gibbons (*Nomascus leucogenys*), although this population is thought to consist of captive rather than wild founders.

However, it was felt that these positive points would still be unlikely to persuade the Chinese government. Permission for this possible action might be given to support Hainan gibbon conservation only if there is a successful demonstration of the capture and subsequent breeding in captivity for wild individuals of another gibbon species in China.

The general feeling was that the Chinese government would be unlikely to approve any such scheme at present. Therefore, this potential response was not discussed further during this meeting.

However, there was overwhelming support that a meeting should be held as a priority between scientists, zookeepers (both international staff and staff from Nanning Zoo and other Chinese zoos, e.g. XTBG), and policy makers (including the State Forestry Administration), to increase capacity and awareness and allow knowledge exchange on how to keep gibbons in captivity and successfully breed them.

Hybridization with another Nomascus *species*

The attendees briefly discussed the option of introducing individuals from another closely-related *Nomascus* species, e.g. the sister species *N. nasutus*, to increase numbers in the surviving Hainan gibbon population. It was generally felt that hybridization with *N. nasutus* was not a viable option due to the fact that this species is also Critically Endangered with a very low population size, and there are no individuals in captivity, meaning that there are not sufficient animals available for such an action. Furthermore, it was thought that there was a risk that the two species might not breed successfully.

It was made clear that hybridization with a species from the same genus would be the only viable way to carry out this step if it was ever deemed necessary.

However, the point was also raised that any hybrid animals produced from such an action would not be likely to be recognised as *N. hainanus* by the Chinese government and would not be protected under Chinese legislation, and after a few generations the 'species' (population mix of hybrids and *N. hainanus*) would no longer be included as a protected species in Chinese (and possibly international) legislation, even if it was hybridised with another protected species.

The general consensus was that this course of action is unlikely to be appropriate or feasible at present, and should only ever be considered as an absolute 'last resort' option in a worst-case scenario.

Funding for ERP actions

Participants suggested that a portion of money, either from an application to the local government or raised externally, should be allocated to an emergency response fund to be kept in reserve by BNNRMO to use in the event of an emergency requiring implementation of actions set out in the ERP. Unfortunately, at present, funding to carry out any identified emergency response actions cannot be put aside in advance by BNNRMO to be used should such an emergency event occur, as Chinese government policy dictates that all BNNRMO account balances must be resolved at the end of each financial year. It is also unlikely that funds to implement required response actions could come from an external foundation set up to fund efforts for the Hainan gibbon, as previous efforts to set up such a foundation proved unsuccessful due to administrative problems associated with provincial governmental decision-making and management. However, should an emergency event occur, BNNRMO will be able to use the funds available from their regular management budget to enact emergency response actions, and these costs could then be reimbursed by the government.

Approval process

During the course of discussions, it was made clear that some of the more invasive individual response actions within the proposed ERP (e.g. translocation, captive breeding) may require separate approvals, as such actions would be unlikely to be approved 'in principle' before an emergency event requiring these response actions were to occur, but may possibly be approved as a necessary reactive response to a specific emergency event.

However, it was thought prudent that an ERP should be drafted and submitted to provincial-level government for their consideration. It was felt that if ZSL and BNNRMO could present the proposed ERP to the Hainan Forestry Bureau (including Hainan Wildlife Conservation Office) to seek provincial government approval, the scheme may be more likely to be approved. It may then be possible for the ERP to be submitted to a higher level of government, such as the State Forestry Administration, for their approval and/or endorsement.

It was felt that if the ERP could be reviewed first by a small Hainan gibbon advisory committee (as proposed by the 2014 workshop but yet to be formed), then it may carry more weight with the various government authorities. As such, participants recommended that the Hainan Gibbon Advisory Committee be officially formed as an immediate priority.

Additional considerations

Below are a number of additional points and recommendations made by the 'Catastrophic Decline Subgroup' at the 2014 International Conservation Planning Workshop for the Hainan Gibbon, which were not discussed explicitly during the ERP advisory meeting:

- Establishment of an Emergency Monitoring Team (pre-identified personnel with designated responsibilities ready to respond in the event of an emergency)
- Implementation of intensive monitoring (e.g. satellite collaring/safe radioactive labelled isotopes)
- Biosecurity measures (quarantine the reserve, e.g. if an infectious disease is detected nearby)
- Adopt preventative health measures (vaccination of the gibbon population and human population in surrounding villages to eliminate the risk of certain communicable diseases)

- Investigate artificial reproductive technologies

These ideas for ways to prevent emergency events, and respond in a timely way to such events, each require additional discussion and consideration to determine if they are appropriate actions for the Hainan gibbon population at BNNR.

Preliminary Emergency Response Plan for the Hainan gibbon

The actions proposed below constitute a summary of the steps recommended during the course of discussions at the ERP advisory meeting and cover the period of the next 1-2 years following this meeting (2017-2019).

Threat	Objective	Action	Timeline	Responsible parties
Disease outbreak	Prevent and/or control disease outbreaks via early detection	Monitor population for possible diseases with regular disease screening via scat samples: at least once a month with >2 samples using 3 preservation methods: i) ethanol (for DNA) ii) formalin (for parasites, diseases) iii) distilled water (for ketones, stress hormones) If cost is an issue, monitoring should focus on breeding females as a priority as these are the most at-risk and important individuals	Establish Hainan gibbon scat screening programme by August 2017	Fan PF to draft a faecal sampling protocol including likely costs for sample processing at Sun Yat-Sen University Hong XJ to draft proposal for ongoing support for long-term disease monitoring (>3yrs)
	Prevent outbreaks via human disease transfer from BNNRMO staff	Control exposure to novel diseases by screening BNNRMO staff for communicable/infectious diseases and denying access to forest (and providing treatment for TB, hepatitis etc.) and/or providing masks (minor colds etc.) for any ill/infected forest workers across BNNRMO	Establish human disease screening programme for BNNRMO staff by August 2017	Not decided

	Treat disease when detected to minimise spread and impact	Trial supplementary feeding/provisioning based upon methods that have been employed elsewhere successfully, to determine if this method can be used to administer medicine should a disease be detected in population	BNNRMO to trial provisioning before end of 2017, based upon guidance from international experts	S Cheyne to provide a protocol for food and water provisioning to BNNRMO BNNRMO to conduct trials
		'Low risk'* diseases/infections: treat with medication hidden in food supplementation parcels 'High-medium risk'* diseases/infections (e.g. TB, hepatitis, ebola): vaccination required via animal capture (darting and net procedure) * See Box 1	Treatment as required following disease detection	Not decided
Fire	Detect and prevent spread of fires within BNNRMO to avoid loss of habitat and death of gibbons due to fire or its impacts on the forest	Follow Central Government procedure and plan for management of fires in nature reserves	As required	BNNRMO
	Provide food and water provisions to supplement forest resources available to gibbons following a fire and minimise impact of fire on gibbon population survival beyond fire event	Trial supplementary feeding and water provisioning based upon methods that have been employed elsewhere successfully	BNNRMO to trial provisioning before end of 2017, based upon guidance from international experts	S Cheyne to provide a protocol for food and water provisioning to BNNRMO BNNRMO to conduct trials
		Implement supplementary feeding and water provisioning (if the trial proves successful) as soon it is safe to enter forest during/after a fire	As required	BNNRMO

Typhoon	Provide food and water provisions to supplement forest resources available to gibbons following a typhoon and minimise impact of typhoon on gibbon population survival beyond typhoon event	Trial supplementary feeding and water provisioning based upon methods that have been employed elsewhere successfully	BNNRMO to trial provisioning before end of 2017, based upon guidance from international experts	S Cheyne to provide a protocol for food and water provisioning to BNNRMO BNNRMO to conduct trials
		Implement supplementary feeding and water provisioning (if the trial proves successful) as soon it is safe to enter forest during/after a fire	As required	BNNRMO
Hunting	Reduce hunting activity within BNNR	Implement SMART software to improve monitoring efficiency and randomise patrolling to prevent hunters learning monitoring team routines and routes	Before end of 2017	ZSL to organise SMART training for BNNRMO staff BNNRMO to trial SMART software and identify any additional training requirements
ALL threats	Rapidly detect any decline in population size (due to any factor), track population changes (e.g. females maturing to breeding age, loss of immature individuals)	Increased monitoring of remaining population via establishment of a new BNNRMO monitoring team dedicated only to gibbon monitoring and with a daily presence on the ground in BNNR	Requests to be drafted and submitted to the Hainan Forestry Bureau by August 2017	International participants to write proposal on behalf of scientific community requesting additional funds for BNNRMO to support more intensive population monitoring Hong XJ to draft proposal for ongoing support for long-term monitoring (>3yrs) to Chinese government

	Implement SMART software to improve monitoring efficiency and randomise patrolling to prevent hunters learning monitoring team routines and routes	Before end of 2017	ZSL to organise SMART training for BNNRMO staff BNNRMO to trial SMART software and identify any additional training requirements

Other General Recommendations

A knowledge-sharing meeting between scientists, zookeepers (both international staff and staff from Nanning Zoo and other Chinese zoos, e.g. XTBG), and policy makers (including State Forestry Administration) should be held as a priority before the end of 2017 to increase capacity and awareness, and allow knowledge exchange on how to keep gibbons in captivity and successfully breed them.

Annual DNA-based sexing should be undertaken to determine the sex of young individuals, which are otherwise very difficult to sex at a distance on the basis of morphological characteristics alone.

The fate of dispersing individuals should be tracked.

Disease in and around the reserve should be investigated and monitored; this should include at least maintenance of a freezer for the storage of dead animals (both gibbons and other species) found in and around the reserve for post-mortem investigation. Gibbon carcasses should be prioritised for analysis. Local people from communities around BNNR, domestic animals and wild animals should all be considered as potential vectors of disease that could have an adverse impact on the BNNR gibbon population.

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