Key words for book as a whole: gibbon; hylobatid; conservation; Southeast Asia; endangered

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Chapter 1. Taxonomy, Ecology and Conservation of Cao Vit Gibbon (*Nomascus nasutus*) since its Rediscovery

Peng-Fei Fan and Chang-Yong Ma

Abstract

Except for the eastern hoolock (*Hoolock leuconedys*), all gibbon species are regarded as critically endangered or endangered. The rediscovery of the Cao vit gibbon (*Nomascus nasutus*) in 2002 was exciting news for gibbon conservationists. However, its importance was hindered by disputation of its species status. Herein, we review the taxonomy, ecology, and conservation of *N. nasutus* since its rediscovery. Morphology, vocalisations, and genetic evidence suggests that *N. nasutus* is a distinct species from the western black crested (*N. concolor*) and Hainan gibbon (*N. hainanus*). There is one confirmed population of approximately 120 individuals in a small karst forest along the China-Vietnam border. Although their habitat has been degraded by human activities, they have adapted behavioural strategies to life in karst forest, and reproduction has been successful. Two reserves have been established in both Vietnam and China, and no hunting has been reported. Besides goat grazing, human disturbances have largely been eliminated or controlled. Successful transboundary conservation interventions have contributed to this population's slow increase despite it approaching its habitat carrying capacity. Habitat restoration is a priority for this species' conservation. Future research directions include long-term population monitoring, karst forest restoration, impacts of human disturbances, and intra- and inter-species food competition.

Keywords: karst forest, small population, behavioural adaptation, transboundary conservation, population increase, habitat restoration

Chapter 2. Conservation Status of the Northern Yellow-cheeked Crested Gibbon (*Nomascus annamensis*) in Vietnam: An Update

Duc Minh Hoang, Bang Van Tran, Chuong Van Hoang and Herbert H. Covert

Abstract

We review the results of recent surveys for the northern yellow-cheeked crested gibbon (*Nomascus annamensis)* on the eastern slope of the Annamite Range in Binh Dinh and Quang Ngai provinces, and update its conservation status in Vietnam. Surveys were conducted in three adjacent forest blocks: West Ba To Proposed Nature Reserve (NR), An Toan NR and Vinh Son Commune, with a total area of 367 km^2. We documented gibbon densities of 0.41 and 0.15 groups/km^2 in the first two sites but did not find any groups in the third location. We detected 46 groups and estimated 114 groups in these areas, about 14 percent of Vietnam's known population of *N. annamensis*. Our archival study revealed that at least 317 groups of this species have been confirmed in Vietnam. The distribution range is between approximately 14°00' N and 16°50' N latitude with potential overlap with the southern white-cheeked gibbon in the northernmost portion of this range. Important drivers influencing the distribution of the species in Vietnam include temperature seasonality, elevation, precipitation of the driest month, annual precipitation, and precipitation of driest quarter. This species faces extinction in Vietnam due to fragmented habitat, small sub-population sizes, illegal hunting, and forest conversion.

Keywords: conservation status, population size, habitat, gibbons, Hylobatidae

Chapter 3. Strategies for Recovery of the Hainan Gibbon (*Nomascus hainanus*): Twenty Years of Multidisciplinary Conservation Effort

Bosco Pui Lok Chan and Yik Fui Philip Lo

Abstract

The Hainan gibbon (*Nomascus hainanus*) is endemic to China's Hainan Island, and is the world's rarest primate species. With rampant deforestation and hunting, by 1980 less than 10 individuals reportedly survived at Bawangling National Nature Reserve. A systematic population census in 2003 confirmed only 13 individuals and it was feared that it would be the first modern primate species to go extinct. In 2003, Kadoorie Farm and Botanic Garden was invited by the local conservation authority to take an active role in saving the species from extinction. Together with relevant government agencies and other stakeholders, a conservation strategy with prioritised conservation actions were devised and implemented; these ranged from reforestation of prime lowland habitat, establishment of gibbon monitoring teams, scientific research, awareness-raising and provision of alternative livelihoods to surrounding communities. With years of continuous presence and open dialogue, the local authorities and communities embraced the suite of conservation actions, and the species is on a slow but steady recovery pathway. The population is expanding its range and currently stands at five family groups of at least 35 gibbons.

Keywords: outreach activities, community work, critically endangered, forest restoration, human resources, long-term monitoring, trust-building

Chapter 4. Gibbons in the Anthropocene: Lessons from a Long-term Study in Indonesia

Susan M. Cheyne, Abdulaziz K, Supiansyah, Twentinolosa, Adul, Claire J. H. Thompson, Lindy Thompson, Reychell Chadwick, Hélène Birot, Carolyn Thompson, Cara H. Wilcox and Eka Cahyaningrum

Abstract

Since 2005, Borneo Nature Foundation has produced 50 peer-reviewed papers/book chapters on gibbons plus several reports, standard operating procedures, training materials and DVDs. Here, we present 15 years of long-term wild gibbon behavioural data which represents one of the longest continuous datasets on any gibbon species. Not only has our knowledge of gibbons increased, but the profile of the small apes has also increased since 2005. This review presents data gathered by the Borneo Nature Foundation highlighting new insights into gibbon behavioural ecology and conservation lessons learnt. Gibbons are proving to be relatively consistent in their behaviour, irrespective of changes in the group demography. Although threats to gibbons across their range remain high, they demonstrate their ability to adapt their behaviour to anthropogenic disturbance. While flexible in behaviour (e.g., adapting travel routes in disturbed habitat), there is a threshold at which a forest becomes unsuitable for sustaining viable gibbon populations. We must understand more about their behavioural ecology in order to determine this threshold to help protect gibbons.

Keywords: gibbon, Sebangau, behaviour, ecology, conservation, *Hylobates albibarbis*

Chapter 5. Demography of a Stable Gibbon Population in High-Elevation Forest on Java

Susan Lappan, Rahayu Oktaviani, Ahyun Choi, Soojung Ham, Haneul Jang, Sanha Kim, Yoonjung Yi, Ani Mardiastuti and Jae Chun Choe

Abstract

Demography is fundamental for conservation planning, but important information is often lacking. Here, we describe the demography of wild Javan gibbons (*Hylobates moloch*) from 2007 to 2020 in Citalahab Research Area, Gunung Halimun-Salak National Park, Indonesia. Mean group size was 3.95 ± 0.78 individuals. All groups (n = 8) included an adult pair and 0-3 immature individuals. All adults survived throughout the study, indicating that the lifespans of paired adults exceeded 24 years. Births occurred throughout the year, with intervals of 3.65 ± 0.70 years between births. Age-specific survivorship was 1.0 from birth to age four years (n = 12), 0.83 for four-to-six-year-olds (n = 6) and 1.0 for six-to-eight-year-olds (n = 2). Six individuals disappeared between ages four and 10 years. One juvenile male (<5 years) is assumed to have died. One male disappeared at age 5.2 years. Four sub-adults (>8 years) experienced increasing aggression from same-sex adults before disappearing. The fates of dispersing individuals are unknown. Gibbon demography at Citalahab was similar to that of stable gibbon populations at other sites, although Citalahab is in submontane forest on a habitat edge. Most remaining Javan gibbons live in fragmented hill and montane forests, so demographic parameters from Citalahab may be helpful in population modelling for this species.

Keywords: silvery gibbon, demography, vital rates, age-specific mortality

Chapter 6. A Tale of Two Gibbon Studies in Thailand

Sompoad Srikosamatara and Intanon Kolasartsanee

Abstract

Narratives are presented on the first studies of white-handed gibbons (*Hylobates lar*) in Khao Yai National Park and pileated gibbons (*Hylobates pileatus*) in Khao Soi Dao Wildlife Sanctuary in Thailand. We describe local methods of camping (adapted from non-timber forest product (NTFPs) collectors and cardamom harvesters) during the habituation process for studying gibbon behaviour in both areas. Gibbons were successfully habituated by a British physical anthropologist, Jeremy Raemaekers, who laid down the foundations for studies on white-handed gibbons in Khao Yai. Meanwhile, conservation work was being done on pileated gibbons in Khao Soi Dao by local Thai biologists. A television documentary on pileated gibbons, made by a local Thai celebrity, used situational comedy in real-field situations to raise local awareness about the gibbons, and helped to reconnect conservation efforts. We recommended that education in local schools should address conservation efforts and include knowledge on gibbon recolonisation after conservation interventions. ‘Tales of Two Gibbon Studies in Thailand’ reflects the local perspectives on both local and international primatologists contributing towards the field of ‘gibbonology’ and should be considered as an additional style of describing ‘ethnoprimatology’ by biologists from a primate habitat country.

Keywords: gibbon, Khao Yai, Khao Soi Dao, habituated camp, conservation, habitat country

Chapter 7. Accessibility as a Factor for Selecting Conservation Actions for Pileated Gibbons

Intanon Kolasartsanee and Sompoad Srikosamatara

Abstract

Three types of conservation strategies on pileated gibbons (*Hylobates pileatus*) in Thailand have included protection, community-based initiatives, and reintroductions. Besides conservation interventions, we also believe that topographic characters (i.e., elevation, slope and distance from forest border), should be considered when reducing hunting pressures on gibbons in Ta-riu Tributary, Khao Soi Dao Wildlife Sanctuary (KSD). However, limited access of poachers to the pileated gibbons' occupied area also limits rangers' ability to patrol at the same time. In this case, community-based conservation strategies should be considered. However, for areas close to the forest border without gibbon populations, reintroduction strategies should be considered. Therefore, to select the most suitable conservation strategy for each area, correlation and linear regression between the number of pileated gibbon groups and topographic characters were analysed. Distance from the forest border significantly affects the number of pileated gibbon groups. Thus, this factor was used to select the suitable conservation strategy in both Ta-riu Tributary and the wildlife sanctuary. Community-based conservation strategies should benefit 6 percent of the wildlife sanctuary forested area, whilst protection and reintroduction strategies, would benefit 58 and 36 percent, respectively. We recommended that Ta-riu Tributary should be the priority area for pileated gibbon conservation in KSD.

Keywords: topography, hunting, conservation planning, Khao Soi Dao, Thailand

Chapter 8. Calling from the Wild: Mentawai Gibbon Conservation Fieldwork

Arif Setiawan and Damianus Tatteburuk

Abstract

Mentawai gibbons (*Hylobates klossii*) are one of the nine species of gibbon in Indonesia, all of which are threatened with extinction. We present a view of the future for gibbons on the Mentawai Islands using information from previous research as well as recent surveys. The largest gibbon population and habitat is currently in the Siberut National Park area, with approximately 10,484 individuals. In addition, there are 13 locations outside the national park with a density of 1.04 groups/km^2 to 4.01 groups/km^2. A serious threat to the Mentawai gibbon is forest loss and hunting. Our survey also shows that the cultural value of Mentawai gibbons are being lost due to acculturation with modern culture. *Uma* (the Mentawai long house) and *Sikerei* (the Mentawai Shaman) are cultural centres which are no longer found on the islands of Sipora and Pagais. Currently there are only 94 *Uma* and 135 *Sikerei* people on Siberut Island (who have an average age of 64 years old). We recommend conservation activities at the grassroots level for the Mentawai gibbon, activities that encourage local community capacity development and enhance the local economy, whilst at the same time strengthening Mentawai cultural and customary values.

Keywords: Kloss's gibbon, Mentawai, culture, conservation, community development

Chapter 9. Demography and Group Dynamics of Western Hoolock gibbons (*Hoolock hoolock*) in a Community Conserved Village Population in Upper Assam, India

Jihosuo Biswas, Diplob Chutia, Jayanta Das, Joydeep Shil, and H.N. Kumara

Abstract

Fragmentation and rapid conversion of forested landscapes to farmland and human settlements in Upper Assam, India, has led to the isolation of western hoolock gibbon (*Hoolock hoolock*) families in fragmented patches of village areas. Many families have perished due to resource scarcity and conflict with development, however, the villages of Barekuri area in Upper Assam have retained a substantial number of gibbon families for many years. We monitored the population (nine families) from 2011 to 2017 and present long-term data on social organisation and its dynamics in Barekuri area. We recorded eight births, nine deaths, and four dispersals in the population. Five of the 9 deaths were due to electrocution that reduced the population size from 29 individuals in 9 groups in 2011 ($3.22\pm0.67_{SD}$) to 24 in 7 groups in 2017 ($3.29\pm0.76_{SD}$), with the mean group size of $3.67\pm0.85_{SD}$ which did not differ over the years. Female inter-birth intervals and ages at first reproduction are comparable with those in wild populations. Both males and females took the opportunity to form groups and breed, and male replacement and female surrogacy indicate flexibility in a pair bond. Our observations thus support a growing knowledge of variability in the social organisation of gibbons.

Keywords: hoolock gibbon, Barekuri, birth, death, dispersal

Chapter 10. Challenges and Prospects in the Conservation of Hoolock Gibbon in India

Dilip Chetry, Rekha Chetry and Parimal Chandra Bhattacharjee

Abstract

Western hoolock (*Hoolock hoolock*) and eastern hoolock gibbons (*Hoolock leuconedys*) represent the ape group in India. The seven northeastern states (i.e., Assam, Arunachal Pradesh, Meghalaya, Mizoram, Tripura, Nagaland and Manipur) support the entire gibbon population in India, where their distribution is limited to the southern bank of the Dibang-Brahmaputra River system. Rapid loss of habitat, habitat fragmentation and hunting are the major threats to hoolock gibbons in India. The launch of the Indo-US Primate Project gave motivation to conserve the hoolock gibbon in the region. Research, education and awareness, training, capacity building and socio-economic development programmes carried out during and after the Indo-US Primate Project, created a healthy environment for the conservation of gibbons in India. *Ex-situ* conservation practices like rescue and rehabilitation, translocation, conservation breeding programmes, and community-based conservation have been the result of collaborations between the government and non-governmental organisations over the past two decades, thus raising new hope for the survival of these species. The recent declaration of protected areas will ensure long-term survival of the gibbons and its habitats. We feel that all stakeholders should emphasise the development of workable plans for the conservation of gibbons after the COVID-19 pandemic.

Keywords: hoolock gibbon, threats, conservation, northeast India

Chapter 11. Gibbons of Assam: Impacts of Environment and Anthropogenic Disturbance

Jayashree Mazumder

Abstract

The current study was conducted among 18 groups of western hoolock gibbon (*Hoolock hoolock*) in the Hoollongapar Gibbon Wildlife Sanctuary of Assam to understand their behavioural pattern in a wild habitat when influenced by environment and anthropogenic factors. Mainly, the study aims to understand how they adapt to region-specific conditions such as heavy rain, mate selection, and protection against predators. Focal animal sampling and all occurrence sampling were used to record the behavioural patterns during the study. Although the northern region of the forest is rich in biodiversity, it has witnessed heavy wood poaching, which directly affects the movement and territory of the gibbon populations. There is also an acute scarcity of biogeographic corridors, thereby weakening the gibbons' movement and resulting in the formation of larger groups. This study suggests that the behavioural activities of these gibbons augment most of their requirements without any (visible) need for innovative behaviour, such as the use of or manufacture of tools. Also, the forest has witnessed a slow yet gradual decrease in the total land cover, and with the increased anthropogenic pressure, the gibbons are being centred towards a particular geographical point which has raised the aggressive behaviour amongst them.

Keywords: gibbons, timber poaching, movement, territory, aggression

Chapter 12. Movement Ecology of Siamang in a Degraded Dipterocarp Forest

Christopher D. Marsh, Stephanie A. Poindexter, Ross A. Hill, Matthew G. Nowak, Abdullah Abdullah and Amanda H. Korstjens

Abstract

Globally, primates are experiencing the pressures of anthropogenic influences altering natural landscapes. Given the interconnectedness of land use and species conservation, it is vital to understand how primates move within their environments and how they may respond to future land-use changes. Herein, we used Unmanned Aerial Vehicle vegetation surveys and direct behavioural observations to determine how living in a degraded forest has influenced a wild siamang group in northern Sumatra. Within this population, we found a high level of folivory, relatively infrequent territorial long calls, reused routes, and a preference for areas that corresponded with canopy topography high in elevation. With these results, we can see that forest degradation can affect the ranging patterns and land use behaviour of siamangs. To conserve this species and others that display a comparable response to changes in their environment, we need to prevent further degradation before populations are separated and unable to adapt to the limitations that come with human-mediated landscape changes.

Keywords: movement ecology, animal behaviour, UAV, remote sensing, canopy structure, forest degradation, rainforest, Indonesia

Chapter 13. Sympatric Gibbons in Historically Logged Forest in North Sumatra, Indonesia

Emma L. Hankinson, Vincent Nijman, Amanda H. Korstjens, Matthew G. Nowak and Ross A. Hill

Abstract

The complex, structural canopy of tropical forests is extremely important for the survival and continued presence of arboreal primates. The destruction and degradation of tropical rainforest on the Indonesian island of Sumatra is causing significant declines to the endemic gibbon species residing in these shrinking habitats. This chapter compares recent density estimates of the lar gibbon (*Hylobates lar*) and the siamang (*Symphalangus syndactylus*) in a historically logged area of lowland forest, Sikundur, north Sumatra, to range-wide densities of both species and the ecologically similar agile gibbon (*Hylobates agilis*) across the island. Density estimates for Sumatran gibbon species are largely influenced by altitude and habitat preference. Siamang densities in Sikundur were similar to previously obtained range-wide densities, whereas lar gibbon densities were lower than their reported natural density range. Sikundur's degraded forest consisting of reduced tree heights and low tree connectivity has potentially impeded the ability of the lar gibbon to attain higher densities. However, the presence of these small apes in this degraded lowland forest, albeit at lower densities demonstrates these areas can still be important habitats for gibbons, and emphasises the importance of ongoing regeneration of previously degraded forest for the future survival of these species.

Keywords: rainforests, small apes, acoustic surveys, habitat destructions, Sumatra, gibbons

Chapter 14. Adopting an Interdisciplinary Biosocial Approach to Determine the Conservation Implications of the Human-Gibbon Interface: A Systematic Review

Carolyn Thompson, Helen J. Chatterjee, Samuel T. Turvey, Susan M. Cheyne and Peng-Fei Fan

Abstract

The gibbons (family Hylobatidae) represent one of world's most threatened group of taxa. In theory they are an attractive group for interdisciplinary research but are often unconsciously overlooked. We conducted a systematic review in Web of Science and Google Scholar between January 1900 and February 2020 using PRISMA guidelines and strict search criteria to investigate the i) number of mixed-method biosocial studies published on gibbons; ii) focus species and countries; iii) social analytical approaches used; and iv) the success of this approach in elucidating conservation issues. Only 31 mixed-method biosocial studies have been published on gibbons. Fifty-six percent were on *Nomascus* species, whereas none were on *Symphalangus*. China and Vietnam were the most popular study locations. Optimistically, 68 percent of publications were led by gibbon-range country researchers, but only 48 percent of studies represented international collaborations. Eighty-one percent of studies addressed a conservation-related topic, highlighting the potential efficacy of using this approach in primate conservation research. Few studies provided details of data collection methods, methods of analysis and sample sizes however, and only one study used an anthropological analytical approach. We therefore encourage further cross-disciplinary, international collaborations to better our understanding of human-gibbon relations on a deeper, more contextual level.

Keywords: biological anthropology, primatology, social anthropology, mixed-methods, ethnoprimatology, interdisciplinary conservation methods, interview surveys, gibbon, Hylobatidae

Chapter 15. Listen to the People, Hear the Gibbons Sing: The Importance of Incorporating Local People's Perceptions in Conservation

Jaima H. Smith, Anton Ario, Rahayu Oktaviani, Arif Setiawan, Agung Gunawan and Vincent Nijman

Abstract

Knowing how people perceive and relate to the environment is invaluable to conservation efforts. The mechanisms that drive conservation initiatives are social in nature, and it must be acknowledged that conservation is as much about people as it is the environment and non-human species. This research explored how local communities living on the border of Gunung-Gede Pangrango National Park in West Java, Indonesia, perceive the natural environment and the wildlife with which they share the forest. More specifically, the goal was to determine the depth of their knowledge about Javan gibbons (*Hylobates moloch*) and the threats they face in the wild. Face-to-face, semi-structured interviews were conducted with over 100 people during the months of June through August, 2016. Interviews revealed an unexpected narrative. Local people have limited knowledge and information with regards to the forest and its inhabitants. Responses varied between how important people thought protecting the forest was, and how crucial the need to expand agriculture is for their personal livelihoods. People also expressed a desire to be more involved in local conservation initiatives. Support from local governments and community engagement is crucial to ensure the success of conservation programmes for Javan gibbons in west Java.

Key Words: Javan gibbons; community engagement; conservation; wildlife; Gunung Gede-Pangrango; ethnoprimatology

Chapter 16. Long-term Outcomes of Positive Cultural Value for Biodiversity: Historical Insights from Chinese Gibbons

Samuel T. Turvey

Abstract

Local awareness and cultural value of threatened species are regarded as integral components of conservation programmes, but pro-environmental attitudes do not necessarily prevent negative human interactions with threatened species. The history of cultural attitudes towards gibbons in China provides an important case study about long-term conservation effectiveness of positive biodiversity values. Animals readily identifiable as gibbons are frequently recorded in Chinese culture from the Zhou Dynasty onward. Gibbons were interpreted as symbols of the supernatural and celebrated in Chinese literature and art. They were also regarded as positive moral exemplars embodying virtuous filial Confucian values, and were equated with the concept of *junzi*, a noble person who strives after virtue and inspires by example. However, positive cultural associations had little effect in preventing the historical loss of gibbon populations across nearly all of China. Historical records also document exploitation of gibbons for medicinal and other uses, and gibbon declines likely reflect historical conflict with economic demands for local subsistence in marginalised low-income communities. Positive cultural values may therefore be insufficient to prevent species losses if they are outweighed by economic pressures, and awareness may not contribute to positive behavioural change if it does not address drivers of negative human-wildlife interactions.

Keywords: China, conservation education, cultural value, environmental archives, extinction, historical baseline, population decline

Chapter 17. Gibbon Phylogenetics and Genomics

Lucia Carbone, Mariam Okhovat and Christian Roos

Abstract

The gibbons (family Hylobatidae) occupy a key node in the primate phylogenetic tree. They are characterised by an accelerated rate of evolutionary chromosomal rearrangements. To date, despite much effort, the phylogeny of gibbons remains largely unresolved at the genus level, likely due to rapid divergence of the four genera approximately five million years ago. In this chapter we discuss various approaches used to untangle the complex gibbon's phylogeny. We highlight the unique branching pattern of the gibbon tree, which suggests that the four genera diverged over short evolutionary time. Furthermore, we review how cutting-edge DNA sequencing technologies have improved our understanding of the evolution of the gibbon genome and how this can guide conservation efforts. In particular, we describe the mechanisms that have contributed to the highly rearranged karyotypes of the gibbon genera and how the birth and consequent propagation of the gibbon specific transposable element, 'LAVA', might have shaped the evolution of this lineage by inserting within and nearby genes involved in chromosome segregation and DNA repair. As more genetic resources and data are generated from gibbon species, we will gain further insight into the evolutionary history and enable progress towards generating greater infrastructures to conserve these threatened species.

Keywords: gibbon genera, genome, phylogeny, chromosomes, karyotype, transposable elements

Chapter 18. The Use of Microsatellites in the Management of Captive Gibbons

Lauren Lansdowne, Matyas Liptovszky, Kristiana Brink, Katie Dripps, Vivienne Li, Ed Hollox, Richard Badge

Abstract

Genetic profiling can validate pedigrees and reveal genetic diversity/inbreeding within populations. We have developed 12 autosomal microsatellite markers that can be used to DNA profile gibbon species. The panel generated full profiles for 39 individuals currently or previously housed at Twycross Zoo, United Kingdom, representing 5 species across 3 genera. The study is extending to a further approximate 100 samples, including three additional species, from captive populations across Europe. The panel's cross-species utility allows for a single protocol to be used for all DNA profiling, avoiding the need for species-specific testing. In addition, the panel resolved an issue of uncertain paternity in a breeding group, with direct implications for group management and welfare. The loci reported here yielded profiles from blood, tissue, and non-invasive hair samples. Positive impact on the viability and sustainability of captive breeding programmes is anticipated, by clarifying cryptic relatedness and informing future pairings. Potential exists for field application to investigate population dynamics, mating behaviours, relatedness, dispersal patterns, as well as assessing the impact of anthropogenic disturbances on genetic architecture of populations. This established panel, effective across multiple gibbon species and genera, presents an affordable and expedient tool for research and captive management.

Keywords: gibbons, microsatellites, captive breeding, genetic diversity, paternity testing.