

Polygynous Mating System and Behavioural Reason of Black Crested Gibbon (*Nomascus concolor jingdongensis*) at Dazhaizi, Mt. Wuliang, Yunnan, China

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Abstract: The field research on five black crested gibbon groups, recently performed at Dazhaizi, Mt. Wuliang, Central Yunnan, China, showed that all groups in the local population consisted of one adult male, two adult females and 2–5 sub-adults, juveniles and infants. The mean group size was 6.2 in August 2003 and 6.4 in August 2005. Two sub-adult males disappeared from their natal home range and three newborns were given birth in Group 3 (G3) and G4 during this study. The two adult females in G1, G2 and G3 gave births and/or carried babies but at different times. There was no aggressive or dominating behaviour observed between the two adult females. One floating female was first seen in G3's territory on April 15, 2005. The two resident females interrupted her duet with adult male and chased her. We did not observe adult male chased this floating female and she left G3's territory 10 days later. Sub-adult males often kept distance with the family, and they often sang solo bouts in their natal territory before they dispersed. The sub-adult males and females dispersed from natal territory and two adult resident females rejected the third one, which might were the reasons why the black gibbon groups were polygyny in Dazhaizi.

Key words: *Nomascus concolor jingdongensis*; Group size and composition; Social structure; Polygyny; Local population; Wuliang Mountain

无量山大寨子黑长臂猿一夫二妻制的群体结构及其行为学原因

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摘要: 2003年8月—2005年8月, 对无量山大寨子5个黑长臂猿群体的结构和组成进行了观察。当一个群体在早晨鸣叫或依次通过树冠时, 记录群体的结构和组成。每个群体都由1个成年雄性、2个成年雌性及其后代组成。2003年8月平均群体大小为6.2只; 到2005年8月, 平均群体大小发展为6.4只, 其中有2个亚成年雄性从出生群迁出, 且有3只幼猿出生。在3个群体(G1、G2和G3)中两个成年雌性都成功繁殖了后代。同一群体内两个成年雌性间无攻击或等级行为。2005年4月15日, 当一只亚成年雌性进入G3的领域后, 两只成年雌性对其进行追逐驱赶, 并且干扰其与成年雄性配合进行二重唱, 成年雄性没有直接驱赶流浪的亚成年雌性, 10天后这只亚成年雌性离开了G3的领域。亚成年雄性经常与群体其他成员保持一定距离, 并且在出生地通过独唱练习鸣叫。黑长臂猿可能通过亚成年雄性和雌性的迁出, 及成年雌性对外来流浪雌性的驱赶维持这种一夫二妻的群

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体结构。

关键词:黑长臂猿景东亚种;群体大小和组成;社会结构;多配制;地方种群;无量山

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Gibbons are normally regarded as the primates with monogamous mating system (Leighton, 1987). A male and a female form a mating pair for their entire lives, and produce their offspring in a strict territory. Sommer and Reichard (2000) summarized the characteristics about monogamous territorial families: strict territoriality, pair formation through natal dispersal, lifelong monogamy, mating exclusivity, nuclear families and pair bond advertised through duetting. However, the view of nuclear families centering adult pairs has been challenged by observations of extra-pair copulations and partner changes (Palombit, 1994; Reichard, 1995; Brockelman et al, 1998). Sommer and Reichard (2000) summarized three different aspects of male-female associations in gibbons: grouping, mating and breeding. They concluded mating monogamy probably non-existent, breeding monogamy certainly not in all groups, but most groups were grouping monogamy and they did not find polygynous group in single-species.

Polygynous grouping was seldom reported in single gibbon species. Limited cases were found in western black crested gibbon (*Nomascus concolor*) (Delacour, 1933; Haimoff et al 1986, 1987; Bleisch & Chen 1991; Jiang et al, 1999), Hainan gibbon (*N. sp. cf. nasutus hainanus*) (Xu et al, 1983; Liu et al, 1989), lar gibbon (*Hylobates lar*) (Sommer & Reichard, 2000), pileated gibbon (*H. pileatus*) (Srikosamatara & Brockelman, 1987), and hoolock gibbon (*Bunopithecus hoolock*) (Ahsan, 1995). The presence of polygamous group in Hainan gibbon might be a result of limited habitat (Liu et al, 1989). Despite two females both carried infants in one lar gibbon group, this polygamous group just existed about eight months (Sommer & Reichard, 2000). In the polygamous pileated gibbon group, two adult females both carried infants, but the infant of the second adult female disappeared later (Srikosamatara & Brockelman, 1987). Ahsan (1995) speculated the adult male and the two adult females were siblings in the hoolock gibbon group, and the older female expelled the younger one after 14 months.

Polygynous grouping in western black crested gibbon was reported. However, no breeding or babies carrying by more than one adult female was observed in their short-termed studies. In the recent field observation, each group of a local population at Dazhaizi, Wu-

liang Mountain, was composed of two adult females, and babies were given births in three groups. This paper also provided some information of the time of birth, colour change of babies and dispersal of sub-adults of western black crested gibbon in Mt. Wuliang.

1 Study area and Methods

1.1 Study area

A field observation, from August 2003 to August 2005, was committed at Dazhaizi (24°42'N, 100°42'E), the western slope of Mt. Wuliang, central Yunnan, China. The study site is located in the core area of the Wuliang Nature Reserve, and covered mainly with semi-humid evergreen broadleaved forests and mid-mountain humid evergreen broadleaved forests. In addition to black crested gibbon, another two primates, *Macaca arctoides* and *Trachypithecus barbei*, occur in the same forests.

1.2 Methods

Black crested gibbon is sexual dimorphism in the pelage: adult males are completely black, and adult females show thicker buff-colored fur and black patch on the crown, chest and abdomen. Infants display buff colour and change into black at the age of 1-2 years, and then the colour of the sub-adult female change gradually from black to the colour described for adults. Therefore, unlike infants, juveniles, and sub-adults, sexual identification on adults is quite easy. The gender of sub-adults was identified through the observation of the external genitals and calls of some groups.

Since the black crested gibbon is very shame, our observations were made sneakily. Data collection related to group size and social structure was performed while a group gave out morning songs or passed one by one through the canopy. Data records are about: (1) the singing spots; (2) the direction of movement after singing; (3) individuals observed; (4) relative body size and colour of observed individuals; (5) behaviours among adult male and females. The infants carried by adult females and the external genitals of males were observed with Eagle 7×35 binoculars.

Group 2 (G2) and G3 became the animals for the ecological and behavioural observation, because they were near to our encampment. G3 was mainly followed after October 2004 and became habituated in March

2005. Records on social behaviour included grooming, conflicting, feeding, resting and sleeping trees among the adult male and females.

2 Results

2.1 Group size and social structure of the black crested gibbon

Tab. 1 Group size and composition of the central Yunnan black crested gibbon at Dazhaizi, Mt. Wuliang during August 2003 and August 2005

Group	Adult male	Adult females	Sub-adults	Juveniles	Infants	Total
G1	1	2	1	1	2	7
G2	1	2	1 (male) ^a	2	2	8
G3	1	2	1 (male) ^a	2	2 ^b	7
G4	1	2	—	2	1 ^b	6
G5	1	2	—	2	—	5

^a The sub-adult males in G2 and G3 disappeared; ^b Newborn was given birth in G3 and G4, during this study.

The two adult females in G1, G2 and G3 also gave births and/or carried babies. Two buff infants were observed taken by the two females in G2 in August 2003 respectively; one of them changed its colour from buff to black in March 2004 and became independent in July 2005 when it was about 30 months. The same colour change to another one might occur sometime between June and October 2004 (note: since no field observation permitted in July, August and September, and the infant was observed in buff in June, however, in black in October). With regard to G3, a black infant was carried by an adult female with yellow abdomen in August 2003 and became independent in December 2003, and this female born a new baby in July 2005. The other adult female with black abdomen in the same group was found to carry a buff baby in February 2004, whose colour changed to black in January 2005 in its eleven months old.

2.2 Results of behavioural observation

In G3, though the two females often fed in the same tree, and were observed to groom for each other thrice and for the infant of the other female once, they usually kept a certain distance in foraging, and were never found to sleep in the same tree.

Sub-adult male in G2 started to sing solo in August 2003 and disappeared in October 2004. Before he disappeared, he could not sing perfect solo bouts just like adult male sing. Solo bouts sung by sub-adult male in G3 were first heard in October 2004. This male often sang solo before the adult pairs sang their duet bouts, after the adult male started sing, he stopped his solo at once. The sub-adult male and adult male never sang in

There were five groups living in the study area. All groups consisted of one adult male, two adult females and 2 to 5 sub-adults, juveniles and infants, the mean group size was 6.2 in August 2003 and 6.4 in August 2005 (Tab. 1). Two sub-adult males disappeared from their natal home range and three newborns were given birth in G3 and G4 during this study.

the same tree, but they often fed and rested in the same tree. We did observed aggression behaviour between them. The sub-adult male often followed the group but kept a distance while moving, and it disappeared in January 2005. Since no new territory was built in adjacent to their parental range, these two sub-adult males might disperse.

A floating sub-adult female was also observed during the study in the home range of G3, though no solos given out, from April 15 to 24, 2005. The adult male called on every day during this period, giving out solos in the morning of April 16, 17 and 24, and duets with his mates in the morning from April 18 to 23. When the adults of G3 gave out duets on April 19, 21, 22 and 23, the floating female appeared nearby and tried to make great calls, but interrupted immediately by the resident adult females, who even chased the floating female 100 m away on the 19th and 23th of April, but not out of their territory, and gave out 28 great calls in the song bout on April 19, usually, only 5.4 great calls occurred in one duet bout. On the 23th of April, the floating female followed about 200 m after G3 giving out duet and then was chased away. However, no evict was observed performed by the adult male. The last observation of the floating female was on the 24th of April.

3 Discussion

Gibbons are generally reported to maintain monogamous mating system and be more territorial. A family usually consists of four individuals (a pair of adults and their offspring) (Leighton, 1987). However, more individuals, especially more than one adult female, in a

group have been reported in concolor gibbons (Haimoff et al, 1986, 1987; Bleisch & Chen, 1991; Jiang et al, 1999). And the findings were achieved in different local populations (Jiang et al, 1999; Lan, 2001). The current research suggests that polygynous mating system in the black crested gibbon not only scatters in groups of different local populations but also exists in all groups of the local population at Dazhaizi, Wuliang Mountains, the central Yunnan. The average group size is 6.2 - 6.4, larger than that of the other gibbons and recorded in other groups of the same species. Although seven individuals in one *lar* group were observed in late 1987 in Khao Yai National Park, Thailand, the group was a special group formed by two different groups (Brockelman et al, 1998).

All groups of the local population consisting of one adult male and two adult females with the offspring during the observation period suggested that they were polygynous in grouping. In addition, the six adult females in G1, G2 and G3, three of the five groups at Dazaizi, were all found to give birth and/or to carry babies during the period from August, 2003 to August, 2005. This suggested that they were polygynous in breeding, but had different reproductive strategies: breeding time is alternative among females. This is consistent to the report that reproductive interests of same-sex group members did not overlap much if they bred take turns (Sommer & Reichard, 2000). However, copulation behaviour was very difficult to observe in the field. Thus whether the two infants came from the same father is needed to be clarified through genetic studies.

The tolerance between *lar* and *pileated* females resulted 'mixed trios' in group containing one adult male and two adult females from different species (Brockelman & Srikosamatara, 1984). Such tolerance might encourage polygyny in black crested gibbons (Jiang et al, 1999). The findings from our study supports the tolerance between the two resident females: they could feed in the same tree, sing great calls synchronously, groom and be groomed with adult male, and groom each other. Though they usually kept a certain distance in foraging and were never found to sleep in the same canopy. Previous study suggested that aggression among females was deemed to prevent males from acquiring new mates (Brockelman & Srikosamatara, 1984). The

adult male in G3 had two mates, and seemed not to reject a third one. When the floating female appeared to G3's territory, the male sang solos or duets everyday, and was not observed to approach or to chase the floating female. In addition to the interruption of great calls and chase away from their group by the resident females, no serious aggression was observed among the resident females and the floating female. Therefore, the tolerance exists not only between the adult females within groups but also to the alien female at some extent.

It seems that polygyny is a dominant mating system in black crested gibbons at Dazhaizi. However, monogamy is popular in the species at Xiaobahe, Wuliang Mountain, where many field studies have been conducted on black crested gibbons before. Only one or two of the five groups consisted of one adult male and two adult females with their offspring (Haimoff et al, 1987; Lan, 1989; Bleisch & Chen, 1991; Sheeran, 1993; Jiang et al, 1999). The habitat differences might provide some explanations. Brockelman and Srikosamatara (1984) proposed that: if the difference in habitat quality between territories did not exceed the 'polygyny threshold', monogamy would be beneficial to females, and 'when male reproductive success on the territory was less with two females than with one, monogamy will benefit the male'. Furthermore, gibbons might live in changing social organizations because of the different ecological features (Fuentes, 2000). The Dazhaizi population occurs at an altitude of 1 900 to 2 700 m, while Xiaobahe population at an altitude of 2 200 to 2 500 m. The former inhabit an undisturbed primary forest, while the latter in isolated, disturbed habitat. A further detailed habitat inventory of different local populations is needed to provide basic data for ecological and social behaviour of the black crested gibbons.

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早年从事鱼类寄生虫和鱼病防治的研究。1960年后系统地进行原尾虫的分类、形态、生态、胚后发育、生物地理、比较精子学和亚显微结构等研究,记述我国原尾虫164种,其中141新种,18新属和4新科,提出原尾虫系统发生新概念,并据此建立了原尾纲新的分类体系,1999年出版了《中国动物志:原尾纲》。1985年后,主持和推动土壤动物学的系统研究,联合60多位学者在6个气候带完成土壤动物组成(3000多种)变动规律及其在土壤物质循环中的作用以及环境污染的影响等试验研究,其结果主编写成《中国亚热带土壤动物》、《中国土壤动物检索图鉴》和《中国土壤动物》等专著。自21世纪开始主持六足动物(昆虫)高级阶元系统进化的研究,已获得许多新的数据和结

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