

# MULTI-FEMALE GROUP IN THE SOUTHERNMOST SPECIES OF *Nomascus*: FIELD OBSERVATIONS IN EASTERN CAMBODIA REVEAL MULTIPLE BREEDING FEMALES IN A SINGLE GROUP OF SOUTHERN YELLOW-CHEEKED CRESTED GIBBON *Nomascus gabriellae*

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## ABSTRACT

Previous field studies of gibbon groups of the genus *Nomascus* have shown that multi-female polygynous groups are present and quite common in the northernmost species. Our research shows that multi-female groups are also present in the southernmost species, the Southern Yellow-cheeked Crested Gibbon *Nomascus gabriellae* (Thomas). Various gibbon groups are being followed and habituated in Seima Protection Forest by local and international researchers. Data collected during the first nine months of observations shows the presence of a stable multi-female family group in the study area, with two breeding females with infants. This is the first time this has been reported and confirmed for this particular species of *Nomascus*.

**Keywords:** Seima Protection Forest, social structure, range, extra-pair copulation, habituation

## INTRODUCTION

The Southern Yellow-cheeked Crested Gibbon, *Nomascus gabriellae* (Thomas), like other members of the genus *Nomascus*, is only found east of the Mekong River (Geissmann et al., 2008). It is found only in eastern Cambodia and southern Vietnam, and inhabits mainly evergreen and semi-evergreen forest, but has also been found in mixed deciduous and bamboo forest (Rawson et al., 2008). It is listed as Endangered on the IUCN Red List of Threatened Species (Geissman et al., 2008); this assessment did not distinguish *N. gabriellae* from the Northern Yellow-cheeked Crested Gibbon *N. annamensis* (Thinh et al., 2010). Seima Protection Forest (SPF), in east Cambodia is a stronghold for *N. gabriellae*, the latest estimates indicating a population of 1,016 (95% CI [595, 1763]) individuals (Nuttall et al., 2013). It is likely this is the largest intact population of this species globally.

There have been few behavioural and ecological studies on this species (see Kenyon et al., 2007),

because of the difficulty of observing them in their natural habitat. A lack of habituated groups, their naturally shy and cryptic nature, and their preferred terrain (mainly hilly, dense forest) renders such studies challenging. *N. gabriellae* has been described as being territorial and monogamous (Traeholt et al., 2006; Rawson et al., 2008). Monogamy was believed to be predominant in most gibbon species, however studies on the genus *Nomascus* over the last decade have uncovered that many of the species in this genus have multi-female family groups, and some of these species have also been shown to have polygynous mating systems. Among the seven recognised species of *Nomascus* (Mootnik & Fan, 2011; Thinh et al., 2010) polygyny has been reported in three: the Hainan Gibbon *N. hainanus* (Thomas) (Zhou et al., 2008), the Cao Vit Gibbon *N. nasutus* (Kunkel d'Herculais)(Fan et al., 2010) and the Western Black-crested Gibbon *N. concolor* (Harlan) (Fan & Jiang, 2010; Huang et al., 2013). However polygynous mating systems have

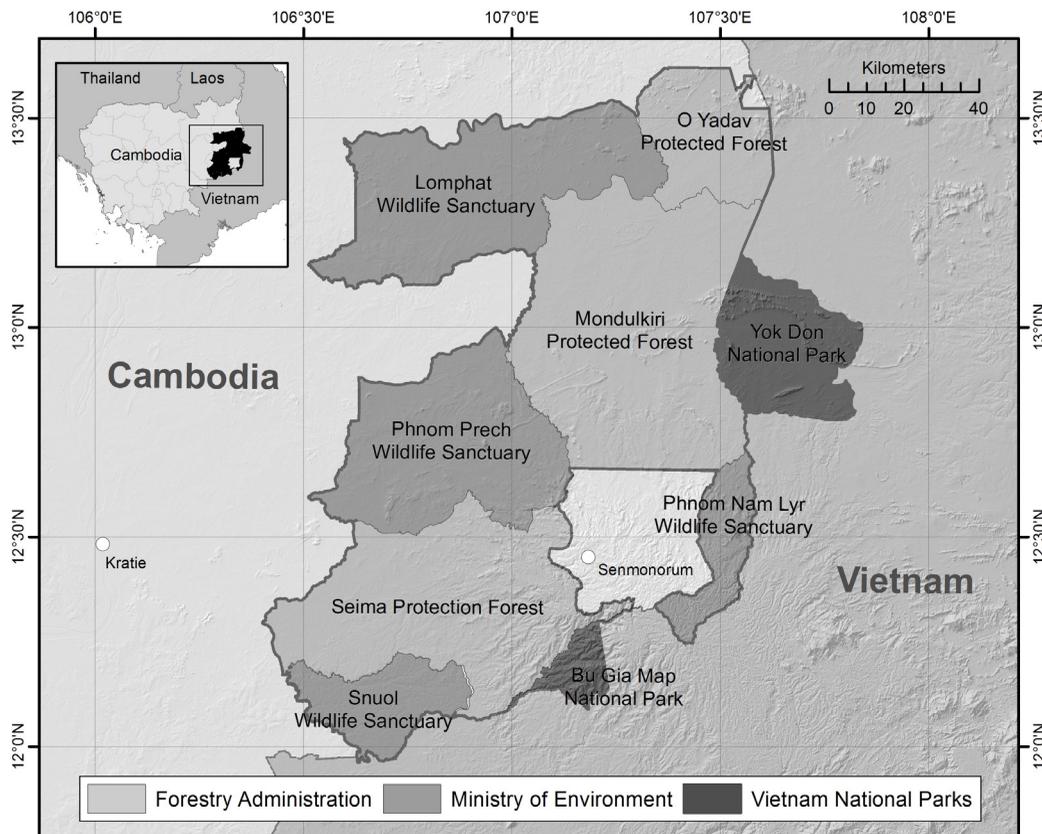
not yet been observed in the remaining four species: the Northern White-cheeked Gibbon *N. leucogenys* (Ogilby) the Southern White-cheeked Gibbon *N. siki* (Delacour), the Southern Yellow-cheeked Crested Gibbon *N. gabriellae* and the recently described Northern Yellow-cheeked Gibbon *N. annamensis* (Thinh et al., 2010). In this study we introduce new field data to elucidate the social system of *N. gabriellae* and the presence of multi-female single-male groups that show polygynous mating patterns in this species.

## STUDY SITE AND METHODS

Seima Protection Forest is composed of diverse forest types including evergreen and deciduous dipterocarp forest, and ranges in elevation from 60 to 750m asl. The forest has a tropical monsoonal climate with a distinct wet season from May to October and dry season from November to April. The mean annual rainfall is 2,200-2,800mm, with the majority falling during the wet season (Evans et al., 2013). The field site where the gibbon groups were observed is within the Core Zone of SPF, in an area less than 500m from

the indigenous Bunong village of Pu Klair, along a dirt road that runs through Andong Kralong village, Sen Monorum Commune, Ou Raing District, Mondulakiri Province (N12° 19', E107° 03') (Fig. 1).

A total of 134 survey days took place between 19 October 2014 and 27 June 2015, spanning both the dry and the beginning of the wet season. Starting at 05:00 h the research team located the target gibbon group by following their vocalizations into the forest, usually after sunrise. Data were collected on location (GPS coordinates, compass bearing and distance from observers), group size, age-sex categories of individuals, and response behaviour. Like all crested gibbons variation in fur colour is marked and changes visibly throughout the lifetime of an individual (Pocock, 1927). *N. gabriellae* is sexually dimorphic with the adult females having yellow pelage and a black crest, and adult males with black pelage and yellow cheeks. The infants of both sexes are born yellow, and both turn to black at approximately 1.5-2 years of age. The juveniles of both sexes exhibit the same coloration as adult males, with the females turning back to yellow



**Fig. 1.** Seima Protection Forest is located in Mondulakiri Province, Cambodia, and borders with Vietnam to the east.

once they reach sexual maturity at 6-8 years (Mootnik & Fan, 2011). Gibbons were classified into four categories based on age and sex: adult male, adult female, juvenile, and infant.

The focal group that was observed will be referred to as G2 and the area in which they were observed as A2. The group G2 was not yet fully habituated, and were thus only seen for short periods at a time (10-30 minutes), and only in the morning when the research teams were in the forest. The data collected regarding group composition varied between observations, however the researchers were able to obtain clear views of the whole group (inferred as the maximum number of individuals seen when considering all encounters) and thus account for the total number of individuals on regular occasions (about 50% of the time).

## RESULTS

Based on field observations, we know that G2 was composed of one adult male, two adult females, both with infants of roughly the same age based on their similar body size and development, and two young juveniles (of approximately the same size). From a total of 86 observations made within A2, 40 observations

were assumed to be of the focal group G2 based on the location of observations and the presence of two females with infants in the group. The remainder of the observations were of three distinct neighbouring groups, which were identifiable by differing group structures, one observation revealing three females in a single group. A lone male, possibly an older subadult or young adult male in its parental territory, was also observed within the range of G2 on various occasions in the first six months of surveys (November 2014 to April 2015); this individual later appeared to have moved out of the range of G2. Reports from tourist guides, who are currently guiding visitors in the forest around Andong Kralong village, have suggested that large gibbon groups in SPF are not uncommon. In the forest surrounding the village gibbon groups composed of up to eight individuals have been observed (Blong Mo-euk tourist guide, pers. comm.).

On 26 June 2015 the group G2 was seen feeding, and the two adult females were clearly observed as they fed separately. For the first time the infants, who had always been seen attached to their respective mothers, were seen playing and practising swinging around their mothers as they fed. A few days later,



**Fig. 2.** The image shows the two females from G2 holding their respective infants. The infant in the foreground is more obvious and the arm and leg can be seen in the mother's fur. The second can be seen from the black colouring on the back of the female, which is the black hand of her infant clinging to her fur. Photo Credit: Claire Vincent, WCS (04.02.2015)

on a separate survey the two infants were again seen playing together in close proximity to their mothers. On 27 June 2015, whilst feeding on the same tree, observations were made of two same-sized juveniles of the group interacting: play-fighting and socializing. Two more similar observations were made on 29 June 2015. Such circumstantial evidence suggests that these juveniles, like the infants, may be half-siblings with same father and different mothers (Fig. 2). However there is presently no way to definitively say they are not twins, as twin births have been recorded, both in captivity and more rarely in the wild, in hylobatids.

On 25 January 2015, the two adult females from G2 were seen while simultaneously duetting with the male in what could be defined as a trio-duet, however the male and juveniles were responding to the females calling at a distance of about 100-200m north-west from the calling females. Shortly afterwards, once the duet finished, the male and one of the juveniles were seen on their own, 100m north-east of the females. On a second occasion, during a 36 minute observation of G2, whilst feeding on a fig tree (*Ficus altissima*) on 4 February 2015, one of the adult females saw the research team and moved towards the second female. Together with their infants, they quickly disappeared into the forest. However, the adult male and juveniles remained in the feeding tree 30m away from the team for another 19 minutes after the females disappeared. A lone female with an infant was sighted on two occasions within the known range of G2, suggesting it was one of the females of the group that had detached from the main group. These observations suggest that this large group in some cases disperses into smaller units explaining why some of the observations in the G2 area did not account for all individuals in the group.

## DISCUSSION

There has only been one published study looking at group composition and social structure in *N. gabriellae*. Kenyon et al. (2011), working in Cat Tien National Park, Vietnam, found that although most groups of *N. gabriellae* observed were pair-living and presumably monogamous, some multi-female groups persisted. However in all multi-female groups observed, only one of the females carried an infant at any one time. The results from this study confirm that *N. gabriellae* can be found in a multi-female group, and suggest, though cannot confirm, a polygynous mating system; further observations may help confirm this.

It is difficult to infer whether this is a regular pattern or if it could be a more isolated case and further research

of new groups, as well as continued habituation and observations of G2, will help to understand this better. The proportion of polygynous groups recorded in the genus *Nomascus* is higher than in all other gibbon genera (Malone & Fuentes, 2009). However, most of the observations of multi-female polygynous groups come from those species found at the northernmost border of the *Nomascus* range; *N. gabriellae* is the southernmost species of *Nomascus*, and so these preliminary findings are of particular interest and may add to the mounting evidence indicating high levels of inherent social flexibility in the family Hylobatidae (Sommer & Reichard, 2000).

Multi-female polygynous *Nomascus* groups, on average, are composed of more individuals than monogamous groups (Zhou et al., 2008; Fan et al., 2010). This can lead to increased resource competition but larger groups may also have multiple benefits, such as protection from predators, efficiency in foraging and range defence (Fan et al., 2015). Jiang et al. (1999) have suggested that large home ranges are less defensible, and can result in the formation of multi-female groups. Observations from this field site suggest that this is unlikely as G2 does not appear to have a large range (preliminary data suggest a home range between 15ha and 30ha) compared with those of *Nomascus* species in the northernmost range of the genus, whose home ranges can exceed 100ha (Fan & Jiang, 2010; Fan et al., 2010).

It is important to consider that this group has only been observed for eight months of the year and considerable range expansion or contraction may still be possible, depending on the seasons and resource availability (Brockelman et al., 2014; Fan et al., 2015). For example, gibbon species have been found to become particularly stressed during the dry season and this may affect their ranging behaviour and foraging strategies (Bartlett, 2009b). Kenyon et al. (2011) also found evidence of extra-pair paternity in *N. gabriellae*, using DNA from fecal samples. Further research may help identify the possibility of extra-pair copulations occurring within the population of *N. gabriellae* in SPF, as well as confirm the presence of other multi-female polygynous groups of *N. gabriellae* within the same population.

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## REFERENCES

- Bartlett, T.Q. 1999. *The gibbons*. In: *The Nonhuman Primates*, P. Dolhinow and A. Fuentes (eds.), pp. 44–49. Mayfield Publishing Company, London, UK.
- Brockelman, W.Y., Nathalang, A., Greenberg, D.B. and Suwanvecho, U. 2014. Evolution of small-group territoriality in gibbons. In: *Primates and Cetaceans*, J. Yamagiwa and L. Karczmarski (eds.), pp. 213–230. Springer, Japan.
- Fan, P.F. and Jiang, X. 2010. Maintenance of multifemale social organization in a group of *Nomascus concolor* at Wuliang Mountain, Yunnan, China. *International Journal of Primatology* **31**: 1–13.
- 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., Bartlett, T.Q., Fei, H.L., Ma, C.Y. and Zhang, W. 2015. Understanding stable bi-female grouping in gibbons: feeding competition and reproductive success. *Frontiers in Zoology* **12**: 5.
- Geissmann, T., Manh Ha, N., Rawson, B., Timmins, R., Traeholt, C. and Walston, J. 2008. *Nomascus gabriellae*. In: The IUCN Red List of Threatened Species. Version 2015.2. www.iucnredlist.org. Accessed on 12 July 2015.
- Huang B, Guan Z.H., Ni Q.Y., Orkin J.D., Fan P.F. and Jiang X.L. 2013. Observation of intra- and extra-group copulation and reproductive characters in free ranging groups of western black crested gibbon (*Nomascus concolor jingdongensis*). *Inter Zoology* **8**: 427–440.
- Jiang, X., Wang, Y. and Wang, Q. 1999. Coexistence of monogamy and polygyny in Black-crested Gibbon (*Nomascus concolor*). *Primates* **40**(4): 607–611.
- Kenyon, M., Roos, C., Thanh Binh, V. and Chivers, D. 2011. Extrapair paternity in Golden-Cheeked Gibbons (*Nomascus gabriellae*) in the secondary lowland forest of Cat Tien National Park, Vietnam. *Folia Primatologica* **82**: 154–164.
- Lan D. 2001. *Ecology and Behaviour of Black Gibbons in Yunnan, China*. PhD dissertation, University of Liverpool, UK.
- Malone, N. and Fuentes, A. 2009. The ecology and evolution of hylobatid communities: causal and contextual factors underlying inter- and intraspecific variation. In: *The Gibbons: New Perspectives on Small Ape Socioecology and Population Biology*, S. Lappan and D.J. Whittaker (eds.), pp. 241–264. Springer, New York, USA.
- Mootnik, A. R. and Fan, P. 2011. A comparative study of crested gibbon (*Nomascus*). *American Journal of Primatology* **73**: 135–154.
- Nuttall, M., Menghor, N. and O’Kelly, H., 2013. *Monitoring of key species in the Seima Protected Forest*. Wildlife Conservation Society Cambodia Program and the Forestry Administration, Cambodia.
- Pocock R. 1927. The gibbons of the genus *Hylobates*. *Proceedings of the Zoological Society of London* **97**: 719–741.
- Rawson, B. M., Clements, T., Meng Hor, N. 2008. *Status and conservation of Yellow-Cheeked Crested Gibbons (Nomascus gabriellae) in the Seima Biodiversity Conservation Area, Mondulhiri Province, Cambodia*. Wildlife Conservation Society Cambodia Program, Cambodia.
- Sommer V. and Reichard U. 2000. *Rethinking monogamy: the gibbon case*. In: *Primate Males*, Kappeler P. (ed.), pp 159–168. Cambridge University Press, Cambridge.
- Srikosamatar, S. and Brockelman, W.Y. 1987. Polygyny in a group of pileated gibbons via a familial route. *International Journal of Primatology* **8**(4): 389–393.
- Thinh, V.N., Mootnick, A.R., Thanh, V.N., Nadler, T. and Roos, C. 2010. A new species of crested gibbon, from the central Annamite mountain range. *Vietnamese Journal of Primatology* **4**: 1–12.
- Traeholt, C., Bonthoeun, R., Virak, C., Samuth, M. and Vutthin, S. 2006. Song activity of the Pileated Gibbon, *Hylobates pileatus*, in Cambodia. *Primate Conservation* **21**: 139–144.
- Zhou J., Wei F.W., Li M., Chan B.P.L. and Wang D.L. 2008. Reproductive characters and mating behaviour of wild *Nomascus hainanus*. *International Journal of Primatology* **29**: 1037–1046.