Sleeping Sites of *Rhinopithecus brelichi* at Yangaoping, Guizhou

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Abstract Arboreal primates spend about half of their lives at sleeping sites; hence, selection of sleeping sites is crucial for individual survival, and data concerning them is important for conservation efforts. We collected data on sleeping sites for a group of the endangered snub-nosed monkey (*Rhinopithecus brelichi*) at Yangaoping (27°58′N, 108°45′E) from January 2006 to December 2007. All sleeping sites were located in the mid-slope and in the shadow of ridges facing the northeast and southeast. The monkeys remained quiet while entering and occupying sleeping sites, and slept in evergreen species during the cold season (December–March). Trees in sleeping sites were similar in height and girth at breast height to those elsewhere, but some trees in lower areas were larger. The monkeys usually slept in close proximity to the last feeding spot, and their daily activities usually occurred around the sleeping site. Areas adjacent to sleeping sites were used more intensively than those not adjacent. Monkeys left the sleeping sites later in the morning in the cold season. These behavioral responses suggested that predation risk, thermoregulation, and climate stresses are the main determining factors in the selection of sleeping sites for this temperate monkey.

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Introduction

Arboreal primates spend about half of their lives at sleeping sites (Chapman *et al.* 1989), and the selection of these is likely crucial for individual survival (Reichard 1998). Researchers have suggested many factors to account for the selection of sleeping places in nonhuman primates. The avoidance of predators is often stressed as a major influence (Anderson 1998; Di Bitetti *et al.* 2000); it is thought that individuals choose sleeping sites such as a tall tree, a steep slope, or a ledge in the middle of a cliff that are inaccessible to predators (Anderson 1984; Reichard 1998), keep quiet around them (Caine 1987), and avoid using the same site on consecutive days (Heymann 1995) to minimize the risk of being detected by predators. Besides predation pressure, temperate primates must cope with low temperatures and food scarcity in winter. To minimize thermoregulation stress in extreme weather conditions, forest primates may choose a slope facing east–south to maximize sun exposure (Liu and Zhao 2004), or ledge or evergreen tree to provide shelter from rain (Aquino and Encarnación 1986; Fan and Jiang 2008; Zhao and Deng 1988). To maximize efficient foraging, forest primates often sleep in the same area as their late afternoon feeding bouts (Anderson 1984) or in an area with access to food for morning (Chapman 1989; Furuichi and Hashimoto 2004). Alternatively, monkeys may also prolong staying at sleeping sites to reduce energy expenditure in winter (Liu and Zhao 2004; Xiang 2005; Zhao 1999).

The gray or Guizhou snub-nosed monkey (*Rhinopithecus brelichi*, Colobinae) is categorized as an endangered species by the World Conservation Union (IUCN 2007), and is also listed as a Category I species under the Chinese Wild Animal Protection Law. Currently, *Rhinopithecus brelichi* is restricted to *ca*. 750 individuals living in a small region in the Mt. Fanjing area in the northwest of Guizhou province, China (Xiang *et al.* 2009). The social organization of the snub-nosed monkey involves 1-male, multifemale units (OMUs); many OMUs travel together in a band, and ≥ 1 all-male unit has been observed (Bleisch *et al.* 1993). In the face of strong ecological pressures, the species would be expected to respond to both predation risk and thermoregulation or climate stress. Our main aim here is to provide data on the sleeping sites of this rare species that may aid conservation efforts. Another intention is to examine chosen sleeping sites in light of potential selective pressure, such as predators risk and climate stress. In relation to predation risk, we predicted the monkeys would select steep slopes or tall trees as sleeping trees, would keep quiet while at sleeping sites, and avoid using the same sleeping sites on consecutive nights. In relation to thermoregulation, we predicted that the snub-nosed monkeys would choose the east-south slope and the middle of a cliff as sleeping sites, or utilize evergreen trees in the cold season. Also, we predicted that the monkeys would range around the sleeping sites or prolong their stays in them during times of energetic stress.

Methods

Study Area

We conducted the study at Yangaoping (27°58′N, 108°45′E), which covers *ca.* 10–12 km^2 of temperate forest in the Fanjingshan National Nature Reserve (FNNR), northeast of Guizhou (Fig. 1). FNNR is a national Buddhist and tourist center founded in 1978 and later accepted as a member of the Man and Biosphere Program by the United Nations Educational, Scientific, and Cultural Organization in 1987
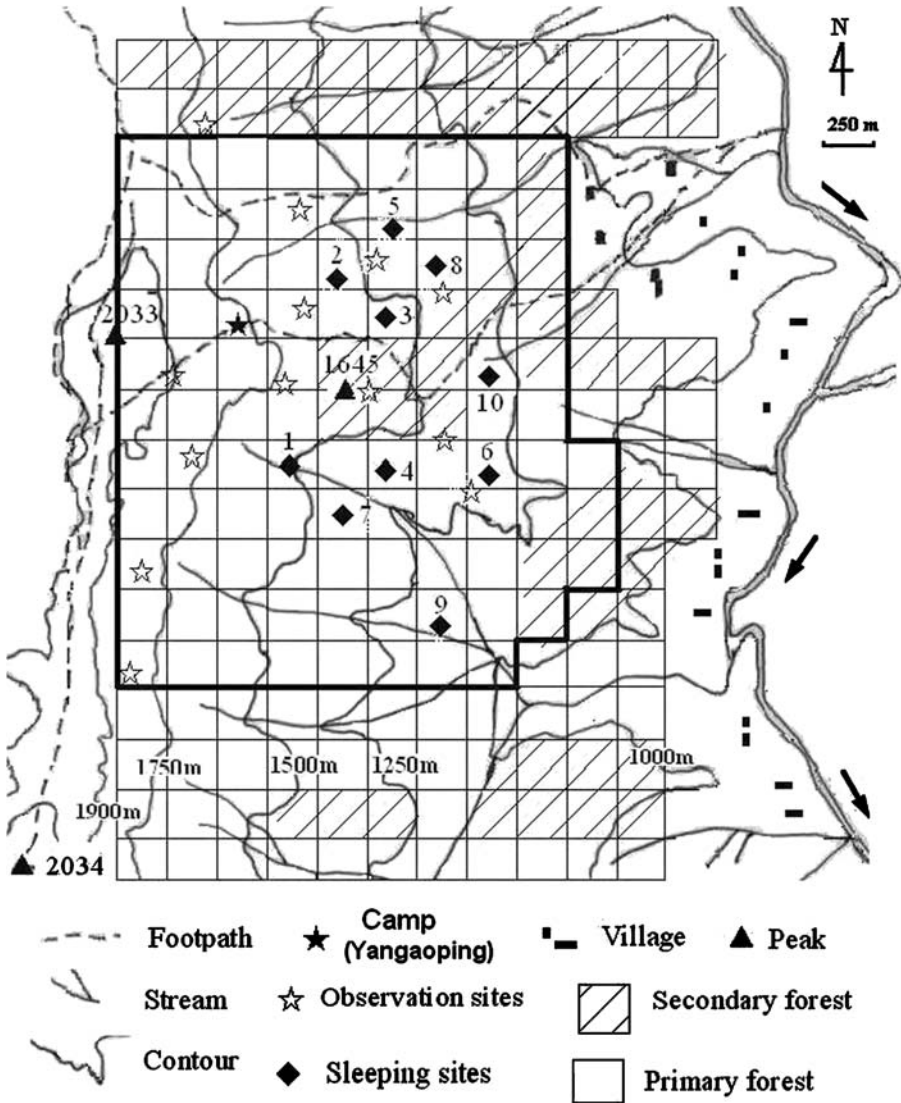

Fig. 1 Distribution of sleeping sites of *Rhinopithecus brelichi* within the Yangaoping area of Fanjingshan National Nature Reserve, Guizhou, China.

(Yang *et al.* 2002). Focusing on the conservation of *Rhinopithecus brelichi*, dove trees (*Davidia involucrata*), and the representative terrestrial ecosystems, FNNR occupies 41,900 ha of mountainous terrain ranging from > 800 to 2570 m asl (above sea level), with a 26,667-ha core area.

Habitat Description

The vegetation exhibits striking altitudinal changes with subtropical broad leaf evergreen forest at low elevations and fir, hemlock, and giant rhododendron on the peaks (Zhu and Yang 1990). With the exception of several large secondary forest patches, which regenerated *ca.* 60 yr ago after extensive cutting for corn production, only 2 distinct forest types appear within the study area. These include 1) evergreen broad leaf forest (900 m–1300 m asl), in which the dominant species are *Castanopsis* spp., Asian oaks (*Cyclobalanopsis* spp.), and *Lithocarpus* spp. and 2) evergreen-deciduous broad leaf forest (1300 m–2000 m asl), in which the dominant species are *Fagus* spp., *Eurya* spp., and *Schima* spp. Dwarf bamboo (*Sinarundinaria* spp.), with densities that can reach 1,000,000/ha (Zhu and Yang 1990), form a dense and nearly impenetrable ground cover in many areas. Walking through the forest is difficult without cutting to remove the bamboo. Canopy height varies from 3 to 25 m, depending on the microhabitat and level of disturbance.

For a simplified description of the habitat of Yangaoping, we adopted quadrat sampling (50 m×4 m) and assembled a series of sampling belts along an east–west-oriented valley at 200 m elevation intervals from 1000 to 2000 m asl. Within these belts, we distributed 6 quadrats at random every 200 m. At each quadrat sampling point, we recorded diameter at breast height (DBH) and height and girth for trees with ≥ 10 cm DBH or perimeter ≥ 31.4 cm. We used a direct-reading optical range finder (600XV, OLC) to measure tree height and forestry tape to measure girth at breast height. We counted the number of trees with DBH ≥ 10 cm to calculate the density of trees (Di Bitetti *et al.* 2000).

Climate

We recorded meteorological data at 1800 m asl, next to our study camp, using the HOBO pro v2 RH/Temp (U23-001, no. 1186046) and Data Logging Rain Gauge (RG2M, no. 20981), manufactured by Onset Computer Corporation. Because nautical twilight (time period defined as beginning in the morning and ending in the evening when the sun is geometrically 12° below the horizon) was considered similar to the Light Intensity Logger records (Fernandez-Duque *et al.* 2002), we adopted this time as the transitional point of dawn and dusk. We obtained this parameter from the U.S. Naval Observatory Astronomical Applications Department Web page (http://aa.usno.navy.mil/AA/) by inputting the coordinates and time zone of the study sites.

Data Collection

The focal individuals include a fission-fusion band of *ca.* 450 individuals in spring, summer, and early autumn (Xiang *et al.* 2009), and 4 identified groups varying from

50 to 200 individuals in late autumn and winter (Nie *et al*. 2009). Owing to difficult terrain and climatic factors, we observed the monkeys from 13 fixed observation sites (Fig. 1) when they had entered into the Yangaoping area. These observation sites included 1 steep slope, 11 branch-platforms built on the canopy, and 1 open area devoid of trees. We took the locations where the monkeys stopped moving at dusk and remained until morning as sleeping sites, and confirmed this by examining fecal remains under trees after the monkeys' departure. We determined the sleeping site position on the topographic map (1:50,000) with the aid of a GPS receiver. We used an altimeter to measure altitude and a clinometer to measure slope inclination.

To investigate differences between trees inside and outside sleeping sites within the forest, we used the point-centered quarter or quadrant method to sample trees (Phillips 1959, cited in Eisenberg *et al*. 1981). We took the midpoint of an area where feces were concentrated underneath trees on the ground as the sleeping site center. At this point, we collected the first sample by measuring the traits of the tree (DBH≥10 cm) nearest to the center of the cross [+, with the axes placed north–south (*y*-axis) and east–west (*x*-axis)] in each of the 4 quadrants divided by the cross. We collected other sampling points along the straight line starting from the first point and running toward the north, south, west, and east every 20 m inside and outside the sleeping site, but ≤ 200 m outside the sleeping sites. For logistic reasons, we sampled only 2 sleeping sites in the warm season and 2 in the cold season, but unlike most others, these were used repeatedly during the different seasons. We also measured tree height from ground to first branch (bole height), and recorded whether the tree in question was deciduous or evergreen.

We gridded the topographical map into cells of 250 m×250 m, and marked group locations (recorded using visual or auditory confirmation) on the gridded map with the aid of GPS and land-markers. We scored the cell as 1 if monkeys entered it on a given day; otherwise, we scored the cell as 0. Thus, we estimated the intensities of cell utilization with the number of records for the cell; we also determined the seasonal range (Fig. 2).

We studied snub-nosed monkeys from January 2006 to December 2007. In 2006, we only located the sleeping site and followed the monkeys in the forest. In 2007,
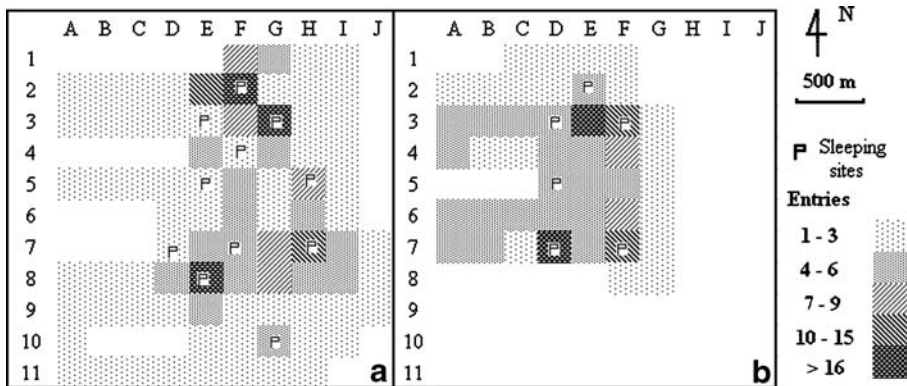

Fig. 2 Intensity of utilization for each grid cell of the *Rhinopithecus brelichi* home range in the Yangaoping area for different seasons. Each cell is 250×250 m. (**a**)Cold season. (**b**) Warm season.

we conducted a more detailed study, recording tree trait, slope of the sleeping sites, and the time it took the monkeys to enter and leave the sleeping sites.

Data Analysis

We pooled data into cold season (December, January, February, and March) and warm season (July, August, September, and October). Dense fog hampered data collection in May and June, and we excluded these months from the analysis.

We used the *t*-test to investigate potential differences in 1) tree traits between sleeping sites and other locations, 2) sleeping tree traits between cold and warm season, 3) altitude of sleeping sites between cold and warm season, 4) duration from entrance into the sleeping sites until dusk and from dawn until leaving the sleeping sites, between cold and warm season, and 5) use intensities between the cells adjacent to the sleeping sites and those not adjacent. We used χ^2 analysis to investigate 1) if the monkeys avoid sleeping at the same site as previous nights, 2) if the monkeys exhibited a preference for slope direction in selection of the sleeping site, and 3) if the monkeys exhibited a preference for using evergreen species as sleeping trees in the 2 seasons. This last test was operationalized by comparing observed values (O) with expected values (E), wherein E_i = seasonal sleeping tree number of both evergreen and deciduous species × percent (P) of evergreen species (DBH>10 cm) in that sleeping site ($p=0.62$, Xiang ZF, *unpub. data*). We analyzed all data via SPSS 13.0.

Results

Habitat Description

Both girth and tree height exhibited significant differences with altitude; there were no significant differences for tree density (Table I). From October 2007 to September 2008, the annual precipitation was 1433 mm, and the mean annual temperature was

Table I Tree traits [mean ± SD (n)] in the habitat of *Rhinopithecus brelichi* at Yangaoping, Guizhou

Variables	Parameter and difference in altitude						
	1000 m asl	1200 m asl	1400 m asl	1600 m asl	1800 m asl	2000 m asl	F [a]
Girth at breast height (cm)	76.6±42.4 (112)	69.5±30.0 (134)	58.8±15.1 (158)	54.4±17.9 (191)	56.6±23.8 (160)	55.7±20.2 (194)	28.54***
Tree height (m)	11.8±3.9 (112)	11.0±3.0 (134)	9.1±3.5 (158)	8.9±4.7 (191)	8.4±3.6 (160)	9.1±2.1 (194)	19.07***
Tree density	19±5 (6)	25±3 (6)	26±10 (6)	23±2 (6)	27±2 (6)	32±43 (6)	1.73[NS]

[a] One-way ANOVA between groups

*** $p<0.001$; [NS] no significance

9.2°C. The monthly variation in precipitation and temperature is provided in Fig. 3. The month with the highest precipitation level was July (278 mm), and the month with the least precipitation was November (14 mm). The highest monthly mean temperature was 19.3°C in July, and the lowest was −4.5°C in January. The highest temperature was 36.9°C in July, and the lowest was −12.2°C in January.

Sleeping Sites and Sleeping Trees

From January 2006 to December 2007, we detected the monkeys on 256 d and recorded 10 sleeping sites that the monkeys used on 103 d. The monkeys almost certainly have many other sleeping sites in the study area, but we were unable to document them; e.g., visual contact with the monkeys was sometimes lost before they had entered a sleeping site. We observed monkeys entering sleeping sites on 21 d in 2007 and departure on 14 d.

All sleeping sites were located in the middle of the slope and in the shadow of ridges facing to the northeast and southeast (Table II). The monkeys preferred to locate the sleeping sites on the east–south slope of the range (χ^2=12.76, df=1, $p<0.001$) in the cold season, but there is no significant difference in slope direction for the warm season (χ^2=3.33, df=1, $p>0.05$; Table II). In addition, the monkeys slept at lower altitudes in the cold season than in the warm season (t=−14.55, df=77, $p<0.001$).

Identified sleeping trees grow contiguously with a well-connected canopy. Sleeping site trees were similar in girth at breast height to those beside and above the site, but those below the sleeping site were significantly broader; the bole height of sleeping site trees was significantly taller than those beside, below, and above sleeping sites; finally, tree height was taller in sleeping site trees than trees below and above sleeping sites (Fig. 4). The monkeys' daily activities usually occurred around the sleeping site, and the monkeys slept close to where the last feeding bouts occurred. Use intensities were greater for the habitat cells located adjacent to the sleeping sites than for those not adjacent to sleeping sites [Fig. 2 (mean±SD); 4.6±2.6 d per cell vs. 1.7±1.5; t=5.53, df=84, $p<0.001$]. The monkeys avoided
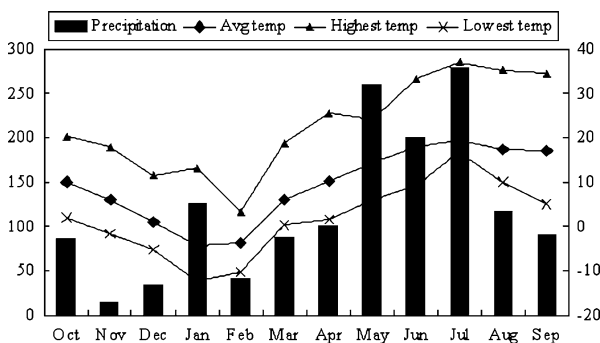

Fig. 3 Monthly precipitation (mm) and lowest, mean, and highest temperatures (°C) in Yangaoping, Guizhou, China (data collected at 1800 m *asl* over 1 yr).

Table II Elevations of sleeping sites and number of stays per sleeping site for *Rhinopithecus brelichi* at Yangaoping, Guizhou

Sites	Elevation (m)	Slope direction	Gradient (°)	Nights observed		Consecutive nights	
				Cold season	Warm season	Cold season	Warm season
1	1750	ES	25	0	9	0	0
2	1700	EN	27	1	11	0	2
3	1650	ES	30	1	4	0	0
4	1400	ES	28	0	6	0	0
5	1320	ES	27	14	0	5	0
6[a]	1250	ES	30	7	0	7	0
7	1200	EN	26	10	0	5	0
8	1150	ES	30	9	0	0	0
9	1150	ES	24	3	0	0	0
10	1150	ES	27	4	0	0	0
Total				49	30	17	2

[a] Although this site was used by a group with *ca.* 50 individuals for 7 consecutive days (February 1–7, 2006) when there was a heavy snow storm at high altitude, the site was not utilized in 2007 when a hydropower station was being built nearby.

ES=east–south; EN=east–north

sleeping at the same site as the previous night if foraging had occurred nearby ($\chi^2=27.00$, df=1, $p<0.001$; 15 vs. 60, Table II).

There were significant differences in sleeping tree traits between seasons, though the sleeping sites did overlap (Table III). In the cold season, the monkeys used only evergreen species as sleeping trees. Evergreen trees mainly consisted of *Lithocarpus hancei*, *Lithocarpus cleistocarpus*, *Cyclobalanopsis glauca*, *Quercus engleriana*, *Castanopsis chunii*, *Castanopsis fargesii*, *Schima grandiperulata*, *Schima superba*, *Cyclobalanopsis stewarddiana*, *Cyclobalanopsis nubium*, and *Cyclobalanopsis gambleana*. Both deciduous trees, e.g., *Fagus longipetiolata*, *F. engleriana*, *F. lucida*, *Sassafra tzumu*, and evergreen trees were used for sleeping in warm season, with no detectable preference between these 2 categories ($\chi^2=1.05$, df=1, $p>0.05$; Table III).

Monkeys entered sleeping sites at 1700–1800 h during the cold season ($n=6$) and 1800–1930 h during the warm season ($n=8$). The monkeys entered sleeping sites quietly and rapidly from different directions, and finally disappeared in the continuous canopy, though with juveniles playing on extruding twigs in some cases. There are no seasonal differences for the duration from entrance into the sleeping sites to dusk [(mean ± SD); warm season: 93.1±30.6 min ($n=8$); cold season: 89.8±31.4 min ($n=6$), $t=-0.20$, df=12, $p>0.05$]. The duration of time spent leaving the sleeping sites after dawn was longer in the cold season than in the warm season [(mean±SD); cold season: 179.8±43.4 min ($n=6$); warm season: 133.0±23.3 min ($n=8$), $t=-2.60$, df=12, $p<0.05$]. The monkeys stayed in the sleeping sites until 1100 h on days of heavy snow in winter.
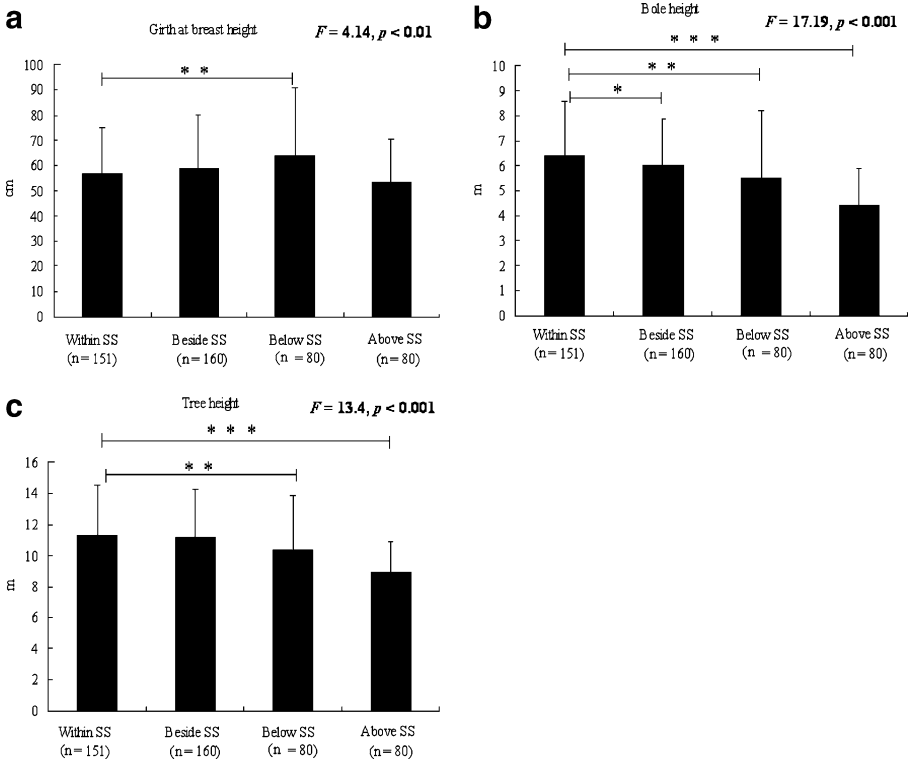
Fig. 4 Difference in tree parameters inside and outside sleeping sites (SS) for *Rhinopithecus brelichi* at Yangaoping, Guizhou [1-way ANOVA with 2-group *t*-test (inside and outside SS)]. Horizontal lines indicate significant *post hoc* difference between columns (LSD, *$p<0.05$, **$p<0.01$, ***$p<0.001$).

Discussion

Adaptive Significance of Sleeping Sites

This study presents information regarding sleeping site choice of a varying population of snub-nosed monkeys at Yangaoping. Our data set, although some what limited, is consistent with predictions that sleeping site selection in

Table III Differences in characteristics (mean±SD) of sleeping trees at similar sites (Site 2 and Site 3, Table II and Fig. 1) during 2 seasons (August and December) in Yangaoping, Guizhou

	Cold season ($n=57$)	Warm season ($n=119$)	t	p
Girth at breast height (cm)	72.7±19.4	64.0±23.8	2.38	0.018
Bole height (m)	7.9±1.8	7.3±1.8	1.98	0.040
Height (m)	14.7±1.6	13.5±2.0	3.93	<0.0001
Number of deciduous species	0	38		
Number of evergreen species	57	81		

Rhinopithecus brelichi is influenced by predation risk, thermoregulation, and climate stress.

Predators exert major pressure on primates, especially when they sleep (Caine *et al*. 1992; Liu and Zhao 2004). Primates tend to minimize the risk of detection by remaining quiet at sleeping sites and by staying in areas that are difficult for predators to approach (Reichard 1998). *Rhinopithecus brelichi* at Yangaoping behaved similarly; they usually entered sleeping sites quietly and rapidly and from different directions. The lack of noise might minimize the risk of detection by predators (Caine 1987; Heymann 1995). The monkeys also chose relatively taller sleeping trees, which had higher bole heights and were located on steeper slopes; such trees may be more difficult for terrestrial predators such as leopards to climb or access. Other primates in the temperate zone, such as *Macaca fuscata* (Suzuki 1965), *M. sylvanus* (Ansorge *et al*. 1992), and *M. thibetana* (Zhao and Deng 1988), also exhibit this behavior. Further, the monkeys selected sleeping trees that grow continuously with a well-connected canopy, and this could hypothetically ease escape during attacks. Predation risk also may be reduced by utilizing many sleeping sites (Reichard 1998) and avoiding the utilization of the same site on consecutive days because this could be noticed by predators (Heymann 1995). The gray monkeys do avoid using the same sleeping site on consecutive nights, although it is not known at present to what degree factors other than predation pressure, e.g., patch depletion, may contribution to this. Finally, becaue most predators are nocturnal, retiring relatively early, e.g., before dusk, before potential predators become active, may be another behavioral strategy to avoid detection, e.g., *Saguinus labiatus* (Caine 1987) and *Hylobates lar* (Reichard 1998).

Humans were likely the primary predators of the gray monkeys before the FNNR was founded; from 1962 to the present, ≥32 *Rhinopithecus brelichi* are known to have been killed in hunting events, and the actual number may be substantially greater (Xiang *et al*. 2009). In addition to human threats, researchers assumed clouded leopards (*Neofelis nebulosa*), leopard cats (*Prionailurus bengalensis*), leopards (*Panthera pardus*), and tigers (*P. tigris*) to be potential predators in the Mt. Fanjing area (Yang *et al*. 2002), although the present field study identified only tracks from the clouded leopard and leopard cats. The selection of sleeping trees on steep slopes, the maintenance of quiet at sleeping sites, and the usage of multiple sites on consecutive days may have evolved in the past under what were possibly heavier predation pressures.

Compared with species in the tropical zone, temperate primates have to cope with cold temperatures and heavy snow in the winter (Oates 1987). Of the 3 Chinese snub-nosed monkeys, *Rhinopithecus brelichi* has the smallest body size (Kirkpatrick 1996), which may leave them especially vulnerable to heat loss during the night. The lowest temperature recorded in the present study was −12.2°C. Snow blanketed the ground from December to March, with ice and frost frequently appearing at high altitudes during the winter. Thermoregulation or climate stress may thus be another explanation for sleeping site selection and some sleeping behaviors of *Rhinopithecus brelichi*. First, the focal group chose sleeping sites close to the middle of slopes and in the shadow of ridges to the east and southeast. The middle of the slope provides greater protection from strong winds than on the ridges and prevents exposure to lower wind-chill temperatures (Liu and Zhao 2004). Although sites closer to the

valley bottom would allow for easier avoidance of wind, less sunshine in the valleys (Gittins 1982) appears to preclude the group from further establishing sleeping sites at lower elevations, even though the larger and more continuous canopy of the forest at the valley bottom could provide shelter from snow (Wada and Tokida 1981) and rain. Similarly, sleeping in the shadow of ridges to the east and southeast should result in the animals being exposed to early morning sun. Himalayan langurs (*Semnopithecus entellus*: Bishop 1979) and Japanese macaques (*Macaca fuscata*: Furuichi *et al*. 1982) select sleeping sites that ensure that they bathe in the morning sun. Langurs in Junbesi also selected the highest locations in their home range for sleeping to attain the first available light from morning sun (Boggess 1980; *cf*. Bishop 1979). Second, some temperate monkeys adopt altitude migration to buffer the seasonal climate stress (*Macaca fuscata*: Wada and Ichiki 1980; *Rhinopithecus roxellana*: Li *et al*. 1999). In the cold season, the focal group tended to locate their sleeping sites at lower altitudes with higher temperatures and possibly greater food availability. They also prolonged their time at sleeping sites in the cold season, perhaps a general mechanism for balancing energy income and expenditure as in Tibetan macaques (Zhao 1999) and black-and-white snub-nosed monkeys (Liu and Zhao 2004; Xiang 2005), which exhibit less movement in snowy winter. Third, to maximize efficient foraging, primates sometimes choose sleeping sites strategically (Chapman 1989). Forest primates often choose sleeping sites in the same area as their late afternoon feeding (Anderson 1984). Fan and Jiang (2008) often observed black crested gibbons (*Nomascus concolor jingdongensis*) sleeping in close proximity to their last feeding bout, with sleeping site distribution related to the distribution of important food patches. Behavioral responses of the focal group, such as sleeping close to the site of the last feeding bout and using adjacent cells at greater intensities than those not adjacent, may also relate to climate stress. Fourth, the monkeys prefer sleeping in evergreen trees bearing denser foliage instead of in bare deciduous trees in the cold season because the former obviously offer better protection against the cold. In winter in the snowy Shiga Heights, Japanese macaques sleep on conifers with temperatures that are 1–2°C higher than in deciduous trees (Wada and Ichiki 1980). Fan and Jiang (2008) also observed black crested gibbons sleeping on bare branches in the warm season and on ferns or orchids during the cold season. Choosing sleeping sites with an optimal degree of insulation may have important thermoregulatory implications.

The various factors that influence the selection of sleeping sites in *Rhinopithecus brelichi* are interactive and may sometimes conflict. The monkey group has to develop some strategic tradeoffs in the selection of sites, such as choosing the middle slope toward the east or southeast, possibly to balance the following physical requirements: 1) avoidance of strong winds (choosing a site not on the ridges), 2) sun exposure for sunbathing at the middle level (not attainable in the shadow at the bottom), and 3) avoidance of predation and maintenance of heat equilibrium (the trees at the valley bottom were the largest and safest, but also received the least sunshine). Overall, the behavioral responses of the group were site-specific in the temperate zone, similar to that of another snub-nosed monkey, *Rhinopithecus bieti*: Liu and Zhao 2004) and generally in accordance with current theories of primate ecology (Anderson 1998).

Implications for Conservation

Given that identified sleeping trees grow contiguously with a well-connected canopy, and that the monkeys slept at lower altitudes in the cold season, good forest at relatively low elevations may be crucial resource for the monkey's survival in the cold season. However, at Yangaoping, local people habitually extract wood for building and heating at edge habitats with resultant forest retreat. It is crucial to curtail such activities at the edge of the FNNR. To reduce firewood usage and ensure greater habitat protection, we propose the designation of specific forest reserve areas for sustainable wood extraction and the discouragement of other activities, e.g., building hydropower stations at forest edges, that could disturb the preferred sleeping sites of this rare primate (Xiang *et al.* 2009).

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