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...with the description of a new gibbon species

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A new species of crested gibbon, from the central Annamite mountain range

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Key words: Hylobatidae, *Nomascus*, crested gibbon, Vietnam, Laos, Cambodia, new species

Summary

Crested gibbons are endemic to the Indochinese bioregion and occur only in Vietnam, Laos, Cambodia and southern China. However, their diversity is not completely understood and the number of recognized species is still under debate. Recent investigations divide crested gibbons into six species, namely *Nomascus hainanus*, *N. nasutus*, *N. concolor*, *N. leucogenys*, *N. siki* and *N. gabriellae*. However, there is evidence that gibbons in the range of *N. siki* represent two taxa. Based on genetic, acoustic and morphological data, a new gibbon species - *Nomascus annamensis* - is herein described.

Loài vượn mới ở dãy Trung Trường Sơn

Tóm tắt

Vượn có mào đặc hữu ở vùng sinh thái Đông Dương và chỉ được tìm thấy ở Việt Nam, Lào, Campuchia và Nam Trung Quốc. Tuy nhiên, sự đa dạng của chúng vẫn chưa hoàn toàn biết đến và số lượng loài ghi nhận vẫn còn tranh luận. Những nghiên cứu gần đây phân chia vượn có mào thành 6 loài bào gồm *Nomascus hainanus*, *N. nasutus*, *N. concolor*, *N. leucogenys*, *N. siki* và *N. gabriellae*, tuy nhiên bằng chứng đã chứng minh có sự hiện diện của hai giống trong loài *N. siki*. Căn cứ vào dữ liệu phân tích về gen, âm học và hình thái, thì loài mới về vượn được mô tả là loài *Nomascus annamensis*.

Introduction

Crested gibbons, genus *Nomascus*, represent one of four gibbon genera constituting the primate family Hylobatidae (Brandon-Jones et al., 2004; Roos & Geissmann, 2001; Mootnick, 2006; Mootnick & Fan in press). *Nomascus* differs from other gibbon genera in various morphological, anatomical, acoustic and chromosomal features (Carbone et al., 2009; Geissmann et al., 2000; Groves, 1972, 2001; Mootnick, 2006; Mootnick & Fan, in press; Müller et al., 2003). All taxa in this genus show strong sexual dichromatism, with the adult females varying from orange, buff, tan, tawny or yellow in coloration, and males and immatures being black, with some species having light cheeks (Geissmann et al., 2000; Groves, 2001; Mootnick, 2006; Mootnick & Fan in press). In adult

males and immatures, the crown hair is erect, which gives them their common name “crested gibbons”. Crested gibbons occur in Vietnam, Laos, Cambodia and parts of southern China. They are mainly restricted to the region east of the Mekong River and the western black gibbon (*N. concolor*) is the only species that has crossed the upper Mekong to the west (Geissmann et al., 2000; Groves, 2001) (Fig. 1).

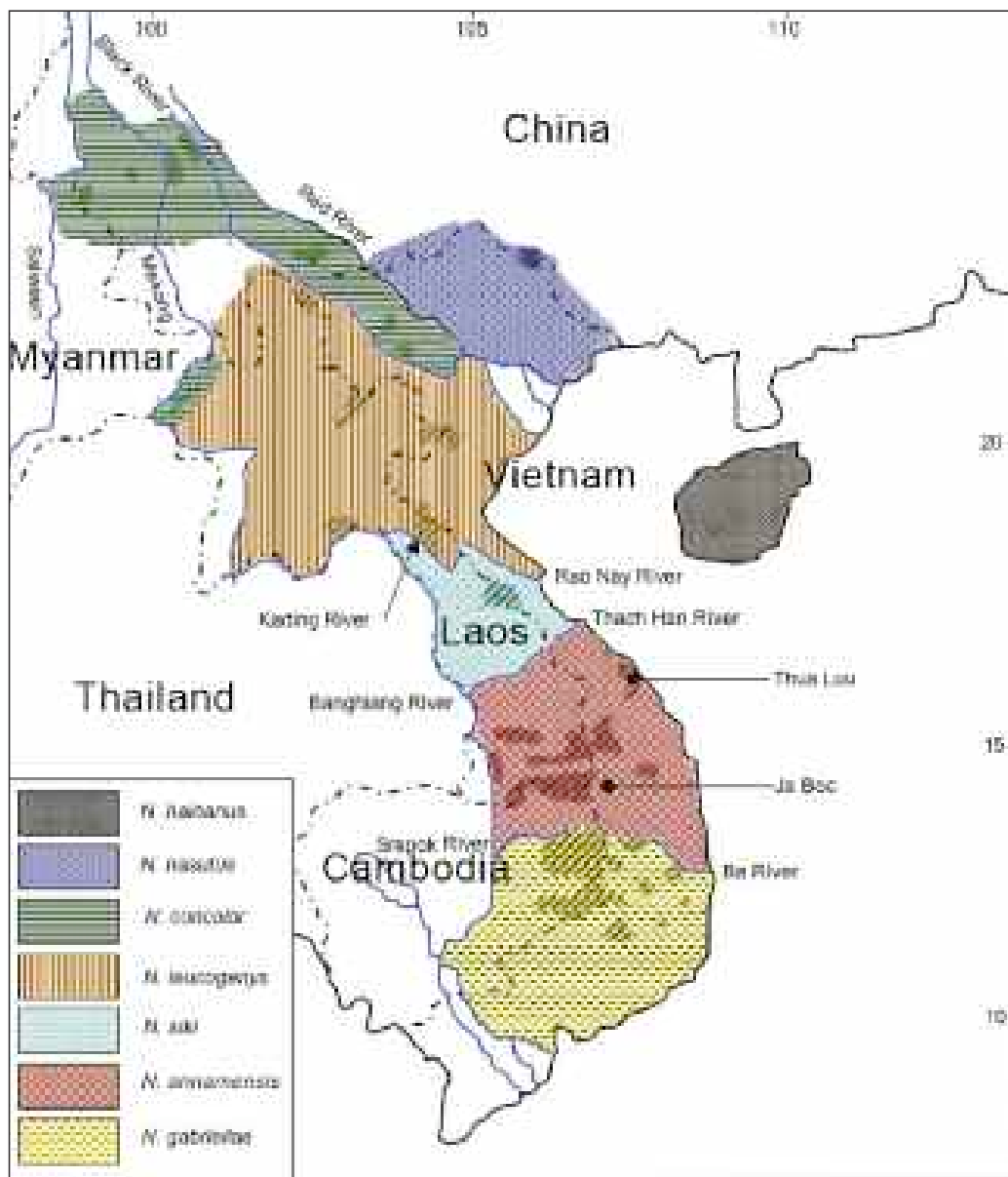


Fig.1. Historical distribution of crested gibbon species 19th and early 20th century, and the current shrunk and fragmented distribution (after Chinese Primate Specialist Group, 1996; Duckworth, 2008; Geissman, 1995; Traeholt et al., 2006; Van Ngoc Thinh et al., in press 2; Zhang Yongzu et al., 2002). Country borders are indicated as dashed lines. Thua Luu and Ja Boc indicate the type localities of *N. siki* and *N. annamensis*, respectively. Note that Thua Luu as type locality of *N. siki* is most likely incorrect.

The classification of crested gibbons has been disputed over decades. Initially, all taxa were lumped into one species, *N. concolor* (Chivers, 1977; Groves, 1972; Haimoff et al., 1982; Marshall & Sugardjito, 1986; Napier & Napier, 1967), but recent investigations based on morphological, genetic and acoustic data divided them into four, five or even six species (Geissmann, 1997; 2000; 2007; Geissmann et al., 2000; Groves, 2001; Monda et al., 2007; Mootnick, 2006; Roos, 2004; Roos et al.,

2007; Takacs et al., 2005; Van Ngoc Tinh et al., 2010). According to the most recent classification (IUCN, 2010; Mootnick & Fan, in press; Van Ngoc Tinh et al., 2010), a total of six crested gibbon species, including the Hainan gibbon (*N. hainanus*), the eastern black gibbon (*N. nasutus*), the western black gibbon (*N. concolor*), the northern white-cheeked gibbon (*N. leucogenys*), the southern white-cheeked gibbon (*N. siki*) and the buff-cheeked gibbon (*N. gabriellae*), are recognized. Moreover, recent acoustic and genetic data provide evidence that gibbons in the range of the southern white-cheeked gibbon represent two taxa (Geissmann, 2007; Geissmann et al., 2000; Konrad & Geissmann, 2006; Roos, 2004; Van Ngoc Tinh et al., in press 1; in press 2; submitted). Both are likely to be separated from each other by the Banghiang River in Laos and the Thach Han River (Quang Tri River) in Vietnam (Van Ngoc Tinh et al., in press 2) (Fig. 1).

Which of both taxa has to be given a new species name is a dilemma due to geographical distribution. The type locality of *N. siki* (Delacour, 1951) is Thua Luu (16°16'N, 108°00'E) in Thua Thien-Hue Province, Vietnam. This site is well in the range of the southern taxon and about 200 km south of the southernmost distribution of the northern taxon (Van Ngoc Tinh et al., in press 2) (Fig. 1). Although the holotype of *N. siki* (British Museum of Natural History - BM[NH] 1933.4.1.6[a]) is a subadult male. The teeth are not completely erupted (Fig. 2) but its pelage coloration is fully developed and clearly can be assigned to the northern taxon (Fig. 3). Unfortunately, information about whether Jean Delacour and Pierre Jabouille collected the specimen on 4th February 1931 in the wild near Thua Luu or whether they obtained the gibbon at a market or from a poacher is not traceable. However, since Thua Luu is close to the coast and along the Vietnamese national railway line and the national road no. 1, the specimen could have come in trade from a wild origin other than Thua Luu.

Since the cheek coloration and shape of the *N. siki* holotype clearly resembles that of the northern taxon, its putative type locality Thua Luu seems to be incorrect. Thus, we conclude that the *N. siki* holotype refers to the northern taxon (with now an unknown type locality), while the southern taxon remains unnamed. Accordingly, and since no synonym is available for the southern taxon, we herein described it as a new species.



Fig.2. Skull of the *N. siki* type specimen. The teeth are not fully erupted. Photo: Anna Barros.



Fig.3. Skin of the *N. siki* type specimen. Photo: Anna Barros.

Nomascus annamensis nov. spec.

Holotype

ZMVNU M735 at the Zoological Museum of the Vietnam National University, Hanoi, Vietnam (ZMVNU). Skin of an adult male (weight 7 kg) collected on January 28, 1980 in Ja Boc, Sa Thay District, Kon Tum Province, Vietnam. Hands and feet are missing from the skin (Fig. 4 and 5). GenBank accession number of the complete mitochondrial cytochrome b gene (1140 bp): GU595010.



Fig.4. Skin of the holotype of *N. annamensis* nov. spec. at the Zoological Museum of the National University Hanoi. Photo: Tilo Nadler.



Fig.5. Head of the holotype of *N. annamensis* nov. spec. at the Zoological Museum of the National University Hanoi. Photo: Tilo Nadler.

Type locality

Ja Boc, Sa Thay District, Kon Tum Province, Vietnam (ca.14°25' N, 107°35' E, Chu Mom Ray National Park) (Fig. 1).

Paratypes

ZMVNU M733: Skin of a young male, changing colour from buff to black, collected in May 1982 in Sa Son, Sa Thay District, Kon Tum Province, Vietnam. GenBank accession number of the complete mitochondrial cytochrome b gene (1140 bp): GU595011. ZMVNU M734: Skin of an adult male collected on January 28, 1980 in Ja Boc, Sa Thay District, Kon Tum Province, Vietnam. In the complete mitochondrial cytochrome b gene, M734 has an identical haplotype as the holotype M735 (GenBank accession number: GU595010). The skins of the paratypes are incomplete; hands and feet are missing and parts of the head.

Diagnosis and Description

N. annamensis mainly resembles *N. gabriellae* in external characteristics. Adult males and immatures ($n = 3$) are black in color, and when in the sun light there are a few silvery hairs intermixed. The chest has a brownish tinge that contrasts with the black body. They have a noticeable crest, and black hairs under the orbital ridges. Their cheek patches were deep orangish gold (varied in color in some individuals) reaching less than halfway up the ears with a rounded upper margin, and connected under a black chin (Fig. 6 and 7). *N. annamensis* adult males and immatures clearly differ from *N. leucogenys* (Fig. 8 and 9) and *N. siki* (Fig. 10 and 11) in having



Fig.6 and 7. Subadult male of *N. annamensis* nov. spec. housed at the Endangered Primate Rescue Center, Vietnam. Photo: Tilo Nadler.



Fig.8. Juvenile male of *N. leucogenys*. Photo: Tilo Nadler.



Fig.9. Adult male of *N. leucogenys*. Photo: Tilo Nadler.

goldish instead of white cheeks that did not extend as far up the sides of the face, and from *N. gabriellae* by being in the darker scale of coloration of the cheek patches (Fig 12).



Fig.10. Juvenile male of *N. siki*. Photo: Tilo Nadler.



Fig.11. Adult male of *N. siki*. Photo Tilo Nadler.



Fig.12. Adult male of *N. gabriellae*. Photo Tilo Nadler.

Adult females of *N. annamensis* (Fig. 13 and 14) do not show differences to adult females of *N. gabriellae* (Fig. 15 and 16), but are clearly different from *N. siki* (Fig. 17 and 18) (Mootnick 2006; Mootnick & Fan, in press). The size, intensity of color, and position of the black streak on the head is variable among individuals. The amount of dark hairs on the chest also varied.



Fig.13 and 14. Adult female of *N. annamensis* nov. spec. housed at the Endangered Primate Rescue Center, Vietnam. Photo: Tilo Nadler.



Fig.15. Adult female of *N. gabriellae*. Photo: Tilo Nadler.



Fig.16. Adult female *N. gabriellae*. Photo: Tilo Nadler.



Fig.17. Adult female *N. siki*. Photo: Tilo Nadler.



Fig.18. Adult female *N. siki*. Photo: Tilo Nadler.

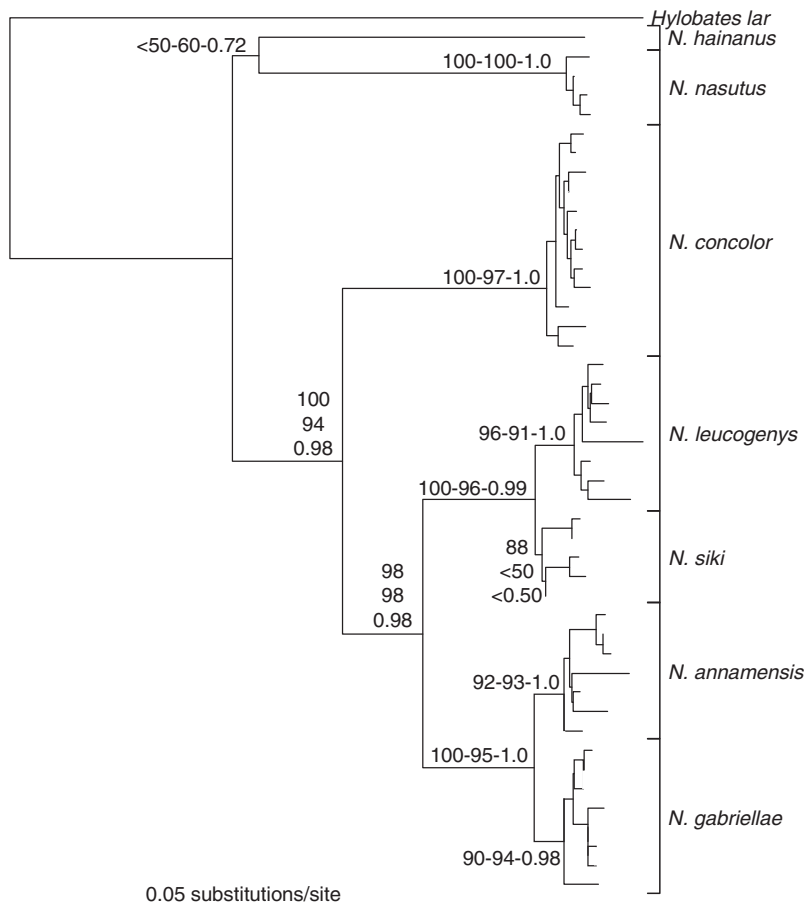


Fig.19. Phylogenetic relationships among crested gibbon species based on complete mitochondrial cytochrome b sequence data. Modified after Van Ngoc Thinh et al. (in press 2). Numbers on branches refer to support values as obtained from neighbor-joining, maximum-likelihood and Bayesian reconstructions, respectively.

Based on complete mitochondrial cytochrome b gene sequence data, *N. annamensis* is closest related to *N. gabriellae* (Fig. 19). In this gene, *N. annamensis* (n=22) differs from *N. gabriellae* (n=69), *N. siki* (n=32) and *N. leucogenys* (n=29) in 1.26 (SD±0.11)%, 3.23 (SD ±0.45)% and 3.58 (SD±0.35)%, respectively. Intra-specific variation for *N. annamensis*, *N. gabriellae*, *N. siki* and *N. leucogenys* is 0.48 (SD±0.05)%, 0.42 (SD±0.03)%, 0.38 (SD±0.03)% and 0.43 (SD±0.06)%, respectively.

N. annamensis differs from the other light-cheeked species in several acoustic features, e.g. frequency and tempo (Fig. 20), which can clearly be differentiated by discriminant function analysis (Fig. 21). Details are exposed by Van Ngoc Thinh *et al.* (in press 1; submitted).

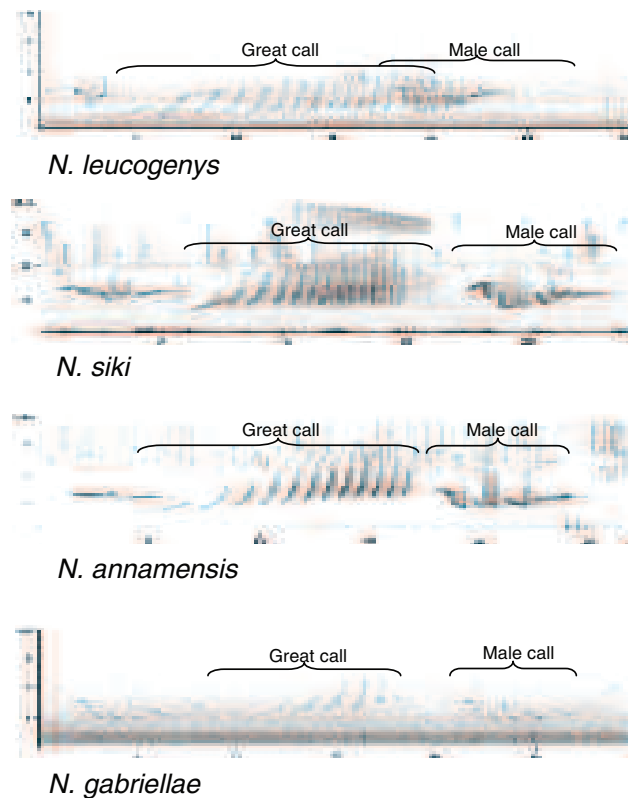


Fig.20. Spectrograms of *N. leucogenys*, *N. siki*, *N. annamensis* and *N. gabriellae*. Modified after Van Ngoc Thinh *et al.* (submitted).

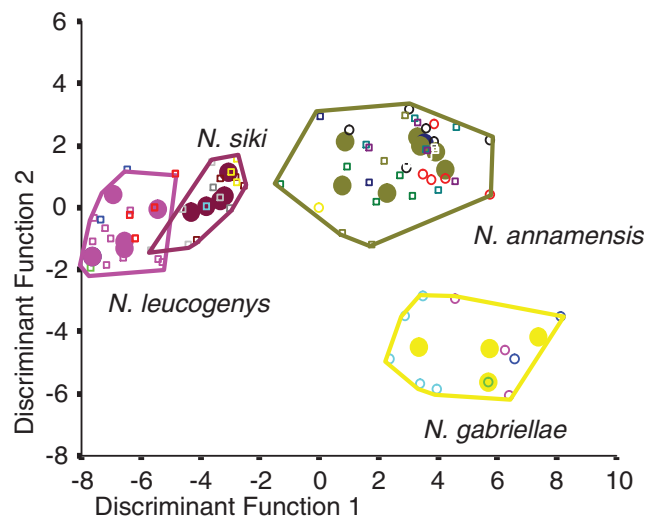


Fig.21. Discriminant function analysis of acoustic data. Modified after Van Ngoc Thinh *et al.* (submitted).

Etymology

The species is named after the central part of the Greater Annamite mountain range in the border region of Vietnam, Laos and Cambodia. English name: northern buff-cheeked gibbon, French name: Gibbon à joues jaunes du Nord, German name: Nördlicher Gelbwangen-Schopfgibbon.

Distribution

N. annamensis occurs in Vietnam, Laos and Cambodia, east of the Mekong River (Fig. 1). In Vietnam, it is distributed south of the Thach Han River (Quang Tri River) (about 16°40'-16°50' N) south to the Ba River (about 13°00'-13°10' N) in the provinces Quang Tri, Thua Thien-Hue, Thanh Po Da Nang, Quang Nam, Quang Nai, Kon Tum, Gia Lai, Binh Dinh and Phu Yen (Van Ngoc Thinh et al., in press 2). In Laos, the species occurs in the southern provinces Savannakhet, Saravan, Champasak, Xekong and Attapeu. Its northernmost locality in Laos is unknown, but most likely it is separated from *N. siki* by the Banghiang River (about 16°00'-16°03' N). In Cambodia, *N. annamensis* is distributed in the northeastern provinces Stung Treng and Rattanakiri, north of the Srepok River (about 13°30' N). Genetic and/or acoustic data confirm its occurrence in Vietnam in Phong Dien Nature Reserve, Da Krong Nature Reserve, Sao La Nature Reserve, Bach Ma National Park, Song Thanh Nature Reserve, Chu Mom Ray National Park and Kon Ka Kinh National Park, in Laos in Xe Pian National Biodiversity Conservation Area, Xe Sap National Biodiversity Conservation Area, and Xe Bang-Nouan National Biodiversity Conservation Area, and in Cambodia in Virachey National Park (Duckworth, 2008; Konrad & Geissmann, 2006; Ruppel, 2010; Van Ngoc Thinh et al., in press 2, submitted).

This report presents the first description of *N. annamensis* based on morphological, genetic and song analysis. Accordingly, there are seven species in the genus *Nomascus*. This information will assist with the conservation of the genus *Nomascus*, and in the prevention of hybridization in captive conservation programs.

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Fig.22. Subadult male of *N. annamensis* nov. spec. Photo: Tilo Nadler.



Fig.23. Adult female of *N. annamensis* nov. spec. Photo: Tilo Nadler.