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Activity and Dietary Spectrum of Golden Langur *(Trachypithecus geei)* in Kakoijana Reserve Forest, Assam, India

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ABSTRACT

Langurs' activity patterns and time allocation are primarily determined by environmental and habitat conditions. Activity pattern and feeding behaviour of golden langurs (*Trachypithecus geei*) were studied in Kakoijana Reserve Forest from January, 2015, to December, 2017. Focal animal scan sampling of six social troops (n = 11–20 individuals per troop) was done, and data were collected with a fixed time interval of 5 minutes from dawn to dusk. A total of 9940 scans were collected, and the golden langur has allocated the most time to resting in the study area (52.22 ±SD 3.11%), followed by feeding (28.87 ± 3.14), travelling (7.93 ± 1.47%), vigilance (6.51± 1.59%), grooming (3.40 ± 0.86%) and other miscellaneous activities comprising 1.07± 0.86% (n = 144). About 60% of total daily food was composed of leaves, followed by fruits (13.69±14.41%) and flowers (7.75± 9.91%). A total of 134 food plant species were used by the study troops and recorded in the study area. *Albizia chinensis* (7.35%), *Mikania micrantha* (7.08%), *Thunbergia grandiflora* (6.00%), *Litsea monopetala* (5.11%), and *Albizia procera* (4.36%) were among the top annual food plant species of study troops. There was significant monthly and seasonal variation in the plant parts eaten. The finding help in the proper management and conservation of the isolated population of golden langurs, which are endemic to Assam, India.

Key words: *Activity-pattern, Dietary-spectrum, Golden langur, Kakoijana reserve forest, Social troop, Seasonal variation.*

Introduction

Langurs' activity patterns and time allocation are primarily determined by environmental and habitat conditions. The spatial and temporal availability of food can also influence activity budgets (Isbell and Young, 1993). The golden langur (*Trachypithecus geei*) is a folivorous colobine species that also consumes a broad range of foods such as flowers, shoots, seeds, fruits, insects, etc. (Biswas, 2002; Das *et al*., 2013; Gee, 1961; Medhi *et al.*, 2004). The behavioural ecology of the golden langur has been well studied in its primary habitats of Assam and Bhutan (Biswas 2002; Ghosh and Biswas, 1976; Mukherjee and Saha, 1974; Subba, 1989). Major behavioural activities recorded in the case of the golden langur as in other langurs were feeding, resting, monitoring, travelling, grooming, and others including playing, aggression, vocalization, urination and defecation, copulation, etc. According to Biswas (2002) and Gupta and Chivers (2000), the golden langur has two feeding peaks per day: in the

morning and late afternoon before going to bed. Social play is found to occur in trees with activities like climbing, running, jumping, and chasing and is predominant in juveniles. During mid-day rest, self-grooming and allo-grooming are observed (Mukherjee and Saha, 1974). The major portion of the diet of the golden langur, as reported by Gupta and Chivers (2000), is composed of young leaves all over the year. Though arboreal, the golden langur occasionally comes down to the ground for drinking, salt licking, or crossing canopy gaps (Biswas, 2002; Geei, 1961). Water is mainly obtained from their foliage diet, but drinking is also noticed in the summer (Khajuria, 1981).

Despite extensive research on the golden langur's activity and feeding patterns in its primary habitat, there has been no systematic study of the species' activities, food, and feeding in the isolated habitat of Kakoijana Reserve Forest (KRF) with secondary vegetation growth and edges. In this context, the present study aims to investigate the activity pattern and feeding ecology of golden langurs in KRF, with the major goal of documenting the key food resources as well as the dietary spectrum of the species. The outcome of the study is thought to be important for the future conservation of the species in the isolated habitat of the golden langur, like Kakoijana Reserve Forest.

Materials and Methods

Study Site

The KRF (26.22N–26.21N and 90.33E–90.34E), having an area of 17.19 km^2, is situated in the district of Bongaigoan, Assam, India (Fig. 1). The forest is on a hilly terrain (41m to 321 m AMSL), surrounded by human habitation. Secondary growth of moist mixed open deciduous forest with scrub land and degraded areas. The water source of the forest is supported by a numbers of small natural streams and reservoirs. Four distinct seasons could be recognized in the study area, viz., pre-monsoon (March-

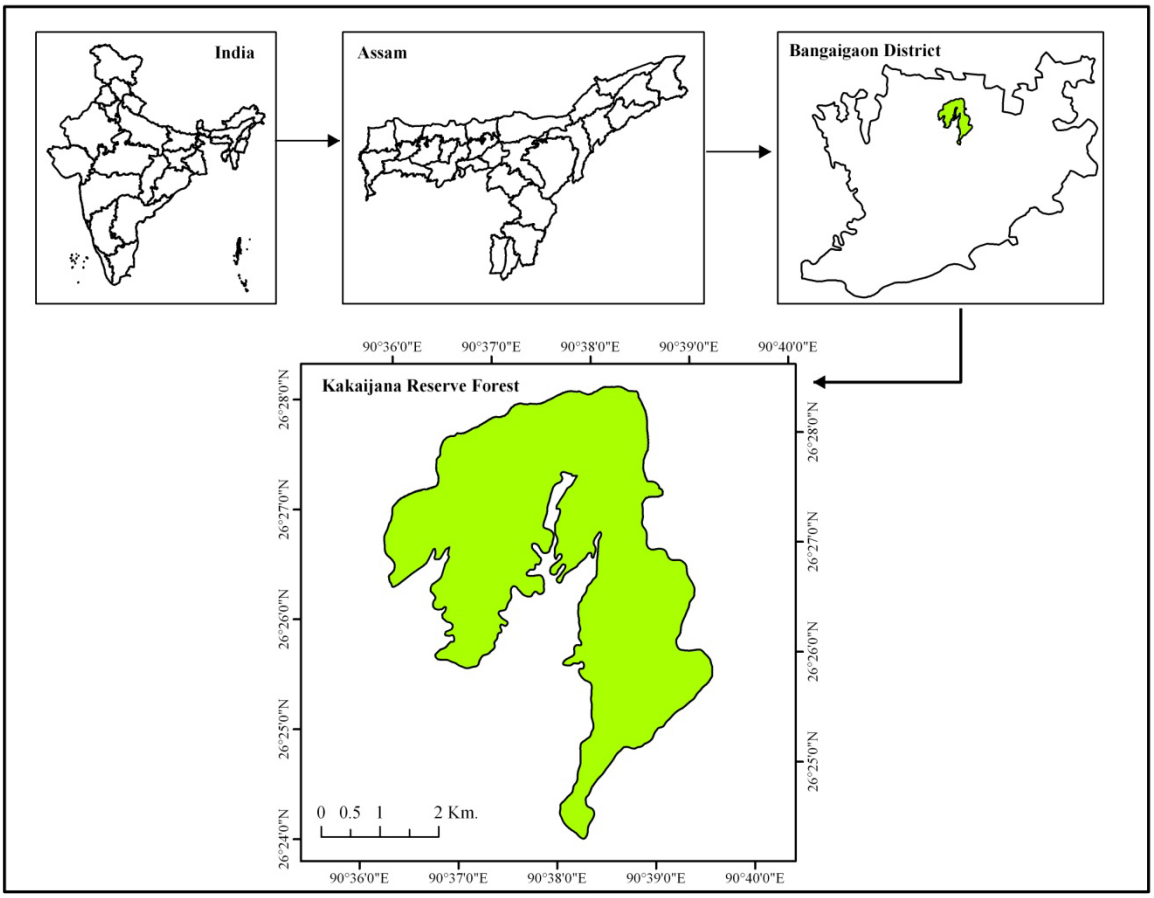

Fig. 1. Map showing location of Kakoijana reserve forest.

May), monsoon (June-August), retreating monsoon (September-November), and winter (December-February). The annual rainfall ranges from 2631 mm to 3136 mm, with an average monthly rainfall of 134.12 mm. The temperature ranges from 9 °C to 10 °C in the winter and 33°C to 38 °C in the summer. The soil in the research area is made up of red coarse loams.

Study troops

Six social troops of golden langurs were selected and habituated prior to behavioural data collection. The selected troops comprised of 11–20 individuals, and each troop was given a unique ID, viz., K-01, K-03, K-32, K-37, K-05, and K-39 (Table 1). Their age-sex composition was determined according to Biswas (2002), and photographs taken in the field (Chakravarty *et al*. 2020).

Methods

The study was carried out from January, 2015–December, 2017, and behavioural data were collected via focal animal scan sampling (Altmann, 1974). The selected troops were habituated for 3 months prior to data collection. The focal animal of each troop was followed from dawn to dusk to collect data for at least three full days in every month of the study period, with a fixed time interval of 5 minutes. Observed behaviours were categorised into six different behavioural categories as per Zhou *et al.* (2007; Table 2). To collect feeding data, food plants and different food items were noted down during the behavioural observations. Only adult sexes were considered for activity and feeding data collection, and focal animals were rotated among adults each day of work (Solanki *et al.*, 2008).

Data analysis

The time allocation to each behavioural category was converted into a percentage as per Clutton-Brock (1977). Each scan budget is treated as an independent data point and used in succeeding analyses. The monthly time budget was calculated by averaging the daily time budget and is shown with standard deviation (SD). The average percentage of time (allocated to each behavior) was assigned to six categories: feeding, resting, travelling, vigilance, grooming, and others. A total of 9940 scans were recorded, and the results of the present study were based on these scans. The SPSS 16.0 version was used for statistical analysis. One-way ANOVA was done to test for significant variation in percentage time spent in each behavioural category (if any) and also to test the seasonal and monthly variation of feeding different plant parts.

Table 1. Age-sex composition of the six studied troops of golden langur in KRF

Troop ID	Troop Size	Composition					
		AM	AF	SAM	SAF	JUV	INF
K-01	12	1	4	1	3	3	0
K-03	20	2	5	2	4	6	1
K-32	12	1	4	2	3	2	1
K-37	10	1	4	1	2	2	1
K-05	13	1	5	1	2	4	0
K-39	12	1	4	1	2	4	0

AM-adult male; AF-adult female; SAM-sub-adult male; SAF- sub-adult female; JUV-juvenile; INF-infant.

Table 2. Behavioural categories and their definitions (Zhou *et al*. 2007)

Sl/No.	Behaviour	Definitions
1.	Feeding	Reaching for and manipulating a food item with hands or mouth, bringing it into the mouth, and chewing; including shifting its position during feeding.
2.	Resting	Not involve themselves in a change of position, sitting or lying down inactively.
3.	Vigilance	Maintain heightened awareness of your surroundings and any intruders.
4.	Travelling	Any type of movement that results in a change in position, such as a quadrupedal walk on tree and ground, running over trees and ground, leaping, and climbing.
5.	Grooming	Related to auto-grooming and allo-grooming.
6.	Others	Include all other activities like urination and defecation, play, agonistic behaviour (mainly aggression), vocalization, escape behaviour, copulation, etc.

Results

Activity pattern

In the study area, the golden langur spent the most time resting (52.22 ± 3.11%; n = 5194 scans), followed by feeding (28.87 ± 3.14%; n = 2865 scans), travelling (7.93 ± 1.47%; 788 scans), vigilance (6.51± 1.59%; 694 scans), grooming (3.40 ± 0.86%; 337 scans), and the least time in others (1.07 ± 0.86%; 107 scans; Plate 1). Resting was also found to be highest in all the months of the year, with the highest recorded in the month of August with significant monthly variation (55.76 ±3.69%; one-way ANOVA: F = 3.557, P = 0.000; Table 3). The percentage of time spent feeding varied significantly by month (one-way ANOVA: F = 5.087, P = 0.000; N = 144), with January having the highest percentage (32.45 ± 2.58%) and August having the lowest (27.13 ± 3.58%). Feeding was also found negatively correlated with all other major activities, viz., resting, vigilance, and grooming (Table 4). Travel was recorded highest in the month of March (8.99±1.02%) and lowest in July (6.71±0.92%) with significant monthly variation (one-way ANOVA: F = 3.916, P = 0.000; N = 144). Besides that, vigilance was found to be highest in June (7.73± 1.05%) with significant monthly variation (N = 144, one-way ANOVA: F = 2.990, P = 0.001). Vigilance shows a significant negative correlation with feeding and grooming. On the other hand, time spent on grooming was recorded at its highest in July (3.79 ± 1.00%). It showed a significant positive correlation with feeding but a significant negative correlation with resting and vigilance. Again, feeding was also found to be negatively correlated with all other major activities, viz., resting, vigilance, and travelling (Table 4).

Seasonal Activity Pattern

Resting was found to be highest in monsoon (53.84

Table 3. Monthly variation in percentage time spent on different behavioural activities (Mean ± SD) (M= Months, J= January, F= February, M= March, A= April, M= May, J= June, J= July, A= August, S= September, O= October, N= November, D= December. F= Feeding, R= Resting, V= Vigilance, Tr= Travelling, OS= Others).

M	F eeding	Resting	Vigilance	Travelling	Grooming	Others	Total Scan
J	32.45±2.58	50.42±3.06	5.30±1.88	8.04±1.50	3.02±1.06	0.78±0.55	798
F	30.34±2.45	50.26±2.17	6.34±0.92	8.58±0.80	3.52±0.79	0.96±0.48	819
M	28.29±2.84	52.18±2.97	5.89±1.18	8.99±1.02	3.67±0.57	0.99±0.71	846
A	28.91±2.85	52.81±1.91	6.97±1.53	7.28±1.87	3.03±0.67	1.02±0.74	829
M	27.85±3.30	51.96±3.35	6.75±1.59	8.11±1.15	3.62±0.52	1.70±1.37	844
J	27.45±2.66	52.88±2.35	7.73±1.05	7.22±1.08	3.43±0.68	1.30±1.19	838
J	27.89±2.41	53.58±2.48	7.06±1.36	6.71±0.92	3.79±1.00	0.98±0.84	843
A	27.13±3.58	55.76±3.69	5.86±1.44	6.93±0.81	3.27±0.88	1.05±0.73	838
S	27.75±1.99	51.82±3.07	7.54±2.08	8.58±1.37	3.13±1.07	1.19±1.18	844
O	27.89±2.51	52.33±3.22	6.34±1.83	8.49±1.75	3.69±0.53	1.26±0.81	839
N	28.44±2.80	52.35±2.89	6.57±1.41	8.62±1.44	3.13±1.28	0.89±0.63	806
D	32.06±2.50	50.26±2.38	5.76±1.00	7.67±1.63	3.53±0.83	0.73±0.52	796
F	5.087**	3.557**	2.990**	3.916**	1.250^{ns}	1.131^{ns}	
P	0.000	0.000	0.001	0.000	0.261	0.341	

**p<0.01; *p<0.05; ^{ns} No significance; df= 11, N= 144

Table 4. Correlation matrix showing the relationship among different behavioural categories of golden langur (Spearman's).

Categories	Feeding	Resting	Vigilance	Travelling	Grooming	Othres
Feeding	1					
Resting	-0.688**	1				
Vigilance	-0.496**	0.059	1			
Travelling	-0.067	-0.377**	-0.009	1		
Grooming	0.227**	-0.414**	-0.253**	0.009	1	
Othres	-0.011	-0.249**	0.015	-0.007	0.134	1

**. Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed).

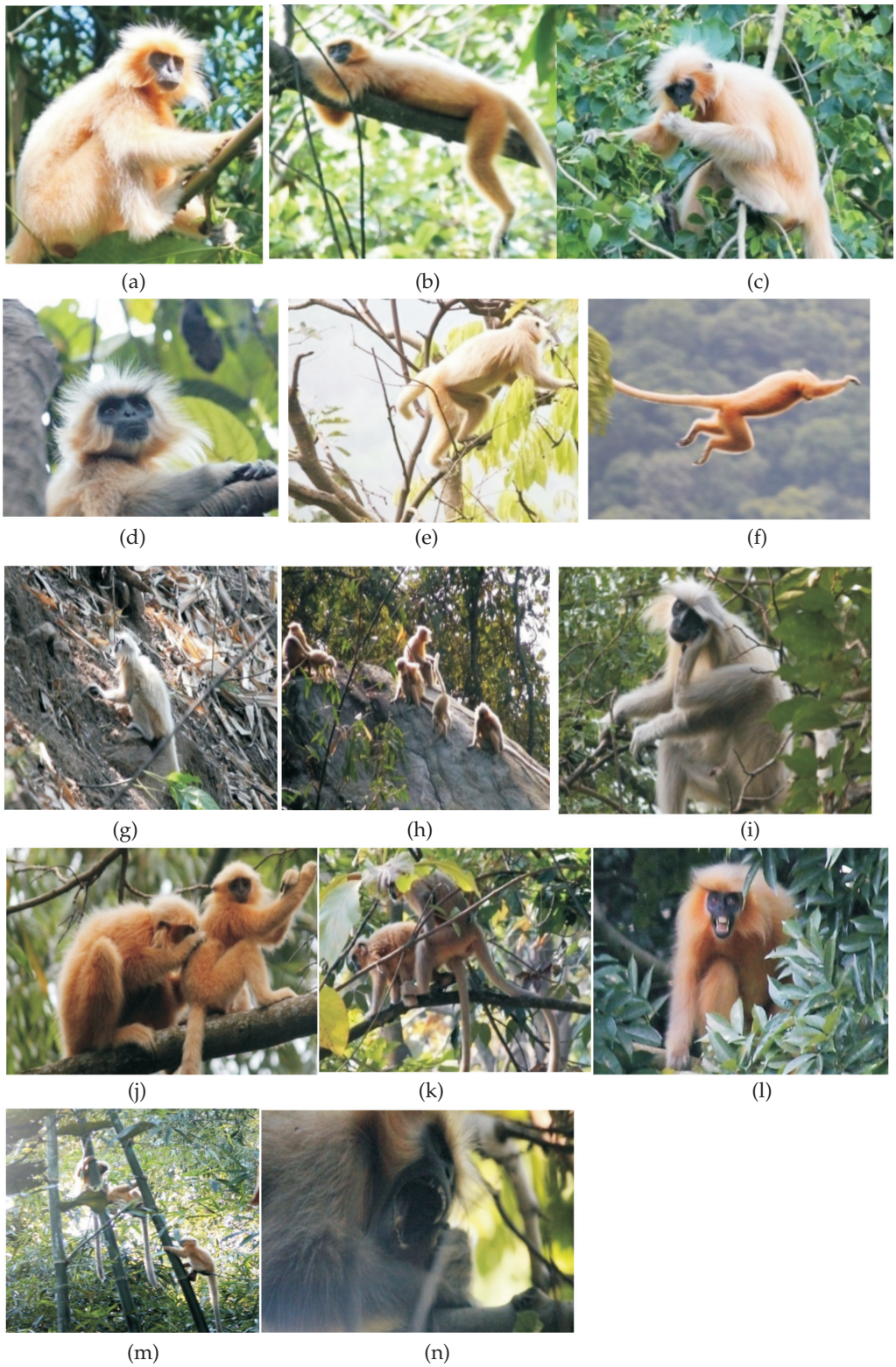

Plate 1. Different activities of golden langur recorded in the study area: (a) resting, (b) sleeping, (c) feeding, (d) vigilance, (e) walking on tree, (f) jumping, (g) travelling over ground (h) sun basking on open rock, (i) autogrooming (j) allo grooming (k) courtship (l) aggression (m) playing (n) yawning.

± 3.06%), followed by pre-monsoon (52.32 ± 2.76%), retreating monsoon (52.22 ± 3.10%), and winter (50.31± 2.49%) (Table 5), with a significant difference between seasons (one-way ANOVA: F = 9.607, p = 0.000). Feeding time spent was also shown to differ significantly in different seasons (one-way ANOVA: F = 16.918, p = 0.000). Travel was highest during the retreating monsoon (8.57 ± 1.44%), then during the pre monsoon (8.13 ± 1.53%), and finally during the winter (8.10 ± 1.38%). The least amount of travel was recorded in monsoon season (7.11 ± 1.16%; one-way ANOVA: F = 7.53, p = 0.000). Moreover, vigilance was found to be highest in the monsoon (6.97 ± 1.61%) and lowest in the winter (5.80 ± 1.37%; one-way ANOVA: F = 3.90, p = 0.010). Grooming was found to be highest during the monsoon season (3.49 ± 0.85%) and lowest during the retreating monsoon season (3.30 ± 1.05%). In the study area, the golden langurs spent the least time in "others" (miscellaneous activities as mentioned in methods) and the most time in the pre-monsoon (1.24 ± 1.02%) season, followed by the retreating monsoon (1.18 ± 0.91%) season.

Dietary spectrum

Annual Diet Composition

From the total of 2865 feeding scans, it was recorded that, about 60% of the total annual food was comprised of leaves (mature leaves: 22.85 ± 16.95%; 660 scan and young leaves: 36.67 ± 19.83%; 1074 scans) followed by fruits (13.69 ± 14.41%; 395 scans), flowers (7.75 ± 9.91%; 220 scans). Shoots comprised 6.00 ± 9.33% (171 scans) of the diet, followed by seed and pod (5.90± 10.80%; 170 scans) whereas; twigs (5.79±7.83%; 167 scans) had the lowest contribution. Other foods, including bark, latex, termites, etc., contributed the least (0.28 ± 1.47%; 08 scans).

Mature leaves were consumed at their highest rate in December (42.83 ± 13.88%), and at their lowest rate in June (10.25 ± 6.00%). with significant differences among the months (one-way ANOVA: F = 5.955, P = 0.0000; N = 144). In the case of young leaves, maximum consumption was recorded in May (51.75 ± 22.82%) and that of minimum in the month of December (22.92 ± 14.34%), with significant monthly differences (one-way ANOVA: F = 3.886, P = 0.000). Twigs of plants were found to be consumed highest in November (9.10 ± 8.43%) and lowest in March (2.67 ± 5.48%). Shoots in the diet of the golden langur were mainly contributed by three bamboo species, with maximum consumption in the month of September (17.25 ± 10.75%) and no consumption of shoots during June (one-way ANOVA: F = 5.252, P = 0.000). On the other hand, feeding on fruits was found to be highest in July (25.67 ± 15.22%) and lowest in the month of November (2.83 ± 5.46%; one-way ANOVA: F = 3.380, P = 0.000). Furthermore, flowers were one of the most important dietary components, with the highest levels recorded in December (13.17 ± 13.99%) and the lowest levels recorded in July (2.42 ± 4.89%). Consumption of seeds and pods reached an all-time high in January (20.85 ± 13.43%). However, June and July months did not show seeds and/or pods consumption (one-way ANOVA; F = 5.745, P = 0.000, N = 144). Other foods included were the consumption of bark, petiole, latex, etc., which was found to be highest in the month of February (1.50 ± 4.34%). A few subsidiary food items in the form of hyphae of fungi and insect pupae, termites were also recorded once each in less than average 0.25-minute bouts in the month of September (Fig. 2).

Seasonal Dietary Pattern

Maximum feeding on mature leaves (35.31 ±

Table 5. Seasonal variation of time spent in different behavioural activities by golden langurs (W= winter, PM= premonsoon, M= monsoon, RTM= retreating monsoon)

S	Mature leaves (ML)	Young leaves (YL)	Twig (T)	Shoot (S)	Flower (FL)	Fruit (FR)	Seed and Pod (SP)	Others	Total scan
W	35.31± 14.66	27.33 ±18.10	5.20 ± 6.87	5.14 ± 9.09	9.81 ±12.34	5.54 ±6.82	14.57 ±13.59	0.49± 2.27	762
PM	17.25 ±20.33	43.72 ± 23.80	4.78 ± 7.90	3.90 ± 7.74	4.88 ± 7.56	16.52 ± 6.82	4.90 ±13.59	0.33 ±1.23	714
M	15.90 ± 11.71	44.03 ±17.12	6.81 ± 8.68	3.88 ± 8.36	5.25 ± 7.03	21.44± 16.56	0.67 ±6.32	0.06 ±0.37	692
RTM	23.81 ± 112.80	30.06 ± 12.72	5.97 ± 8.14	12.18 ± 10.08	10.99± 10.90	12.2± 14.59	2.78 ±6.31	0.09 ±0.51	697
F-value	12.489**	8.299**	0.222^{ns}	6.548**	3.594*	8.466**	17.856**	0.983^{ns}	
P-value	0.000	0.000	0.875	0.000	0.015	0.000	0.000	0.403	

**p<0.01; *p<0.05; ^{ns} No significance; df= 3, N= 144

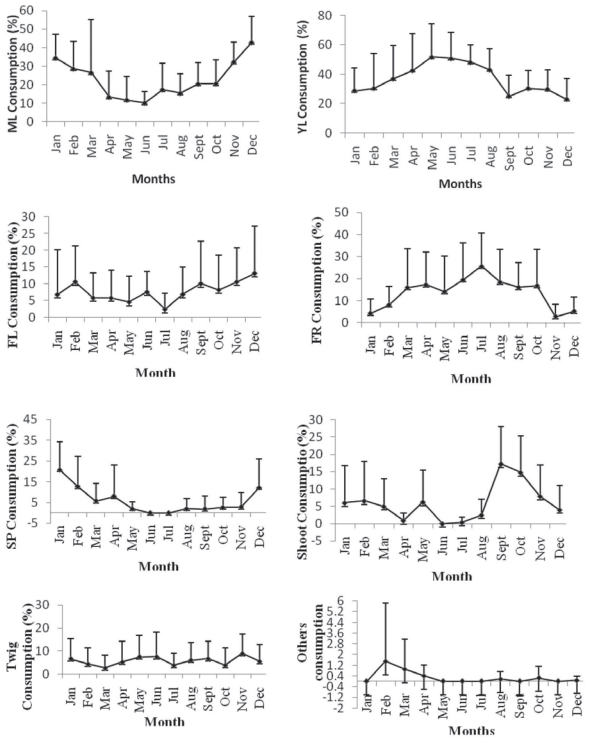

Fig. 2. Monthly consumption of different Plant parts by golden langur in the study area. (ML= mature leave, YL= young leave, FL= flower, FR= fruits. *ML, *YL, *FR, *Shoot, *Seed & pod; *Significant at P< 0.01).

14.66%) was recorded in the winter season and minimum in the monsoon season (15.90 ± 11.71%; one-way ANOVA: $F_{3,140}$= 12.489, P = 0.000, N = 144). Young leaf consumption was least in the winter season (27.33 ± 18.10%) and was maximum in the monsoon season (44.03 ± 17.12%; one-way ANOVA: F = 8.299, P = 0.000). Consumption of twigs was also found in all the seasons, with a maximum in the monsoon (6.81 ± 8.68%) and a minimum in the pre-monsoon (4.78 ± 7.90%; $F_{3,143}$ = 0.222, P = 0.875). Shoot consumption was recorded at its maximum in the retreating season (12.18 ± 10.08%) and at its minimum in the monsoon season with a significant seasonal difference (3.88 ± 8.36%; One-way ANOVA: F = 6.548, P = 0.000). The consumption of flowers found its maximum in the retreating monsoon season (10.99 ± 10.90%) followed by the winter season (9.81 ± 12.34%), and was recorded at its minimum in the pre-monsoon season (4.88 ± 7.56%; one-way ANOVA: F = 3.594, P = 0.015). Furthermore, feeding on fruits was highest during the monsoon season (21.44 ± 16.56%) and lowest during the winter (5.54 ± 6.82%; one-way ANOVA: F = 8.466, P = 0.000). The seasonal consumption of seeds and pods was also found to be significantly different (one-way ANOVA: F =17.856, P = 0.000), with the winter season having the highest consumption (14.57 ± 13.59) and the monsoon season having the lowest (0.67 ± 6.32). Other food consumption was discovered to be lowest during the monsoon (0.06 ± 0.37) and highest during the winter (0.49 ± 2.27; one-way ANOVA: F = 0.983, P = 0.403; Table 6).

Food plant species

During the study, the annual food of the study troop of golden langurs was comprised of a total of one hundred thirty four (N= 134) plant species in fifty two (52) families, along with five unidentified species (Annexure 1). All these 134 species were abundantly available at the study site (Plate 2 to 5). Trees contributed the most food (61.92% (1774 scans), followed by climber species at 26.91% (771 scans), shrubs at 7.92% (227 scans), bamboo at 3.11% (89 scans), and underbrush at 0.14% (4 scans).

Preferred food plant

Survey results revealed that, *Albizia chinensis* was the most consumed plant species of golden langur in

Table 6. Seasonal variation of consumption of different plant parts by golden langur (data were in % time spent) (S=season, W= winter, PM= pre-monsoon, M=monsoon, RTM= retreating monsoon).

Season	Feeding	Resting	Vigilance	Travelling	Grooming	Others	scan
W	31.62±2.61	50.31±2.49	5.80±1.37	8.10±1.38	3.36±0.91	0.82±0.51	2413
PM	28.35±2.95	52.32±2.76	6.54±1.48	8.13±1.53	3.44±0.64	1.24±1.02	2519
M	27.54±2.74	53.84±3.06	6.97±1.61	7.11±1.16	3.49±0.85	1.05±0.90	2519
RTM	28.03±2.52	52.22±3.10	6.70±1.71	8.57±1.44	3.30±1.05	1.18±0.91	2489
Mean	28.87±3.14	52.22±3.11	6.51±1.59	7.93±1.47	3.40±0.86	1.07±0.86	
F	16.918**	9.607**	3.901*	7.529**	0.336ns	1.636ns	
P	0.000	0.000	0.010	0.000	0.799	0.184	

**p<0.01; *p<0.05; ns No significance; df= 3; N= 144

Annexure 1. Seasonal and annual feeding frequency of food plant species of golden langur in the study area (T= tree, Cl= climber, Sh= shrub, B= bamboo, TF= tree fern, CT= climbing fern, US= under shrub, CT= climbing Tree; W= winter, PM= pre-monsoon, M= monsoon and RTM= re- treating monsoon; ML= mature leave, YL= young leave, TW= twig, FL= flower, FR= fruit, SP= seed and pod, Ba= bark, L= latex, P= petiole).

S. N.	Plant type	Family	Species	Plants parts eaten	W (Feeding frequency %)	PM (feeding frequency %)	M (Feeding frequency %)	RTM (Feeding frequency %)	Annual (Feeding frequency %)
1	T	Fabaceae	*Albizia chinensis* (Osbeck) Merr.	ML / SP	12.43	0.98	0.72	15.27	7.35
2	Cl	Asteraceae	*Mikania micrantha* Kunth	ML/YL/ TW/FL	4.51	3.66	16.97	3.18	7.08
3	Cl	Acanthsceae	*Thunbergia grandiflora* (Rotlb) Roxb.	YML/YL/ FL/FR	4.92	4.81	10.27	4.00	6.00
4	T	Lauraceae	*Litsea monopetala* (Roxb.) Pers.	ML/YL/FR	4.46	6.08	4.16	5.74	5.11
5	T	Fabaceae	*Albizia procera* (Roxb.) Benth.	ML/ SP	12.04	1.52	0.46	3.43	4.36
6	Cl	Fabaceae	*Millettia pachycarpa* Benth.	YL/ TW	3.96	5.84	1.87	4.70	4.09
7	T	Moraceae	*Ficus racemosa* L.	YL/ FR	3.41	4.33	3.94	2.00	3.42
8	Sh	Lamiaceae	*Holmskioldia sanguinea* Retz.	YL	7.14	0.42	2.09	4.02	3.42
9	T	Malvaceae	*Kydia calycina* Roxb.	YL/ FL	0.49	0.28	2.28	10.34	3.35
10	T	Urticaceae	*Oreocnide integrifolia* (Gaudich.) Miq.	YL/ FL/ FR	3.12	2.94	3.21	2.01	2.82
11	T	Fabaceae	*Bauhinia acuminata* L.	YL/ FL/SP	2.51	2.11	2.96	3.28	2.71
12	T	Euphorbiaceae	*Mallotus philippensis* (Lam.) Muell. Arg.	YL/ FL/ S	3.79	3.08	0.15	3.59	2.65
13	Cl	Vitaceae	*Ampelocissus barbata* (Wall.) Planch.	ML/YL/ TW/FL/ FR	0.26	2.82	3.64	3.85	2.64
14	Cl	Vitaceae	*Cayratia trifolia* (L.) Domin	YL/ FR	0.78	3.78	3.89	2.01	2.62
15	T	Phyllanthaceae	*Bridelia stipularis* (L) Bl.	ML/YL/FR	2.39	2.51	2.75	1.30	2.24
16	T	Burseraceae	*Protium serratum* (Wall. Ex Colebr.)Engl.	YL/ FR	0.64	3.76	0.43	1.74	1.64
17	B	Poaceae	*Dendrocalamus hamiltonii* Nees	BS	0.37	1.68	1.68	2.45	1.54
18	T	Moraceae	*Ficus auriculata* Lour.	YL/ FR	1.50	2.23	0.00	2.44	1.54
19	T	Moraceae	*Ficus hispida* L.f.	YL/ FR	1.22	1.25	1.95	1.43	1.46
20	B	Poaceae	*Bambusa tulda* Roxb.	BS	0.00	0.56	2.62	2.57	1.44
21	Sh	Urticaceae	*Sarcochlamys pulcherrima* Goud.	YL FL	0.96	1.11	0.55	3.04	1.42
22	T	Bignoniaceae	*Oroxylum indicum* (L.) Benth. ex Kurz.	ML/ YL/ FR	0.87	2.11	2.17	0.00	1.29
23	T	Sonneratiacaea	*Duabanga grandiflora* (Roxb. ex DC) Walpers.	FL	1.03	1.69	1.40	1.02	1.28
24	T	Cornaceae	*Alangium chinense* (Lour.) Harms.	ML/ YL/ FR	2.00	1.40	1.70	0.00	1.27
25	Cl	Rubiaceae	*Paederia foetida* L.	ML/ YL	1.80	0.84	2.20	0.15	1.25
26	T	Moraceae	*Ficus nervosa* B. Heune ex Roth.	YL / FR	0.00	3.09	1.88	0.00	1.24
27	Sh	Fabaceae	*Dalbergia stipulacea* Roxb.	ML/ YL/ FL	1.43	2.11	0.00	1.31	1.21
28	T	Fabaceae	*Derris robusta* (DC.) Benth	FL/ FR	1.54	0.69	0.00	2.14	1.09
29	Cl	Fabaceae	*Spatholobus parviflorus* (DC.) Kuntze	TW/ FL	1.05	1.00	1.71	0.59	1.09
30	T	Combretaceae	*Terminalia bellirica* (Gaertn) Roxb.	FR/ L	0.92	0.42	1.57	1.23	1.04
31	T	Lauraceae	*Actinodaphne angustifolia* Nees.	YL/ FR	0.26	0.00	1.97	1.45	0.92
32	T	Lamiaceae	*Gmelina arborea* Roxb.	ML/ YL / FL / L	0.39	2.66	0.41	0.00	0.86
33	Cl	Convolvulaceae	*Merremia vitifolia* (Burm.fil) Hall.fil.	ML/ YL	1.35	0.14	0.00	1.89	0.84
34	T	Malvaceae	*Sterculia villosa* Roxb. ex Sm.	FL/ SP	2.80	0.42	0.00	0.00	0.81
35	T	Lauraceae	*Actinodaphne obovata* (Nees) Bl.	YL/ FR/ Ba	1.16	0.28	0.62	0.72	0.69
36	T	Meliaceae	*Dysoxylum binectariferum* Hiern	YL/ FR	0.90	0.84	0.00	0.88	0.65
37	T	Anacardiaceae	*Lannea grandis* A. Rish.	YL/ FL/ FR	0.78	1.11	0.27	0.43	0.65
38	T	Tiliaceae	*Grewia glabra* Blume	YL/ FL/ FR	0.00	0.00	2.52	0.00	0.63

Annexure 1. *Continued ...*

S. N.	Plant type	Family	Species	Plants parts eaten	W (Feeding frequency %)	PM (feeding frequency %)	M (Feeding frequency %)	RTM (Feeding frequency %)	Annual (Feeding frequency %)
39	T	Apocynaceae	*Holarrhena antidysenterica* Wall.	YL/ SP	1.44	0.28	0.43	0.00	0.54
40	T	Moraceae	*Streblus asper* Lour	YL/ FR	0.26	1.82	0.00	0.00	0.52
41	T	Moraceae	*Ficus lamponga* Miq.	YL/ FR	0.64	0.84	0.55	0.00	0.51
42	T	Bignoniaceae	*Stereospermum chelonoides* D.C	YL/ FL	0.00	1.27	0.73	0.00	0.50
43	T	Euphorbiaceae	*Balakata baccata* (Roxb.) Esser	YL	0.00	0.28	1.53	0.00	0.45
44	T	Dilleniaceae	*Dillenia pentagyna* Roxb.	YL/ FR	0.00	1.81	0.00	0.00	0.45
45	T	Tetramelaceae	*Tetrameles nudiflora* R. Br.	YL/ FR	0.00	0.97	0.00	0.74	0.43
46	Sh	Mimosaceae	*Mimosa rubicaulis* Lam.	YL/ FL	0.00	0.28	0.00	1.28	0.39
47	T	Boraginaceae	*Ehretia acuminata* R.Br.	YL/ FR	0.26	0.56	0.70	0.00	0.38
48	T	Moraceae	*Artocarpus lacucha* Buch -Ham.	FR	0.25	0.41	0.83	0.00	0.37
49	T	Fabaceae	*Dalbergia assamica* Benth.	YL	0.00	0.00	1.23	0.00	0.31
50	T	Moraceae	*Ficus benjamina* L.	YL	0.00	0.00	0.43	0.74	0.29
51	T	Burseraceae	*Garuga pinnata* Roxb.	YL/ FR	0.00	0.14	0.58	0.41	0.28
52	Sh	Rutaceae	*Micromelum minutum* (G.Frost.) Wight. & Arn.	ML/ YL	0.00	1.12	0.00	0.00	0.28
53	Sh	Mimosaceae	*Acacia intsia* (L.) Willd	ML/ YL	0	1.12	0	0	0.28
54	T	Anacardiaceae	*Mangifera indica* L.	FL, FR	0.00	0.69	0.41	0.00	0.27
55	H	Musaceae	*Musa sapientum* L.	FR	0.39	0.70	0.00	0.00	0.27
56	Cl	Apocynaceae	*Cryptolepis buchananii* Roemer & Schultes	YL	0.26	0.28	0.30	0.15	0.25
57	T	Myrtaceae	*Syzygium cumini* (L.) Skeels.	YL/ FR	0.00	0.70	0.28	0.00	0.25
58	T	Fabaceae	*Archidendron clypearia* (Jack) I.C. Nielsen	YL	0.00	0.98	0.00	0.00	0.24
59	T	Fabaceae	*Tamarindus indica* L.	FR	0.26	0.69	0.00	0.00	0.24
60	T	Lamiaceae	*Callicarpa arborea* Roxb.	YL/ FL/ FR	0.49	0.00	0.45	0.00	0.24
61	Cl	Convolvulaceae	*Ipomoea kingii* Prain	ML/ YL	0.29	0.57	0.05	0.00	0.23
62	T	Verbenaceae	*Tectona grandis* L.f.	YL	0.00	0.85	0.00	0.00	0.21
63	T	Araliaceae	*Heteropanax fragrans* (Roxb.) Seem	YL	0.00	0.41	0.41	0.00	0.21
64	B	Poaceae	*Bambusa balcooa* Roxb.	BS	0.00	0.00	0.82	0.00	0.20
65	Sh	Lauraceae	*Litsea salicifolia* (Nees) Hook.fil.	YL	0.00	0.70	0.05	0.00	0.19
66	T	Moringaceae	*Moringa oleifera* Lamk.	ML /YL	0.00	0.00	0.72	0.00	0.18
67	T	Meliaceae	*Melia azedarach* L.	YL/ FR	0.00	0.71	0.00	0.00	0.18
68	T	Fabaceae	*Dalbergia sissoo* Roxb.	YL	0.00	0.70	0.00	0.00	0.18
69	T	Moraceae	*Ficus rumphii* Blume	YL	0.00	0.70	0.00	0.00	0.17
70	T	Rubiaceae	*Neolamarckia cadamba* (Roxb.) Bosser	FL	0.00	0.00	0.70	0.00	0.17
71	T	-	Unidentified	YL	0.00	0.69	0.00	0.00	0.17
72	T	Moraceae	*Hevea brasilliensis* Mull.Arg.	YL/ FR	0.27	0.42	0.00	0.00	0.17
73	T	Actinidiaceae	*Saurauia napaulensis* DC.	YL/ FL	0.25	0.28	0.14	0.00	0.17
74	T	-	Unidentified	YL	0.64	0.00	0.00	0.00	0.16
75	T	Phyllanthaceae	*Bischofia javanica* Blume	FR	0.00	0.00	0.00	0.59	0.15
76	T	Salicaceae	*Flacourtia jangomas* (Lour.) Raeusch.	FR	0.00	0.00	0.00	0.59	0.15
77	Cl	Araliaceae	*Schefflera venulosa* (Wight & A.) Harms.	FR	0.00	0.00	0.58	0.00	0.14
78	T	Annonaceae	*Polyalthia simiarum* Hook.f. & Th.	FR	0.00	0.57	0.00	0.00	0.14
79	T	Anacardiaceae	*Spondias pinnata* (L.f.) Kurz.	FR	0.13	0.00	0.43	0.00	0.14
80	T	Magnoliaceae	*Michelia baillonii* (Pierre) Finet & Gagnep.	YL/ SP	0.00	0.56	0.00	0.00	0.14
81	T	Apocynaceae	*Alstonia scholaris* (L.) R. Br.	YL/ FL	0.12	0.14	0.29	0.00	0.14
82	Cl	Menispermaceae	*Tinospora cordifolia* (Wild.) Miers	FR	0.00	0.55	0.00	0.00	0.14
83	T	Fabaceae	*Delonix regia* (Boj. Ex Hook.) Raf.	ML/YL/FL	0.00	0.00	0.55	0.00	0.14
84	Cl	Vitaceae	*Cissus repanda* Vahl	YL	0.13	0.00	0.41	0.00	0.13
85	US	Athyriaceae	*Diplazium esculentum* (Retz.) Sw.	ML/YL	0.53	0.00	0.00	0.00	0.13

Annexure 1. *Continued ...*

S. N.	Plant type	Family	Species	Plants parts eaten	W (Feeding frequency %)	PM (feeding frequency %)	M (Feeding frequency %)	RTM (Feeding frequency %)	Annual (Feeding frequency %)
86	Sh	Sapindaceae	*Sapindus attenuatus* Wall.	YL/SP/TW	0.51	0.00	0.00	0.00	0.13
87	sh	Rutaceae	*Murraya koenigii* (L.) Sprenge	FR	0.00	0.43	0.00	0.00	0.11
88	T	Myrtaceae	*Syzygium formosum* (Wall.) Masam.	YL	0.26	0.14	0.00	0.00	0.10
89	T	Phyllanthaceae	*Phyllanthus assamimicus* Mull. Arg.	FR	0.39	0.00	0.00	0.00	0.10
90	T	Rhamnaceae	*Ziziphus mauritiana* Lam.	FR	0.39	0.00	0.00	0.00	0.10
91	T	Myrsinaceae	*Ardisia paniculata* Roxb.	FR	0.00	0.00	0.31	0.00	0.08
92	T	Boraginaceae	*Chordia dichotoma* G. Forst.	YL	0.29	0.00	0.00	0.00	0.07
93	T	-	Unidentified	YL	0.00	0.28	0.00	0.00	0.07
94	Cl	Fabaceae	*Canavalia gladiata* (Jacq.) DC.	YL	0.00	0.00	0.00	0.28	0.07
95	T	Moraceae	*Ficus glaberrima* Blume	YL	0.00	0.28	0.00	0.00	0.07
96	T	Malvaceae	*Bombax ceiba* L.	YL	0.00	0.28	0.00	0.00	0.07
97	T	Myrtaceae	*Psidium guajava* L.	YL	0.00	0.28	0.00	0.00	0.07
98	TF	Cyatheaceae	*Cyathea gigantea* (Wall. Ex. Hook.) Holttom	YL	0.27	0.00	0.00	0.00	0.07
99	T	Fabaceae	*Erythrina stricta* Roxb.	FL	0.27	0.00	0.00	0.00	0.07
100	T	Oxalidaceae	*Averrhoa carambola* L.	FR	0.26	0.00	0.00	0.00	0.06
101	T	Euphorbiaceae	*Mallotus paniculatus* (Lam.) Mull.Arg.	YL/FR	0.26	0.00	0.00	0.00	0.06
102	T	Fagaceae	*Castanopsis indica* (Roxb.ex Lindl.) A. DC.	YL	0.25	0.00	0.00	0.00	0.06
103	T	Euphorbiaceae	*Mallotus roxburghianus* Mull.Arg.	YL	0.25	0.00	0.00	0.00	0.06
104	Sh	Rubiaceae	*Morinda angustifolia* Roxb.	FR	0.00	0.14	0.05	0.00	0.05
105	T	Dipterocarpaceae	*Shorea robusta* Gaertn.	YL	0.00	0.03	0.14	0.00	0.04
106	Sh	Apocynaceae	*Tabernaemontana divaricata* (L.) R. Br.	YL	0.03	0.00	0.00	0.15	0.04
107	Cl	Annonaceae	*Desmos chinensis* Lour.	YL	0.00	0.00	0.15	0.00	0.04
108	Cl	Convolvulaceae	*Argyreia nervosa* (Burm.f.) Boj.	YL	0.00	0.00	0.00	0.15	0.04
109	Cl	Cucurbitaceae	*Trichosanthes tricuspidata* Lour.	ML/YL	0.00	0.00	0.00	0.15	0.04
110	CT	Rutaceae	*Paramignya griffithii* Hook.f	FR	0.00	0.00	0.00	0.15	0.04
111	T	Meliaceae	*Aphanomixis polystachya* (Wall.) Parker	FR	0.00	0.00	0.00	0.15	0.04
112	T	Moraceae	*Morus australis* Poir.	YL	0.00	0.00	0.14	0.00	0.04
113	Cl	Apocynaceae	*Cryptolepis sinensis* (Lour.) Merr.	YL	0.14	0.00	0.00	0.00	0.04
114	Cl	Fabaceae	*Lablab purpureus* (L.) Sweet.	FR	0.14	0.00	0.00	0.00	0.04
115	T	Rutaceae	*Aegle marmelos* L.	YL	0.00	0.14	0.00	0.00	0.04
116	Cl	Cucurbitaceae	*Hodgsonia macrocarpa* (Bl.) Cogn.	YL/FL	0.00	0.14	0.00	0.00	0.03
117	T	Lythraceae	*Lagerstroemia parviflora* Roxb.	FR	0.00	0.14	0.00	0.00	0.03
118	Cl	Anacardiaceae	*Pegia nitida* Colebr.	FR	0.00	0.14	0.00	0.00	0.03
119	Cl	Rubiaceae	*Uncaria macrophylla* Wall.	YL	0.00	0.14	0.00	0.00	0.03
120	Sh	Euphorbiaceae	*Codiaeum variegatum* (L.) Bl.	ML/Ba/P	0.00	0.00	0.00	0.14	0.03
121	Cl	Dioscoreaceae	*Dioscorea alata* L.	FR	0.00	0.00	0.00	0.14	0.03
122	T	Fabaceae	*Adenanthera pavonina* L.	ML	0.00	0.00	0.14	0.00	0.03
123	T	Phyllanthaceae	*Baccaurea ramiflora* Lour.	FR	0.00	0.00	0.14	0.00	0.03
124	Sh	Euphorbiaceae	*Manihot esculenta* Crantz.	FR	0.00	0.00	0.14	0.00	0.03
125	T	Araliaceae	*Trevesia palmata* Vis.	YL/ Ba	0.00	0.00	0.14	0.00	0.03
126	Sh	Acanthaceae	*Justicia Adhatoda* L.	YL	0.13	0.00	0.00	0.00	0.03
127	Cl	Vitaceae	*Cissus* sp	YL	0.13	0.00	0.00	0.00	0.03
128	CF	Lygodiaceae	*Lygodium microphyllum* (Cav.) R. Brown	YL	0.12	0.00	0.00	0.00	0.03
129	T	Theaceae	*Schima wallichii* (DC.) Korth.	FR	0.12	0.00	0.00	0.00	0.03
130	T	Meliaceae	*Toona ciliata* M. Roem.	FR	0.00	0.03	0.05	0.00	0.02
131	T	-	Kalti (Local name)	ML/YL/Ba	0.00	0.03	0.00	0.00	0.01
132	Cl	Asparagaceae	*Asparagus recemosus* Willd.	YL	0.00	0.03	0.00	0.00	0.01
133	Sh	Malvaceae	*Hibiscus rosa- sinensis* L.	ML/YL/FL	0.00	0.03	0.00	0.00	0.01
134	T	-	Unidentified	YL/ FR	0.02	0.00	0.00	0.00	0.01

Plate 2. Some food plant species of golden langur in the study area (A) Tree species. (a) *Albizzia chinensis*; (b) *Bauhinia accuminata* (c) *Tetrameles nudiflora* (d) *Kydia calycina* (e) *Hollarhena antidysenterica* (f) *Litsea monopetala* **(g)** *Malotus philippinensis* **(h)** *Sterculia villosa* **(i)** *Oreocnidae integrifolia* **(j)** *Daubbanga grandiflora* **(k)** *Bridelia stipularis* **(l)** *Terminalia bellirica* (m) *Albizzia procera* (n) *Protium serratum* (o) *Temarindus indica* (p) *Alangium chinense* (q) *Actinodaphne angustifolia (r)Oroxylum indicum* (s) *Moringa oleifera* (t) *Gmelina arborea.*

the study area, while four plant species, including two unidentified tree species, one shrub species, *Hibiscus rosa sinensis*, and one climber, *Asparagus recemosus*, were the least consumed plant species (0.01%) of golden langur in KRF. Top ten food plant species of the golden langur in the study site, based on seasonal feeding frequency were depicted in the Fig. 3 (a-d).

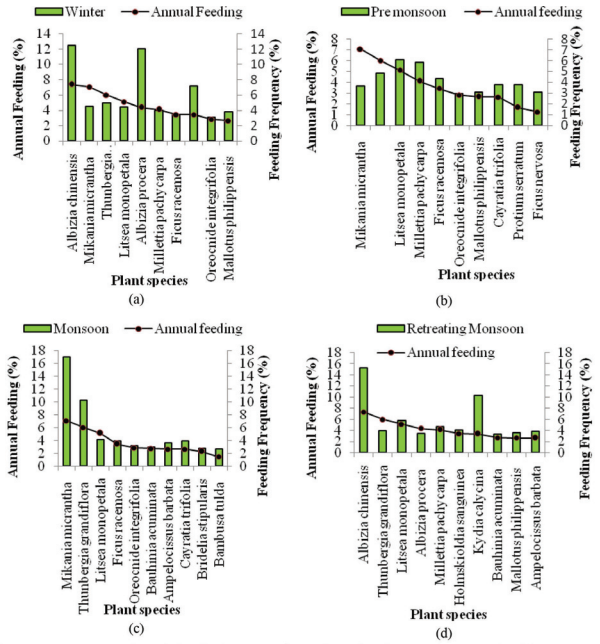

Fig. 3. Top ten preferred food plant species of golden langur in KRF in (a) winter Season; (b) pre-monsoon Season; (c) monsoon season and (d) re-treating monsoon Season.

Discussion

The time budget and feeding behaviour of the study groups revealed that the golden langur spent the maximum of its daytime resting, which is a key technique for physiological adaptation in colobines. The golden langur activity budget in the Kakoijana reserve forest clearly stated that the folivorous colobines required more processing time to digest the leaf content of the diet as the study troops spent more time resting. This result is in accordance with other studies on the species in Assam (Biswas, 2002; Chetry *et al*., 2017). Edwards & Ullrey (1999) have argued that the higher processing time required to digest leaf is required for breaking the fibrous cell wall into usable energy. The present study restricted itself only to adult individuals, and the time spent on other behaviours such as grooming is greater, whereas playing is more occasional, in the form of group play by jumping, swinging, and quadrupedally walking on the branches. This result, however, contradicts the findings of folivorous Asian colobines, where social behaviour is sometimes completely absent (Bennett and Sebastian, 1988). On the other hand, capped langurs are reported to perform extensive grooming in Pakhui Wildlife Sanctuary (Kumar and Solanki, 2014). Adult female members of the study troop spend more time foraging and feeding to compensate for the energy required for infant care and lactation.The seasonal variation on time spent in different behavioural categories also signifies that when the food resource is abundant, the resting time is more in the monsoon, but that essentially does not tally with the higher feeding time in the winter. The study also suggests that the reason travel time is the shortest in the monsoon is due to an increase in vegetative biomass also seen in some other primate studies (Rowell, 1966; Bronikowski and Altmann, 1996). The study troops utilise maximum daytime for feeding and foraging and less time for resting in the winter season in comparison to the monsoon season to cope with the scarcity of food as well as to ensure quality nutritional intake. The variation in grooming is very minimal, as expected for colobines. The result suggests that, weather and temperature have a negative impact on feeding and travelling but a positive impact on resting, which might be an energy-conserving technique as both feeding and travelling are energy consuming activities (Coellho *et al*., 1976; Xiang *et al*., 2010). Rainfall, on the other hand, has an influence on daily activity patterns in resting and traveling, even though it has been observed in many cases that they feed and travel during low rain (Biswas, 2002). The results suggest that time budgeting and activity patterns show significant variation to cope with seasonal changes in the habitat. Other activities, including mainly agonistic behaviours like aggression, vocalization, escape behavior, copulation, etc., show no significant increase in the pre-monsoon and retreating monsoon season. This might be due to the consumption of ephemeral nutritious food, as also confirmed in a previous study of the golden langur (Biswas, 2002).

Being a folivorous primate, the major portion of the diet of the golden langur is leaves, like that of other folivores such as the capped langur (Stanford, 1991; Solanki *et al*., 2008). Other studies on the species in various habitats have documented folivory,

Plate 3. Some food plant species of golden langur in the study area (A) Fig tree species (a) *Ficus hispida* (b) *Ficus racemosa* (c) *Ficus auriculata* (d) *Ficus lamponga* (e) *Ficus rumphii* (f) *Ficus glaberrima.* B) **Short tree and bamboo species**. (g) *Grewia glabra* (h) *Ardisia paniculata* (i) *Sarcochlamys pulcherrima* (j) *Bambusa tulda* (k) *Bambusa balacoa* (l) *Dendrocalamus hamiltonii*.C). **Shrub species** (m) *Holmskioldia sanguinea* (n) *Dalbergia stipulacea* (o) *Morinda angustifolia* (p) *Codiaeum variegatum* (q) *Hibiscus rosa- sinensis* (r) *Sapindus attenuatus* (s) *Murraya koenigii* (t) *Manihot esculenta*.

Plate 4. Some food plant species of golden langur in the study area (C) Shrub, herb and climber species (a) *Mimosa rubicaulis* (b) *Micromelum minutum* (c) *Litsea salicifolia* (d) *Musa balbisiana* (e) *Thunbergia grandiflora* (f) *Mikania micrantha* (g) *Ampelocissus barbata* (h) *Millettia pachycarpa* (i) *Cayratia trifolia* (j) *Schefflera venulosa.* (k) *Argyreia nervosa* (l) *Uncaria macrophylla* (m) *Tinospora cordifolia* (n) *Pegia nitida* (o) *Dioscorea alata* (p) *Dolicos lablab.*

with varying percentages of leaf consumption (Biswas *et al.*, 1996; Gupta and Chivers, 2000). The higher resting time is due to the fact that leaf digestion requires a lot of energy and takes a long time compared to fruit digestion (Chiver, 1998). Contrary to some other studies where a higher percentage of mature leaves were recorded in the diet of golden langurs (Gupta and Kumar, 1994; Biswas, 2002), the present study recorded a higher consumption of young leaves, which might be due to the inclusion of a large number of climbers in their diet along with Ficus species. Consumption of a higher percentage of young leaves over mature leaves may be due to the high protein content with low fibre and other digestive inhibitors, as proposed by Waterman in 1984 and confirmed by a previous study (Biswas,

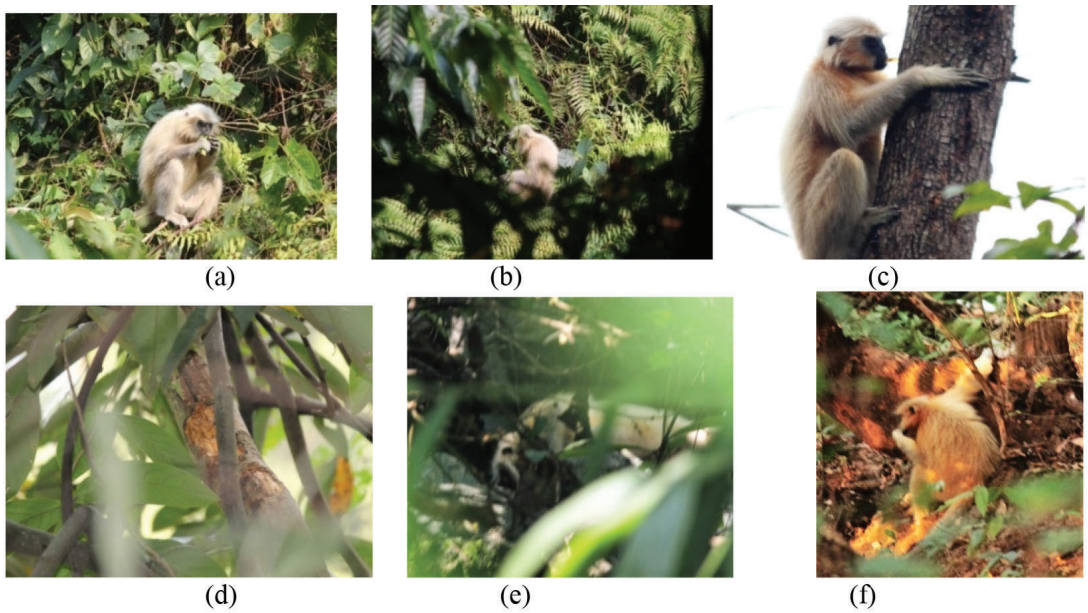

Plate 5. Some unusual plants and animal eaten by Golden Langur in the study area. Fern- (a) *Diplazium esculentum* (b) *Cyathea gigantea*; gum/latex- (c) *Terminalia bellirica*; bark- (d) *Actinodaphne obovata*; (e) drinking water from stream; (f) animal protein- termite.

2002). Significant monthly as well as seasonal differences in the consumption of fruits and seeds/pods depend on the availability of the food items. Due to winter leave fall and a scarcity of other nutritious food, the troops in the study area rely heavily on the seed and pod of certain species, such as Albizzia and Bauhinia species, as well as mature leaves, during the winter months. The availability of sprouting leaves in the months of April and May after spring showers in the deciduous forest resulted in the highest pre-monsoon leaf consumption recorded. Moreover, in monsoon season, study troops enjoy different fleshy, ripe fruits in addition to young leaves. During the retreating monsoon season, about 35% of the diet consists of bamboo shoots, flowers, and fruits, which may satisfy the body's water requirement. Intake of animal protein in the form of insect larvae is also recorded in a previous study by Biswas (2002). In terms of availability, a significant number of local resources were used as food in different seasons. In the case of feeding, high food plant diversity is due to the secondary growth of the forest as well as human habitation at its edges. The golden langur has 200 identified food plant species in its distributional range (previous studies of 53 food plant species in Sepahijala Wild Life Sanctuary (Gupta and Chivers, 2000), 143 food plant species in Ultapani Reserve Forest (Biswas, 2002), and 91 plant species in Chirang Reserve Forest (Das *et al*., 2013) confirmed the wide spectrum of food plant species). The dietary spectrum of golden langur in the study area shows the species' dependency on secondary vegetation, particularly climber species such as *Mikania micrantha*, listed as one of the top five food plant species in all four seasons is also recorded in some other studies (Gupta and Chiver, 2000).

Overall, the activity pattern and dietary spectrum of golden langur in the study area are similar to some previous studies. As the study area is an isolated habitat with an edge matrix and human habitation in its periphery, along with high anthropogenic activities in the form of firewood collection, grazing, etc., conservation efforts should not be ended by merely upgrading the status of the forest. For proper management, the socio- economic condition of the villagers of nearby villages should be improved by adopting the villages as model villages. Restriction of grazing and plantation of non-timber food plant species is of urgent need in scrub and degraded forest areas for safe movement of the species in the habitat. Corridors should be established among the hillocks that are present in the vicinity of the area and that once had golden langur troops of their own.

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Conflict of Interest statement

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References

Altmann, J. 1974. Observational study of Behaviour: Sampling Methods. *Behaviour*. 49: 227- 267. DOI: https://www.jstor.org/stable/4533591

Bennett, E.L. and Sebastian, A.C. 1988. Social organization and ecology of proboscis monkeys (*Nasalis larvatus*) in mixed coastal forests in Sarawak. *International Journal of Primatology*. 9 (3): 233- 255. DOI: https://doi.org/10.1007/BF02737402

Biswas, J., Medhi, R. and Mohnot, S.M. 1996. Behavior and ecology of introduced pair of golden langur to Umananda river island, Assam. IPS/ASP Congress Abstracts. Madison, WI, USA, 041.

Biswas, J. 2002. *Ecology and Social Behaviour of Golden Langur, Trachypithecus geei (Khajuria, 1956) in Assam*. Gauhati University (PhD thesis) 456 Pp.

Borthakur, M. 1986. Weather and climate of north east India. *The Northeast Geographer.* 18(1-2): 22-27.

Bronikowski, A.M. and Altmann, J. 1996. Foraging in a variable environment: Weather patterns and the behavioural ecology of baboons. *Behavioural Ecology and Sociobiology*. 39: 11-25. DOI: http://doi.org/10.1007/s002650050262.

Chakravarty, A., Saikia, M.K. and Saikia, P.K. 2020. Population status, demography and conservation of Golden Langur Trachypithecus geei in an isolated habitat of Kakoijana Reserve Forest, Assam, India. *Asian Journal of Conservation Biology*. 9(1) : 25-38.

Chetry, R., Chetry, D. and Bhattacharjee, P.C. 2017. *Trachypithecus geei* (Khajuria, 1956). In: Schwitzer, C., Mittermeier, R. A., Rylands, A. B., Chiozza, F., Williamson, E. A., Macfie, E. J. *et al.* (eds.). (2017). Primates in Peril: The World's 25 Most Endangered Primates 2016–2018. IUCN SSC Primate Specialist Group (PSG), International Primatological Society (IPS), Conservation. International (CI), and Bristol Zoological Society, Arlington, VA. 99 pp.

Chivers, D.J. 1998. Measuring food intake in wild animals: Primates. In Proceedings of the Nutrition Society, 577 pp. 321- 332.

Clutton-Brock, T.H. and Harvey, P.H. 1977. Species differences in feeding and ranging behavior in primates. In: T.H. Clutton-Brock, (Eds.), In: *Primate Ecology: Studies of feeding and ranging behavior in lemurs, monkeys and apes* (pp. 585- 590). Academic press, London, 631pp.

Coellho, A.M., Barmblett, C.A., Quick, L.B. and Bramlet, S.S. 1976. Resource availability and population density in primates: A socio-bioenergetic analysis of the energy- budgets of Guatemalan howler and spider monkeys. *Primates*. 17: 63-80. DOI: https://doi.org/10.1007/BF02381567

Das, R., Singha, H., Sahu, H.K. and Choudhury, K. 2013. Golden Langur *Trachypithecus geei* (Khajuria, 1956) feeding on Cryptocoryne retrospiralis (Roxb.) Kunth (Family: Araceae): A rare feeding observation in Chirang Reserve Forest, Assam, India. *Journal of Threatened Taxa.* 5(15) : 5013- 5015. DOI: http://dx.doi.org/10.11609/JoTT.o3535.5013-5

Edwards, M.S. and Ullrey, D.E. 1999. Effects of the dietary fiber concentration on apparent digestibility and digesta passage in non-human primates. II. Hindgut-and foregut- fermenting folivores. DOI: https://doi.org/10.1002/(SICI)1098-2361(1999)18:6<537::AID-ZOO8>3.0.CO;2-F

Gee, E.P. 1961. The distribution and feeding habits of the golden langur *(Presbytis geei* Khajuria*). Journal of Bombay natural History Society*. 58 (1) : 1-12.

Ghosh, A.K. and Biswas, S. 1976. A note on the ecology of the golden langur *(Presbytis geei Khajuria). Journal of Bombay natural History Society.* 72: 524-528.

Gupta, A. K. and Kumar, A. 1994. Feeding ecology and conservation of the Phayre's eaf monkey, Presbytes phayrei, in Northeast India. *Biological Conservation*. 69(3) : 301-306.

Gupta, A.K. and Chivers, D.J. 2000. Feeding ecology and conservation of the Golden Langur *Trachypithecus geei* Khajuria in Tripura, Northeast India. *The Journal of Bombay Natural History Society.* 97 (3) : 349-362.

Isbell, L.A. and Young, T.P. 1993. Social and ecological influences on activity budgets of vervet monkeys, and their implications for group living. *Behavioral Ecology and Sociobiology.* 32(6) : 377-385. https://doi.org/ 10.1007/BF00168821

Khajuria, H. 1981. The Golden Langur (Ppresbytis Geei Khajuria). *Zoologiana*. 4: 39-43.

Kumar, A. and Solanki, G.S. 2014. Role of mother and allo mothers in infant independence in capped langur *Trachypithecus pileatus*. *Journal of Bombay Natural History Society.* 111(1) : 3-9. DOI: https://doi.org/10.17087/bnhs/2014/v111i1/56506

Medhi, R., Chetry, D., Bhattachrjee, P.C. and Patiri, B.N. 2004. Status of Golden Langur, *Trachypithecus geei* in a Rubber Plantation in Western Assam, India. *Inter-*

national Journal of Primatology. 25(6) : 1305- 1337. DOI: https://doi.org/10.1023/B:IJOP.0000043965.38722.

Mukherjee, R.P. and Saha, S.S. 1974. The golden langurs *(Presbytis geei* Khajuria, 1956) of Assam. *Primates.* 15(4) : 327-340. DOI: https://doi.org/10.1007/BF01791670

Rowell, T.E. 1966. Forest living baboons in Uganda. *Journal of Zoology, London.* 147: 344- 354. DOI: https://doi.org/10.1111/j.1469-7998.1966.tb04054.x

Solanki, G.S., Kumar, A. and Sharma, B.K. 2008. Feeding ecology of Trachypithecus pileatus in India. *International Journal of Primatology*. 29(1) : 173-182. DOI: https://doi.org/10.1007/s10764-008-9234-0

Stanford, C.B. 1991. *The Capped Langur In Bangladesh: Behavioral Ecology and Reproductive Tactics* (Vol. 26). Karger Medical and Scientific Publishers.

Subba, P.B. 1989. The status and Conservation of the golden langur (Presbytis geei Khajuria, 1956) in the Manas National Park, Bhutan. *Tiger Paper*. 16: 16- 18.

Wayre, P. 1968. The Golden langur and the Manas Sanctuary. *Oryx.* 9: 37-339.

Xiang, Z., Sheng, H. O. U. and Wen, X.I.A. O. 2010. Activity Budget of *Rhinopithecus bieti* at Tibet: Effects of day length, temperature and food availability. *Current Zoology.* 56(6) : 650-659.

Zhou, Q., Wei, F., Huang, C., Li, M., Ren, B. and Luo, B. 2007. Seasonal Variation in the Activity Pattern and Time Budgets of Trachypithecus francoisi in the Nonggang Nature Reserve, China. *International Journal of Primatology*. 28: 657-671. DOI: https://doi.org/10.1007/s10764-007-9144-6