Supplementary Materials

Supplementary Materials and Methods

Study site and animals

The study site was located in the Banli area of the Guangxi Chongzuo White-Headed Langur National Nature Reserve, southwest Guangxi, China (E107°16′53″–107°59′46″, N22°10′43″–22°36′55″). The reserve is dominated by seasonal limestone rainforests and limestone hills. The limestone mountains are covered by many exposed rocks and forest and the altitude ranges from 400 m to 600 m (Guangxi Forestry Department, 1993).

Over the study period, we observed four groups of white-headed langurs: G-DS, G-ZWY, G-LZ, and G-NN. At the beginning of the study, G-DS was composed of 15 individuals, which increased to 25 by the end of this study; G-ZWY was composed of 16 individuals, which increased to 19; G-LZ consisted of six individuals, which increased to eight; and G-NN consisted of five individuals, which increased to nine. The variation in number of individuals was primarily due to the birth of infants (Zhang et al., 2020).

Data collection on ecological factors

From September 2016 to August 2017, we collected rainfall data using a rain gauge (20 cm diameter, TZZT-J16022, Taizhou Zhongtai Teaching Equipment Co., Ltd, Jiangsu, China). We used two electronic automatic temperature and humidity data loggers (SSN-22, Yowexa Sensing Systems Ltd., Shenzhen, China) to collect temperature and humidity data. One thermometer was set in the middle forest layer, and the other was placed on bare rock to record the temperature and humidity of the forest and bare rock, respectively. We calculated the mean temperature and humidity data of each month, including mean highest temperature of forest (HTF), mean lowest temperature of forest (LTF), mean temperature of forest (MTF), mean relative humidity of forest (RHF), mean highest temperature of bare rock (HTR), mean lowest temperature of bare rock (LTR), mean temperature of bare rock (MTR), and mean relative humidity of bare rock (RHR). For the convenience of hourly data analysis, we calculated the average temperature and humidity each hour from 06:00 to 19:00. Daylength data were obtained from local weather stations. During our study period, climatic factors varied across the year (Figure 1). Specifically, HTF ranged from 19.5 ℃ in January 2017 to 32.5 ℃ in September 2016, LTF ranged from 12.0 ℃ in December 2016 to 24.4 ℃ in June 2017, MTF ranged from 15.7 ℃ in January 2017 to 27.9 ℃ in September 2016, RHF ranged from 75.1% in February 2016 to 92.4% in May 2017, HTR ranged from 31.3 ℃ in March 2017 to 50.7 ℃ in June 2017, LTR ranged from 11.8 ℃ in December 2016 to 24.6 ℃ in July 2017, MTR ranged from 19.1 ℃ in January 2017 to 32.2 ℃ in June 2017, and RHR ranged from 65.5% in February 2017 to 80.8% in March 2017. Rainfall ranged from 37 mm in December 2016 to 840 mm in May 2017. Based on monthly rainfall, the study period was roughly divided into two seasons: a dry season from September to February and a rainy season from March to August. Daylength ranged from 692.1 min in December 2016 to 856.4 min in June 2017. Rainfall and daylength varied significantly between seasons (rainfall: F=6.282, df=1, P=0.031; daylength:

F=26.321, df=1, P<0.001). Temperature and humidity were higher in the rainy season than in the dry season (HTF: F=63.813, df=1, P<0.001; MTF: F=116.723, df=1, P<0.001; HF: F=42.475, df=1, P<0.001; HTR: F=21.317, df=1, P<0.001; MTR: F=83.751, df=1, P<0.001), except for the humidity of bare rock (HR: F=0.003, df=1, P=0.956).

Vegetation composition and food availability index (FAI)

We randomly established 37 quadrats across the main study site to investigate vegetation composition, including thirty 20 m×20 m quadrats and seven 10 m×10 m quadrats. We recorded trees, shrubs, and woody lianas with a diameter at breast height or basal diameter >2 cm within the quadrats, and then determined plant dominance using relative density. We recorded canopy width and height of plants to calculate canopy volume. According to the plant sample survey, the dominant trees in our study area were *Fabaceae*, *Euphorbiaceae*, *Moraceae*, *Rhamnaceae*, *Rubiaceae*, *Ulmaceae*, *Anacardiaceae*, *Lauraceae*, and *Verbenaceae.*

According to Huang et al. (2015) and Zhang et al. (2017), we selected 27 main food species of the white-headed langurs (with each species accounting for more than 0.5% of feeding time), totaling 270 trees (i.e., 10 individuals per species), for food availability monitoring. At the middle of each month, we visually inspected the sampled trees for the presence of food (e.g., young leaves, mature leaves, flowers, and fruits), and the abundance of various food parts was scored on a six-point scale (0–5 point). The monthly FAI for young leaves, mature leaves, flowers, and fruits was calculated by integrating canopy volume and phenology score of the sampled trees, using the following formula:

$$FAI=\sum_{i=1}^{n} ViPi,$$

where Vi denotes the canopy volume of species i and Pi represents the assignment values of different food parts of species i. During the study period, the FAI varied across the year (Figure 1). The availability of young leaves ranged from 2 377.5 in January 2017 to 15 827.8 in March 2017, mature leaves ranged from 20 677.4 in March 2017 to 37 758.4 in July 2017, flowers ranged from 9.7 in July 2017 to 3 919.6 in April 2017, and fruits ranged from 295.8 in September 2016 to 5 224.7 in June 2017. The availability of young leaves (F=9.661, df=1, P=0.011) and fruits (F=13.523, df=1, P=0.004) in the rainy season was higher than that in the dry season, but there was no significant seasonal difference in the availability of mature leaves (F=0.498, df=1, P=0.496) or flowers (F=154, df=1, P=0.703).

Behavioral data collection

During observations (September 2016 to August 2017), we used instantaneous scan sampling (Altmann, 1974) to collect behavioral data on langurs, including activity budget, daily path length, and diet. Each scan began every 15 min and lasted for 5 min, followed by 10 min with no recording until the next scan began (Zhang et al., 2020). We recorded the main behaviors of the langurs, including feeding, resting, moving, grooming, playing, and others (behavior not classified into any of the five previous categories) (Huang et al., 2015; Li et al., 2020). When the target individual was feeding, the food species and parts eaten (young leaves, mature leaves, flowers, fruits, other) were recorded.

We constructed a grid map to calculate the daily path length by superimposing a 50 m×50 m (0.25 ha) grid cell system on a topographic map (scale 1:10 000) (Huang et al., 2017; Zhou et al., 2011). During each scan, we recorded the central position of the langur group and marked it on the grid map, and then estimated the ranging distance based on the two central positions on the map, and the straight-line distances between successive chronological locations for each day was the daily path length (Huang et al., 2017; Zhou et al., 2011). We combined topographical maps with actual observations and included vertical movements in ranging distance when recording behaviors.

Data analysis

The activity budget was expressed as a percentage of time spent on a particular activity (Fan et al., 2012; Li et al., 2020). Specifically, we averaged the data of four scans per hour, and hourly time budgets were generated. The data for each hour were averaged to calculate the average monthly activity budget, thus avoiding bias due to uneven data collection times throughout the sampling periods. Annual time budgets were obtained by averaging all monthly percentages (Fan et al., 2012; Zhang et al., 2020). We used similar methods to generate statistics on dietary data, i.e., diet composition as a percentage of feeding time spent on particular food items or food species (Li et al., 2020). We used the Shannon-Wiener index to calculate the monthly dietary diversity index, with the following formula:

$$H' = -\sum_{i=1}^{n} Pi \times lnPi,$$

where Pi is the percentage of food species i in the monthly diet based on time spent on feeding.

Normality of the variables was examined using the one-sample Kolmogorov-Smirnov test. Most variables were normally distributed, except for time devoted to playing, which followed a non-normal distribution. Thus, we used the Mann-Whitney U test to examine seasonal variations in time budget and daily path length. Furthermore, to improve linearity and normality, the variables expressed as percentages were logit-transformed (Warton & Hui, 2011), and variables not expressed as percentages were $\log_{10}(X+1)$-transformed (Li et al., 2020; Xu et al., 2017). We used Spearman's rank correlation to estimate the relationships among variables. To control the collinearity of the predictive variables, most pairwise correlation coefficients were controlled within the commonly used threshold of $|r|<0.70$ (Li et al., 2016), and all were controlled within the more stringent (but common) threshold of $|r|=0.85$ (Liu et al., 2014). Monthly and seasonal variations in climatic variables were measured using one-way analysis of variance (ANOVA).

We constructed generalized linear mixed models (GLMMs) to examine the influence of diet, food availability, and climatic factors on activity budget and daily path length (Bolker et al., 2009; Eppley et al., 2017; Kelley et al., 2016). If a model did not converge, a generalized linear model (GLM) was alternatively used (Aristizabal et al., 2018; Hanya et al., 2018; Li et al., 2020). We set the monthly activity budget and daily path length as the response variables, and dietary composition (including young leaves, mature leaves, flowers, and fruits) and dietary diversity index as the explanatory variables to test the impact of diet on ranging behavior. Similarly, when analyzing the impact of ecological factors, the monthly activity budget and daily path length were taken as the response variables, and food availability (including young leaves, mature leaves, flowers, and fruits) and climatic factors (including rainfall, daylength, temperature, and humidity of the middle forest layer and bare rock surface) were taken as the explanatory variables to examine the influence of ecological factors (Li et al., 2020). Considering the correlation coefficients between ecological factors, we used average maximum temperature (HTF and HTR) as the proxy for temperature. Furthermore, we set the hourly activity pattern and ranging distance (06:00–19:00) as the response variables and average temperature and humidity of each hour from 06:00–19:00 as the explanatory variables to test the hourly influence of environmental factors on ranging behavior. We introduced the multi-model inference grounded on information theory (Akaike's Information Criterion corrected for small sample sizes (AICc)) to evaluate the relative importance of each variable in the models (Burnham & Anderson, 2002; Li et al., 2020; Xu et al., 2017).

Models that considered all possible combinations of all predictive variables were ranked according to their AICc values. We obtained a total of $2^5-1=31$ models for diet composition and $2^{10}-1=1\,023$ models for ecological factors for monthly data analysis, and $2^4-1=15$ models for hourly data analysis. We summed the Akaike weights of each model, including specific variables, to obtain the relative importance of each predictor (W_{ip}). We regarded the model with the lowest AICc value as the top model, and the model within two AICc units ($\Delta AICc \leq 2$) in the reported top model as a highly supported model (Burnham & Anderson, 2002). We used the model average regression coefficient (β) with a 95% confidence interval to estimate the effect of each prediction variable on the model. The predictors contained in the highly supported models were the most important factors influencing the response variables as their 95% confidence intervals never overlapped with zero (Li et al., 2016, 2020). We used the *MuMIn* and *lme4* packages in R 3.6.3 for analysis. The *dredge* and *model.avg* functions in the *MuMIn* package were used to conduct multi-model inference analysis of GLMMs and GLM (Bartoń, 2020), and the lme4 package was used for GLMMs. All tests were two-tailed and $P<0.05$ was considered statistically significant.

REFERENCES

Altmann J. 1974. Observational study of behavior: sampling methods. *Behaviour*, **49**(3–4): 227–266.

Aristizabal JF, Lévêque L, Chapman CA, Serio-Silva JC. 2018. Impacts of temperature on behaviour of the Mexican endangered black howler monkey *Alouatta pigra* Lawrence, 1933 (Primates: Atelidae) in a Fragmented Landscape. *Acta zoologica Bulgarica*, **70**(3): 377–382.

Bartoń K. 2020. MuMIn: multi-model inference. R package version 1.43.17. https://CRAN.R-project.org/package=MuMIn.

Bolker BM, Brooks ME, Clark CJ, Geange SW, Poulsen JR, Stevens M, et al. 2009. Generalized linear mixed models: a practical guide for ecology and evolution. *Trends in Ecology & Evolution*, **24**(3): 127–135.

Burnham KP, Anderson DR. 2002. Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach. New York: Springer.

Eppley TM, Watzek J, Dausmann KH, Ganzhorn JU, Donati G. 2017. Huddling is more important than rest site selection for thermoregulation in southern bamboo lemurs. *Animal Behaviour*, **127**: 153–161.

Fan PF, Fei HL, Ma CY. 2012. Behavioral responses of Cao Vit gibbon (*Nomascus nasutus*) to variations in food abundance and temperature in Bangliang, Jingxi, China. *American Journal of Primatology*, **74**(7): 632–641.

Guangxi Forestry Department. 1993. Nature Reserves in Guangxi. Beijing: China Forestry Publishing House. (in Chinese)

Hanya G, Otani Y, Hongo S, Honda T, Okamura H, Higo Y. 2018. Activity of wild Japanese macaques in Yakushima revealed by camera trapping: patterns with respect to season, daily period and rainfall. *PLoS One*, **13**(1): e0190631.

Huang ZH, Huang CM, Tang CB, Huang LB, Tang HX, Ma GZ, et al. 2015. Dietary adaptations of Assamese macaques (*Macaca assamensis*) in limestone forests in Southwest China. *American Journal of Primatology*, **77**(2): 171–185.

Huang ZH, Yuan PS, Huang HL, Tang XP, Xu WJ, Huang CM, et al. 2017. Effect of habitat fragmentation on ranging behavior of white-headed langurs in limestone forests in southwest China. *Primates*, **58**(3): 423–434.

Kelley EA, Jablonski NG, Chaplin G, Sussman RW, Kamilar JM. 2016. Behavioral thermoregulation in *Lemur catta*: the significance of sunning and huddling behaviors. *American Journal of Primatology*, **78**(7): 745–754.

Li YH, Ma GZ, Zhou QH, Huang ZH. 2020. Seasonal variation in activity budget of assamese macaques in limestone forest of Southwest Guangxi, China. *Folia Primatologica*, **91**(5): 495–511.

Li YM, Li XP, Sandel B, Blank D, Liu ZT, Liu X, et al. 2016. Climate and topography explain range sizes of terrestrial vertebrates. *Nature Climate Change*, **6**(5): 498–502.

Liu X, Li XP, Liu ZT, Tingley R, Kraus F, Guo ZW, et al. 2014. Congener diversity, topographic heterogeneity and human-assisted dispersal predict spread rates of alien herpetofauna at a global scale. *Ecology Letters*, **17**(7): 821–829.

Warton DI, Hui FKC. 2011. The arcsine is asinine: the analysis of proportions in ecology. *Ecology*, **92**(1): 3–10.

Xu Y, Lin SL, He JK, Xin Y, Zhang LX, Jiang HS, et al. 2017. Tropical birds are declining in the Hainan Island of China. *Biological Conservation*, **210**: 9–18.

Zhang KC, Yuan PS, Huang HL, Tang XP, Zhou QH, Huang ZH. 2017. Inter-site variation in dietary composition of white-headed langurs (*Trachypithecus leucocephalus*). *Journal of Guangxi Normal University*: *Natural Science Edition*, **35**(1): 75–81. (in Chinese)

Zhang KC, Zhou QH, Xu HL, Huang ZH. 2020. Effect of group size on time budgets and ranging behavior of white-headed Langurs in limestone Forest, Southwest China. *Folia Primatologica*, **91**(3): 188–201.

Zhou QH, Huang CM, Li M, Wei FW. 2011. Ranging behavior of the François' langur (*Trachypithecus françoisi*) in limestone habitats of Nonggang, China. *Integrative Zoology*, **6**(2): 157–164.

Supplementary Tables

Supplementary Table S1. Effects of diet on ranging behavior of white-headed langurs based on monthly data model averaging.

Variables	Resting				Moving			
	w β	95%CI		W_{ip}	β	95%CI		W_{ip}
Intercept	0.890	0.226	1.554	0.02	-2.398	-2.881	-1.914	0.00
Young leaves	-0.142	-0.312	0.027	0.22	0.071	-0.054	0.196	0.07
Mature leaves	0.132*	0.022	0.243	0.37	-0.043	-0.138	0.051	0.04
Flowers	0.025	-0.024	0.073	0.02	-0.030	-0.069	0.010	0.03
Fruits	-0.079	-0.194	0.036	0.08	-0.014	-0.106	0.078	0.03
DDI	-1.326*	-2.164	-0.487	0.96	2.472*	1.796	3.148	0.98
Variables	Feeding				Grooming			
	β	95%CI		W_{ip}	β	95%CI		W_{ip}
Intercept	-0.488	-0.675	-0.302	0.73	-2.248	-3.025	-1.471	0.00
Young leaves	-0.015	-0.129	0.098	0.02	0.604*	0.390	0.818	0.90
Mature leaves	0.001	-0.083	0.084	0.04	-0.135	-0.387	0.117	0.11
Flowers	0.010	-0.021	0.041	0.01	-0.043	-0.097	0.012	0.06
Fruits	-0.004	-0.077	0.069	0.02	0.357*	0.216	0.498	0.99
DDI	-0.060	-0.663	0.543	0.18	2.006*	0.864	3.148	0.99
Variables	playing				Other			
	β	95%CI		W_{ip}	β	95%CI		W_{ip}
Intercept	-3.396	-8.258	1.467	0.05	-3.529	-8.929	1.871	0.01
Young leaves	0.797	-0.855	2.448	0.25	-0.273	-2.450	1.904	0.79
Mature leaves	0.063	-1.336	1.462	0.47	1.251*	0.046	2.457	0.45
Flowers	-0.036	-0.467	0.395	0.11	0.261	-0.168	0.689	0.23
Fruits	0.632	-0.360	1.623	0.41	0.372	-0.705	1.449	0.32
DDI	0.312	-7.775	8.399	0.75	2.216	-6.042	10.477	0.76
Variables	Distance							
	β	95%CI		W_{ip}				
Intercept	1.850	1.538	2.162	0.00				
Young leaves	0.023	-0.060	0.106	0.03				
Mature leaves	0.006	-0.057	0.068	0.02				
Flowers	0.013	-0.013	0.039	0.01				
Fruits	-0.041	-0.100	0.019	0.05				
DDI	1.123*	0.680	1.567	0.99				

DDI: dietary diversity index. β: model-averaged regression coefficients. 95% CI: the 95% confidence intervals of regression coefficients β. W_{ip}: relative variable importance. *: regression coefficients β with the 95% confidence intervals excluding zero.

Supplementary Table S2. Top linear regression models (lm) (ΔAICc≤2) examining effects of diet on ranging behavior of white-headed langurs.

Variables	Resting			Feeding	Moving
	1	2	3	1	1
Intercept				●	●
Young leaves		●			
Mature leaves			●		
Flowers					
Fruits					
DDI	●	●	●		
ΔAIC	0.00	0.21	1.70	0.00	34.38
AICc	-46.59	-46.38	-44.89	-80.83	-29.52
W_i	0.43	0.39	0.18	1	1

Variables	Grooming	Playing					
	1	1	2	3	4	5	6
Intercept	●	●					
Young leaves			●		●		●
Mature leaves						●	●
Flowers							
Fruits				●	●		●
DDI		●	●	●	●	●	●
ΔAIC	27.17	0.00	0.71	0.74	0.97	1.82	1.89
AICc	4.23	156.55	157.25	157.29	157.52	158.37	158.44
W_i	1	0.26	0.18	0.18	0.16	0.11	0.10

Variables	Other			Distance
	1	2	3	1
Intercept				●
Young leaves		●		
Mature leaves	●	●	●	
Flowers				
Fruits			●	
DDI	●	●	●	
ΔAIC	0.00	0.92	1.51	18.30
AICc	154.95	155.87	156.47	-84.34
W_i	0.48	0.30	0.22	1

●: the variable is included in the model. ΔAIC: the difference between each model and the highest ranked model. AICc: Akaike's information criterion adjusted for small sample sizes. W_i: Akaike weights, the probability that a model is best given the particular set of models considered; models are ranked in the order of increasing AICc. DDI: Dietary diversity index.

Supplementary Table S3. Effects of food availability and climatic factors on ranging behavior of white-headed langurs based on monthly data model averaging.

Variables	Resting				Moving**			
	β	95% CI		W_{ip}	β	95% CI		W_{ip}
Intercept	1.429	-8.774	11.633	0.00	8.664	-0.463	17.792	0.00
YL-FAI	0.120	-0.359	0.599	0.03	-0.119	-0.447	0.208	0.14
ML-FAI	0.719*	0.077	1.361	0.59	-0.908*	-1.576	-0.241	0.54
FL-FAI	0.047*	0.004	0.090	0.06	-0.011	-0.068	0.046	0.09
FR-FAI	-0.251*	-0.409	-0.093	0.65	0.394*	0.216	0.572	0.69
Rainfall	0.125	-0.058	0.309	0.07	0.001	-0.141	0.144	0.12
Daylength	-2.222	-5.991	1.547	0.48	-2.922*	-5.472	-0.374	0.61
HTF	1.002	-0.448	2.452	0.41	-0.175	-1.755	1.405	0.12
RHF	-0.358	-0.981	0.265	0.20	0.023	-0.721	0.767	0.09
HTR	0.367	-0.621	1.356	0.20	-0.816	-2.143	0.511	0.19
RHR	-0.454	-1.074	0.165	0.26	-0.043	-0.773	0.687	0.11
Variables	Feeding				Grooming			
	β	95% CI		W_{ip}	β	95% CI		W_{ip}
Intercept	-1.209	-4.824	2.406	0.17	-21.320*	-30.133	-12.507	0.00
YL-FAI	-0.023	-0.384	0.339	0.02	0.095	-0.441	0.631	0.05
ML-FAI	-0.125	-0.721	0.470	0.08	-0.350	-1.365	0.665	0.19
FL-FAI	-0.017	-0.061	0.026	0.00	-0.040	-0.109	0.030	0.02
FR-FAI	-0.012	-0.150	0.126	0.00	0.170	-0.092	0.433	0.05
Rainfall	-0.087	-0.234	0.059	0.01	0.111	-0.077	0.299	0.07
Daylength	0.807	-1.209	2.822	0.31	8.075*	4.663	11.486	0.83
HTF	-0.444	-1.310	0.421	0.25	-1.761*	-3.138	-0.385	0.81
RHF	0.236	-0.142	0.614	0.13	-0.220	-1.157	0.717	0.13
HTR	-0.176	-0.857	0.505	0.15	-0.681	-1.919	0.557	0.34
RHR	0.298	-0.181	0.778	0.17	0.334	-0.465	1.134	0.19
Variables	Playing				Other			
	β	95% CI		W_{ip}	β	95% CI		W_{ip}
Intercept	-22.910	-94.704	48.885	0.00	39.881	-37.564	117.327	0.00
YL-FAI	0.041	-3.714	3.796	0.22	-1.431	5.524	2.662	0.32
ML-FAI	-4.614	-12.835	3.606	0.49	-3.965	-13.602	5.672	0.54

FL-FAI	-0.338	-0.887	0.212	0.06	0.254	-0.328	0.835	0.04
FR-FAI	-0.225	-2.140	1.690	0.14	-0.266	-2.273	1.742	0.17
Rainfall	-0.146	-1.797	1.504	0.08	-0.069	-1.965	1.826	0.14
Daylength	12.241	-14.489	38.970	0.52	-13.468	-42.633	15.696	0.60
HTF	-1.772	-15.753	12.209	0.45	3.315	-13.032	19.661	0.56
RHF	1.395	-5.231	8.021	0.36	-2.586	-9.448	4.276	0.45
HTR	4.394	-6.656	15.443	0.50	5.470	-5.958	16.897	0.58
RHR	-0.898	-7.493	5.696	0.38	0.912	-5.993	7.818	0.39

Variables	Distance**			
	β	95% CI		W_{ip}
Intercept	4.994*	0.469	9.518	0.00
YL-FAI	-0.088	-0.361	0.186	0.09
ML-FAI	-0.417	-1.053	0.218	0.25
FL-FAI	-0.012	-0.056	0.032	0.09
FR-FAI	0.144*	0.030	0.259	0.55
Rainfall	0.003	-0.121	0.128	0.08
Daylength	-0.892	-3.184	1.399	0.14
HTR	0.260	-1.040	1.559	0.09
RHF	-0.062	-0.696	0.572	0.11
HTR	-0.738*	-1.393	-0.082	0.43
RHR	-0.307	-0.825	0.211	0.18

YL-FAI: food availability index for young leaves; ML-FAI: food availability index for mature leaves; FL-FAI: food availability index for flowers; FR-FAI: food availability index for fruits. HTF: mean highest temperature of forest; HTR: mean highest temperature of bare rock; RHF: relative humidity of forest; RHR: relative humidity of bare rock. β: model-averaged regression coefficients; 95% CI: the 95% confidence intervals of regression coefficients β; W_{ip}: relative variable importance. *: regression coefficients β with the 95% confidence intervals excluding zero. **: the model was established by GLM

Supplementary Table S4. Top linear regression models (lm) (ΔAICc$\leq$2) examining effects of food availability and climatic factors on ranging behavior of white-headed langurs.

Variables	Distance**							Moving**	
	1	2	3	4	5	6	7	1	2
Null									
YL-FAI									
ML-FAI			●		●		●	●	●
FL-FAI						●			
FR-FAI	●	●	●	●	●	●	●	●	●
Rainfall									
Daylength			●					●	●
HTF									
RHF				●					
HTR	●	●		●	●	●	●		●
RHR	●					●	●		
ΔAIC	0.00	0.45	0.80	0.94	1.61	1.68	1.94	0.00	1.92
AICc	-99.51	-99.07	-98.71	-98.57	-97.91	-97.84	-97.58	-66.14	-64.22
W_i	0.23	0.18	0.15	0.14	0.10	0.10	0.09	0.72	0.28

Variables	Feeding		Grooming			
	1	2	1	2	3	4
Null	●					
YL-FAI						
ML-FAI						●
FL-FAI						
FR-FAI						
Rainfall						
Daylength		●	●	●	●	●
HTF		●	●	●	●	●
RHF						
HTR				●		
RHR					●	
ΔAIC	0.00	1.92	0.00	0.06	1.69	1.78
AICc	-80.83	-78.92	-36.10	-36.05	-34.42	-34.33
W_i	0.72	0.28	0.36	0.35	0.15	0.15

Variables	Resting								
	1	2	3	4	5	6	7	8	9
Null									
YL-FAI									
ML-FAI	●	●	●	●		●	●	●	●
FL-FAI									
FR-FAI	●	●	●	●	●	●	●	●	●
Rainfall									
Daylength		●		●	●			●	
HTF		●		●	●	●			●
RHF			●						
HTR					●				
RHR		●				●	●		
ΔAIC	0.00	0.12	0.41	0.52	0.74	0.86	0.96	1.33	1.47
AICc	-66.25	-66.12	-65.83	-65.73	-65.51	-65.38	-65.28	-64.92	-64.78
W_i	0.11	0.10	0.09	0.08	0.07	0.07	0.07	0.05	0.05

Variables	Resting						
	10	11	12	13	14	15	16
Null							
YL-FAI							
ML-FAI	●		●	●		●	
FL-FAI							
FR-FAI	●	●	●	●			
Rainfall				●			
Daylength		●	●		●	●	●
HTF		●			●	●	●
RHF						●	
HTR	●						●
RHR		●	●	●			
ΔAIC	1.55	1.63	1.75	1.79	1.84	1.88	1.89
AICc	-64.69	-64.62	-64.50	-64.46	-64.41	-64.37	-64.35
W_i	0.05	0.05	0.04	0.04	0.04	0.04	0.04

Variables	Playing								
	1	2	3	4	5	6	7	8	9
Null									
YL-FAI		●			●		●	●	
ML-FAI	●	●	●	●	●	●	●	●	●
FL-FAI									
FR-FAI						●			
Rainfall							●		
Daylength	●	●	●	●	●	●	●	●	●
HTF	●	●	●	●	●	●	●	●	●
RHF	●	●	●		●	●	●		
HTR	●	●	●	●	●	●	●	●	●
RHR	●	●		●		●	●	●	
ΔAIC	0.00	0.53	0.86	1.08	1.27	1.37	1.57	1.58	1.95
AICc	142.02	142.55	142.88	143.10	143.29	143.39	143.59	143.60	143.97
W_i	0.19	0.14	0.12	0.11	0.10	0.09	0.09	0.09	0.07
Variables	Other								
	1	2	3	4	5	6	7	8	9
Null									
YL-FAI	●		●	●	●		●		
ML-FAI	●	●	●	●	●	●	●	●	●
FL-FAI									
FR-FAI								●	●
Rainfall				●					
Daylength	●	●	●	●	●	●	●	●	●
HTF	●	●	●	●	●	●	●	●	●
RHF	●	●	●	●		●	●	●	
HTR	●	●	●	●	●	●	●	●	●
RHR	●	●		●	●		●	●	●
ΔAIC	0.00	0.26	0.90	1.05	1.21	1.38	1.44	1.59	1.97
AICc	140.34	140.60	141.23	141.39	141.54	141.72	141.78	141.93	142.31
W_i	0.18	0.16	0.12	0.11	0.10	0.09	0.09	0.08	0.07

YL-FAI: food availability index for young leaves; ML-FAI: food availability index for mature leaves; FL-FAI: food availability index for flowers; FR-FAI: food availability index for fruits. HTF: mean highest temperature of forest; HTR: mean highest temperature of bare rock; RHF: relative humidity of forest; RHR: relative humidity of bare rock. ●: the variable is included in the model; ∆AIC: the difference between each model and the highest ranked model; AICc: Akaike's information criterion adjusted for small sample sizes; W_i: Akaike weights, the probability that a model is best given the particular set of models considered; models are ranked in the order of increasing AICc. **: the model was established by GLM.

Supplementary Table S5. Effects of temperature and humidity on ranging behavior of white-headed langurs based on hourly data model averaging.

Variables	Resting				Moving			
	β	95%CI		W_{ip}	β	95%CI		W_{ip}
Intercept	-0.359*	-0.480	-0.237	0.42	1.704*	0.475	2.933	0.00
TF	0.037	-0.179	0.253	0.08	-1.091	-3.211	1.029	0.63
TR	0.055	-0.146	0.256	0.08	-1.843	-3.690	0.005	0.77
HF	-0.056*	-0.101	-0.011	0.47	0.577*	0.285	0.868	0.98
HR	0.034	-0.056	0.123	0.05	-0.432*	-0.824	-0.040	0.59
Variables	Feeding				Social behavior (Grooming+ playing)			
	β	95%CI		W_{ip}	β	95%CI		W_{ip}
Intercept	-0.801	-2.116	0.515	0.00	-4.291*	-5.545	-3.037	0.00
TF	-0.584	-2.879	1.711	0.46	-1.802	-3.724	0.120	0.85
TR	0.185	-2.423	2.793	0.45	3.101*	1.127	5.076	0.98
HF	0.402*	0.051	0.753	0.66	0.754*	0.477	1.031	0.99
HR	-0.820*	-1.328	-0.312	0.97	-0.284	-0.790	0.222	0.30
Variables	Distance							
	β	95%CI		W_{ip}				
Intercept	2.674*	2.095	3.252	0.00				
TF	-0.225	-1.318	0.868	0.40				
TR	-0.967*	-1.625	-0.309	0.87				
HF	0.220*	0.079	0.362	0.92				
HR	-0.260*	-0.430	-0.089	0.76				

TF: hourly mean temperature of forest; TR: hourly mean temperature of bare rock; HF: hourly relative humidity of forest; HR: hourly relative humidity of bare rock. β: model-averaged regression coefficients; 95% CI: the 95% confidence intervals of regression coefficients β; W_{ip}: relative variable importance. *: regression coefficients β with the 95% confidence intervals excluding zero.

Supplementary Table S6. Top linear regression models (lm) (ΔAICc≤2) examining effects of temperature and humidity on ranging behavior of white-headed langurs based on hourly data analysis.

Variables	Resting		Feeding				
	1	2	1	2	3	4	5
(Null)	●						
TF				●	●		
TR				●		●	
HF		●	●	●	●	●	
HR			●	●	●	●	●
ΔAIC	0.00	0.20	0.00	0.60	0.92	0.93	1.25
AICc	-273.23	-273.03	1987.65	1988.25	1988.57	1988.57	1988.90
W_i	0.52	0.48	0.28	0.21	0.18	0.18	0.15

Variables	Moving				Social behavior	Distance	
	1	2	3	4	1	1	2
(Null)					●		
TF		●	●	●			●
TR	●	●		●		●	●
HF	●	●	●	●		●	●
HR	●	●				●	●
ΔAIC	0.00	0.34	0.99	1.29	52.51	0.00	0.18
AICc	1590.87	1591.21	1591.86	1592.16	1845.86	569.98	571.78
W_i	0.34	0.28	0.20	0.18	1	0.71	0.29

TF: hourly mean temperature of forest; TR: hourly mean temperature of bare rock; HF: hourly relative humidity of forest; HR: hourly relative humidity of bare rock. Social behavior: Grooming + Playing. ●: the variable is included in the model; ΔAIC: the difference between each model and the highest ranked model; AICc: Akaike's information criterion adjusted for small sample sizes; W_i: Akaike weights, the probability that a model is best given the particular set of models considered; models are ranked in the order of increasing AICc.