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Food Habits and Habitat Use Patterns of Sri Lanka's Western Purple-faced Langur

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Abstract: Sri Lanka's western purple-faced langur (*Semnopithecus vetulus nestor*) is Critically Endangered, mainly because of habitat loss due to deforestation. Reforestation to expand the langur's natural habitat became feasible when the present government mandated the use of native plants to increase the country's forest cover. For reforestation to benefit langur populations, however, the re-created habitat needs to be similar to the natural forest that provides food and space for their survival. This monkey's diet and the manner in which it uses its natural habitat are, therefore, being investigated as the first step. The diet and habitat use patterns of two groups, Tikira and Appu, were studied for 13 and 14 months respectively (n = 1695 hours). Scan sampling (with ten-minute sample periods) was used to record all activities observed in the groups and the trees on which these activities were performed. The plant parts eaten were also noted. Our results showed that Tikira used more species than Appu to perform all of its daily activities. Additionally, while the Tikira group used *Dipterocarpus zeylanicus* most frequently during most months, the Appu group had six species occupying the top rank during different months. Of the ten most frequently used species, only five were common to both groups, and the frequency of use of these plants was sometimes quite variable as well. With respect to diet, Appu used at least 27 species while Tikira fed on more than 41. The top-ranking food plants of the two groups were different, and among the top ten only four were the same. The top fifteen food plants of both groups constituted over 85% of their feeding records. Nineteen species eaten by Appu and 29 eaten by Tikira were exploited for less than two months, and the two groups ate no more than five species for more than seven months of the study. Although the two groups relied on different plants for much of their nutrition, nearly 86% and 74% of feeding observations of Appu (n = 422) and Tikira (n = 685), respectively, were of them feeding on leaves. Blossoms, fruits and petioles made up the remainder of the groups' diets. While these items contributed variable amounts to the monthly diet of both groups, none was exploited more frequently than leaves. The above results are compared to information from other non-human primates, and discussed with respect to reforestation. Two points are emphasized. One is that the langur living in its natural habitat is a typical folivore, unlike those living around home gardens. The other is that while field research is essential to reforest degraded habitats it must be conducted in conjunction with conservation education and other initiatives that are designed to dissuade people from destroying restored and intact natural habitats.

Key words: Western purple-faced langur, *Semnopithecus vetulus*, diet, habitat, conservation, Sri Lanka

Introduction

Sri Lanka's western purple-faced langur (*Semnopithecus vetulus nestor*) has been listed among the 25 most endangered primates in the world since 2006 (Mittermeier *et al.* 2006, 2009, 2012). A field survey was conducted to investigate the cause of the langur's population decline (Rudran 2007). This survey and another study by Nahallage *et al.* (2008) indicated that the decline of this highly arboreal langur was mainly due to deforestation. Hence reforestation was evidently a logical step to increase the extent of the langur's habitat and reverse its decline. This step was also in line with the current government's economic development policy, which mandated the planting of native species to increase Sri Lanka's forest cover from 27% to 36% (Rajapakse 2010; Yatawara 2011). Reforestation was therefore considered a feasible approach to help ensure the langur's future survival. For reforestation to benefit langur populations, however, the re-created habitat needs to be similar to the natural forest that provides the food and space for their survival, and here we report on a study of the habitat use and diets of two groups — the first ecological study of the western purple-faced langur in its natural habitat.

Study Site and Methods

Our study site was located about 50 km southeast of Colombo, Sri Lanka's capital, in the most deforested region of the country (Fig. 1). The site was, however, relatively undisturbed because it was in the water catchment forest for two reservoirs crucial to the well-being of about one million residents of the capital. Besides being protected because of its function, this forest is the largest patch of undisturbed natural habitat (about 21 km²) occupied by the langur, and as such has the population with the best chance of survival over the long term in its highly fragmented range. We therefore decided to study this population's diet and habitat use patterns, in order to obtain a better understanding of its needs for plans to expand its natural habitat and enhance its long-term survival. For added security against deforestation, we established our study site in the Indikada Forest Reserve in the catchment forest, legally protected by Sri Lanka's Forest Department.

Our study site was close to a village called Waga (Fig. 1), and consisted of relatively flat areas and gently undulating terrain where dense-canopied trees rose to heights of about 40 m. These habitat conditions made focal animal sampling unfeasible, requiring as it does relatively long unbroken periods of observations (Altmann 1974). We, therefore, used scan sampling to collect data on the langur's diet and patterns of habitat use. The data were collected from two habituated groups that lived in adjacent home ranges. One group, named Tikira, consisted of eight members and occupied a home range on undulating terrain. The other, named Appu, was made up of seven individuals, and ranged over a relatively flat area.

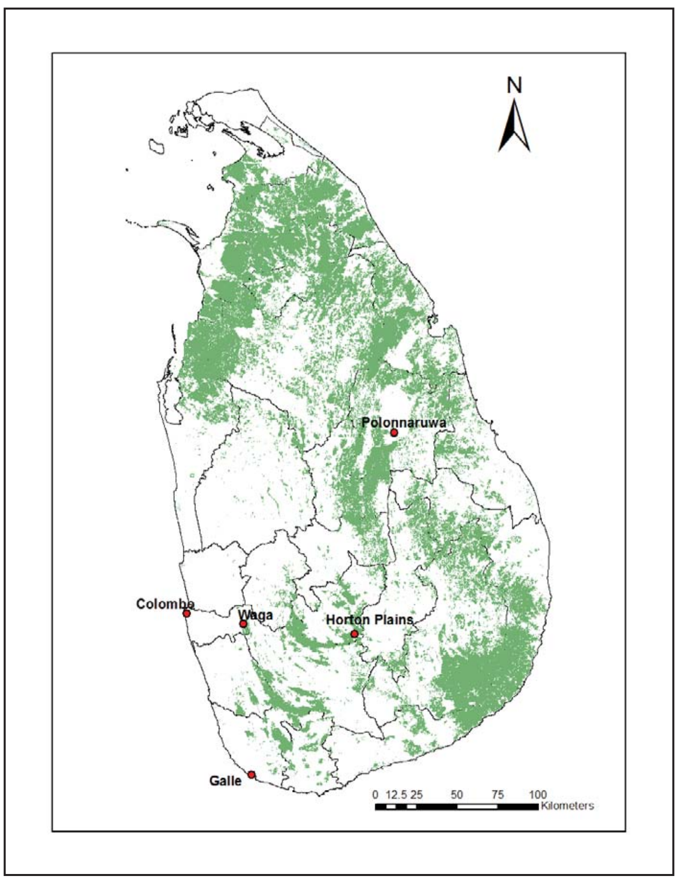

Figure 1. Forest cover of Sri Lanka (2010) showing extensive deforestation in the west, which includes the range of the western purple-faced langur (*Semnopithecus vetulus nestor*). Courtesy of V.A.P. Samarawickrama.

Data from the two groups were collected for three to five days each month between June 2009 and December 2010. Daily observations usually lasted for 8–12 hours but were shorter when the project's conservation-related community activities demanded attention. Data on diet and habitat use patterns were collected during ten-minute sample periods separated by five-minute breaks (Rudran 1978; Struhsaker 1975). During each sample period the first activity performed for at least five seconds by a group member visible to the observer was recorded, along with the tree used to perform that activity. Each group member was sampled for activity only once during a sample period, and if feeding was observed the plant parts eaten were recorded as well. Each sample period started and ended at fixed times during each hour of observation to enable direct comparisons of activity data collected on different days of field work.

The permit we received from the Forest Department to work in its reserve specifically prohibited us from collecting plant specimens. We therefore could not use a herbarium to confirm the identity of plants used by the study groups, and were limited to assigning scientific names only to those that were very familiar to us. Unfamiliar species and even doubtful ones used by the study groups were assigned field names, some of which have been used in this paper.

Results

During our 18-month study, the Tikira group was observed for 793 hours over 13 months and the Appu group for 902 hours over 14 months (Table 1). Delays in the renewal of our reserve entry permits meant that we were unable to observe them in certain months.

Habitat use

The groups used a minimum of 69 plant species during their daily activities — feeding, resting, moving, and social interactions with other group members — but neither used all of them. Appu (observed for a longer period than Tikira) used 36 species, while Tikira used 52 (Table 2). Seventeen species used by Appu (47%) were not used by Tikira, and 33 species used by Tikira (62%) were not used by Appu. Only 19 species were used by both groups. Two species were cultivated varieties—*Hevea brasiliensis* (cultivated rubber) and *Pinus* sp. Appu used both, but they accounted for much less than 1% of the group's habitat use records (n = 3527). Tikira used *Hevea brasiliensis*, which contributed about 3% to the group's total habitat use records (n = 3795).

Table 1. Durations of monthly observations of study groups.

Month	Appu group	Tikira group	Total (hrs)
June 2009	67	-	67
July 2009	91	90	181
August 2009	75	63	137
September 2009	157	-	157
November 2009	103	109	212
December 2009	106	110	216
January 2010	37	67	104
February 2010	48	48	96
May 2010	-	37	37
June 2010	24	49	73
July 2010	73	73	146
August 2010	48	49	97
September 2010	48	35	83
October 2010	14	30	45
December 2010	11	33	44
Total	902	793	1695

Just one species, *Dipterocarpus zeylanicus*, was exploited during all months of observations (Tables 3 and 4). This species was Tikira's most frequently used plant in 12 of 13 months, but was top ranking in use by Appu in only five of 14 months. While Tikira concentrated on a single species during most months, Appu favored the use of six species in the different months (Table 3). Of the 10 species most frequently used by the two groups, only five were common to both (Table 2). The frequency of use of these five species also varied, sometimes quite appreciably. The other five species either occupied ranks below ten or were used only by one group (for example, *Mangifera zeylanica*).

Since *Dipterocarpus zeylanicus* was a dietary item in all months of the study, its total frequency of use by both groups was higher than for any other species. Its use constituted, however, only 14% of Appu's habitat use records, but nearly 41% of Tikira's (Table 2). While the two groups differed substantially in their use of one species, the collective use of their fifteen most frequently exploited species did not differ by much; they represented 92% and 89% of the habitat use records obtained from Appu and Tikira, respectively

Table 2. Intergroup comparisons of habitat use of two groups of the western purple-faced langur (*Semnopithecus vetulius nestor*).

Comparison	Appu group	Tikira group
# months of observations	14	13
# habitat use records	3527	3795
# species used	>36	>52
# species used only by one group	17	33
# species used by both groups	19	19
Use of species (% of records)		
Rank #1	*Dipterocarpus zeylanicus* (14.2)*	*Dipterocarpus zeylanicus* (40.5)*
Rank #2	*Litsea decanensis* (13.0) T	*Stemonurus apicalis* (9.3)*
Rank #3	*Albizia lebbek* (10.6) T	*RBSL* (5.6) X**
Rank #4	*Alstonia macrophylla* (10.4) T	*Mangifera zeylanica* (5.3) X
Rank #5	*Bridelia retusa* (8.9) T	*Persea macrantha* (5.0) A
Rank #6	*Melia azedarach* (7.6)*	*Melia azedarach* (3.7)*
Rank #7	*Artocarpus nobilis* (4.8)*	*Artocarpus nobilis* (3.7)*
Rank #8	*Dillenia retusa* (4.5) T	*UI* (3.4) A**
Rank #9	*Stemonurus apicalis* (3.0)*	*Hevea brasiliensis* (3.1) A
Rank #10	*Horsfeldia iryaghedhi* (2.9)	*Bridelia retusa* (2.8) A
% use of top five species	57	64
% use of top ten species	80	82
% use of top fifteen species	92	89
Use of species (# months)		
≤2 months	14	22
≤7 months	24	41
≥8 months	12	11

* species used by both groups
** Field name and number. Species not identified.
(T) species used by Appu and also found in Tikira range
(A) species used by Tikira and also found in Appu range
(X) species not used by the other group

(Table 2). Nearly 39% and 42% of all species used by Appu and Tikira, respectively, were exploited for two months or less. Only 33% of the species in the diet of Appu and 21% of those in the diet of Tikira were used for more than eight months of the study. Hence, both groups used an appreciable number of species only for short periods.

Diet

At least 27 species were exploited by Appu, while Tikira fed on more than 41 (Table 5). Tikira's diet included 22 species that were absent from that of the Appu group, while eight species in the diet of Appu were absent from that of Tikira. Thus both groups exploited a minimum of 49 species for food. Just one of these was a cultivated plant, *Hevea brasiliensis*, which was eaten only by the Tikira group. During the study, 382 and 567 feeding records were collected from Appu and Tikira, respectively. Appu fed most frequently on *Albizia lebbek* (35.8% of feeding records) and Tikira on *D. zeylanicus* (22.6% of feeding records). Intergroup dietary differences were also evident in the top ten species used for food (Table 5). Only four of these were common to both groups, and sometimes their frequency of use was quite variable as well.

The top fifteen food plants of Appu and Tikira constituted about 95% and 86% respectively of the feeding records obtained from them. Nineteen of the 27 species eaten by Appu and 29 of the 41 species eaten by Tikira were included in the diet for less than two months. Similarly, only four species in Appu's diet and five species in Tikira's were exploited for more than seven months. Similar to the patterns found in their habitat use patterns, both groups relied on relatively few but different species for most of their nutritional requirements.

Although the two groups relied on different food plants for much of their nutrition, nearly 85% and 74% of the observations from Appu (n = 422) and Tikira (n = 685), respectively, were feeding on leaves (Tables 6 and 7). Blossoms, fruits and petioles made up the remainder of the diet of both groups. These items contributed variable amounts to the monthly diet of both groups, but none were exploited more frequently than leaves.

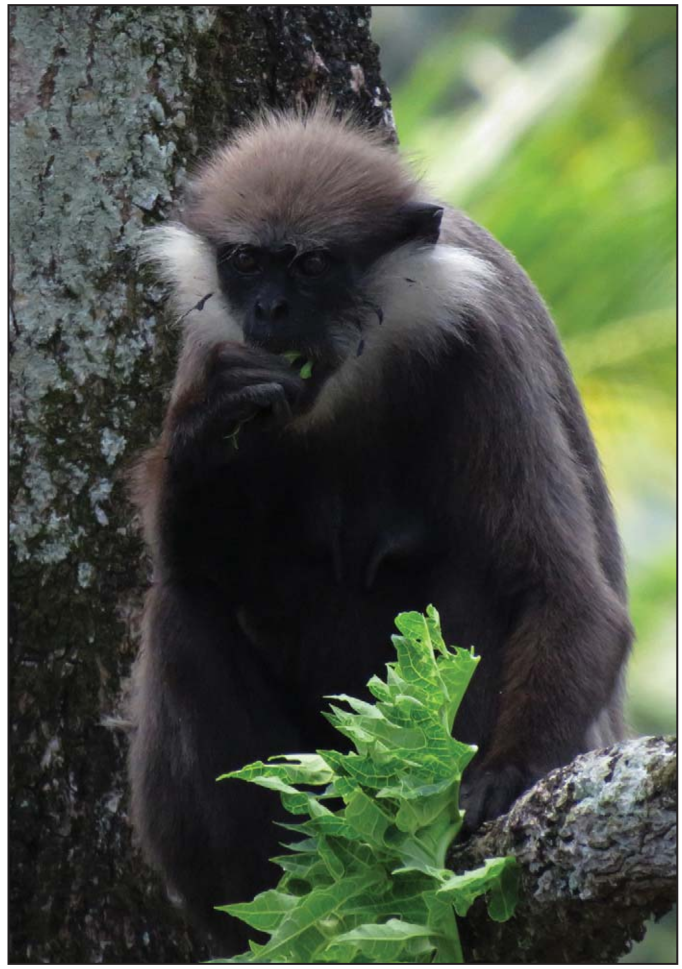

Figure 2. Adult female western purple-faced langur (*Semnopithecus vetulus nestor*). Photo by N. L. Dhangampola.

Table 3. Western purple-faced langur (*Semnopithecus vetulus nestor*) – Appu group. Monthly frequency of use of top ten species for all activities.

Species	2009						2010								
	Jun	Jul	Aug	Sep	Nov	Dec	Jan	Feb	Jun	Jul	Aug	Sep	Oct	Dec	Total
Dipterocarpus zeylanicus	18	34	33	32	**27**	**68**	58	**36**	22	54	**42**	2	**50**	26	502
Litsea decanensis	**27**	38	35	30	15	48	21	17		84	9	**35**	26	**75**	460
Albizia lebbek	21	40	**44**	25	26	67	6	24	7	31	3	31	32	17	374
Alstonia macrophylla	**27**	**79**	43	23	20	51	35	12		31	18	9	12	8	368
Bridelia retusa		9	31	**39**	22	28	**81**	16	10	31	6	1	22	18	314
Melia azaderach	16	48	13	20	11	37	31	6	20	10	19			37	268
Artocarpus nobilis	0	18		4	15	16	17	12	**32**	9	4	1	13	27	168
Dillenia retusa	11	37	21	3	3	17	16	7		20		22			157
Stemonurus apicalis							34	28	7	22	4	5	3	4	107
Horsfeldia iryaghedhi						23	23	16	14	20	8				104

Highest monthly frequency of use each month is in **bold**.

Diversity of diet and habitat use

To compare monthly variations in the diversity of diet and habitat use of the two groups we used the Shannon index (Lloyd and Ghelardi 1964; Pielou 1966), which is given as:

$$H= -\sum p_i \log p_i$$

where pi is the proportion (ni/N) of the ith species used by a group during a particular month. We preferred this index to species richness measures or other diversity indices (for example, Menhinick 1964) because it takes into account the number of species used by a group each month as well as their individual frequencies of use, and produces a single value to compare diet or habitat use diversity of the two groups. Indices calculated for twelve of the fifteen months of our study provided such comparisons (Table 8).

Table 4. Western purple-faced langur (*Semnopithecus vetulus nestor*) – Tikira group. Monthly frequency of use of top ten species for all activities.

Species	2009				2010									
	Jul	**Aug**	**Nov**	**Dec**	**Jan**	**Feb**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Dec**	**Total**
Dipterocarpus zeylanicus	**30**	**111**	**226**	**304**	**189**	**41**	22	**88**	**170**	**56**	**95**	**80**	**126**	1538
Stemonurus apicalis			46	61	63	3		10	66	21	29	21	34	354
*RBSL**			34	9	15	9		1	47		3	53	42	213
Mangifera indica				39	22	10		10	29	8	6	14	63	201
Persea macrantha			1	32	5	4			51	19	6	32	41	191
Artocarpus nobilis	3	5	12	22	14	1	**33**	5	13	1	8	6	20	143
Melia azedarach	**30**		14	26	16	3		2	1	4	9	27	10	142
*UI**			105	14		7		3	3					132
Hevea brasilensis			14	28	31	1		4	17	2	6	12	1	116
Bridelia retusa	1		14		11		7		4	15	2	15	38	107

Highest monthly frequency of use is listed in **bold** numbers *Species not identified.

Table 5. Intergroup comparisons of food habits of two groups of the western purple-faced langur (*Semnopithecus vetulus nestor*).

Comparison	Appu group	Tikira group
# diet records	382	567
# species used	27	41
# species used only by one group	8	22
# species used by both groups	19	19
Use of species (% records)		
Rank #1	*Albizia lebbek* (35.8)T	*Dipterocarpus zeylanicus* (22.6)*
Rank #2	*Pothos scandens* (12.7) T	*Stemonurus apicalis* (12.3)*
Rank #3	*Litsea decanensis* (10.2) T	*Pothos scandens* (8.5) A
Rank #4	*3-leaf vine* (6.5)T	*Hevea brasiliensis (8.0) A*
Rank #5	*Artocarpus nobilis* (5.2)*	*Persea macrantha* (7.6)A
Rank #6	*Dipterocarpus zeylanicus* (3.4)*	*Mangifera zeylanica* (7.1) X
Rank #7	*Alstonia macrophylla* (2.6) T	*RBSL* (5.0) X**
Rank #8	*Hopea-L* (1.8) X**	*Artocarpus nobilis* (3.7)*
Rank #9	*Bridelia retusa* (1.8) T	*Melia azedarach* (4.3)*
Rank #10	*Melia azedarach* (1.3)*	*Bridelia retusa* (2.3) A
% use of top five species	78	59
% use of top ten species	89	80
%use of top fifteen species	95	86
Use of species (# months)		
≤2months	19	29
≤7 months	23	35
≥8 months	4 (ranks 1–4)	5 (ranks 1–3, 6 and 7)

*species consumed by both groups
(T) species eaten by Appu and also found in Tikira range
(X) species not used by the other group
** Field name and number. Species not identified.
(A) species eaten by Tikira and also found in Appu range

The monthly values showed that Appu had lower diet diversity indices than Tikira for 10 of the 12 months of the study. In contrast, it had higher diversity indices for habitat use than Tikira during all twelve months. These results suggest that Tikira's monthly diet was consistently more diverse than Appu's because it exploited more species as food. On the other hand, Appu probably distributed its use of different species in the habitat more equitably, and therefore, had higher monthly values for habitat use diversity than Tikira.

Table 6. Monthly frequency of use of food items; western purple-faced langur groups (*Semnopithecus vetulus nestor*) – Appu group.

Month	Leaves	Blossom	Fruit	Petiole	Seed	UI*	Total
June	22				8	2	32
July	32		1			3	36
August	11					13	24
September	11					1	12
November	18	1				3	22
December	44		1	2		4	51
January	7						7
February	30		5				35
June	9						9
July	24						24
August	51						51
September	22	6					28
October	32		7	1			40
Dec	40						40
Total	360	7	14	3	8	30	422

*Unidentified items

Table 7. Monthly frequency of use of food items; western purple-faced langur groups (*Semnopithecus vetulus nestor*) – Tikira group.

Month	Leaves	bl	Fruits	Petiole	Seed	UI*	Total
July	4		1			2	7
August	19		1			1	21
November	65	30	1			1	97
December	118	1	23			1	143
January	50	14		6			70
February	13		8				21
May	11	1		3			15
June	10	2		2			14
July	54	7		8			69
August	10						10
September	22			1			23
October	23	1	3	5			32
November	65	21	10			1	97
December	37	3	5	13			58
Total	509	80	52	38		6	685

*Unidentified items

Discussion

Similarities between the groups

Despite numerous differences in diet and habitat use patterns, the two groups were similar in many ways. They maintained a highly folivorous diet as is typical of colobines (Horwich 1972; Oates 1977; Hladik 1978; Stanford 1988; Gupta and Kumar 1994; Saj and Sicotte 2007; Struhsaker 2010; Choudhury 2012; Vandercone *et al.* 2012). The proportion of leaves in the monthly diet of our study groups was quite similar to that in the diet of two other subspecies of purple-faced langurs (*S. v. philbricki* and *S. v. monticola*) that were studied in the dry zone forests of Polonnaruwa and the cloud forests of Horton Plains (Fig. 1). In the dry zone forest the average monthly diet of purple-faced langurs consisted of 53% leaves, while in the cloud forest leaves contributed nearly 80% (Rudran 1970, 2012).

The folivorous diet of the langurs in natural habitats is in marked contrast to that of groups living around human habitations and rubber plantations, which have been found to rely mainly on cultivated (human edible) fruits (Dela 2007). The extensive exploitation of cultivated fruits has been interpreted to mean that these langurs are adapting to changing environmental conditions and preferentially selecting and feeding on fruits rather than leaves (Dela 2007, 2012; but see Setchell 2012). As a result, it was recommended that the langur's dietary switch be considered when formulating effective action for its conservation. There are several reasons why we feel this recommendation is untenable.

First, like other colobines, purple-faced langurs have evolved numerous adaptations over several millennia to satisfy their nutritional requirements mainly through a leafy diet. For instance, they harbor numerous symbiotic bacteria in the stomach to ferment the structural carbohydrates in leaves; and the end products become the langur's primary source of energy (Bauchop and Martucci 1968; Bauchop 1975). Second, the stomach is large and sacculated (Hill 1934) to reduce the speed at which it fills up with food and the rate at which the ingesta moves out. The slow passage of ingesta out of the stomach increases the time available for microbial action (Milton 1999). Third, to further improve bacterial action and fermentation efficiency, the langurs rest for long periods between feeding bouts; a behavior characteristic of other colobines (Struhsaker 1975; Oates 1987). Fourth, the symbiotic bacteria can also convert the host's urea into microbial protein, and contribute a valuable supplement to protein derived from leaves. Fifth, bacterial action on the ingesta leads to manifold increases in vitamins that makes the langurs virtually independent of dietary sources of all vitamins except A and D (Bauchop 1975). These morphological, kinetic, physiological and behavioral adaptations clearly show that langurs have evolved highly specialized traits to exploit a leafy diet for their energetic and nutritional requirements.

Langurs do, of course, eat fruits, but the amount consumed in the wild is much less than around home gardens. Cultivated fruits are generally lower in protein, fiber and mineral content than wild fruits (Milton 1999), and are unlikely to provide the langurs with adequate nutrition over the long term. Hence groups that rely on cultivated fruits for extended periods may run the risk of dying of malnutrition (if they do not meet their end before then, through other outcomes of human-monkey conflicts such as electrocution, attacks by village dogs, or parasitic infestations; Ekanayake *et al.* 2006; Rudran 2007; De Silva *et al.* 2012). Furthermore, Nijman (2012) analyzed Dela's (2012) selection ratios and found that there was no statistically significant basis for the claim that the langur was selecting cultivated fruits over leaves. In fact, he showed that some of the plants with the highest selection ratios were used mainly for their leaves.

It is unreasonable, therefore, to assume that the langur is adapting to environmental changes by switching its diet to cultivated fruits and recommend that its conservation be based on this assumption. Nevertheless, this recommendation is already being mentioned by others as a strategy for langur conservation (De Silva *et al.* 2012). Before this notion gains further traction we hope the information in this paper will convince local conservationists to think differently.

Our findings have also indicated that both groups relied on relatively few species for much of their nutritional requirements (Table 5). This feeding pattern is quite widespread among colobines (Hladik 1978; Gupta and Kumar 1994; Struhsaker 2010; Vandercone 2012) and other non-human primates (Rudran 1978; Miller 1998; Watts *et al.* 2012); and likely the result of intergroup differences in food species selection and food plant density differences between home ranges. Furthermore, long-term studies on the red colobus of Kibale National Park have shown that the species most frequently exploited for food can vary between years (Struhsaker 2010) because of naturally occurring events such as tree regeneration or mortality resulting from disease. This suggests that monkeys are to some extent capable of adapting to changes in their natural environment.

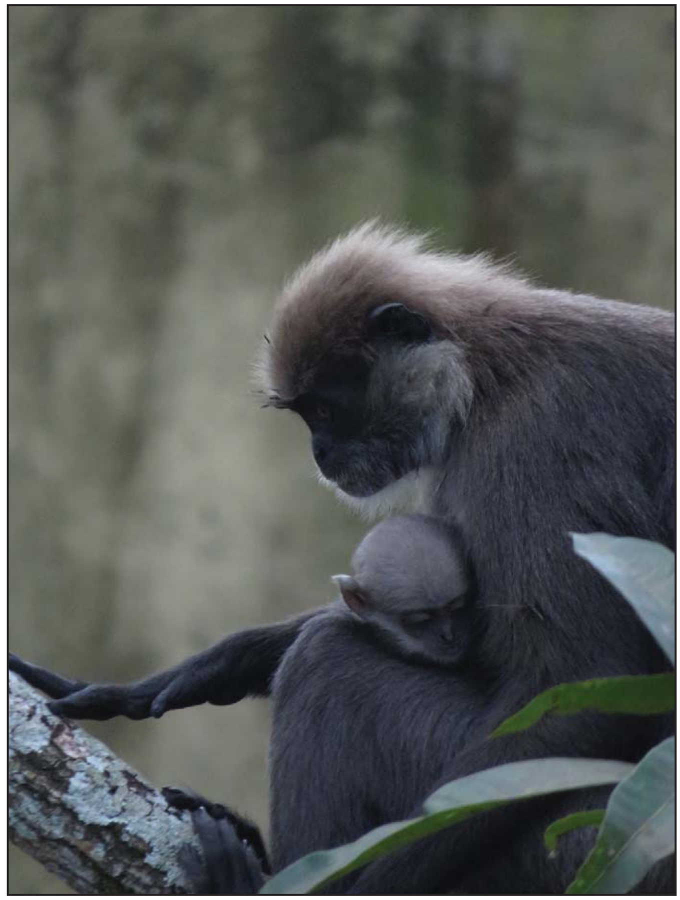

Figure 3. Mother and offspring western purple-faced langur (*Semnopithecus vetulus nestor*). Photo by N. L. Dhangampola.

Table 8. Intergroup comparisons of diet and habitat-use diversity in two western purple-faced langur groups (*Semnopithecus vetulus nestor*).

Month	Appu group		Tikira group	
	Habitat use diversity	Diet diversity	Habitat use diversity	Diet diversity
June 2009	0.916	0.405		
July 2009	0.855	0.515	0.702	0.959
August 2009	0.909	0.444	0.405	0.217
September 2009	0.910	0.747		
November 2009	0.900	0.603	0.617	0.831
December 2009	0.855	0.904	0.671	0.849
January 2010	0.834	0.555	0.659	0.883
February 2010	0.921	0.832	0.763	0.867
May 2010			0.928	0.840
June 2010	0.913	0.620	0.650	0.929
July 2010	0.850	0.564	0.714	0.937
August 2010	0.883	0.560	0.747	0.881
September 2010	0.795	0.573	0.668	0.829
October 2010	0.825	0.845	0.771	0.931
December 2010	0.864	0.734	0.737	0.903

While the groups obtained most of their nutritional requirements from a few species, they also exploited an appreciable number at low frequencies. The additional food intake from several plants may have satisfied a group's total energy and nutritional needs (Struhsaker 2010). However, Freeland and Janzen (1974) have suggested that infrequent feeding on a large number of species helps folivores to maintain metabolic pathways for detoxifying secondary compounds found in plant material. Keeping these pathways open may have been necessary for langurs to exploit alternative food plants without suffering any ill-effects, when food from its most frequently exploited species are in short supply.

Another point related to the langur's heavy dependence on just a few species for feeding and other activities is that only a small number of species may be needed to re-create forests that are optimal for its survival. Detailed investigations of habitat variables (for example, species composition, density and plant phenology), however must be conducted before final decisions could be made about the species most suitable for reforestation. If these investigations are conducted, they would help ensure that reforested areas have adequate amounts of food and space throughout the year for the langurs to thrive.

Differences between the groups

The differences we found are remarkable because the two groups lived in adjacent home ranges. Despite the close proximity of home ranges, data collection in Appu's home range was considerably more difficult than in Tikira's. This was because unlike Tikira's home range, that of Appu was located on relatively flat ground where collecting data by looking straight up into the dark and dense canopies often proved difficult. However, we do not believe that the intergroup differences documented in our study were the result of observation conditions, because such differences have also been found in other field studies of non-human primates. For instance, dietary differences between groups living in adjacent home ranges or close proximity have been reported in capuchin monkeys (*Cebus capucinus*) of Costa Rica (Chapman and Fedigan 1990) and blue monkeys (*Cercopithecus mitis stuhlmanni*), red colobus (*Piliocolobus rufomitratus tephrosceles*), and chimpanzees (*Pan troglodytes schweinfurthii*) in Kibale National Park, Uganda (Rudran 1978; Chapman and Chapman 1999; Struhsaker 2010; Watts *et al.* 2012).

Several reasons have been proposed to explain the above mentioned differences. Fairgrieve and Muhumuza (2003) indicated that dietary differences between blue monkey groups inhabiting Budongo Forest Reserve, Uganda, were the result of logging. This could not have been the case at our study site with its long history of habitat stability. In their study of *Cebus capucinus*, Chapman and Fedigan (1990) asked if intergroup dietary differences were the result of differences in food abundance between home ranges, and found no evidence for it. They were also unable to determine if group specific diets were due to intergroup differences in foraging strategies (Schoener 1971) or the result of group specific traditions (McGrew 1983). Nevertheless, Perry (2011) argued that intergroup differences in foraging in the Costa Rican *Cebus capucinus* were the result of group specific social traditions. Struhsaker (2010), on the other hand, showed that intergroup dietary differences in red colobus monkeys in Kibale National Park, Uganda, were the result of differences in tree species composition between sites and also due to the extent to which groups fed selectively on different species. These differences could also have arisen from intraspecific differences in nutrient content of plants growing in different home ranges (Chapman *et al.* 2003). It is possible that plant density differences between home ranges (habitat heterogeneity) and selective feeding are the underlying reasons for differences in foraging strategies and social traditions that ultimately lead to group specific diets.

Although we were unable to determine the exact reason for group specific diets in these langurs, the fact that they were real, presented a novel way of relating the langur's lifestyle to that of local human communities, where dietary differences between neighbors were quite common. We drew similarities between human families and langur groups with respect to their food habits and composition of social units, to create public empathy for the endangered folivore and discourage the destruction of its natural habitat (Batahira Kaluwandura 2011). In this manner, our field research became an invaluable tool to promote public awareness of the precariousness of the langur's future.

Promoting public awareness of the langur's plight has been an important component since the project's inception. It included workshops to identify the critical needs of the community's adults, which turned out to be focused on employment opportunities, improvement of health services, and the need for vocational training. To address the need for employment opportunities, a home gardening program was launched (Anonymous 2011) to help augment household income and improve nutrition. This program also gave villagers opportunities to grow seedlings of plants important to the langur in backyard nurseries, to satisfy future reforestation needs, and to take pride in helping to conserve the endangered folivore. The other two needs of adults were addressed through an eye-care clinic, and training in making cloth bags for sale to locals and tourists. Activities for young people have included conservation-oriented classroom lectures, nature walks, competitions, and public exhibitions of children's artwork and essays. Because of these activities the local people now view us as people who are not only concerned about monkeys but also genuinely interested in their welfare. We hope this change in attitude will help garner support from local communities to protect the langurs over the long term.

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