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Behavioral Observations and Notes on the Vertical Ranging Pattern of the Critically Endangered Cat Ba Langur (*Trachypithecus poliocephalus poliocephalus*) in Vietnam

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Abstract: The golden-headed or Cat Ba langur (*Trachypithecus poliocephalus poliocephalus*) is endemic to Cat Ba Island in northern Vietnam. Two free-ranging groups were studied for 22 days of data collection. Behavioral data were collected via instantaneous scan sampling for determining the time budget, activity pattern and vertical ranging pattern of these groups. The langurs spent two thirds of their time resting, 15% foraging, 11% moving and 8% in social activities. Time budgets differed between age classes, with infants and juveniles spending more time being social. The activity pattern of the groups revealed that the langurs rested mostly during the morning and at midday when most of the social behavior was also observed. Foraging and moving occurred more often in the morning and afternoon, with foraging being more pronounced later in the day. With respect to their ranging, the langurs spent most of their time in the higher elevations, but foraged more in the lower elevations of the hills where they live. In this study, we show that the best time to census this Critically Endangered species is from sunrise till 12:00 am.

Key words: Cat Ba langur, golden-headed langur, *Trachypithecus poliocephalus poliocephalus*, time budget, activity pattern, vertical ranging pattern

Introduction

Vietnam has a high diversity of primates; 25 species and subspecies of primates are known to occur there (Fooden 1996; Roos *et al*. 2007; Van Ngoc Thinh *et al*. 2010). However, a fast developing economy combined with illegal wildlife trade, habitat degradation and hunting has led to population declines in all species (Lippold and Vu Ngoc Thanh 1998). Currently, five of the world's 25 most endangered primates are found in Vietnam (Mittermeier *et al*. 2009).

One of these five species, arguably the most endangered in Vietnam (Schrudde *et al.* 2009), is the golden-headed or Cat Ba langur, *Trachypithecus poliocephalus poliocephalus* (Trouessart, 1911), which occurs only on Cat Ba Island in northern Vietnam (Schrudde *et al.* 2009). It belongs to the subfamily of the leaf eating monkeys (Colobinae) and has the smallest distribution of any of the langur species (Nadler *et al.* 2007). Cat Ba langurs are classified as Critically Endangered on the IUCN Red List (IUCN 2009) as a result of illegal hunting, which has led to small, isolated subpopulations and low population numbers. Poaching has resulted in a serious population decline from an estimated 2,400–2,700 individuals in the 1960's (Nadler and Long 2000) to only 52–54 individuals in 2000 (Stenke 2003). Concerned about the declining numbers, in 2000, Münster Zoo and the Zoological Society for the Conservation of Species and Populations (ZGAP) founded the Cat Ba Langur Conservation Project (CBLCP). The project's implementation of strict protection measures, such as the Langur Guarding Program, and the establishment of a langur sanctuary, has led to an increase in population numbers to 60–70 Cat Ba langurs at present (Schrudde *et al.* 2009). The remaining individuals at the time of writing are fragmented into six subpopulations of which some are all-female groups while others are isolated on small offshore islands.

Little information is available concerning the ecology and biology of the Cat Ba langur. Research on daily behavior patterns especially can provide crucial data for the conservation management of the Cat Ba langur with respect to population monitoring. The Cat Ba langur shows strict behavioral adaptations to its preferred limestone karst hill habitat. Throughout the year, for example, it sleeps in caves (Nadler and Long 2000). The Cat Ba langur is one of a number of karst-dwelling leaf monkeys that includes another five or six taxa of the *T. francoisi* group (Groves 2001, 2004; Schrudde

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et al. 2009) of which the white-headed langur (*Trachypithecus p. leucocephalus*) in China is its closest relative. Little is known about the ecology and behavior of the *T. francoisi* group, which makes reference material scarce. Investigating the behavioral adaptation of this species to its habitat could help to understand the species' biology and conservation requirements. Furthermore, data about the vertical ranging behavior of a species can provide important information for conservation and management programs (Clemmons and Buchholz 1997; Caro 1998). This paper describes the daily time allocation to different activities and the vertical ranging behavior of two wild groups of Cat Ba langurs.

Methods

Study area

Fieldwork was conducted on Cat Ba Island in Hai Phong Province, northern Vietnam (20°42'–20°54'N and 106°54'–107°09'E). Cat Ba Island (140 km²) is part of the Cat Ba Archipelago which consists of 366 offshore islands (Viet and Lin 2001). The climate is humid, subtropical monsoon, with wet and dry seasons (Nadler and Long 2000). The wet season lasts from May to September and the dry season from November to March. The mean annual rainfall is 1,900 to 2,100 mm, and annual temperatures range from 23°C to 28°C (Viet and Lin 2001). More than half of the main island is covered by the Cat Ba National Park, including the study area. The study site covered an area of about 0.6 km², and is directly connected to human settlements and frequently used boat routes in the west. The area consists largely of vertical limestone cliffs, up to 300 m above sea level, with the slopes mostly covered with dense bushy vegetation (Nadler and Long 2000). Moist tropical limestone forest is found at the lower elevations.

Data collection and analysis

Two family groups of Cat Ba langurs (GR6 and GR10, Table 1) were observed on 22 observation days (52.6 h total observation time) during April and May 2009. GR6 and GR10 were observed on 17 (34.2 h) and 8 days (18.4 h) respectively. The duration of the observations ranged from 10 minutes to 6 hours (continuous). Observation days started at 06:00 and ended usually at 18:00 when the langurs moved to their sleeping caves. We were unable to follow the groups because they were not habituated and because of the difficult terrain. Several fixed hilltop positions, providing a good overview of the area, were used to observe the langurs (with binoculars 7 × 50). On six days, observations were made by boat/kayak along the coastline to catch the langurs emerging from or returning to their sleeping caves, which faced the open water and were not visible from the fixed observation points.

Behavioral data was collected using instantaneous scan sampling (Martin and Bateson 1993). Individual langurs could not be identified because they were generally too far away; up to 300 m from the observers. The scan interval was set at two minutes, and individuals were observed cyclically, scanning the entire group from left to right. The following behavior categories were recorded: moving, resting, foraging and social behavior. Foraging was defined as the active intake

Table 1. Age and sex composition of the two free-ranging study groups of Cat Ba langurs, *Trachypithecus p. poliocephalus*.

Group	No. of adult males	No. of adult females	No. of adults of unknown sex	No. of Juveniles	No. of Infants	Total
GR6	2	2	2	0	0	6
GR10	1	2	3	2	2	10

Figure 1. *Trachypithecus p. poliocephalus* adults, juveniles and infant of group GR10 at the study site. At the time the photograph was taken GR10 comprised six adults, two juveniles and two infants. The pelage gradually changes from all orange in infants to black with golden-yellow heads in adults. Photo by Johanna Rode, 2009.

Figure 2. Floating village adjacent to the study site and the home ranges of GR6 and GR10. Human settlements close to the Cat Ba langur's habitat still pose a threat. Photo by Isabell Schneider, 2009.

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of food and searching for food items (examining vegetation). Social behavior included grooming activities and playing (running, jumping or play-fighting with one another or alone). Individuals that could not be seen during the scans were marked as 'out of sight'. When the langur groups went out of sight during the observation, the observers waited for them to reappear. The langurs were classified into three age groups according to size and fur color: infants (completely orange), juveniles (golden-yellow head, shoulders and extremities) and adults (golden-yellow to creamy-white heads).

Their use of the different elevations on the cliffs and hills was recorded at each scan. Four levels were distinguished. At each scan we noted where the majority of the langurs were to be found: top (upper third of the hill or cliff), middle (middle third), bottom (lowest third) or valley (lowland).

For the data analysis, we calculated total counts of each behavior. For the analysis of the activity pattern, we pooled behavior records into six time-intervals, each of two hours, starting at 06:00 and ending at 18:00. The time the langurs spent in each behavior was then calculated as a percentage of the total count of all behaviors a) per age class (time budget), b) per time interval (activity pattern), and c) per elevation level (ranging pattern). The time the langur groups were observed in each time interval (time seen) was calculated as a percentage of the total observation time (52.6 h). The Friedman Test (SPSS 15.0) was used to examine differences between the means for each behavior category based on 22 (time budget) and 21 (activity pattern) sample days.

Results

Time budget

One or more individuals were out of sight for the majority of observations (55% of the time). The Cat Ba langurs spent on average 66% of their time resting. Considerably less time was spent moving (11%) and foraging (15%), and in social behavior, which accounted for 8% of their daily activities.

The time budgets of adult and juvenile langurs were similar (Fig. 3), but infants spent one-third (33%) of their daily activities in social behavior, which included playing. Adult Cat Ba langurs, on the other hand, spent the least time of all age classes in social behavior (6%) and the most time resting (69%).

Activity patterns

The daily activity pattern of the adult langurs was described using six time intervals of two hours each. Analysis showed that their behavior was significantly related to time of day (Friedman Test: $\chi^2 = 39{,}970$, df = 23, $p < 0.05$) (Fig. 4). They rested more in the morning to the early afternoon, between 08:00 and 14:00. Generally, the time the langurs spent resting decreased towards the end of the day. Foraging, on the contrary, showed a bimodal distribution during the day. Inversely to the pattern in resting behavior, foraging increased towards the end of the day (14:00–18:00). Social behavior was observed most around midday (10:00–14:00), while the time spent moving did not vary notably during the day.

Our data showed that the groups were more visible between 06:00 and 10:00 (17.1% and 24.0%) and especially between 14:00 and 16:00 (18.4%). 'Out of sight' rates were lowest between 08:00 and 12:00 (48.1% and 48.0% respectively).

Vertical ranging pattern

The langurs spent more than half of their time in the top section of the hills (58%). The middle section was used for 29.5% of the time and the lowest part of the hill for 10.3%.

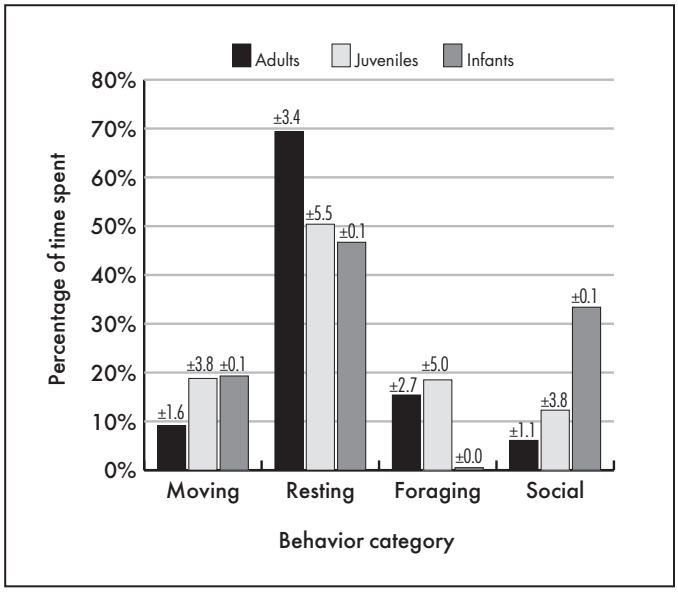

Figure 3. Comparison of time budgets (mean ±SE) between age classes for GR6 and GR10 combined (Adults: out of sight 53%; Juveniles: out of sight 66%; Infants: out of sight 65%).

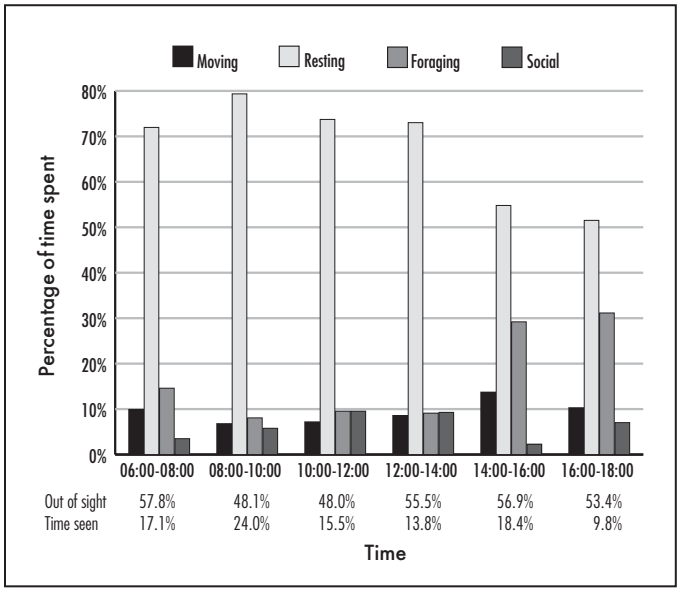

Figure 4. Daily activity pattern of adult langurs of groups GR6 and GR10 for six time intervals between 06:00 and 18:00. Percentages of 'Out of sight' and 'Time seen' of the langurs are given for each interval.

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They only spent 2.2% of the time in the valley. Generally, the langurs moved from one elevation to another 1.5 times per hour. The langurs spent more time resting on the hill slopes and cliffs, and especially near the top, than elsewhere. The time spent in social behavior decreased as they descended, and social behavior was not observed at all in the valley. Foraging activity increased considerably in the lower elevations and was predominant in the valleys (Fig. 5).

Discussion

In this study the langurs were often difficult to see when in the dense vegetation which, as pointed out by Plowman (2006), can lead to underestimation of the frequency of certain behaviors. The fact that we observed the langurs only from some distance away might likewise have led to the frequency of some behaviors being underestimated and others overestimated. Resting and foraging were at times difficult to distinguish and small movements of the hands were difficult to see with the result that foraging as a behavior category may have been underestimated.

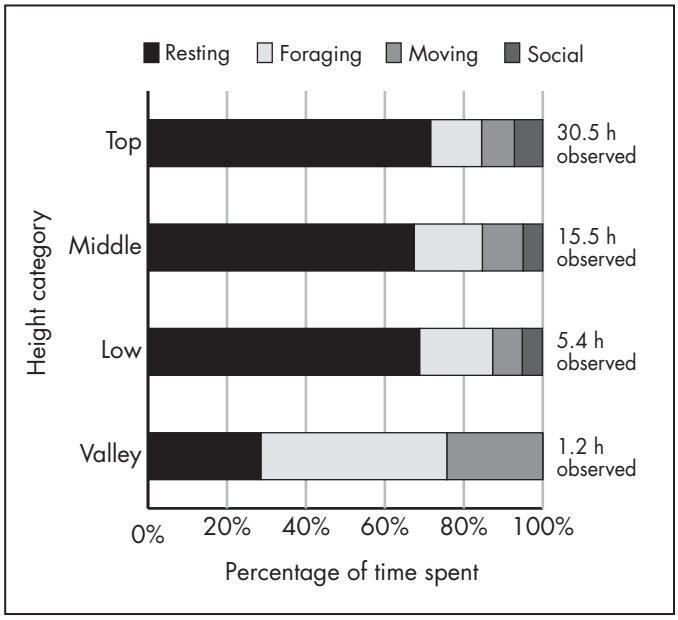

Figure 5. Behaviors displayed in different elevations (GR6 and GR10 combined) and the number of hours that the langurs were recorded in each.

The results of this study show similarities as well as differences in the behavior patterns and spatial distribution of Cat Ba langurs compared to other species of the *Trachypithecus francoisi* group of karst langurs. The time budget of the folivorous colobines is largely influenced by their diet. They spend the majority of their time resting and considerably less time feeding and moving (Clutton-Brock 1977; Stanford 1991; Fleagle 1999), and this is evidently the pattern for the two Cat Ba langur groups that we have studied. Infants and juveniles spent considerably more time than the adults in social behavior—grooming and playing. The same is true for the white-headed langur (Li and Rogers 2004), and is associated with their physical and behavioral development and socialization (Poirier *et al.* 1978).

The langurs spent much of their day resting, especially in the morning hours and around mid-day up to 14:00 (more than 70% of each 2-hour period). Other langurs such as Francois' langur (Zhou *et al.* 2007), the Yunnan snub-nosed monkey (*Rhinopithecus bieti*) (Ding and Zhao 2004) and the white-headed langur (Huang *et al.* 2003) are similar in this respect. The two groups spent less time resting in the afternoon (50% to 55% of the two 2-hour periods from 14:00 to 18:00) and more time foraging. Duc *et al.* (2009) found that, while eating similar amounts of leaves through the day, the black-shanked douc langurs (*Pygathrix nigripes*) they studied ate more fruits (energy-rich) in the morning. They argued that this was to compensate for an energy deficit that they accumulate during the night (as suggested Clutton-Brock 1977; Oates 1987). Perhaps for this reason, the Cat Ba langurs spent a little more time foraging early in the morning (about 15% of the time from 06:00 to 08:00) but less than 10% of their

Figure 6. Limestone karst hills on Cat Ba Island are the prime habitat for *Trachypithecus p. poliocephalus*. The densely vegetated lower slopes of the hills offer abundant food for the Cat Ba langurs. Photo by Pieter Levelink, 2010.

Figure 7. View from one of the fixed observation points showing the preferred limestone karst hill habitat of the Cat Ba langurs on Cat Ba Island. Photo by Johanna Rode, 2009.

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time foraging for the rest of the morning and early afternoon up to 14:00. Lacking fruit for this purpose the langurs may be expected to rest more in order to save energy (Ding and Zhao 2004). Considerably more time was spent foraging in the afternoon (around 30%). Morning and afternoon foraging periods and similar patterns of moving have also been found for the white-headed langur (Huang *et al.* 2003), Francois' langur (Yang *et al.* 2007), the Yunnan snub-nosed monkey (Ding and Zhao 2004), and the Nilgiri langur (*Semnopithecus johnii*) (Sunderraj 1998). The preponderance of social activities around noon shown by the Cat Ba langurs has not been mentioned for other langur species.

Time budgets are in most cases influenced by seasonal changes in temperature. Stanford (1991) observed that from summer to winter, capped langurs (*T. pileatus*) increased their time resting from 26% to 41%, and decreased feeding time from 41% to 27%. Huang *et al*. (2003) also found that midday resting periods of the white-headed langur were related to season; their study group spent less time resting in winter (57%) than in Spring (79%) or Summer and Autumn (84%). We studied the Cat Ba langurs in the early summer when the rainy season begins. This would suggest that the time spent resting by Cat Ba langurs would be less in the winter periods and even more in the summer months. This seasonal variation in time budget could influence the probability of observing the langurs, and thus the efficiency of the monitoring program. Long-term research on time budgets of the Cat Ba langurs is required for that reason.

The results of this study show that the Cat Ba langurs spent most of their time on the highest reaches of the cliffs and hills. This contrasts with the study of Li and Rogers (2005) on the white-headed langurs, which were found to use the lower slopes most of the time (60%). Li and Rogers (2005) suggested that this resulted from a preference for the less fragmented and less disturbed habitats found in the denser vegetation of the lower slopes and valleys in the Fusui Precious Animal Reserve where they lived. Like Fusui, the vegetation in the study area on Cat Ba Island was taller and less fragmented on the lower slopes of the hills but the langurs still used the upper slopes more often. This may indicate that the vertical ranging of the langurs was not directly influenced by the vegetation but by hunting. Cat Ba langurs do not have natural predators but have experienced severe hunting in the past (Nadler and Long 2000; Schrudde *et al.* 2009) and are still threatened by the presence of humans close by. Likewise, white-headed langurs were reluctant to go to the ground when humans were near (Li and Rogers 2005).

The Cat Ba langurs called a lot when on the upper slopes, perhaps to maintain contact, perhaps to alert group members of predators, convey behavioral states, attract mating partners or in territory defense (Eschmann *et al.* 2008).

With respect to their vertical ranging behavior, the langurs tended to rest when on the upper slopes of the hills. Tarsiers and baboons do the same (Fleagle 1999), possibly to avoid predation when they are inactive. The same reasoning would apply for the social behavior which decreased on the lower slopes the hills, as the vigilance levels in primates are usually lower during grooming (Cords 1995). The Cat Ba langurs spent more time foraging on the lower slopes of the hills. The same was found for white-headed langurs, which carried out their maintenance activities such as feeding in the lower and middle slopes (Li and Rogers 2005) as a result of high food diversity (Huang *et al.* 2008). However, one must be careful with these conclusions as the sample size differed for each elevation level, and was especially small for the valley.

Overall, studies on closely related species such as the white-headed langur and Francois' langur suggest that vertical ranging patterns and their activity budgets are strongly dependent on food availability, food diversity and probably human presence. This study has discovered similar dependencies for the Cat Ba langurs. Their vertical ranging pattern is likely adapted to the abundant food in the lower parts of the hills as well as to possible threats from humans. However, since food availability/diversity and human presence have not been measured quantitatively in this study we propose further research in this direction to find possible limiting factors in the distribution of Cat Ba langurs across the island.

In our study, the langurs were most often seen between 06:00 and 10:00, while observations in the afternoon were limited to the period between 14:00 and 16:00. The fact that the langurs were seen less in the late afternoon could be explained by their return to the sleeping caves, which generally faced the open water and were obscured from our observation posts. When censusing the population it is essential to detect all individuals of a group, and we found that most individuals were usually seen between 08:00 and 12:00 in the morning, when 'out of sight' rates were smallest for both study groups. The crucial time for monitoring would be from 08:00–10:00, while the optimal hours for detecting all individuals of a group would be until 12:00. Keeping in mind that there is a potential seasonal effect on the time budget, which could alter the probabilities of observing the langurs and getting good counts, the most favorable hours for monitoring could be different in the summer and winter periods.

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Literature Cited

Caro, T. 1998. *Behavioral Ecology and Conservation Biology*. Oxford University Press, New York.

Clemmons, J. R. and R. Buchholz. 1997. *Behavioral Approaches to Conservation in the Wild.* Cambridge University Press, Cambridge, UK.

Clutton-Brock, T. H. 1977. Some aspects of intraspecific variation in feeding and ranging behaviour in primates. In: *Primate Ecology: Studies of Feeding and Ranging Behaviour in Lemurs, Monkeys and Apes*, T. H. Clutton-Brock (ed.), pp.539–566. Academic Press, London.

Cords, M. 1995. Predator vigilance costs of allogrooming in wild blue monkeys. *Behaviour* 132(7–8): 559–569.

Dasilva, G. L. 1992. The western black-and-white colobus as a low-energy strategist: activity budgets, energy expenditure and energy intake. *J. Anim. Ecol.* 61(1): 79–91.

Ding, W. and Q. K. Zhao. 2004. *Rhinopithecus bieti* at Tacheng, Yunnan: diet and daytime activities. *Int. J. Primatol.* 25(3): 583–598.

Duc, H. M., G. S. Baxter and M. J. Page. 2009. Diet of *Pygathrix nigripes* in southern Vietnam. *Int. J. Primatol.* 30(1): 15–28.

Eschmann, C., R. Moore and K. A. I. Nekaris. 2008. Calling patterns of western purple-faced langurs (Mammalia: Primates: Cercopithecidea: *Trachypithecus vetulus nestor*) in a degraded human landscape in Sri Lanka. *Contrib. Zool.* 77: 57–65.

Fleagle, J. 1999. *Primate Adaptation and Evolution*. Academic Press, San Diego.

Fooden, J. 1996. Zoogeography of Vietnamese primates. *Int. J. Primatol.* 17(5): 845–899.

Groves, C. P. 2004. Taxonomy and biogeography of primates in Vietnam and neighbouring regions. In: *Conservation of Primates in Vietnam*, T. Nalder, U. Streicher and Ha Thang Long (eds.), pp.15–22. Frankfurt Zoological Society, Frankfurt, Germany.

Huang, C., F. Wei, M. Li, Y. Li and R. Sun. 2003. Sleeping cave selection, activity pattern and time budget the white-headed langurs. *Int. J. Primatol.* 24(4): 813–824.

Huang, C., H. Wu, Q. Zhou, Y. Li and X. Cai. 2008. Feeding strategy of Francois' langur and white-headed langur at Fusui, China. *Am. J. Primatol.* 70(4): 320–326.

IUCN. 2009. *2009 IUCN Red List of Threatened Species.* International Union for Conservation of Nature and Natural Resources (IUCN), Species Survival Commission (SSC), Gland, Switzerland, and Cambridge, UK. Available at: <www.iucnredlist.org>. Accessed: 27 January 2010.

Li, Z. and E. Rogers. 2004. Habitat quality and activity budgets of white-headed langurs in Fusui, China. *Int. J. Primatol.* 25(1): 41–54.

Li, Z. and E. Rogers. 2005. Are limestone hills a refuge or essential habitat for white-headed langurs in Fusui, China? *Int. J. Primatol.* 26(2): 437–452.

Lippold, L. K. and Vu Ngoc Thanh. 1998. Primate Conservation in Vietnam. In: *The Natural History of the Doucs and Snub-nosed Monkey*, N. G. Jablonski (ed.), pp.293–300. World Scientific Publishing, Singapore.

Martin, P. and P. Bateson. 1993. *Measuring Behaviour: An Introductory Guide*. Cambridge University Press, Cambridge, UK.

Mittermeier, R. A., J. Wallis, A. B. Rylands, J. U. Ganzhorn, J. F. Oates, E.A. Williamson, E. Palacios, E.W. Heymann, M.C.M. Kierulff, Long Yongcheng, J. Supriatna, C. Roos, S. Walker, L. Cortés-Ortiz and C. Schwitzer (eds.) 2009. *Primates in Peril: The World's 25 Most Endangered Primates 2008–2010.* IUCN/SSC Primate Specialist Group (PSG), International Primatological Society (IPS), and Conservation International (CI), Arlington, VA.

Nadler, T. and H. T. Long. 2000. *The Cat Ba langur: Past, Present and Future. The Definitive Report on* Trachypithecus poliocephalus*, the World's Rarest Primate.* Report of the Frankfurt Zoological Society, Hanoi.

Nadler, T., Vu Ngoc Thanh and U. Streicher. 2007. Conservation status of Vietnamese primates*. Vietnam. J. Primatol.* 1(1): 7–26.

Poirier, F. E., A. Bellisari and L. Haines. 1978. Functions of primate play behavior. In: *Social Play in Primates*, E. O. Smith (ed.), pp.143–168. Academic Press, New York.

Oates, J. F. 1987. Food distribution and foraging behavior. In *Primate Societies*, B. B. Smuts, D. L. Cheney, R. M. Seyfarth, R. W. Wrangham and T. T. Struhsaker (eds.), pp.197-209. The University of Chicago Press, Chicago.

Plowman, A. B. 2006. *Zoo Research Guidelines: Statistics for Typical Zoo Datasets*. BIAZA, London.

Roos. C., Vu Ngoc Thanh, L. Walter, and T. Nadler. 2007. Molecular systematics of Indochinese primates. *Vietnam. J. Primatol.* 1(1): 41–53.

Schrudde, D., R. Stenke, Phan Duy Thuc and M. Raffel. 2009. Golden-headed langur or Cat Ba langur *Trachypithecus poliocephalus poliocephalus* (Trouessart, 1911). In: *Primates in Peril: The World's 25 Most Endangered Primates 2008–2010*, R. A. Mittermeier *et al.* (eds.), pp.51–52. IUCN/SSC Primate Specialist Group (PSG), International Primatological Society (IPS), and Conservation International (CI), Arlington, VA.

Stanford, C. B. 1991. The capped langur in Bangladesh: behavioral ecology and reproductive tactics. *Contrib. Primatol.* 26: 1–179.

Stenke, R. 2003. Projekt Goldkopflangur auf Cat Ba Island, Nordvietnam. *ZGAP Mitteilungen* 19(2): 3–4.

Sunderraj, S. F. W. 1998. Ecology and conservation of Nilgiri langur (*Trachypithecus johnii*). *Envis Bulletin: Wildlife and Protected Areas* 1: 49–59.

Van Ngoc Thinh, A. R. Mootnick, Vu Ngoc Thanh, T. Nadler and C. Roos. 2010. A new species of crested gibbon, from the central Annamite mountain range. *Vietnam. J. Primatol.* 1(4): 1–12.

Viet, H. and K. Lin. 2001. Cat Ba National Park Vietnam*. ITCZM Monograph* 2.

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Yang, L., Z. Minghai, M. Jianzhang, W. Ankang,W. Shuangxi and Z. Shusen. 2007. Time budget of daily activity of Francois' langur (*Trachypithecus francoisi francoisi*) in disturbance habitat. *Acta Ecologica Sinica* 27: 1715−1722.

Zhou, Q., F. Wie, C. Huang, M. Li, B. Ren and B. Luo. 2007. Seasonal variation in the activity patterns and time budgets of *Trachypithecus francoisi* in the Nonggang Nature Reserve, China. *Int. J. Primatol.* 28(3): 657–671.

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