PLANT DIVERSITY IN THE DIET OF GOLDEN LANGUR (*Trachypithecus geei*) IN BAMUNGAON RESERVE FOREST, WESTERN ASSAM, INDIA

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Abstract

The food habits of a species is one of the most basic aspects of its ecology and needs to be understood not only to determine the species' nutritional requirements, but also to understand the distribution of food resources which could determine the local distribution and social interactions. Golden Langur diet composition was assessed by direct observation and scan sampling method in Bamungaon Reserve of Forest of Western Assam from May 2013 to April 2015. Golden Langur was observed to feed on 113 different plant species belonging to 27 orders. The highest percent of food tree species belonged to the fabales followed by rosales and sapindales. Golden Langur preferred young leaf (43%) followed by flower (16%), ripened fruit (15%) and mature leaf (9%). The diet species of Golden Langur was compared with other areas and discussed.

IndexTerms: *Golden langur, Diet, Plant diversity, Bamungaon reserve forest*

INTRODUCTION

Food and shelter are the vital needs of all living organisms. The appraisal of feeding habits of an animal is of the outmost significance for the correct determination of the carrying capacity of their habitat and for the study of their population dynamics (Roy *et al*. 2019). To endure and reproduce successfully every animal needs food. The food habits of a species is one of the most basic aspects of its ecology and needs to be understood not only to determine the species' nutritional requirements, but also to understand distribution of food resources that could determine the density, local distribution and social interactions (Swapna, 2008). Food habit studies help to assess the dietary overlap with other sympatric species. It allows us to assess the impacts of anthropogenic pressures such as fire, cattle grazing, etc., also natural and man-made changes in the structure and composition of vegetation (Ashokkumar, 2011).

Golden Langur Khajuria, 1956 is one of the least studied primate species of North- east India. The Golden Langur *Trachypithecus geei* is a rare colobine monkey with a very restricted range being confined to western Assam in India, and Bhutan only. Within India, its entire population is restricted to parts of western Assam where it is bounded by the rivers, Brahmaputra in the south and its tributaries, the Manas and the Sankosh towards east and west respectively (Khajuria, 1956). The Golden Langur is classified as Endangered (EN) [A2c; C2a (i)] on the IUCN Red List 2008 and is listed on Appendix I of CITES. Listed as Endangered because of a serious population decline, estimated to be more than 50% over the last three generations (thirty years), inferred from observed reduction in the extent of its habitat; and because its population size is estimated to number fewer than 2,500 mature individuals, there is an observed continuing decline in the number of mature individuals, and no subpopulation contains more than 250 mature individuals. The Golden Langur population has recovered significantly at Bamungaon reserve forest recently, after the Golden Langur Conservation Project (GLCP) begun by Community Conservation, Nature's Foster and Green Forest Conservation in 1998 continues to bring locals into the conservation fold.

The study of diet can help to understand the role of a species in the energy flow and nutrient cycle of an ecosystem. It also sets a foundation for understanding of foraging behaviour, population dynamics, habitat use and social organization of a species (Mills, 1992). Knowledge on feeding preferences and

nutritive requirements is essential in planning habitat management. It would be advantageous to have information on the habitat requirements of a species in order to protect and improve these attributes. The present study aims to provide such information for Golden Langur and also aims at increasing our knowledge of the species.

METHODS

Information on the food plants and parts of the plants eaten were collected through direct observation and indirectly by recording plants fed on by Langur by following their feeding trail. The study was conducted in Bamungaon reserve forest, situated in Bongaigaon distrist of western Assam, India from May 2013 to April 2015. Feeding by individuals was observed using scan sampling (Altmann, 1974) during different time blocks throughout the day. Binoculars were used to make all direct observations. The feeding trails were examined for fresh feeding signs after Langur left the location as Langurs have the habit of discarding half of leaf or fruit they consume. Fresh feeding signs could be easily distinguished from old signs by examining the tip of the branches/twigs and fruits with bite signs. A herbarium of the food plants was made for confirmation of the species identity based on Chetry and Chetry (2009).

RESULTS

Golden Langur consumed different plant species of various physiognomic categories. During the study period, it was observed that Golden Langur consumed different plant species from different various physiognomic categories. The list of food plants, parts eaten (based on scan sampling) are given in the (Table-1). Golden Langur was recorded to consume different plant species belonged to 27 orders and 113species. Plant species belonged to category tree constituted 79% in their diet followed by shrub (9%), climber (7%) and other categories viz. grass, liana, orchid and fern constituted less than 3% in the diet of Golden Langur (Fig. 1).

The highest percent of food tree species belonged to the order rosales followed by fabales and sapindales. Moreover, Golden Langur preferred young leaf (43%) followed by flower (16%), ripened fruit (15%) and mature leaf (9%). The other plant parts viz. leaf petiole, fig, seed, unripened fruit and shoot constituted less than 5% each in the diet (Fig. 2)

Table1: Food plants of Golden Langurs identified in Bamungaon Reserve Forest of Western Assam, India. In the column 'Parts Eaten' YL-Young Leaf; ML-Mature Leaf; FL-Flower; UNFR-Unripened fruit; RFR-Ripened fruit; LP-Leaf petiole

Sl no.	Plant species	Category	Order	Parts Eaten
1	*Acacia auriculiformis*	Tree	Fabales	YL/ML
2	*Acacia pinnata*	Tree	Fabales	YL/ML
3	*Aegle marmelos*	Tree	Sapindales	YL/RFR
4	*Alangium chinensis*	Tree	Cornales	YL/ML
5	*Albizia amara*	Tree	Fabales	YL
6	*Albizia lebbeck*	Tree	Fabales	YL/FL
7	*Alstonia scholaris*	Tree	Gentianales	YL/ML
8	*Anthocephalus cadamba*	Tree	Gentianales	YL
9	*Artocarpus chaplasha*	Tree	Rosales	RFR
10	*Averrhoa carambola*	Tree	Geraniales	RFR
11	*Azadiracta indica*	Tree	Sapindales	YL/UNFR
12	*Bauhinia acuminate*	Tree	Fabales	YL/FL/SEED
13	*Bauhinia bhelli*	Tree	Fabales	YL/FL/SEED
14	*Bauhinia purpurea*	Tree	Fabales	YL/FL/SEED
15	*Bischoffia javanica*	Tree	Malpighiales	RFR
16	*Bombax cebia*	Tree	Malvales	YL/ML
17	*Bridelia Montana*	Tree	Malpighiales	RFR

18	*Bursera serrata*	Tree	Sapindales	YL/ML
19	*Butea monosperma*	Tree	Fabales	ML/RFR
20	*Callicarpa macrophylla*	Tree	Lamiales	YL
21	*Careya arborea*	Tree	Ericales	YL/ML
22	*Cassia fistula*	Tree	Fabales	YL/ML
23	*Cedrela toona*	Tree	Sapindales	YL/LP
24	*Cedrela* sp.	Tree	Sapindales	RFR
25	*Chukrasia tabularis*	Tree	Sapindales	YL
26	*Cinnamomum* sp.	Tree	Laurales	YL/FL
27	*Dalbergia paniculata*	Tree	Fabales	YL
28	*Dalbergia sissoo*	Tree	Fabales	YL
29	*Dillenia indica*	Tree	Dilleniales	YL/RFR
30	*Dillenia pentagyna*	Tree	Dilleniales	YL/ML
31	*Duabanga grandiflora*	Tree	Myrtales	YL
32	*Dysoxylum bincetariferum*	Tree	Sapindales	YL
33	*Dysoxylum gobara*	Tree	Sapindales	YL
34	*Emblica officinalis*	Tree	Malpighiales	YL
35	*Erythrina variegata*	Tree	Fabales	YL
36	*Ficus bengalensis*	Tree	Rosales	YL/FIG
37	*Ficus drupacea*	Tree	Rosales	YL/FIG
38	*Ficus glomerata*	Tree	Rosales	YL/FIG
39	*Ficus heterophylla*	Tree	Rosales	YL/FIG
40	*Ficus hirta*	Tree	Rosales	YL/FIG
41	*Ficus hispida*	Tree	Rosales	YL/FIG
42	*Ficus lepidosa*	Tree	Rosales	YL/FIG
43	*Ficus racemosa*	Tree	Rosales	YL/FIG
44	*Ficus* sp.	Tree	Rosales	YL/FIG
45	*Ficus* sp	Tree	Rosales	YL/FIG
46	*Ficus* sp.	Tree	Rosales	YL/FIG
47	*Garcinia xanthochymus*	Tree	Malpighiales	YL
48	*Gmelina arborea*	Tree	Lamiales	YL/ML
49	*Grewia multiflora*	Tree	Malvales	YL
50	*Hevea brasilliensis*	Tree	Malpighiales	YL
51	*Hibiscus macrophyllus*	Tree	Malvales	YL
52	*Holmskiodia sp*	Tree	Lamiales	RFR
53	*Homonoia riparia*	Tree	Malpighiales	YL
54	*Jasminum officinale*	Tree	Lamiales	YL
55	*Kydia calicina*	Tree	Malvales	YL/ML/FL
56	*Lagerstroemia parviflora*	Tree	Myrtales	ML
57	*Lannea coromandelica*	Tree	Sapindales	YL/ML/RFR
58	*Litsaea glutinosa*	Tree	Laurales	YL/ML/RFR
59	*Litsea laeta*	Tree	Laurales	YL
60	*Litsaea polyantha*	Tree	Laurales	YL/ML/RFR
61	*Macaranga denticulata*	Tree	Malpighiales	YL
62	*Mallotus philippinensis*	Tree	Euphorbiales	YL/RFR
63	*Mangifera indica*	Tree	Sapindales	YL/UNFR/RFR
64	*Merremia* sp.	Tree	Solanales	YL/RFR
65	*Micelia* sp.	Tree	Magnoliales	YL
66	*Michelia champaca*	Tree	Magnoliales	YL/FL
67	*Michelia oblonga*	Tree	Magnoliales	YL/ML
68	*Moringa oleifera*	Tree	Brassicales	YL/FL/RFR
69	*Pterospermum acerifolium*	Tree	Malvales	YL/ML
70	*Rus acuminata*	Tree	Sapindales	LP
71	*Sapium baccatum*	Tree	Malpighiales	YL/RFR
72	*Schefflera arboricola*	Tree	Apiales	YL/ML

73	*Schima wallichii*	Tree	Ericales	UNFR/RFR
74	*Shorea robusta*	Tree	Malvales	YL/LP
75	*Spondias pinnata*	Tree	Sapindales	YL/RFR
76	*Stercula villosa*	Tree	Malvales	YL/FL/ML/RFR
77	*Sterospermum chelonoides*	Tree	Lamiales	YL
78	*Streblus asper*	Tree	Rosales	YL/ML
79	*Syzygium cumni*	Tree	Myrtales	YL/RFR
80	*Syzygium jambos*	Tree	Myrtales	YL/ML/RFR
81	*Syzygium kurjii*	Tree	Myrtales	YL/ML/RFR
82	*Tamarindus indica*	Tree	Fabales	YL/ML/UNFR/RFR
83	*Tectona grandis*	Tree	Lamiales	YL/ML/LP
84	*Terminalia bellerica*	Tree	Myrtales	YL/ML/RFR
85	*Terminalia chebula*	Tree	Myrtales	YL/ML/RFR
86	*Tetrameles nudiflora*	Tree	Cucurbitales	YL/ML
87	*Thunbergia alata*	Tree	Lamiales	ML/FL
88	*Wrightia tomentosa*	Tree	Gentianales	YL/ML
89	*Zizyphus jujuba*	Tree	Rosales	UNFR/RFR
90	*Antidesm acidum*	Shrub	Malpighiales	RFR
91	*Cissus quadrangularis*	Shrub	Vitales	YL
92	*Eupatorium odoratum*	Shrub	Asterales	YL/ML
93	*Evolvus alsinoides*	Shrub	Solanales	YL
94	*Flueggea leucopyrus*	Shrub	Malpighiales	RFR
95	*Hemidesmus indicus*	Shrub	Gentianales	YL
96	*Ipomea* sp.	Shrub	Solanales	YL/ML/FL
97	*Mikania micrantha*	Shrub	Asterales	YL/ML
98	*Mimosa pudica*	Shrub	Fabales	ML
99	*Smilax* sp.	Shrub	Liliales	YL.ML
100	*Bulbophyllum* sp.	Orchid	Asparagales	YL
101	*Dendrobium* sp.	Orchid	Asparagales	YL
102	*Aristolochia*	Liana	Magnolids	YL
103	*Bambusa* sp.	Grass	Poales	YL/SHOOT
104	*Bambusa tulda*	Grass	Poales	YL/SHOOT
105	*Asplenium nidus*	Fern	Polypodiales	YL
106	*Dioschorea bulbifera*	Climber	Dioscoreales	TUBER
107	*Dioscorea alata*	Climber	Dioscoreales	TUBER
108	*Dioscorea floribunda*	Climber	Dioscoreales	YL
109	*Paederia foetida*	Climber	Gentianales	YL/ML
110	*Trichosanthes tricuspidata*	Climber	Cucurbitales	YL
111	*Vigna catjang*	Climber	Fabales	RFR
112	*Vigna* sp.	Climber	Fabales	RFR
113	*Vitis latifolia*	Climber	Vitales	YL/ML

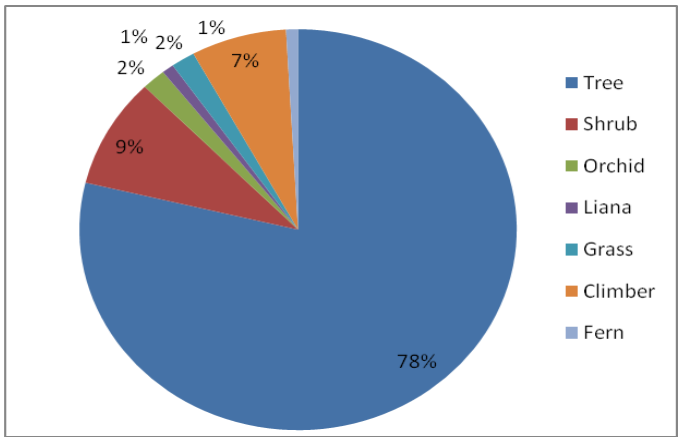

Figure: 1 Proportion of different plant categories in the diet of Golden Langur in Bamungaon Reserve Forest during the study period (from March 2013 to April 2015).

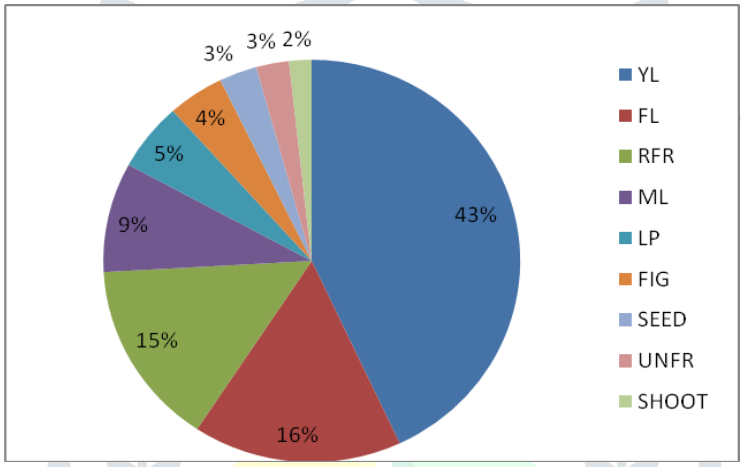

Figure: 2 Proportion of different parts of food plants in the diet of Golden Langur in Bamungaon Reserve Forest during the study period (March 2013 to April 2015).

DISCUSSION

Golden Langur consumed different plant species belonged to 27 orders and 113 species from March 2013 to April 2015. Roy *et al*. (2018) reported 130 plant species comprising trees, shrubs and climbers in Kakoijana reserve forest and Nayakgaon proposed reserve forest. Das (2012) reported 91 plant species as food species for Golden Langur comprising both trees and climbers in Chirang reserve forest in Western Assam. Mukherjee and Saha (1974) reported the names of plants utilized by the Golden Langur for feeding and the most preferred plant items were *Terminalia belerica*, *Lagerstroemia parviflora*, fruits of *Bridelia retusa* in Manas sanctuary. *Terminalia belerica* at Jamduar and flowers of *Salmalia malabarica* at Manas (Mukherjee and Saha 1974). The above results indicate that Golden Langur consumed variety of plants. The number of food species listed could vary greatly with forest type, duration of study period and method of foraging data collection. Golden Langur preferred young leaves since young leaves contain more protein and less fiber. But in some cases during this study, the langurs were observed to consume mature leaves too. An earlier study on the leaf chemistry of Nilgiri Langur's diet showed the preference for mature leaves over young leaves (Sunderraj 2001) as mature leaves of some species were of higher nutritional quality (less fibers) than the young leaves of others. Apart from this, there are some other studies which support that Colobines in different habitats vary the proportions of leaf and non-leaf foods in their diets according to plant species diversity, seasonality, and the nutritional quality of the leaves available (Li and Rogers 2006). When feeding on mature leaves, the lamina was frequently discarded and only the petioles were ingested. However in some cases, Golden Languurs feed on leaf petiole of *Shorea robusta*, *Terminalia chebula* and *Tectona grandis*. A preference for leaf petiole has also been reported in other Colobines and may reflect the fact that

the resources are lower in nonstructural carbohydrates and higher in available nutrients than leaf blades (Garber, 1987). Adaptive success of Asian Colobines lies in their possession of a sacculated stomach which digests cellulose by bacterial fermentation, thereby allowing the exploitation of vegetation parts (Ramachandran, 1998). Also it was reported that 45 food plant species of Golden Langur in Kakoijana Reserve forest in Assam were used by locals as medicines, 17 species used as vegetables and two are rare medicinal plants of Assam (Roy *et al*. 2019).Therefore the consumption of different food items by GL in these plants could be due to high nutritional value as well as due to the bioactive properties of plants.

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